46 Stevens Road, Clarington

Stormwater Management Report

VERSION 1 ▪ JULY 2022

REPORT PREPARED FOR

Kaitlin Corporation
220 Duncan Mill Road, Suite 315
North York, ON
M3B 3J5

REPORT PREPARED BY

T.Y. LIN INTERNATIONAL CANADA INC.
8800 DUFFERIN STREET, SUITE 200,
VAUGHAN, ON L4K 0C5
(905) 738-5700

TYLin PROJECT NUMBER 10521

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1 INTRODUCTION

TYLin, formerly The Municipal Infrastructure Group (TMIG) has been retained by Kaitlin Corporation to prepare a Stormwater Management Report, in support of a proposed Assisted Care and Retirement Development (46 Stevens Road) located in the Municipality of Clarington, Region of Durham. This Stormwater Management Report has been prepared in support of the re-zoning application process.

The site is bounded by Stevens Road to the south, existing residential lots along Munday Court to the west and Bowmanville Creek to the north and east. See **Figure 1-1**.

The objective of this Stormwater Management Report is to:

- Provide background information regarding the subject property and proposed development plans.
- Provide information regarding the existing and future site drainage conditions.
- Provide a stormwater strategy for the proposed development of the lands.

The stormwater management strategy has been developed in accordance with the applicable design criteria and requirements of the Municipality of Clarington and the Central Lake Ontario Conservation Authority (CLOCA).

Figure 1-1: Location Plan

1.1 Project Background

The subject lands are mostly vacant lands currently zoned agricultural with one existing dwelling, with a total approximate area of 8.63ha (21.3 acres) with frontage at the easterly limit of Stevens Road. The lands are currently zoned as Agricultural (A) and Environmentally Protected (EP) in the Clarington Official Plan (Map 3D) per By-Law 84-63 (dated March 2015). Out of the 8.63 Ha owned by the land developer, the area that is being developed is approximately 3.03 Ha.

The site is located within the Bowmanville Creek watershed, which is regulated by CLOCA. The recently completed Bowmanville/Soper Creek Watershed Plan Update (CLOCA, 2020), provides comprehensive information on the watershed as a whole and provides a high-level strategy for stormwater management throughout the watershed.

There are currently erosion concerns in the Bowmanville Creek Valley, which is located to the east of the site. CLOCA has stated that when designing a storm sewer outfall from the site, the stability of the valley slopes must be maintained.

As the Bowmanville Creek Valley is located within CLOCA's Natural Heritage System (NHS), an Environmental Impact Study (EIS) was completed to identify impacts from the development on vegetation, woodlands, valleys, and wildlife. The EIS addresses ways to avoid and mitigate any disturbance caused by the stormwater outfalls to Bowmanville Creek. As a result, the EIS delineated a dripline as well as a 15m buffer from the dripline, where no development should occur. The dripline was defined based on the greater of two buffers: the Vegetation Protection Zone (VPZ) or the erosion and slope protection buffer. The VPZ was determined based on a 15m offset from the NHS at the woodland edges, while the erosion and slope protection buffer was determined based on a 15m offset from the stable top of bank at the Bowmanville Creek Valley. The dripline and 15m dripline buffer are present on the Figures in the report.

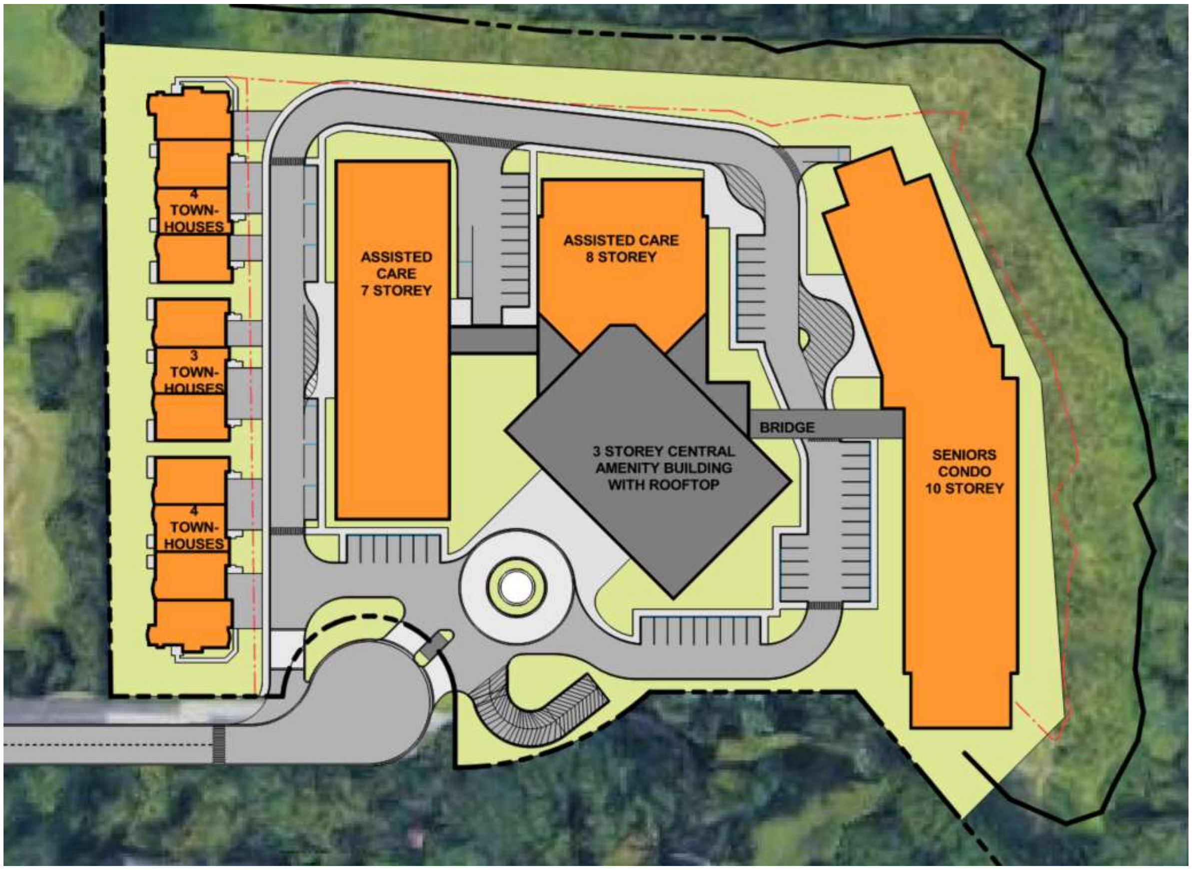
The proposed development is located within an Ecologically Significant Groundwater Recharge Area (ESGRA). As a result, the water balance must be maintained by matching post-development groundwater recharge to pre-development levels. The design of Low Impact Development (LID) measures on site is required by CLOCA, as they will help achieve the water balance objective and other stormwater management (SWM) targets. Infiltration testing will be completed to help determine the feasibility of the various LID measures proposed for the site at the detailed design stage.

1.2 Proposed Development

The proposed development site plan is shown on **Figure 1-2** and consists of a development area of 3.03 Ha. There will be a 10-storey condominium tower on the eastern side of the site and a 7-storey assisted care building on the west, both connected to a central amenity building with an additional 8-storey assisted care building attached to it. There will be three separate 1-storey townhouses providing 11 total units. There will also be an underground parking garage underneath the proposed tower buildings.

A cul-de-sac entrance is proposed at the eastern limit of Stevens Road. The cul-de-sac will be connected to an internal road. The internal road will have lay-by parking and two entrances to the underground parking structure, one located on the south side of the site near the cul-de-sac entrance and the other on the northern side of the site between the 7-storey and 8-storey assisted care buildings.

Figure 1-2: Proposed Site Plan (By Chamberlain Architect Services Limited)



Based on pre-consultation meetings with Durham Region, the theoretical population would be approximately 1,182 people.

1.3 Background Information

Reports and correspondence related to this report include:

- 46 Stevens Road pre-consultation meeting (April 29, 2021) with Municipality of Clarington (Planning and Development, Public Works – Infrastructure, Emergency Services), Region of Durham Works Department, CLOCA, Kaitlin Group, Weston Consulting
- Environmental Impact Study, 46 Stevens Road Development, prepared by GHD (April 2022)

The following historical drawings of the subject area were used in the preparation of the report. The following drawings are included in **Appendix A**:

- Stevens Property Survey prepared by JD Barnes (July 2003)
- G41-STM Servicing Map prepared by Durham Region (April 2022)
- Stevens Road drawing no. C-04-W-340 contract number D2004-040 prepared by Durham Region (2004)
- Stevens Road drawing no. C-04-W-341 contract number D2004-040 prepared by Durham Region (2004)
- Bowmanville Creek and Soper Creek Regulatory Floodplain Mapping sheet BS005 and sheet BS010 prepared by CLOCA (2009)

2 STORMWATER MANAGEMENT

2.1 Existing Site Drainage and Peak Flows

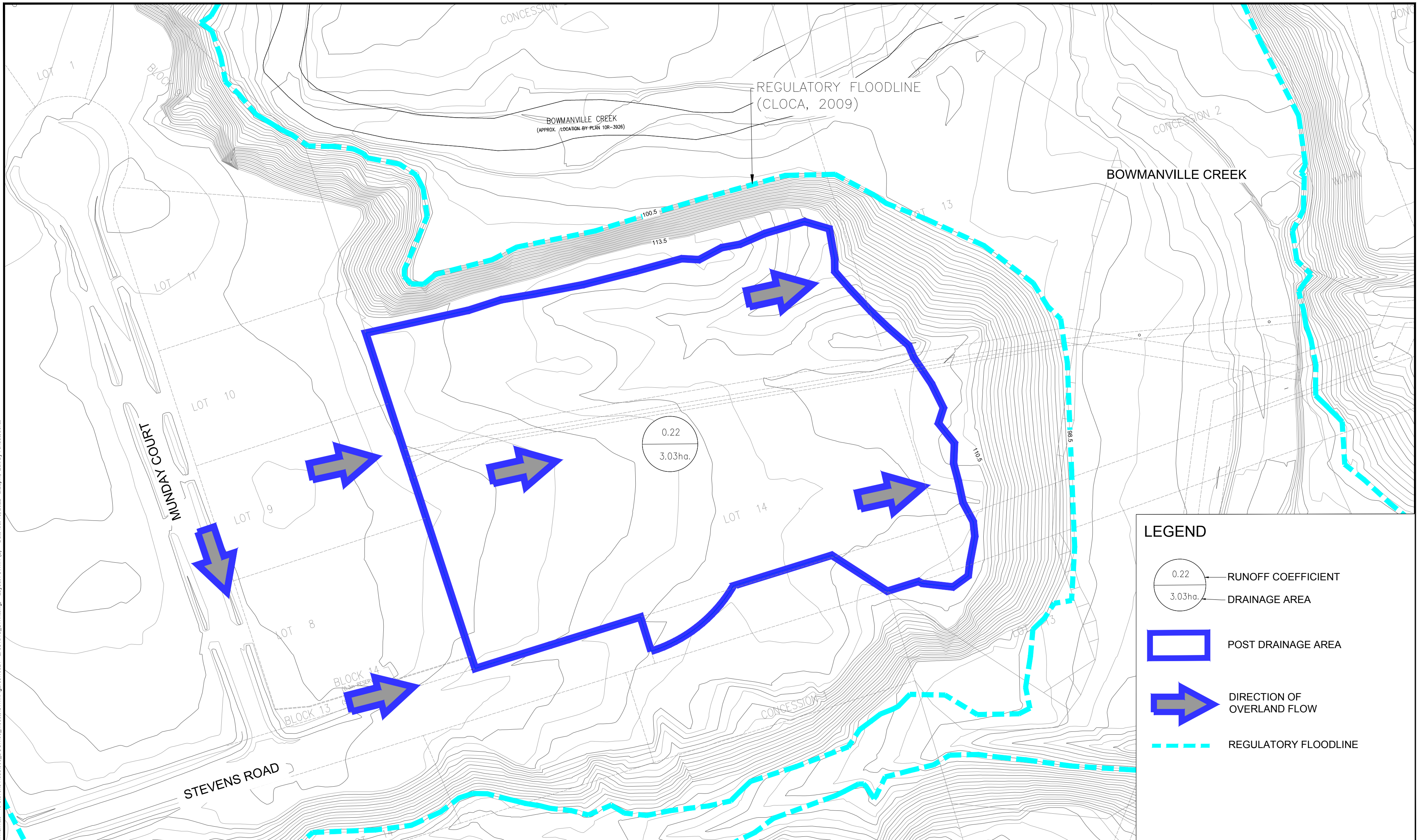
The current site is a relatively flat open space bordered by trees and generally drains west to east towards the Bowmanville Creek valley. The site is nearly entirely pervious under existing conditions, aside from an existing dwelling and tennis court. At the northern and eastern limits of the site, there is existing sloping which falls approximately 12 metres to the Bowmanville Creek. Near the middle of the western property line, there is a highpoint which splits a portion of the drainage north towards the Bowmanville Creek and south towards existing Stevens Road ditches. External drainage from the existing residential lots on the east side of Munday Court also appears to drain towards the site. The ditches along Stevens Road continue in an easternly direction towards Bowmanville Creek. There is an existing 300mm culvert at the current gravel driveway to the site. The site does not have any other existing storm sewers or SWM infrastructure. The site's existing topography is shown on **Figure 2-1.**

In the pre-consultation discussions with the Agencies, CLOCA pointed out that the proposed development is not located within the regulatory floodplain. To confirm the location and elevation of the regulatory floodline within the Bowmanville Creek valley lands, the Bowmanville Creek Floodplain Modelling Package was requested from CLOCA. From the Bowmanville Creek and Soper Creek Regulatory Floodplain Mapping sheets BS005 and BS010, the floodline to the north and east of the site is clearly contained within the valley and the proposed site is not located within the Regulatory floodplain.

When determining existing peak flows, the site was analyzed using one catchment since the entire area drains to the east and ultimately sheet flows to Bowmanville Creek. The existing peak outflows from the respective catchment analysis area were determined using the Rational Method for the 2 to 100-year storm events. CLOCA requires post-development peak flows to be controlled to pre-development levels.

As the site is nearly entirely pervious in existing conditions, it has a runoff coefficient of less than 0.4, and so the Airport Method was selected to calculate the time of concentration, which was found to be 24 minutes based on the longest flow path across the site. After measuring the area of the existing dwelling's rooftop, the existing tennis court, and the surrounding croplands, a weighted runoff coefficient of 0.22 was calculated for the site.

The existing drainage plan is shown on **Figure 2-1.** Detailed stormwater calculations are provided in **Appendix B**. To calculate the existing peak flows from the drainage area using the Rational Method, the parameters in **Table 2-1** were used. The existing peak flows that were calculated are listed in **Table 2-2**.



TYLin

8800 Dufferin Street,
Suite 200
Vaughan, ON
L4K 0C5

p: 905.738.5700
f: 905.738.0065

46 STEVENS ROAD - BOWMANVILLE, MUNICIPALITY OF CLARINGTON

EXISTING DRAINAGE PLAN

SCALE: N.T.S.		PROJECT No. 10521
DATE: JULY 2022		
DESIGNED BY: S.B.	DRAWN BY: S.B.	FIGURE No. 2-1
CHECKED BY: L.K.	CHECKED BY:	

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Table 2-1: Existing Conditions Parameters

Site Outlet	Existing Drainage Areas	Area (ha)	Runoff Coefficient
Bowmanville Creek	Dwelling Rooftop	0.02	0.90
	Tennis Court	0.07	0.90
	Croplands	2.94	0.20
	Total	**3.03**	**0.22**

Table 2-2: Existing Drainage Peak Flows

Catchment Analysis Area	2- Year (m^3/s)	5- Year (m^3/s)	10- Year (m^3/s)	25- Year (m^3/s)	50- Year (m^3/s)	100- Year (m^3/s)
Existing (3.03ha)	0.089	0.114	0.131	0.157	0.184	0.200

2.2 Stormwater Management Design Criteria

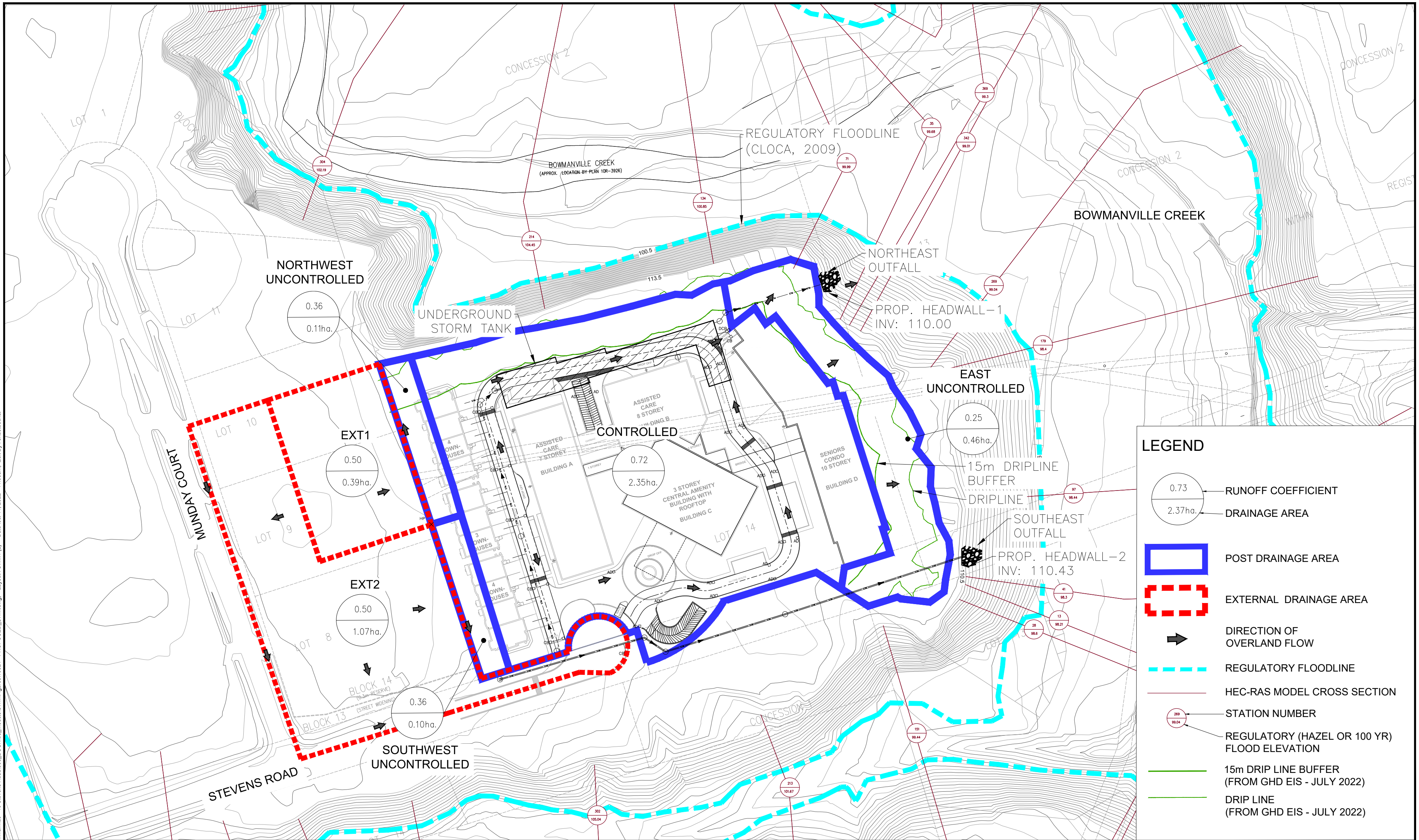
The stormwater strategy for the proposed development will make best efforts to utilize a treatment train approach for stormwater management controls. A conventional SWM pond is not considered feasible, therefore a combination of site based measures along with mechanical treatment via Oil and Grit separators (OGS) and conveyance controls, where possible are proposed to be implemented. The proposed site based measures include: underground storage to meet erosion and water quantity control criteria. The proposed underground tank will have an internal water quality separator row as well as two OGS units upstream and one OGS unit downstream to help meet water quality control criteria. Conveyance and end of pipe measures proposed include: a system of sewers, underground storage, and potential infiltration treatment units around the site.

The proposed stormwater management strategy is based on the criteria from the Ministry of Environment (MECP) Stormwater Management Planning and Design Manual (2003), Municipality of Clarington, and CLOCA standards. The design criteria for the site are as follows:

- **Erosion control:** Runoff from a 25mm rainfall event is to be captured, retained, or detained and discharged over 24-48 hours.
- **Enhanced Water Quality Control:** 80% TSS removal based on MECP SWM Design Manual (March 2003).
- **Quantity Control:** Control post-development peak flows to pre-development peak flows for the 2-to-100-year storm events.
- **Site Water Balance:** Match post to pre-development infiltration volume by capturing up to 5mm from each storm event across the site.

2.3 Proposed Site Drainage

The site has been broken into four post development catchments, in order to preserve the site's existing hydrology to the greatest extent possible. The catchments include a controlled drainage area, a northwest uncontrolled area, a southwest uncontrolled area, and an east uncontrolled area. The proposed drainage areas as well as two external drainage areas, EXT1 and EXT2, are illustrated on **Figure 2-2** and a summary of modeling parameters is provided in **Table 2-3.**



TYLin

8800 Dufferin Street, Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

46 STEVENS ROAD - BOWMANVILLE, MUNICIPALITY OF CLARINGTON

PROPOSED DRAINAGE PLAN

SCALE: N.T.S.		PROJECT No. 10521
DATE: JULY 2022		
DESIGNED BY: S.B.	DRAWN BY: S.B.	FIGURE No. 2-2
CHECKED BY: L.K.	CHECKED BY:	

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Table 2-3: Proposed Site Drainage Catchments

Site Outlet	Site Drainage Areas	Area (ha)	Runoff Coefficient
Northeast Outfall	Building Rooftops, Internal Roadway, Parking/Loading Areas, and Walkway	1.76	0.90
	Landscaping	0.59	0.20
	Total	**2.35**	**0.72**
Northwest Uncontrolled	Townhouse Rooftops	0.02	0.90
	Landscaping	0.08	0.20
	Total	**0.11**	**0.34**
Southwest Uncontrolled	Townhouse Rooftops	0.02	0.90
	Landscaping	0.07	0.20
	Total	**0.10**	**0.38**
East Uncontrolled	Walkway	0.05	0.90
	Landscaping	0.43	0.20
	Total	**0.46**	**0.25**
	TOTAL	**3.01**	

As shown in the table above, the total proposed drainage area is slightly less than the total existing area of 3.03ha. The existing site area of 3.03ha was taken from the exact property line of the site. In proposed drainage conditions, the cul-de-sac entrance at the south of the site is considered external (as shown on **Figure 2-2**), which results in a total proposed drainage area of 3.01ha.

The site is proposed to be drained as follows:

Northeast Outfall to Bowmanville Creek

- All runoff from the 2.35ha controlled drainage area of the site will be directed to the proposed underground storm tank for storage and treatment via a series of catchbasins and area drains located within the site's internal ROW at various low points.
- Catchbasins located within the ROW on the west of the site will convey runoff from the building rooftops and paved areas to a proposed storm sewer. The proposed storm sewer is located within the ROW on the west of the site and is designed to convey up to the 100-year storm event, flowing from the southwest corner of the site, up to the northwest storm tank inlet. An OGS is proposed just upstream of this inlet to provide pre-treatment.
- Area drains are proposed along the site's internal ROW, primarily on the south and east portions of the site where there is an underground parking facility. Area drains will capture runoff from the building rooftops and paved areas, conveying them to a sump within the underground parking facility. The sump within the underground parking facility will discharge to an OGS for pre-treatment, before discharging to the underground storm tank at the north of the site.
- The storm tank outlet will convey flows to a control manhole structure with orifice control to achieve the site's peak outflow targets. Downstream of the control manhole, an additional OGS unit is proposed for further water quality treatment before the flows are conveyed to the site's northeast outfall (Headwall 1).
- The northeast outfall will be designed with a plunge pool and rip-rap liner to further reduce erosion potential by dispersing the outflow and reducing its velocity.

Southeast Outfall to Bowmanville Creek

- The 0.10ha southwest uncontrolled drainage area is delineated to reflect the rear lot drainage from highpoints located along the townhouse block of the site.

- All runoff from the southwest uncontrolled drainage area will be conveyed to a proposed swale located along the western property line of the site from the highpoint down to the southwest corner, where it will connect to the existing ditch along Stevens Road.
- Overcontrol for this portion of the site will be provided within the proposed storm tank.
- Runoff from external drainage area EXT2 is also conveyed to the existing ditch along Stevens Road, combining with the flows from the southwest uncontrolled drainage area, before being collected by a proposed storm sewer within the Stevens Road ROW.
- The external drainage from EXT2 along Stevens Road currently runs west to east along ditches with a high point located near Munday Court. There is an existing culvert at the current gravel driveway to the site. The proposed cul-de-sac and underground parking entrance will prevent the ditches from being able to continue to the top of the Bowmanville creek valley.
- To maintain the existing drainage along Stevens Road, a storm sewer network is being proposed to convey up to the 100-year storm flows. This sewer will act like a culvert allowing the storm flow to continue easterly towards the Bowmanville Creek. A typical culvert crossing is not feasible as it would send flows through the property owner's land to the South and be disrupted by the underground parking lot entrance. The storm sewer network would run through the existing municipal right of way to the southeast outfall (Headwall 2) where it would discharge the flows to the Bowmanville Creek.
- The southeast outfall will be designed with a plunge pool and rip-rap liner to further reduce erosion potential by dispersing the outflow and reducing its velocity.

Northwest Uncontrolled Catchment

- The 0.11ha northwest uncontrolled drainage area is delineated to reflect the rear lot drainage from highpoints located along the townhouse block of the site.
- All runoff from the northwest uncontrolled drainage area and external drainage area EXT1 will be conveyed to a proposed swale located along the western property line of the site. From the existing highpoint located near the middle of the western property line, the swale will flow uncontrolled to the northern top of the valley where it will then discharge to Bowmanville Creek.
- Overcontrol for this portion of the site will be provided within the proposed storm tank.

East Uncontrolled Catchment

- The 0.46ha east uncontrolled drainage area is delineated to reflect the existing topography on that side of the site, which flows easterly from the edge of the Seniors Condo Building towards the Bowmanville Creek Valley.
- Site grading in this area will maintain existing topography as much as possible, by allowing the runoff to sheet flow down to the Bowmanville Creek Valley. A small percentage of this runoff will originate from the proposed walking trail, but the majority will originate from landscaped area.
- Overcontrol for this portion of the site will be provided within the proposed storm tank.

For proposed site grading and servicing, please see Drawings GR01 and GP01 provided in **Appendix D**. Stormwater tank sizing details are provided in **Appendix C.**

2.3.1 Outfall to Bowmanville Creek

After analyzing the Bowmanville Creek Regulatory Floodline, it is clear that the proposed outfall elevations are much higher than floodline elevations at the proposed outfall locations. From the Bowmanville Creek and Soper Creek Regulatory Floodplain Mapping sheets BS005 and BS010, the floodline to the north and east of the site is clearly contained within the valley and appears to range from approximately 98 masl to 101 masl, which is well below the elevation of the proposed outfall inverts, which are 110.0 for the northeast outfall and 110.4 for the southeast outfall.

Figure 2-2 includes the regulatory floodline and HEC-RAS modelling cross section locations with associated flood elevations prepared by CLOCA (2009).

The outfall locations will be further refined at the detailed design stage in conjunction with the findings of the EIS.

2.4 Proposed Stormwater Management Design

2.4.1 Water Balance and Erosion Control

Water Balance: The primary objective of the site water balance measures is to capture and provide infiltration opportunities through a combination of infiltration, evapotranspiration, landscaping, and/or other LID practices. Since the site is located within an ESGRA, it is especially important to implement these measures to ensure pre-development infiltration volumes are maintained. For the proposed development, a subsurface storage unit is proposed. Depending on the suitability of soil underlying the tank, there may also be opportunities to propose a tank with a permeable bottom to promote infiltration. The tank storage serves a multi function as it provides erosion storage as well as helps to meet the site water balance through potential infiltration. Potential LID measures including infiltration trenches, permeable pavements, bioretention systems, etc., will be further explored at later stages of the site design once more information is available. Section 2.5 describes the conceptual LID plan in more detail.

For the water balance analysis, the landscaped areas are assumed to capture and infiltrate up to 5mm and initial abstraction for the impervious surfaces is assumed to be 1.5mm. The water balance deficit for the proposed site is shown in **Table 2-4** below.

Table 2-4: Site Water Balance

Site	Area (ha)	Percent of Total Area (%)	Initial Abstraction (mm)	Required Capture for Water Balance (mm)	Required Volume for 5mm Capture (m^3)	Provided Retention (m^3)	Deficit/Additional Volume Required (m^3)
Paved Area	1.84	61	1.5	5.0	92.0	27.6	
Landscaped Area	1.17	39	5.0	5.0	58.5	58.5	
Total	3.01				150.5	86.1	**64.0**

Spreadsheet calculations are provided in **Appendix B**.

Due to the site's water balance deficit, 64m^3 of runoff is required to be stored in the tank and infiltrated through the bottom of the tank. The storage tank will be sized to provide 64m^3 of dead storage for this purpose.

Erosion control: Runoff from a 25mm rainfall event to be captured, retained, or detained from all new and/or fully reconstructed impervious surfaces. Volume reduction shall be provided to the maximum extent practical with a minimum of 5mm. Following reduction of runoff to the maximum extent possible, the remaining runoff volume from the 25mm event should be detained on site and slowly released to the creek or storm sewer over 24 to 48 hours.

The strategy for erosion control on this site involves detaining the 25mm volume in the underground storage tank and releasing the runoff over 24 to 48 hours. As the water balance volume of 5mm has already been accounted for as dead storage within the proposed tank, the 25mm target runoff depth used in the erosion control calculations are based on a volume of 20mm. The required erosion control volume and target peak outflow over 24 hours is shown in **Table 2-5.**

Table 2-5: Erosion Control

Tank	Total Impervious Area (ha)	25mm Target Runoff Depth (mm)	25mm Target Runoff Volume (m^3)	Average Outflow 24 hr (m^3/s)	25mm Target Peak Outflow (m^3/s)
Tank 1	1.84	20	368	0.004	0.006

Spreadsheet calculations are provided in **Appendix B**.

The underground storage tank has been sized to include the 368m^3 erosion control volume requirement as part of its active storage volume. The target peak outflow for erosion control will be achieved through an orifice sized to control the flows.

2.4.2 Quality Controls

Criteria: Enhanced water quality control: 80% Total Suspended Solids (TSS) removal based on MECP SWM Design Manual (March 2003)

A large percentage of the site is proposed to be rooftop, and runoff from these areas is considered clean and therefore does not require water quality or pre-treatment prior to infiltration or storage. For the paved and landscaped areas surrounding the buildings, treatment of runoff will first be provided from the OGS units proposed just upstream of the two storm tank inlets. Treatment will also be provided within the separator row of the underground storage tank and in an OGS unit at the outlet prior to discharging to the Bowmanville Creek outfall. The reason for an OGS proposed downstream of the tank is because two catchbasin leads will be connected directly to the tank, contributing untreated flows (see GP01 in **Appendix D**). As a result, a downstream OGS is required for final polishing of the stormwater. CLOCA will accept that OGS devices designed as per manufacturer specifications to achieve 80% TSS removal, operating alone, can achieve a TSS removal efficiency of 50%.

While the exact model of storage tank is not yet determined, there are manufacturers such as CULTEC that offer storage tanks designed with a separator row for water quality treatment. The internal treatment of the stormwater entering the storage system, followed by downstream treatment in an OGS at the tank outlet, would provide a treatment train approach to meet the water quality criteria of 80% TSS removal. The OGS manufacturer and model will also be determined in subsequent design stages.

The proposed tank and OGS locations are shown on the General Servicing Plan (GP01) in **Appendix D**.

2.4.3 Quantity Controls

Criteria: Post-development peak flows to pre-development peak flows for the 2-year to 100-year storm events.

The proposed land use for the development is residential, as such the accepted practice of providing underground storage is proposed to mitigate increased post-development stormwater runoff.

Due to the nature of the site grading, as described in Section 2.3., overcontrol will need to be provided within the underground tank to compensate for the runoff draining uncontrolled from the west and the east of the site. The Rational Method was used to calculate the post development peak flows for the 2-year to 100-year storm events for each uncontrolled area. A time of concentration of 10 minutes was assumed. The site outflow targets were set by subtracting the uncontrolled post-development peak flows from the existing total site peak flows.

The resulting target peak flows for the total site are summarized in **Table 2-6.** These are the targets required to be met at the northeast outlet of the site.

Table 2-6: Target Peak Flows

Return Period (Years)	Existing Total Site (m^3/s)	Post-Development Northwest Uncontrolled (m^3/s)	Post-Development Southwest Uncontrolled (m^3/s)	Post-Development East Uncontrolled (m^3/s)	Northeast Outlet Target (m^3/s)
25mm	-	-	-	-	0.006
2	0.089	0.008	0.008	0.025	0.049
5	0.114	0.010	0.010	0.030	0.068
10	0.131	0.011	0.011	0.035	0.077
25	0.157	0.012	0.012	0.038	0.098
50	0.184	0.014	0.014	0.045	0.115
100	0.200	0.015	0.015	0.047	0.124

The tank is required to store the erosion, water balance, and the water quantity volumes. The water balance volume calculated in Section 2.4.1. is equivalent to the dead storage within the tank. The 25mm erosion volume is considered part of the active storage within the tank. The Modified Rational Method was used to determine the quantity storage requirements for the tank by setting the target peak outflows to the northeast outlet targets.

The resulting tank storage volumes and outflows are summarized in **Table 2-7**. All spreadsheet calculations are provided in **Appendix B**.

Table 2-7: Underground Tank Required Storage and Outflow

Water Balance	**Quantity Control Active Storage**						**Total Tank Storage (m^3)**
Dead Storage	2- Year	5- Year	10- Year	25- Year	50- Year	100- Year	
(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	
64	316	413	475	660	736	849	**913**
	Tank Outflows (m3/s)						
25mm	2- Year	5- Year	10- Year	25- Year	50- Year	100- Year	
0.006	0.049	0.068	0.077	0.098	0.115	0.124	

The total tank storage of 913 m^3 was determined by summing the dead storage volume and the 100-year active storge volume. Section 2.6.1. goes into more detail about the tank infrastructure design.

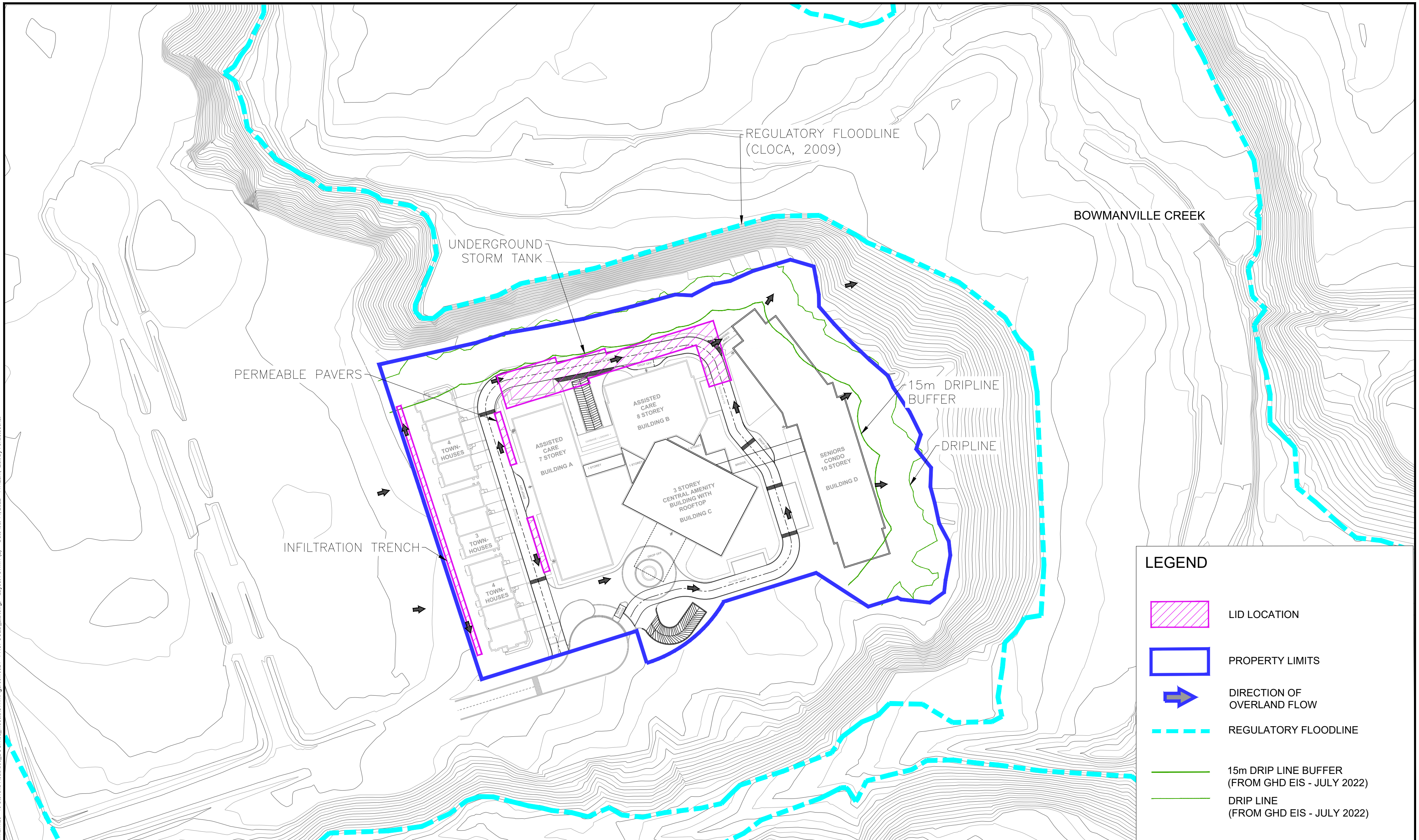
2.5 Low Impact Development

There are limited opportunities for LID measures on the site that can help promote infiltration and water quality treatment due to an underground parking facility. At the time of writing this report, a detailed hydrogeology report for the site is not yet available. As a result, it is not possible to confirm the exact location of the LID measures based on the suitability of underlying soil. This report provides a conceptual strategy for LID implementation on site. The size, location, and configuration of the on-site measures will be determined during the subsequent design stages once soil properties are known. A treatment train approach is proposed, which could involve a combination of some or all of the following measures:

- Infiltration trenches to promote groundwater recharge
- Permeable pavement and permeable surfaces in the non-roof areas of the site
- Storm tank/infiltration chamber with a permeable bottom to promote infiltration and groundwater recharge

At this stage, the above three LID options are recommended based on the proposed site plan. Additional LID options may also be feasible in future design stages once more information is known, as discussed in Section 2.5.4.

Figure 2-3 provides a conceptual LID location plan. The potential locations for LIDs shown on the Figure are based on areas of the site that are not anticipated to have underground parking.



TYLin

8800 Dufferin Street,
Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

46 STEVENS ROAD - BOWMANVILLE, MUNICIPALITY OF CLARINGTON

CONCEPTUAL LID LOCATION PLAN

SCALE: N.T.S.		PROJECT No. 10521
DATE: JULY 2022		
DESIGNED BY: S.B.	DRAWN BY: S.B.	FIGURE No. 2-3
CHECKED BY: L.K.	CHECKED BY:	

2.5.1 Infiltration trenches

Infiltration trenches allow for groundwater recharge to occur by capturing runoff and infiltrating it through granular stone or other void forming material. Water quality treatment is achievable through sedimentation, filtering, and soil adsorption.

A potential location for an infiltration trench would be on the west of the site along the property line to collect the northwest and southwest uncontrolled drainage and provide infiltration and water quality treatment opportunities. This would collect a portion of townhouse roof runoff and rear yard landscaping runoff before the flows are conveyed either north or south from the highpoint along the west property line.

Figure 2-4 presents a typical infiltration trench cross section.

Figure 2-4 Infiltration Trench Typical Cross Section

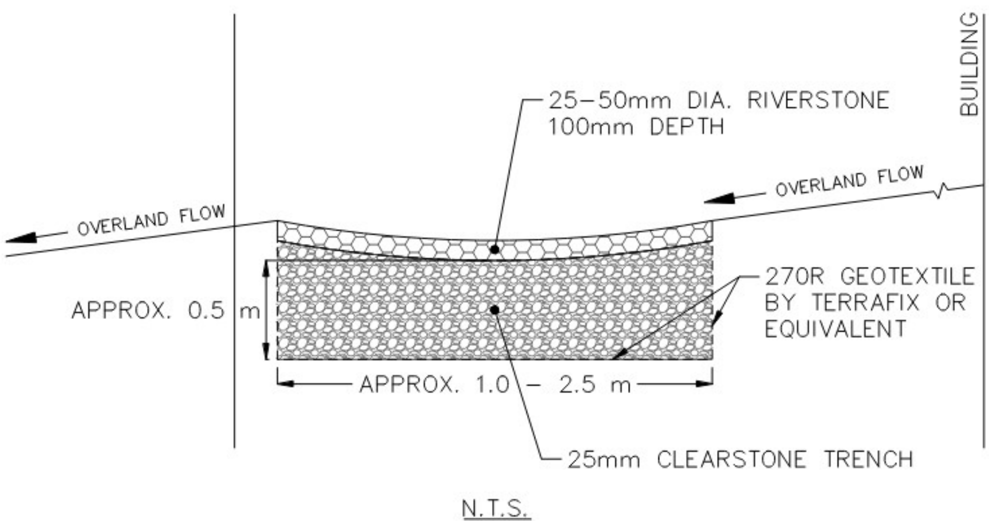


Figure 2-3 provides the potential locations of infiltration trenches on site.

2.5.2 Infiltration Chamber

The proposed underground storm tank could potentially act as an infiltration chamber if the underlying hydrogeology is suitable. If a CULTEC (or similar) system is proposed, there is often the option to order a detention/infiltration system that provides both quantity storage and infiltration opportunities, by incorporating a permeable bottom. This would promote infiltration of the dead storage component (water balance volume) in the tank directly into the groundwater system. The granular material in the tank's infiltration system also helps with water quality treatment by removing pollutants before water is recharged to the groundwater system.

Figure 2-3 provides the potential location of the infiltration chamber (storm tank) on site.

2.5.3 Permeable Pavement

Permeable pavements are an alternative to conventional impervious pavement that allow stormwater to drain through the surface and into a stone reservoir, where it infiltrates into the underlying native soil or is temporarily detained. Depending on the native soil properties and physical constraints, the system may be designed with no underdrain for full infiltration, with an underdrain for partial infiltration, or with an impermeable liner and underdrain for a non-infiltrating, or detention and filtration only practice.

There are limited locations that are suitable for permeable pavement on the site due to the large underground parking facility. However, there are a couple small proposed paved areas next to the drop-off area on the west of the 7-storey

Assisted Care building that could implement permeable pavers to treat runoff from the site's internal roadway and other impervious surfaces.

Figure 2-3 provides the potential locations of permeable pavement on site.

2.5.4 Additional LID Options

Additional LID options that may be considered for the site in subsequent design stages to further promote water balance and water quality treatment include:

- Bioretention infiltration systems and bioswale conveyance systems to manage the quality and quantity of storm runoff, integrated into the landscaped areas of the site.
- Rooftop storage with roof drain restrictions to control peak flow rates from the roof. The system could also be configured to hold a small depth of rainwater for evaporation (i.e. blue roof).
- Rainwater harvesting to capture clean roof runoff for reuse in greywater plumbing systems and/or irrigation
- Integrated stormwater tree trenches to treat runoff from the internal roadway and other hard surfaces

In establishing the preferred SWM strategy during subsequent design stages, priority should be given to measures that retain and/or filter runoff at the source. Consideration should be given to the requirements set out in the CVC/TRCA Low Impact Development Stormwater Management Planning and Design Guide, 2010, which includes important requirements related to minimum clearances required from the base of LID features to bedrock and seasonal high groundwater elevations (minimum 1.0 m), to ensure proper function. To reduce surface runoff and the need for on-site controls, efforts should be made to reduce the area of all impervious surfaces where possible.

2.6 Stormwater Infrastructure Design

2.6.1 Quantity Control Storage

For the purpose of this report, the underground tank was sized assuming a CULTEC Recharger 902HD model (or similar) will be used. Using the CULTEC design sheet, the required tank storage of 913 m^3 was inputted and the spreadsheet helped determine the required tank dimensions, as well as the stage-storage relationship. A CULTEC tank footprint of approximately 822 m^2 is required to accommodate the required storage volume. However, due to unpredictability in terms of future site plan changes and/or shallow groundwater table constraints, the tank footprint will be oversized by 50% for a total area of 1250 m^2 required. This will allow for flexibility with respect to tank depth in the subsequent design stages.

Table 2-8 summarizes the required dimensions for the CULTEC tank on the site in order to achieve SWM control criteria.

Table 2-8: Storage Tank Summary Table

Tank	Total Storage Required (m^3)	Total Storage Provided (m^3)	Tank Dimensions (m)	Required Tank Footprint (m^2)	Oversized Tank Footprint (m^2)
CULTEC Recharger 902HD (or similar)	913	918	Bed length: 89.2 Bed width: 9.22 Bed Depth: 2.06	822	1250

The preliminary design of the storage tank is presented on the General Servicing Plan (GP01) in **Appendix D**.

For Stage-Storage analysis, the invert of the tank will be set at an elevation of 110.10 masl, with the inlet and outlet pipe inverts set at an elevation of 110.30 masl. The CULTEC design sheet and stage-storage calculations are provided in **Appendix C**.

3 CONSTRUCTION EROSION AND SEDIMENT CONTROL

Prior to the commencement of any construction operations on site, an erosion and sediment control (ESC) program will be implemented. The ESC program will include measures to prevent the migration of silt laden runoff to downstream wetlands, water courses or receiving storm sewer infrastructure. The program will also outline measures to prevent tracking of mud and dust to perimeter City and Regional roads.

All measures will be designed in accordance with the 2019 TRCA “Erosion and Sediment Control Guide for Urban Construction”.

Erosion and sediment control measures may include the following:

- Sediment trap to collect drainage from the northern half (1.77ha) of the site
- Sediment trap to collect drainage from the southern half (1.99ha) of the site
- Double row silt fencing
- Runoff interceptor swales to direct runoff to the sediment traps
- Rock check dams
- Silt soxx filters
- Construction entrance mud mat

The ESC program may also incorporate tree and vegetation preservation measures. A detailed erosion and sedimentation control program with be initiated at the detailed design stage. At the detailed design stage, the erosion and sedimentation control plan and drawings will be prepared to the satisfaction of the Municipality of Clarington and CLOCA. Refer to the Functional Servicing Report prepared by TYLin, dated July 2022, for further details on the proposed erosion and sediment control measures. The preliminary Erosion Control Plan (drawing ESC01) is provided in **Appendix D** for reference.

4 CONCLUSION

The stormwater erosion, quantity and quality controls for the proposed subdivision can be implemented in accordance with the guidelines set out by both the Municipality of Clarington and CLOCA for new developments. The following summarizes our conclusions about the subject property:

- The proposed stormwater management and servicing plan provides quantity and quality control of post-development to pre-development levels through the use of a treatment train system that includes a storm sewer system, water quality treatment units, and underground tank storage.
- The water balance requirement will be achieved through potential LIDs including infiltration trenches, an infiltration chamber within the storm tank, and permeable pavers.
- Stormwater quality control will be achieved through a treatment train approach that includes potential LIDs, OGS units, and internal separator row treatment within the storage tank.
- During the construction process, standard sediment and erosion control measures will be implemented.

This report is to be read in conjunction with the Functional Servicing Report prepared by TYLin, dated July 2022.

We trust you will find the contents of this report satisfactory. Should you have any questions or comments please do not hesitate to contact the undersigned.

Sincerely,

T.Y.Lin International Canada Inc.

Laura Koyanagi

Laura Koyanagi B.Sc.
Water Resources Analyst

Shae Buchal

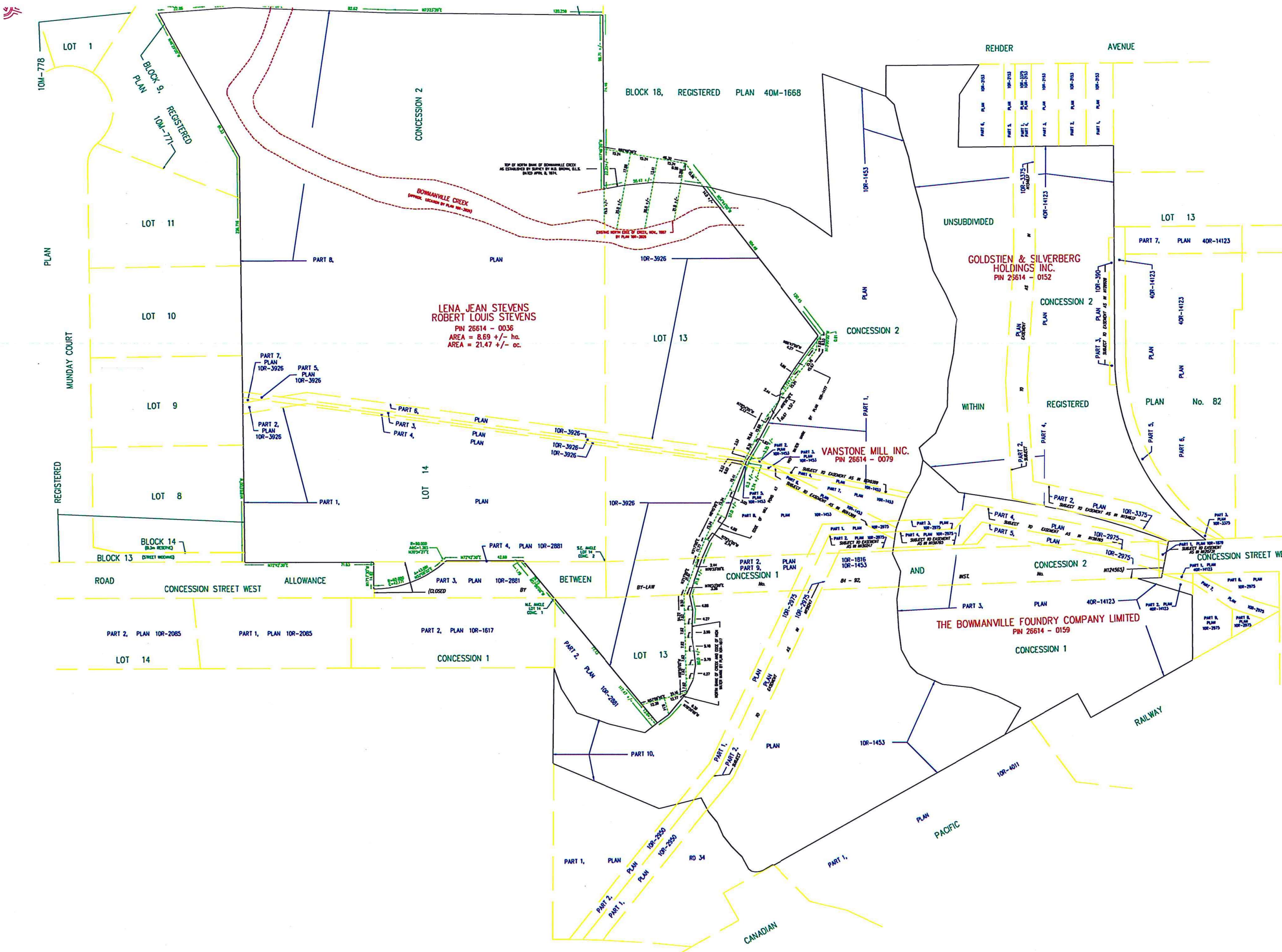
Shae Buchal
EIT

APPENDIX A

Background Information

EXISTING DRAWING:

Stevens Property Survey prepared by JD Barnes (July 2003)



CONCESSION 2, PART OF THE ROAD ALLOWANCE BETWEEN CONCESSIONS 1 AND 2
(CLOSED BY BY-LAW No. 84-92, INST. No. N124565)
AND PART OF UNSUBDIVIDED LOT 13 CONCESSION 2, WITHIN REGISTERED PLAN No. 82
MUNICIPALITY OF CLARINGTON
REGIONAL MUNICIPALITY OF DURHAM

SCALE 1 : 750

J. D. BARNES LIMITED

METRIC DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

NOTES

BOUNDARY INFORMATION DERIVED FROM PLANS 10R-1453, 10R-3926 AND 40R-14123.

INST. No.'s B010309 AND B011369 - (BELL CANADA EASEMENTS)

INST. No.'s N120731 - (REGIONAL MUNICIPALITY OF DURHAM EASEMENT) (SANITARY SEWER)

INST. No. N126828 - (REGIONAL MUNICIPALITY OF DURHAM EASEMENT) (WATERMAIN)

INST. No. N130247 - (REGIONAL MUNICIPALITY OF DURHAM EASEMENT) (WATERMAIN)

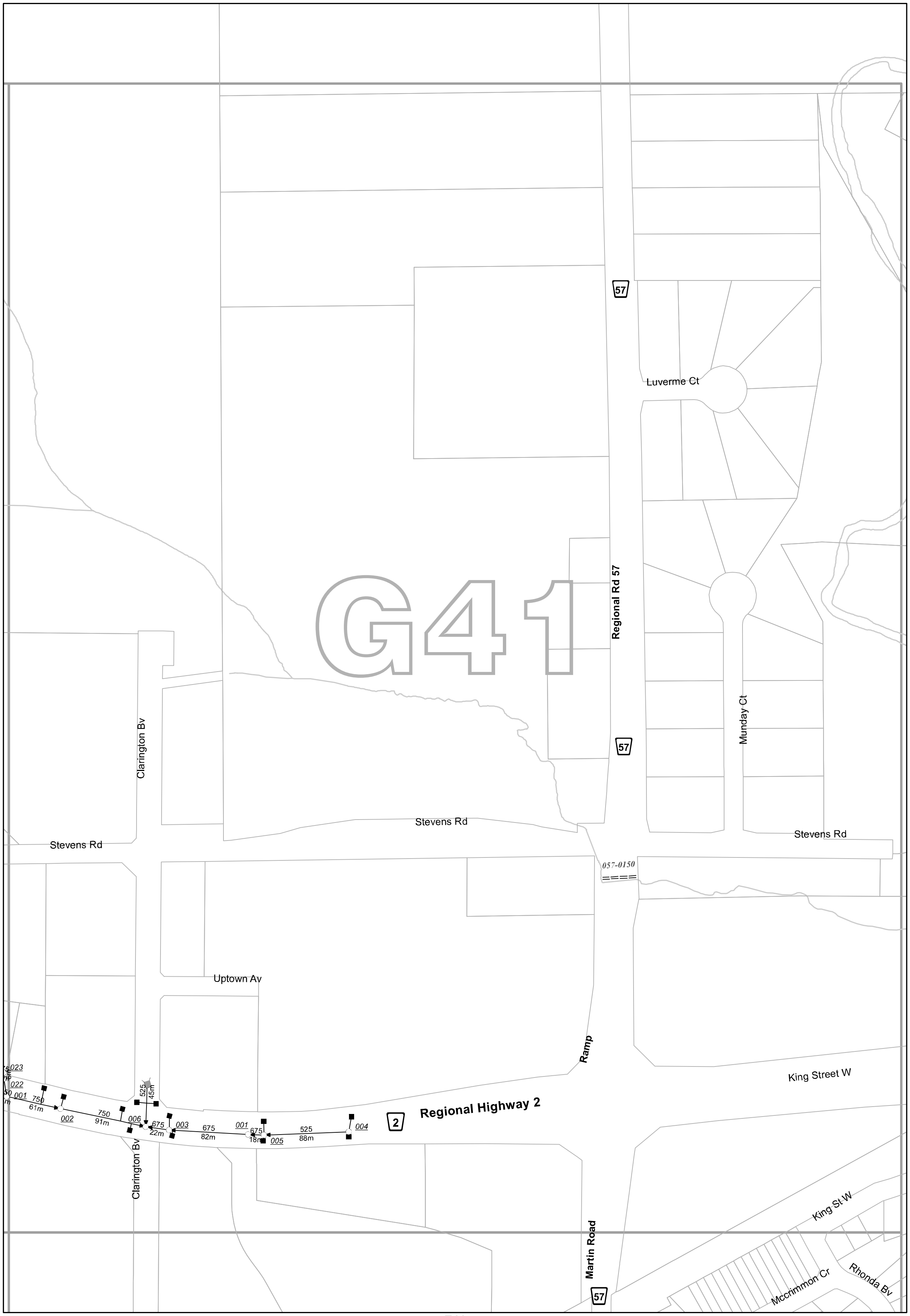
INST. No. N134637 - (REGIONAL MUNICIPALITY OF DURHAM EASEMENT) (SANITARY SEWER)

INST. No. N139765 - (REGIONAL MUNICIPALITY OF DURHAM EASEMENT) (WATERMAIN)

J.D.BARNES LIMITED SURVEYING MAPPING

EXISTING DRAWING:

G41-STM Servicing Map prepared by Region of Durham (April 2022)



The Regional Municipality of Durham
Works Department
Storm Sewer System

This map has been produced from a variety of sources
The Region of Durham does not make any representations concerning the accuracy, likely results, or reliability of the use of these materials. The Region hereby disclaims all representations and warranties.

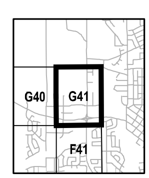
Municipality of CLARINGTON

(BOWMANVILLE)

1:3,750

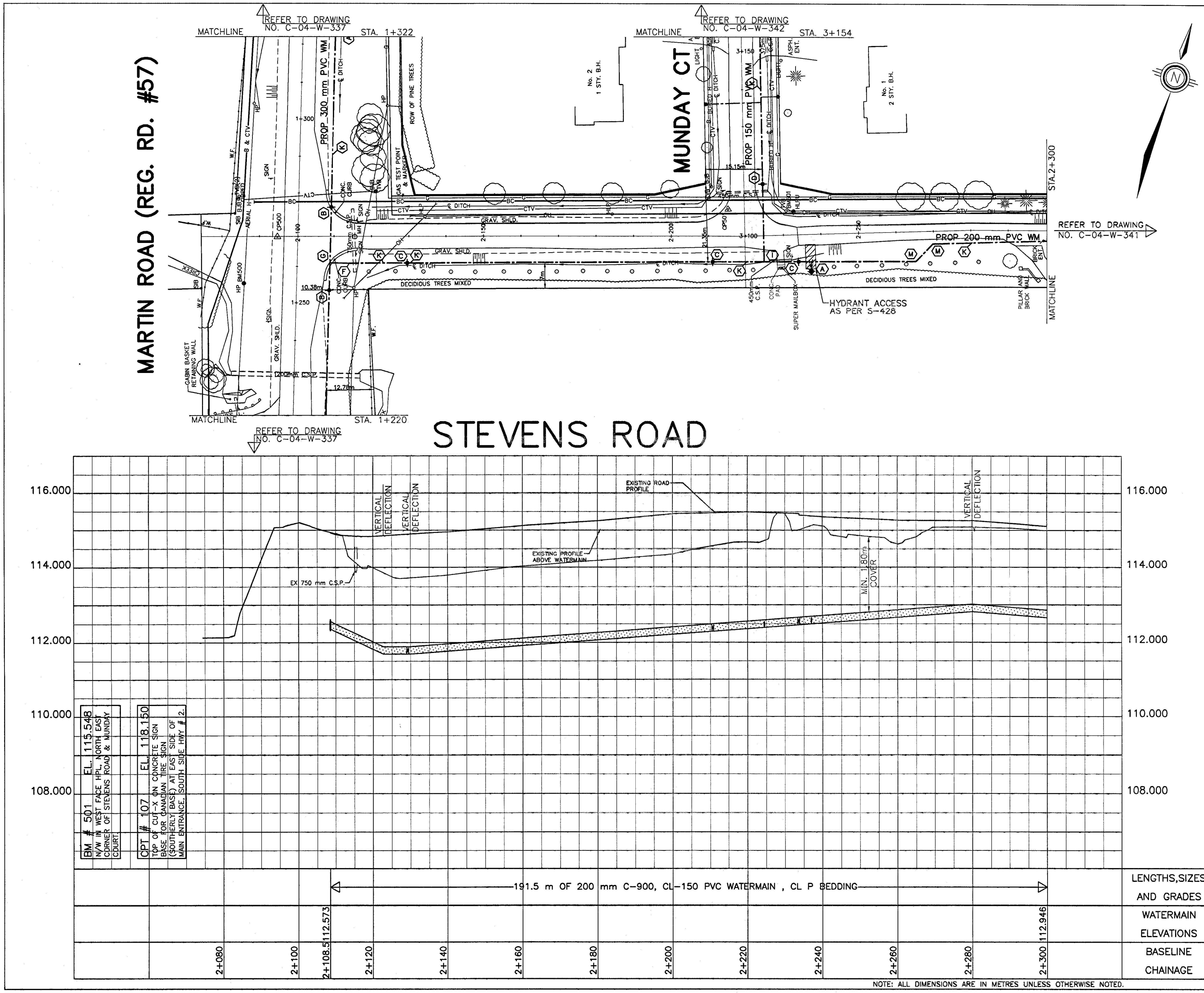
50 25 0 50 100 150 200 Meters

Revised June 2010
Issued for construction up to May 2010



EXISTING DRAWING:

Stevens Road drawing no. C-04-W-340 (contract number D2004-040) and Stevens Road drawing no. C-04-W-341 (contract number D2004-040) prepared by Durham Region (2004)



PROPOSED WATERMAIN DATA

MARK	DESCRIPTION	CHAINAGE	TOP OF WATERMAIN ELEVATION
A	PROPOSED HYDRANT ASSEMBLY (STORZ)(*HYD EXTENSION REQ'D)	2+237.04	112.692*
C	PROP 200 mm GATE VALVE	2+129.22 2+210.66 2+233.65	111.890 112.495 112.666
F	PROP HORIZONTAL DEFLECTION	2+114.05	112.318
I	PROP 200 mm x 150 mm TEE	2+224.44	112.598
K	PROPOSED VERTICAL DEFLECTION	2+122.76 2+130.00 2+280.00	111.890 111.890 113.014
M	PROPOSED 45° BEND	2+265.00 2+269.46	112.902 112.936

REFER TO DWG C-04-W-337 & C-04-W-338 FOR WATERMAIN NOTES AND RESTORATION NOTES

NOTE: FOR 'AS CONSTRUCTED' SERVICE CONNECTION LOCATIONS, REFER TO LATERAL LOCATION SHEETS.

NO.	DATE	NAME	REVISIONS
			AS RECORDED

LOCATION APPROVAL
MUNICIPALITY OF CLARINGTON [signature] DATE July 13/04

UTILITIES VERIFIED

ROGERS CABLE T.V.	2003 12 29	HYDRO ONE	2003 10 12
BELL CANADA	2003 11 27	VERIDIAN CONN.	2003 12 23
CONSUMERS GAS	2003 11 24	MUN. OF CLARINGTON	2004 06 04

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

REGISTERED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO
04/06/28

SURVEY DATA DATE 2003 05 02

SCALE
HORIZONTAL 1:500
VERTICAL 1:50

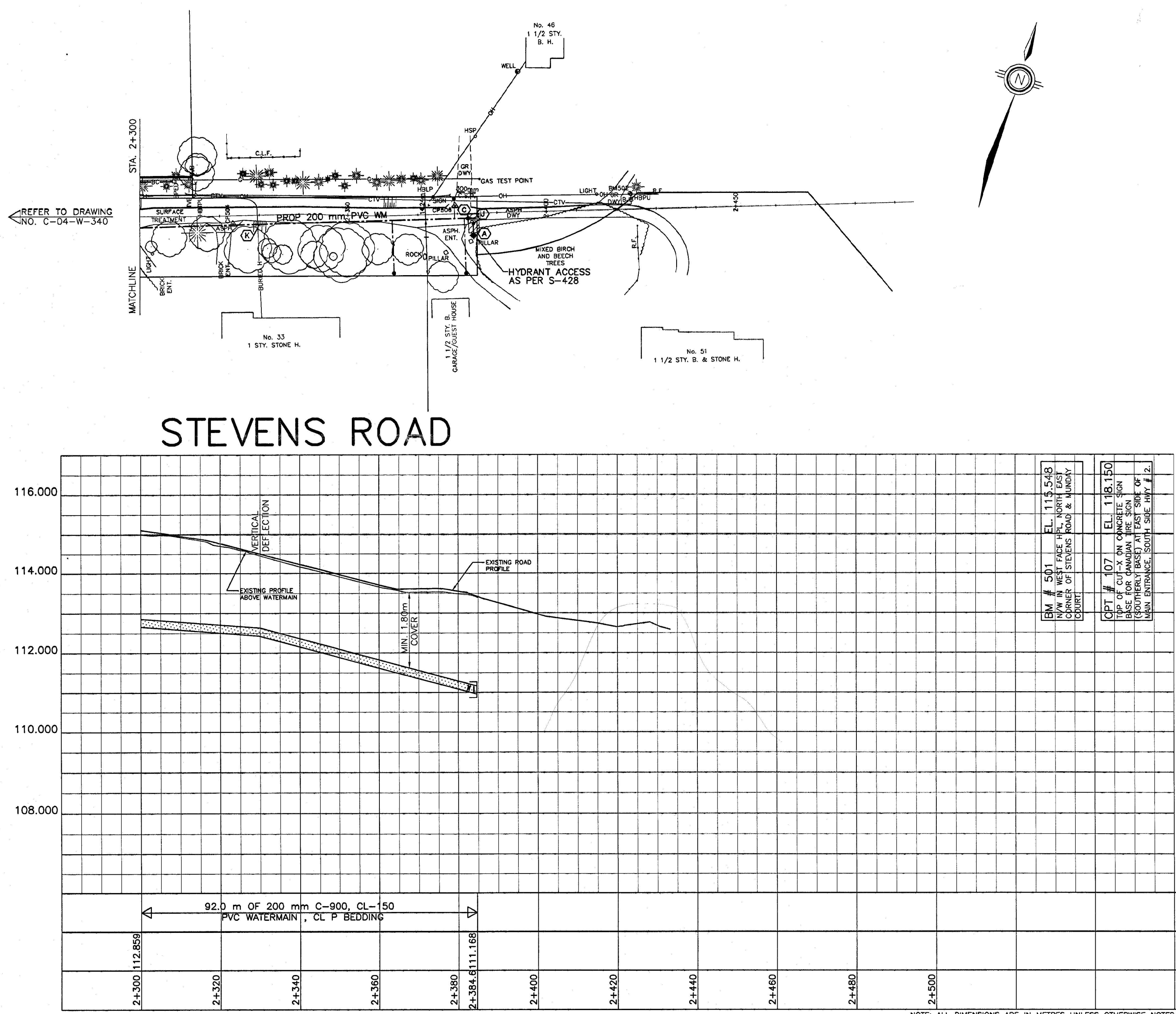
DRAWN:	J. BRUCE	DATE:	2003 11
DESIGN:	J. BRUCE	DATE:	2004 03
CHECKED:	P. STORMS	DATE:	2004 06
APPROVED:	A. W. HO	DATE:	2004 06

THE REGIONAL MUNICIPALITY OF DURHAM
WORKS DEPARTMENT
WHITBY ONTARIO

STEVENS ROAD
FROM MARTIN ROAD TO 80 m EAST OF MUNDAY CT

CONCESSION	REG. RD. NO.	AREA MUNICIPALITY
		CLARINGTON (BOWMANVILLE)

DRAWING NUMBER	CONTRACT NUMBER	SHEET NUMBER
C-04-W-340	D2004-040	6 OF 10



NOTE: ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

PROPOSED WATERMAIN DATA

MARK	DESCRIPTION	CHAINAGE	TOP OF WATERMAIN ELEVATION
A	PROPOSED HYDRANT ASSEMBLY (STORZ)(*HYD EXTENSION REQ'D)	2+383.91	111.188
C	PROP 200 mm GATE VALVE	2+382.65	111.221
J	PROPOSED MECHANICAL PLUG	2+384.66	111.168
K	PROPOSED VERTICAL DEFLECTION	2+330.00	112.627

REFER TO DWG C-04-W-337 & C-04-W-338 FOR WATERMAIN NOTES AND RESTORATION NOTES

NOTE: FOR 'AS CONSTRUCTED' SERVICE CONNECTION LOCATIONS, REFER TO LATERAL LOCATION SHEETS.

NO.	DATE	NAME	REVISIONS
			AS RECORDED

LOCATION APPROVAL
MUNICIPALITY OF CLARINGTON [signature] DATE July 13/04

UTILITIES VERIFIED

ROGERS CABLE T.V.	2003 12 29	HYDRO ONE	2003 10 12
BELL CANADA	2003 11 27	VERIDIAN CONN.	2003 12 23
CONSUMERS GAS	2003 11 24	MUN. OF CLARINGTON	2004 06 04

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

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO — A. W. HO — 04/06/23

SURVEY DATA DATE 2003 05 02

SCALE
HORIZONTAL 1:500
VERTICAL 1:50

DRAWN:	J. BRUCE	DATE:	2003 11
DESIGN:	J. BRUCE	DATE:	2004 03
CHECKED:	P. STORMS	DATE:	2004 06
APPROVED:	A. W. HO	DATE:	2004 06

THE REGIONAL MUNICIPALITY OF DURHAM
WORKS DEPARTMENT
WHITBY ONTARIO

STEVENS ROAD
FROM 80 m EAST OF MUNDAY CT TO 165 m EAST OF MUNDAY CT

CONCESSION | REG. RD. NO. | AREA MUNICIPALITY: CLARINGTON (BOWMANVILLE)

DRAWING NUMBER: C-04-W-341 | CONTRACT NUMBER: D2004-040 | SHEET NUMBER: 7 OF 10

EXISTING DRAWING:

Bowmanville Creek and Soper Creek Regulatory Floodplain Mapping sheet BS005 and sheet BS010 prepared by CLOCA (2009)

CENTRAL LAKE ONTARIO
CONSERVATION AUTHORITY
100 Whiting Avenue Oshawa, Ontario L1H 3T3 (905) 579-0411

LEGEND

- REGULATORY FLOODLINE
- ROADS
- BOWMANVILLE CREEK AND SOPER CREEK (DRAINAGE STREAM)
- MODEL CROSS SECTION
- STATION NUMBER AND REGULATORY (HAZEL OR 100-YR) FLOOD ELEVATION
- LOWEST WEIR ELEVATION

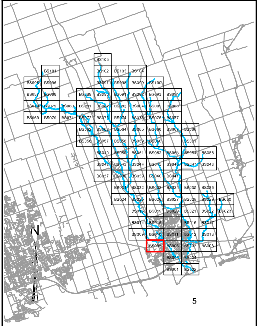
REVISIONS

No.	DESCRIPTION	BY:	DATE:
1	Hydrologic Update	AL	05/10
2	Hydrologic/Version Update	AL	06/15

Note:

1. This map is prepared for use in conjunction with the Bowmanville Creek and Soper Creek Floodplain Mapping Report dated May 2009.
2. Floodplain modeling was prepared by Aquafor Beech Limited using HEC-RAS 4.0, March 2008. Input parameters were extracted from base mapping with the use of HEC-GeoRAS.
3. Base mapping has been prepared by Central Lake Ontario Conservation Authority's Geomatics and Information Technology Department. Base Mapping was derived from First Base Solutions Digital Mapping and DEM Mapping produced from Aerial photography carried out in the spring of 2005.

PLEASE NOTE:
THE PROFESSIONAL ENGINEER STAMP VERIFIES THE FLOODLINE AND ASSOCIATED DATA UNLESS OTHERWISE NOTED



Meters 0 12.5 25 50 75 100 125 150 1:2,000

BOWMANVILLE CREEK & SOPER CREEK
REGULATORY FLOOD PLAIN MAPPING
Sheet Number: BS005 - 68354864

May, 2009

Central Lake Ontario Conservation

CENTRAL LAKE ONTARIO
CONSERVATION AUTHORITY

100 Whiting Avenue Oshawa, Ontario L1H 3T3 (905) 579-0411

LEGEND

- REGULATORY FLOODLINE
- ROADS
- BOWMANVILLE CREEK AND SOPER CREEK (DRAINAGE STREAM)
- MODEL CROSS SECTION
- STATION NUMBER AND REGULATORY (HAZEL OR 100-YR) FLOOD ELEVATION
- LOWEST WEIR ELEVATION

REVISIONS

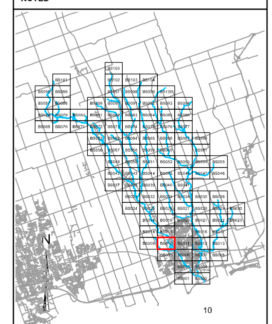
No.	DESCRIPTION	BY:	DATE:
1	Hydrologic Update	AL	05/10
2	Hydrologic/Version Update	AL	06/15

Note:

1. This map is prepared for use in conjunction with the Bowmanville Creek and Soper Creek Floodplain Mapping Report dated May 2009.
2. Floodplain modeling was prepared by Aquafor Beech Limited using HEC-RAS 4.0, March 2008. Input parameters were extracted from base mapping with the use of HEC-GeoRAS.
3. Base mapping has been prepared by Central Lake Ontario Conservation Authority's Geomatics and Information Technology Department. Base Mapping was derived from First Base Solutions Digital Mapping and DEM Mapping produced from Aerial photography carried out in the spring of 2005.

Aquafor Beech Limited

PLEASE NOTE:
THE PROFESSIONAL ENGINEER STAMP VERIFIES THE FLOODLINE AND ASSOCIATED DATA UNLESS OTHERWISE NOTED



Meters
0 12.5 25 50 75 100 125 150 1:2,000

BOWMANVILLE CREEK & SOPER CREEK
REGULATORY FLOOD PLAIN MAPPING
Sheet Number: BS010 - 68354865

May, 2009

APPENDIX B

Stormwater Design Calculations

APPENDIX B1

Existing Conditions

46 Stevens Rd. Stormwater Calculations
City of Clarington
Project # : 10521
Date: May 2022
Prepared by: S.B.

City of Clarington IDF Curves

Time of Concentration Tc = **24.0** min

Return Period	A	B	Rainfall Intensity, i	
2 year	1778.0	13.00	48.063	mm/hr
5 year	2464.0	16.00	61.611	mm/hr
10 year	2819.0	16.00	70.487	mm/hr
25 year	4318.0	27.00	84.678	mm/hr
50 year	4750.0	24.00	98.973	mm/hr
100 year	5588.0	28.00	107.476	mm/hr

CAD Area Measurements

Existing Site	3.03 ha
Existing Roof	0.02 ha
Existing Tennis Court	0.07 ha

Runoff coefficient calculation

Total Site	Area (ha)	C	I
Existing IMP	**0.09**	**0.90**	**1.00**
Existing Pervious	**2.94**	**0.20**	**0.00**
Total	**3.03**	***0.22***	***0.03***

Existing Peak Discharge

Rational Runoff Coefficient, c	0.22	
Drainage Area, A	3.03	ha
2 Year Peak Discharge, Q_2	0.089	m^3/s
5 Year Peak Discharge, Q_5	0.114	m^3/s
10 Year Peak Discharge, Q_{10}	0.131	m^3/s
25 Year Peak Discharge, Q_{25}	0.157	m^3/s
50 Year Peak Discharge, Q_{50}	0.184	m^3/s
100 Year Peak Discharge, Q_{100}	0.200	m^3/s

APPENDIX B2

Post-Development Conditions

TYLin

46 Stevens Rd. Stormwater Calculations
City of Clarington
Project # : 10521
Date: May 2022
Prepared by: S.B.

CAD Area Measurements

Proposed Site	3.01	ha
Total PERV	1.17	ha
Total IMP	1.84	ha

City of Clarington IDF Curves

Time of Concentration Tc = **10.00** min

Return Period	A	B	Rainfall Intensity, i	
2 year	1778.0	13.00	77.304	mm/hr
5 year	2464.0	16.00	94.769	mm/hr
10 year	2819.0	16.00	108.423	mm/hr
25 year	4318.0	27.00	116.703	mm/hr
50 year	4750.0	24.00	139.706	mm/hr
100 year	5588.0	28.00	147.053	mm/hr

Runoff coefficient calculation

Proposed Controlled	Area (ha)	C	I
Proposed IMP	**1.76**	**0.90**	**1.00**
Proposed Pervious	**0.59**	**0.20**	**0.00**
Total	**2.35**	***0.72***	***0.75***

Post Peak Discharge

Rational Runoff Coefficient, c	0.72	
Drainage Area, A	2.35	ha
2 Year Peak Discharge, Q_2	0.369	m^3/s
5 Year Peak Discharge, Q_5	0.452	m^3/s
10 Year Peak Discharge, Q_{10}	0.517	m^3/s
25 Year Peak Discharge, Q_{25}	0.556	m^3/s
50 Year Peak Discharge, Q_{50}	0.666	m^3/s
100 Year Peak Discharge, Q_{100}	0.701	m^3/s

Runoff coefficient calculation

East Uncontrolled	Area (ha)	C	I
Proposed IMP	**0.03**	**0.90**	**1.00**
Proposed Pervious	**0.43**	**0.20**	**0.00**
Total	**0.46**	***0.25***	***0.07***

Post Peak Discharge

Rational Runoff Coefficient, c	0.25	
Drainage Area, A	0.46	ha
2 Year Peak Discharge, Q_2	0.025	m^3/s
5 Year Peak Discharge, Q_5	0.030	m^3/s
10 Year Peak Discharge, Q_{10}	0.035	m^3/s
25 Year Peak Discharge, Q_{25}	0.038	m^3/s
50 Year Peak Discharge, Q_{50}	0.045	m^3/s
100 Year Peak Discharge, Q_{100}	0.047	m^3/s

Target Outflows:
Existing total site peak flows
- Post uncontrolled peak flows

2 Year Peak Discharge, Q_2	0.049	m^3/s
5 Year Peak Discharge, Q_5	0.068	m^3/s
10 Year Peak Discharge, Q_{10}	0.077	m^3/s
25 Year Peak Discharge, Q_{25}	0.098	m^3/s
50 Year Peak Discharge, Q_{50}	0.115	m^3/s
100 Year Peak Discharge, Q_{100}	0.124	m^3/s

Runoff coefficient calculation

Northwest Uncontrolled	Area (ha)	C	I
Proposed IMP	**0.02**	**0.90**	**1.00**
Proposed Pervious	**0.08**	**0.20**	**0.00**
Total	**0.11**	***0.34***	***0.21***

Post Peak Discharge

Rational Runoff Coefficient, c	0.34	
Drainage Area, A	0.11	ha
2 Year Peak Discharge, Q_2	0.008	m^3/s
5 Year Peak Discharge, Q_5	0.010	m^3/s
10 Year Peak Discharge, Q_{10}	0.011	m^3/s
25 Year Peak Discharge, Q_{25}	0.012	m^3/s
50 Year Peak Discharge, Q_{50}	0.014	m^3/s
100 Year Peak Discharge, Q_{100}	0.015	m^3/s

Runoff coefficient calculation

Southwest Uncontrolled	Area (ha)	C	I
Proposed IMP	**0.02**	**0.90**	**1.00**
Proposed Pervious	**0.07**	**0.20**	**0.00**
Total	**0.10**	***0.38***	***0.25***

Post Peak Discharge

Rational Runoff Coefficient, c	0.38	
Drainage Area, A	0.10	ha
2 Year Peak Discharge, Q_2	0.008	m^3/s
5 Year Peak Discharge, Q_5	0.010	m^3/s
10 Year Peak Discharge, Q_{10}	0.011	m^3/s
25 Year Peak Discharge, Q_{25}	0.012	m^3/s
50 Year Peak Discharge, Q_{50}	0.014	m^3/s
100 Year Peak Discharge, Q_{100}	0.015	m^3/s

APPENDIX B3

Quantity Storage Calculations

TYLin

46 Stevens Rd. Stormwater Calculations
City of Clarington
Project # : 10521
Date: May 2022
Prepared by: S.B.

Controlled Site - Required Storage

Allowable Release Rate (m^3/s)
0.049

Required Storage - 2 Year Target

Duration (min)	2 yr Intensity mm/hr	Post Development Flow (m^3/s)	Total Flow (m^3/s)	Required Storage Volume (m^3)
10.00	77.304	0.369	0.369	191.9
15.00	63.500	0.303	0.303	235.9
20.00	53.879	0.257	0.257	264.4
25.00	46.789	0.223	0.223	283.5
30.00	41.349	0.197	0.197	296.4
35.00	37.042	0.177	0.177	305.1
40.00	33.547	0.160	0.160	310.8
45.00	30.655	0.146	0.146	314.2
50.00	28.222	0.135	0.135	316.0
55.00	26.147	0.125	0.125	316.4
60.00	24.356	0.116	0.116	315.7
65.00	22.795	0.109	0.109	314.2
70.00	21.422	0.102	0.102	312.0
75.00	20.205	0.096	0.096	309.2
80.00	19.118	0.091	0.091	306.0
85.00	18.143	0.087	0.087	302.3
90.00	17.262	0.082	0.082	298.3
95.00	16.463	0.078	0.078	293.9
100.00	15.735	0.075	0.075	289.3
105.00	15.068	0.072	0.072	284.5
110.00	14.455	0.069	0.069	279.4
115.00	13.891	0.066	0.066	274.2
120.00	13.368	0.064	0.064	268.9
125.00	12.884	0.061	0.061	263.4

Required Storage - 5 Year Target

Allowable Release Rate (m^3/s)
0.068

Duration (min)	5 yr Intensity mm/hr	Post Development Flow (m^3/s)	Total Flow (m^3/s)	Required Storage Volume (m^3)
10.00	94.769	0.452	0.452	230.2
15.00	79.484	0.379	0.379	289.9
20.00	68.444	0.326	0.326	330.2
25.00	60.098	0.287	0.287	358.1
30.00	53.565	0.255	0.255	377.8
35.00	48.314	0.230	0.230	391.6
40.00	44.000	0.210	0.210	401.1
45.00	40.393	0.193	0.193	407.4
50.00	37.333	0.178	0.178	411.1
55.00	34.704	0.165	0.165	412.9
60.00	32.421	0.155	0.155	413.1
65.00	30.420	0.145	0.145	412.0
70.00	28.651	0.137	0.137	409.9
75.00	27.077	0.129	0.129	406.9
80.00	25.667	0.122	0.122	403.1
85.00	24.396	0.116	0.116	398.7
90.00	23.245	0.111	0.111	393.7
95.00	22.198	0.106	0.106	388.2
100.00	21.241	0.101	0.101	382.4
105.00	20.364	0.097	0.097	376.2
110.00	19.556	0.093	0.093	369.6
115.00	18.809	0.090	0.090	362.8
120.00	18.118	0.086	0.086	355.7
125.00	17.475	0.083	0.083	348.4

Required Storage - 10 Year Target

Allowable Release Rate (m^3/s)
0.077

Duration (min)	10 yr Intensity mm/hr	Post Development Flow (m^3/s)	Total Flow (m^3/s)	Required Storage Volume (m^3)
10.00	108.423	0.517	0.517	264.1
15.00	90.935	0.434	0.434	332.6
20.00	78.306	0.373	0.373	378.9
25.00	68.756	0.328	0.328	411.1
30.00	61.283	0.292	0.292	433.8
35.00	55.275	0.264	0.264	449.7
40.00	50.339	0.240	0.240	460.8
45.00	46.213	0.220	0.220	468.2
50.00	42.712	0.204	0.204	472.7
55.00	39.704	0.189	0.189	474.9
60.00	37.092	0.177	0.177	475.3
65.00	34.802	0.166	0.166	474.3
70.00	32.779	0.156	0.156	472.0
75.00	30.978	0.148	0.148	468.8
80.00	29.365	0.140	0.140	464.6
85.00	27.911	0.133	0.133	459.7
90.00	26.594	0.127	0.127	454.2
95.00	25.396	0.121	0.121	448.2
100.00	24.302	0.116	0.116	441.7
105.00	23.298	0.111	0.111	434.8
110.00	22.373	0.107	0.107	427.5
115.00	21.519	0.103	0.103	419.9
120.00	20.728	0.099	0.099	412.0
125.00	19.993	0.095	0.095	403.8

Required Storage - 25 Year Target

Allowable Release Rate (m^3/s)
0.098

Duration (min)	25 yr Intensity mm/hr	Post Development Flow (m^3/s)	Total Flow (m^3/s)	Required Storage Volume (m^3)
10.00	116.703	0.556	0.556	275.2
15.00	102.810	0.490	0.490	367.9
20.00	91.872	0.438	0.438	437.7
25.00	83.038	0.396	0.396	491.2
30.00	75.754	0.361	0.361	532.8
35.00	69.645	0.332	0.332	565.4
40.00	64.448	0.307	0.307	590.9
45.00	59.972	0.286	0.286	610.8
50.00	56.078	0.267	0.267	626.2
55.00	52.659	0.251	0.251	637.9
60.00	49.632	0.237	0.237	646.6
65.00	46.935	0.224	0.224	652.8
70.00	44.515	0.212	0.212	656.8
75.00	42.333	0.202	0.202	659.0
80.00	40.355	0.192	0.192	659.6
85.00	38.554	0.184	0.184	658.9
90.00	36.906	0.176	0.176	657.0
95.00	35.393	0.169	0.169	654.0
100.00	34.000	0.162	0.162	650.1
105.00	32.712	0.156	0.156	645.4
110.00	31.518	0.150	0.150	639.9
115.00	30.408	0.145	0.145	633.8
120.00	29.374	0.140	0.140	627.2
125.00	28.408	0.135	0.135	620.0

Required Storage - 50 Year Target

Allowable Release Rate (m^3/s)
0.115

Duration (min)	50 yr Intensity mm/hr	Post Development Flow (m^3/s)	Total Flow (m^3/s)	Required Storage Volume (m^3)
10.00	139.706	0.666	0.666	330.5
15.00	121.795	0.581	0.581	436.2
20.00	107.955	0.515	0.515	514.0
25.00	96.939	0.462	0.462	572.3
30.00	87.963	0.419	0.419	616.7
35.00	80.508	0.384	0.384	650.6
40.00	74.219	0.354	0.354	676.5
45.00	68.841	0.328	0.328	696.1
50.00	64.189	0.306	0.306	710.8
55.00	60.127	0.287	0.287	721.4
60.00	56.548	0.270	0.270	728.7
65.00	53.371	0.254	0.254	733.2
70.00	50.532	0.241	0.241	735.4
75.00	47.980	0.229	0.229	735.6
80.00	45.673	0.218	0.218	734.2
85.00	43.578	0.208	0.208	731.3
90.00	41.667	0.199	0.199	727.1
95.00	39.916	0.190	0.190	721.9
100.00	38.306	0.183	0.183	715.6
105.00	36.822	0.176	0.176	708.5
110.00	35.448	0.169	0.169	700.7
115.00	34.173	0.163	0.163	692.2
120.00	32.986	0.157	0.157	683.0
125.00	31.879	0.152	0.152	673.4

Required Storage - 100 Year Target

Allowable Release Rate (m^3/s)
0.124

Duration (min)	100 yr Intensity mm/hr	Post Development Flow (m^3/s)	Total Flow (m^3/s)	Required Storage Volume (m^3)
10.00	147.053	0.701	0.701	346.3
15.00	129.953	0.620	0.620	464.7
20.00	116.417	0.555	0.555	554.5
25.00	105.434	0.503	0.503	623.9
30.00	96.345	0.459	0.459	678.1
35.00	88.698	0.423	0.423	720.7
40.00	82.176	0.392	0.392	754.4
45.00	76.548	0.365	0.365	780.9
50.00	71.641	0.342	0.342	801.6
55.00	67.325	0.321	0.321	817.5
60.00	63.500	0.303	0.303	829.6
65.00	60.086	0.286	0.286	838.3
70.00	57.020	0.272	0.272	844.3
75.00	54.252	0.259	0.259	847.9
80.00	51.741	0.247	0.247	849.4
85.00	49.451	0.236	0.236	849.1
90.00	47.356	0.226	0.226	847.3
95.00	45.431	0.217	0.217	844.1
100.00	43.656	0.208	0.208	839.7
105.00	42.015	0.200	0.200	834.3
110.00	40.493	0.193	0.193	827.9
115.00	39.077	0.186	0.186	820.6
120.00	37.757	0.180	0.180	812.6
125.00	36.523	0.174	0.174	803.9

APPENDIX B4

Erosion and Water Balance

TYLin

Site Water Balance and Erosion Control

PROJECT: 10521
DATE: MAY 2022
MUNICIPALITY: Clarington
Prepared By: S.B.

Erosion Control

Site	Drainage Area (ha)	25mm Runoff Depth	25mm Runoff Volume	Average Outflow 24 hr (m^3/s)	Peak Outflow Target (m^3/s)
Northwest Uncontrolled Paved Area	0.02				
Southwest Uncontrolled Paved Area	0.02				
East Uncontrolled Paved Area	0.03				
Controlled Paved Area	1.76				
Total Paved Area	**1.84**	20	368	0.004	0.006

*Runoff depth for erosion control is 20mm after subtracting 5mm water balance volume

Water Balance

Site	Area (m^2)	% of Total Area	IA (mm)	Required Capture for Water Balance (mm)	Required Retention (m3)	Provided Retention (m3)
Paved Area	18,392.50	61%	1.5	5	92.0	27.6
Landscaped Area	11,704.50	39%	5.0	5	58.5	58.5
Tank Water Balance	30,097			**Totals**	150.5	86.1
*IA values taken from CLOCA SWM criteria					**Deficit/Additional Volume Required**	64

Water Balance/Infiltration Storage: 64 m3
Erosion Storage: 368 m3

APPENDIX C

Stormwater Infrastructure

CULTEC Stormwater Design Calculator

Date:	May 19, 2022

Project Number:	10521

Project Information:
46 Stevens Road SWM Report
46 Stevens Road
Clarington
Ontario
Canada

Calculations Performed By:
Shae Buchal
TYLin

RECHARGER 902HD

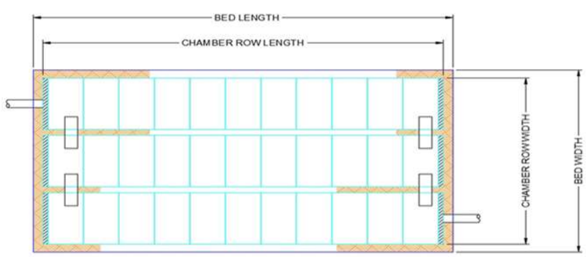
Recharger 902HD Chamber Specifications		
Height	**1219**	mm
Width	**1981**	mm
Length	**1.25**	meters
Installed Length	**1.12**	meters
Bare Chamber Volume	**1.80**	cu. meters
Installed Chamber Volume	**2.81**	cu. meters

Breakdown of Storage Provided by Recharger 902HD Stormwater System		
Within Chambers	**568.56**	cu. meters
Within Feed Connectors	**0.12**	cu. meters
Within Stone	**349.13**	cu. meters
Total Storage Provided	**917.8**	**cu. meters**
Total Storage Required	913.00	cu. meters

Materials List

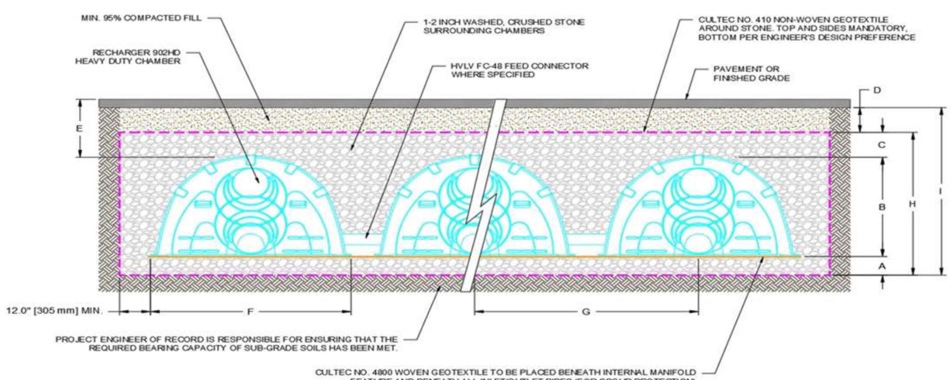
Recharger 902HD			
Total Number of Chambers Required	**316**	**pieces**	
Separator Row Chambers	**79**	pieces	Separator Row Qty Included in Total
Chamber Units	**316**	pieces	
End Caps	**8**	pieces	
HVLV FC-48 Feed Connectors	**6**	pieces	*Based on 2 Internal Manifolds*
CULTEC No. 410 Non-Woven Geotextile	**2487**	sq. meters	
CULTEC No. 4800 Woven Geotextile	**45**	meters	
Stone	**873**	cu. meters	

Bed Detail



Bed Layout Information		
Number of Rows Wide	**4**	pieces
Number of Chambers Long	**79**	pieces
Chamber Row Width	**8.61**	meters
Chamber Row Length	**88.60**	meters
Bed Width	**9.22**	meters
Bed Length	**89.21**	meters
Bed Area Required	**822.49**	sq. meters
Length of Separator Row	**88.60**	meters

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference			
A	Depth of Stone Base	**229**	mm
B	Chamber Height	**1219**	mm
C	Depth of Stone Above Units	**305**	mm
D	Depth of 95% Compacted Fill	**305**	mm
E	Max. Depth Allowed Above the Chamber	**2.54**	meters
F	Chamber Width	**1981**	mm
G	Center to Center Spacing	**2.21**	meters
H	Effective Depth	**1.75**	meters
I	Bed Depth	**2.06**	meters

CULTEC

CULTEC Stage-Storage Calculations

Date:	May 19, 2022

Project Information:
46 Stevens Road SWM Report
46 Stevens Road
Clarington
Ontario
Canada

Project Number:
10521

Chamber Model -	**Recharger 902HD**	
Number of Rows-	4	units
Total Number of Chambers -	316	units
HVLV FC-48 Feed Connectors-	6	units
Stone Void -	40	%
Stone Base -	229	mm
Stone Above Units -	305	mm
Area -	822.49	m2
Base of Stone Elevation -	110.10	

Recharger 902HD Incremental Storage Volumes

Height of System		Chamber Volume		HVLV Feed Connector Volume		Stone Volume		Cumulative Storage Volume		Total Cumulative Storage Volume		Elevation		
in	mm	ft³	m³	ft3	m3	ft³	m³	ft³	m³	ft³	m³	ft	m	
69.0	1753	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	32411.64	917.79	115.850	111.85	Top of Stone Elevation
68.0	1727	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	32116.53	909.44	115.770	111.83	
67.0	1702	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	31821.42	901.08	115.680	111.80	
66.0	1676	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	31526.31	892.72	115.600	111.78	
65.0	1651	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	31231.21	884.37	115.520	111.75	
64.0	1626	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	30936.10	876.01	115.430	111.73	
63.0	1600	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	30640.99	867.65	115.350	111.70	
62.0	1575	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	30345.88	859.30	115.270	111.67	
61.0	1549	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	30050.78	850.94	115.180	111.65	
60.0	1524	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	29755.67	842.59	115.100	111.62	
59.0	1499	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	29460.56	834.23	115.020	111.60	
58.0	1473	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	29165.45	825.87	114.930	111.57	
57.0	1448	23.3	0.7	0.0	0.0	285.8	8.1	309.105	8.8	28870.35	817.52	114.850	111.55	Top of Chamber Elevation
56.0	1422	58.2	1.6	0.0	0.0	271.8	7.7	330.007	9.3	28561.24	808.76	114.770	111.52	
55.0	1397	81.3	2.3	0.0	0.0	262.6	7.4	343.911	9.7	28231.24	799.42	114.680	111.50	
54.0	1372	139.4	3.9	0.0	0.0	239.4	6.8	378.718	10.7	27887.32	789.68	114.600	111.47	
53.0	1346	185.8	5.3	0.0	0.0	220.8	6.3	406.572	11.5	27508.61	778.96	114.520	111.45	
52.0	1321	232.0	6.6	0.0	0.0	202.3	5.7	434.334	12.3	27102.03	767.44	114.430	111.42	
51.0	1295	255.3	7.2	0.0	0.0	193.0	5.5	448.284	12.7	26667.70	755.14	114.350	111.40	
50.0	1270	278.5	7.9	0.0	0.0	183.7	5.2	462.188	13.1	26219.42	742.45	114.270	111.37	
49.0	1245	313.2	8.9	0.0	0.0	169.8	4.8	483.044	13.7	25757.23	729.36	114.180	111.34	
48.0	1219	313.2	8.9	0.0	0.0	169.8	4.8	483.044	13.7	25274.18	715.68	114.100	111.32	
47.0	1194	336.4	9.5	0.0	0.0	160.5	4.5	496.948	14.1	24791.14	702.01	114.020	111.29	
46.0	1168	348.1	9.9	0.0	0.0	155.9	4.4	503.947	14.3	24294.19	687.93	113.930	111.27	
45.0	1143	359.6	10.2	0.0	0.0	151.3	4.3	510.852	14.5	23790.25	673.66	113.850	111.24	
44.0	1118	382.7	10.8	0.0	0.0	142.0	4.0	524.756	14.9	23279.39	659.20	113.770	111.22	
43.0	1092	394.4	11.2	0.0	0.0	137.3	3.9	531.755	15.1	22754.64	644.34	113.680	111.19	
42.0	1067	405.9	11.5	0.0	0.0	132.7	3.8	538.660	15.3	22222.88	629.28	113.600	111.17	
41.0	1041	405.9	11.5	0.0	0.0	132.7	3.8	538.660	15.3	21684.22	614.03	113.520	111.14	
40.0	1016	417.6	11.8	0.0	0.0	128.1	3.6	545.659	15.5	21145.56	598.77	113.430	111.12	
39.0	991	429.1	12.2	0.0	0.0	123.5	3.5	552.564	15.6	20599.90	583.32	113.350	111.09	
38.0	965	440.8	12.5	0.0	0.0	118.8	3.4	559.609	15.8	20047.34	567.68	113.270	111.07	
37.0	940	452.3	12.8	0.0	0.0	114.2	3.2	566.468	16.0	19487.73	551.83	113.180	111.04	
36.0	914	452.3	12.8	0.0	0.0	114.2	3.2	566.515	16.0	18921.26	535.79	113.100	111.01	
35.0	889	463.9	13.1	0.0	0.0	109.5	3.1	573.467	16.2	18354.75	519.75	113.020	110.99	
34.0	864	463.9	13.1	0.0	0.0	109.6	3.1	573.420	16.2	17781.28	503.51	112.930	110.96	
33.0	838	475.5	13.5	0.0	0.0	104.9	3.0	580.419	16.4	17207.86	487.27	112.850	110.94	
32.0	813	475.5	13.5	0.0	0.0	104.9	3.0	580.419	16.4	16627.44	470.84	112.770	110.91	
31.0	787	475.6	13.5	0.0	0.0	104.9	3.0	580.465	16.4	16047.02	454.40	112.680	110.89	
30.0	762	487.1	13.8	0.0	0.0	100.3	2.8	587.371	16.6	15466.56	437.96	112.600	110.86	
29.0	737	487.1	13.8	0.0	0.0	100.3	2.8	587.371	16.6	14879.19	421.33	112.520	110.84	
28.0	711	487.1	13.8	0.0	0.0	100.3	2.8	587.371	16.6	14291.82	404.70	112.430	110.81	
27.0	686	498.7	14.1	0.0	0.0	95.6	2.7	594.323	16.8	13704.45	388.07	112.350	110.79	
26.0	660	498.7	14.1	0.0	0.0	95.6	2.7	594.323	16.8	13110.12	371.24	112.270	110.76	
25.0	635	510.4	14.5	0.0	0.0	91.0	2.6	601.321	17.0	12515.80	354.41	112.180	110.74	
24.0	610	510.3	14.4	0.0	0.0	91.0	2.6	601.275	17.0	11914.48	337.38	112.100	110.71	
23.0	584	521.9	14.8	0.0	0.0	86.4	2.4	608.227	17.2	11313.20	320.35	112.020	110.68	
22.0	559	521.9	14.8	0.0	0.0	86.4	2.4	608.227	17.2	10704.98	303.13	111.930	110.66	
21.0	533	521.9	14.8	0.0	0.0	86.3	2.4	608.284	17.2	10096.75	285.91	111.850	110.63	
20.0	508	521.9	14.8	0.1	0.0	86.3	2.4	608.310	17.2	9488.47	268.68	111.770	110.61	
19.0	483	533.5	15.1	0.3	0.0	81.6	2.3	615.387	17.4	8880.16	251.46	111.680	110.58	
18.0	457	533.5	15.1	0.3	0.0	81.6	2.3	615.422	17.4	8264.77	234.03	111.600	110.56	
17.0	432	533.5	15.1	0.4	0.0	81.6	2.3	615.444	17.4	7649.35	216.61	111.520	110.53	
16.0	406	533.5	15.1	0.4	0.0	81.5	2.3	615.455	17.4	7033.90	199.18	111.430	110.51	
15.0	381	545.0	15.4	0.4	0.0	76.9	2.2	622.371	17.6	6418.45	181.75	111.350	110.48	
14.0	356	545.1	15.4	0.4	0.0	76.9	2.2	622.428	17.6	5796.08	164.13	111.270	110.46	
13.0	330	556.7	15.8	0.4	0.0	72.3	2.0	629.386	17.8	5173.65	146.50	111.180	110.43	
12.0	305	556.8	15.8	0.4	0.0	72.2	2.0	629.438	17.8	4544.26	128.68	111.100	110.40	
11.0	279	556.7	15.8	0.4	0.0	72.2	2.0	629.396	17.8	3914.83	110.86	111.020	110.38	
10.0	254	556.8	15.8	0.5	0.0	72.2	2.0	629.462	17.8	3285.43	93.03	110.930	110.35	
9.0	229	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	2655.97	75.21	110.850	110.33	Bottom of Chamber Elevation
8.0	203	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	2360.86	66.85	110.770	110.30	
7.0	178	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	2065.75	58.50	110.680	110.28	
6.0	152	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	1770.65	50.14	110.600	110.25	
5.0	127	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	1475.54	41.78	110.520	110.23	
4.0	102	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	1180.43	33.43	110.430	110.20	
3.0	76	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	885.32	25.07	110.350	110.18	
2.0	51	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	590.22	16.71	110.270	110.15	
1.0	25	0.0	0.0	0.0	0.0	295.1	8.4	295.108	8.4	295.11	8.36	110.180	110.13	
0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.00	0.00	110.100	110.10	Bottom of Stone Elevation
-1.0														
-2.0														
-3.0														
-4.0														
-5.0														
-6.0														
-7.0														
-8.0														
-9.0														
-10.0														
-11.0														

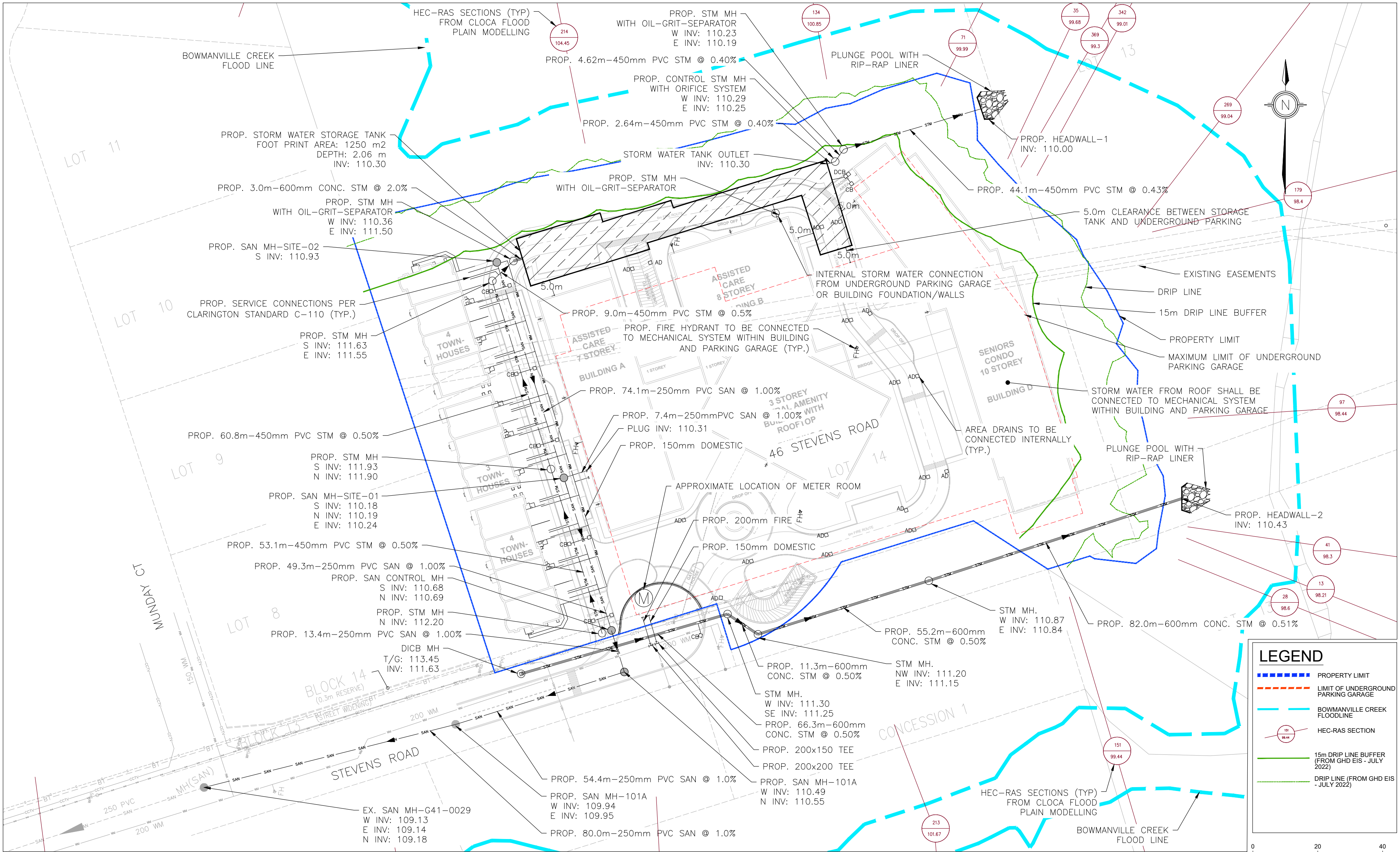
CULTEC, Inc.
P.O. Box 280
Brookfield, CT 06804

Phone: 203-775-4416
www.cultec.com
tech@cultec.com

Created on: 5/19/2022

APPENDIX D

Drawings



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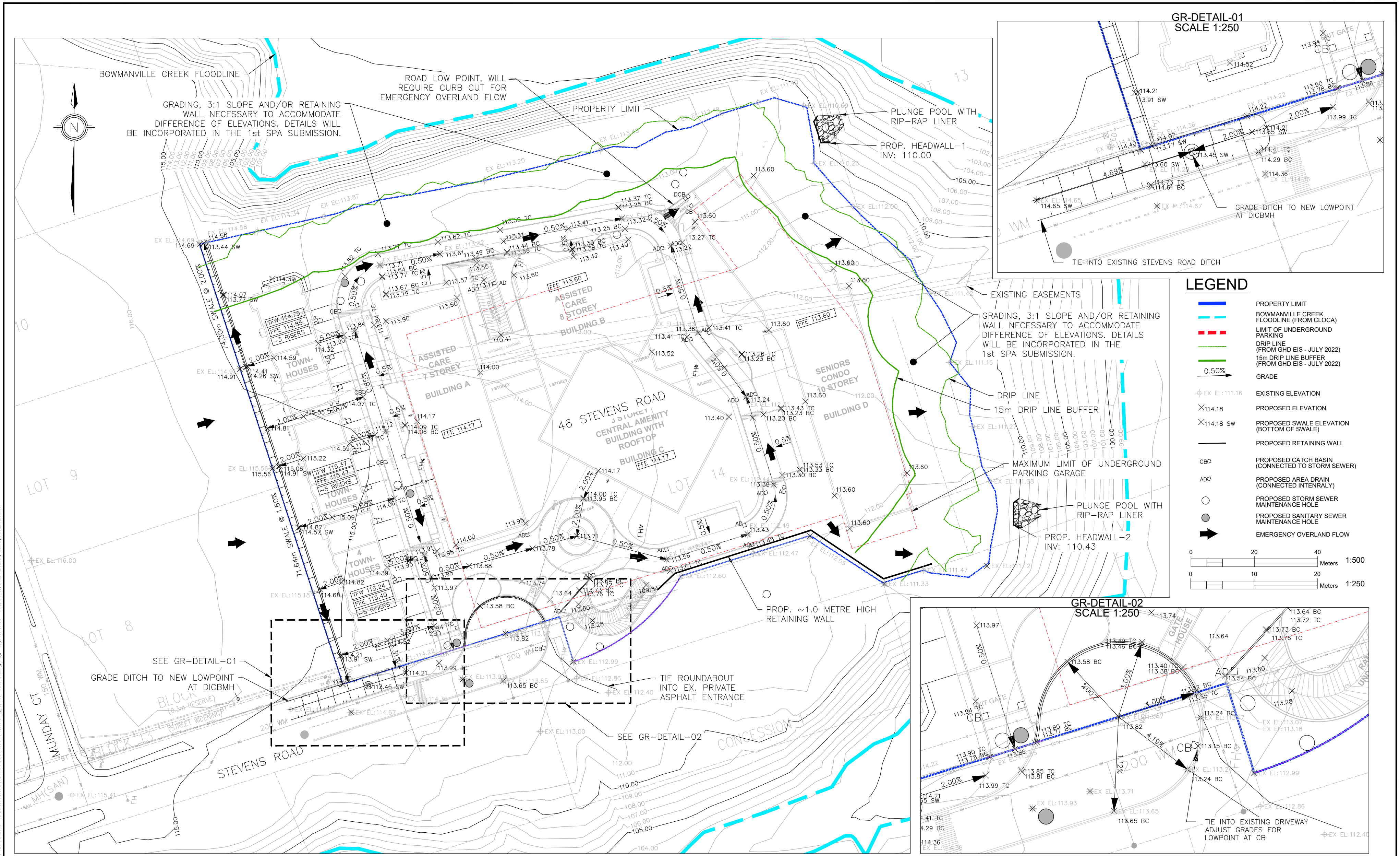
TYLin
8800 Dufferin Street, Suite 200 Vaughan, ON L4K 0C5
p: 905.738.5700 f: 905.738.0065

46 STEVENS ROAD
FUNCTIONAL SERVICING REPORT
PRELIMINARY GENERAL SERVICING PLAN

SCALE: 1:500
DATE: JULY 2022
DESIGNED BY: C.D.
DRAWN BY: C.D.,H.L.,S.B.
CHECKED BY: C.D.
CHECKED BY: M.R.
PROJECT No. 10521
FIGURE No. GP01



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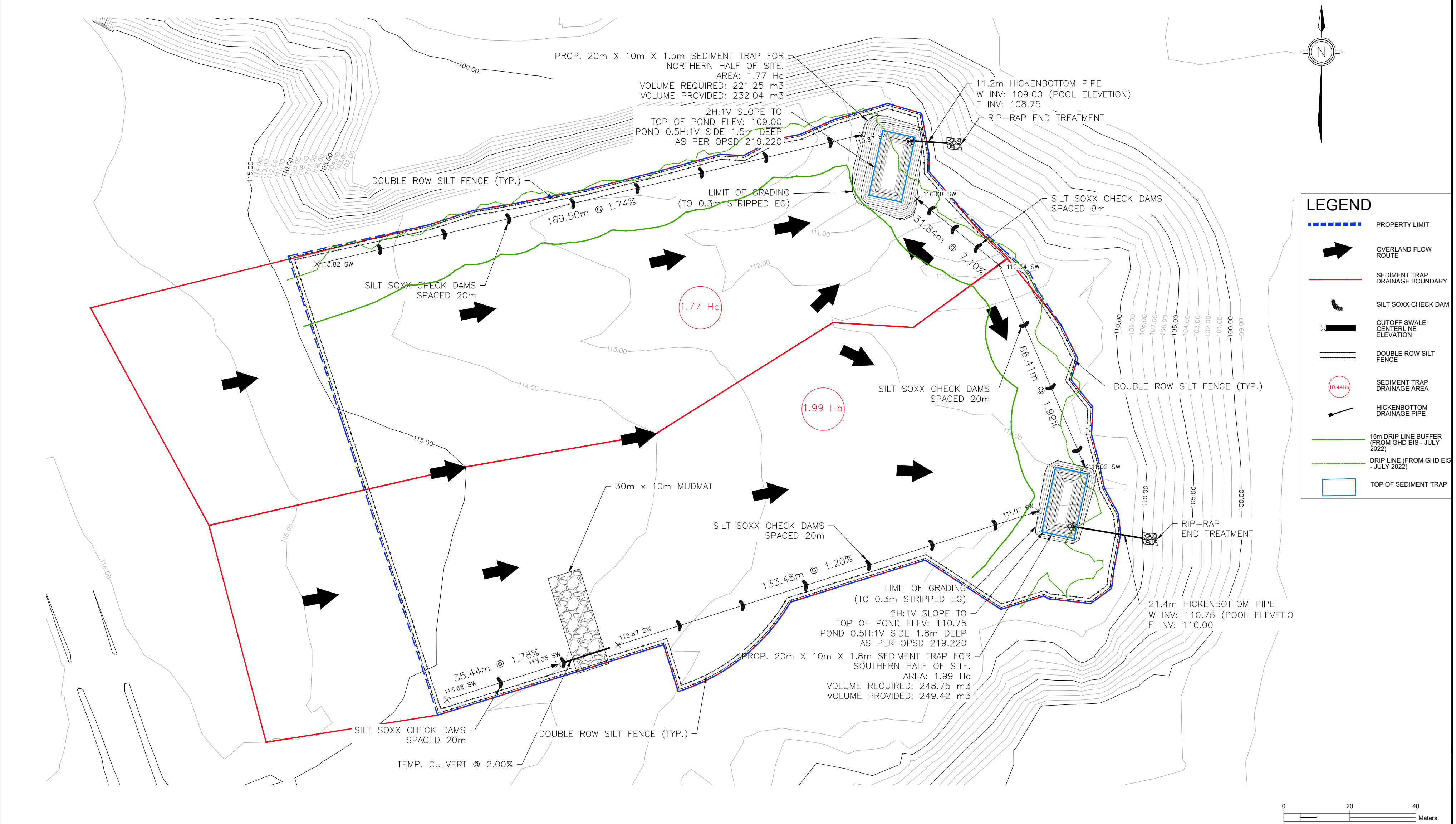
TYLin
8800 Dufferin Street, Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

46 STEVENS ROAD
FUNCTIONAL SERVICING REPORT
PRELIMINARY GRADING PLAN

SCALE: 1:500		PROJECT No.	10521
DATE: JULY 2022			
DESIGNED BY: C.D.	DRAWN BY: C.D.,H.L.,S.B.	FIGURE No.	GR01
CHECKED BY: C.D.	CHECKED BY: M.R.		



TYLin
8800 Dufferin Street, Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

46 STEVENS ROAD
FUNCTIONAL SERVICING REPORT
PRELIMINARY EROSION CONTROL PLAN

SCALE: 1:500	PROJECT No. 10521
DATE: JULY 2022	
DESIGNED BY: C.D.	DRAWN BY: C.D.,H.L.,S.B.
CHECKED BY: C.D.	CHECKED BY: M.R.
FIGURE No.	ESC01