Prepared for:

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Line 8 from Barrie Street/Hwy. 11 to Sideroad 10 & Sideroad 10 from North of Line 8 to Reagens Industrial Parkway Class EA Study

Interim Stormwater Management Report

Submitted by:

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Line 8 near Summerlyn Trail Crossing

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1 INTRODUCTION

1.1 Study Objective

Aquafor Beech Limited was retained by Planmac Engineering to prepare a stormwater management report in support of a Class EA study for the Town of Bradford West Gwillimbury. The project area is located along Line 8 from Barrie Street to the east to Sideroad 10 to the west, and from Sideroad 10 just north of Line 8 until south to Reagens Industrial Parkway. The study area is highlighted in **Figure 1.1**.

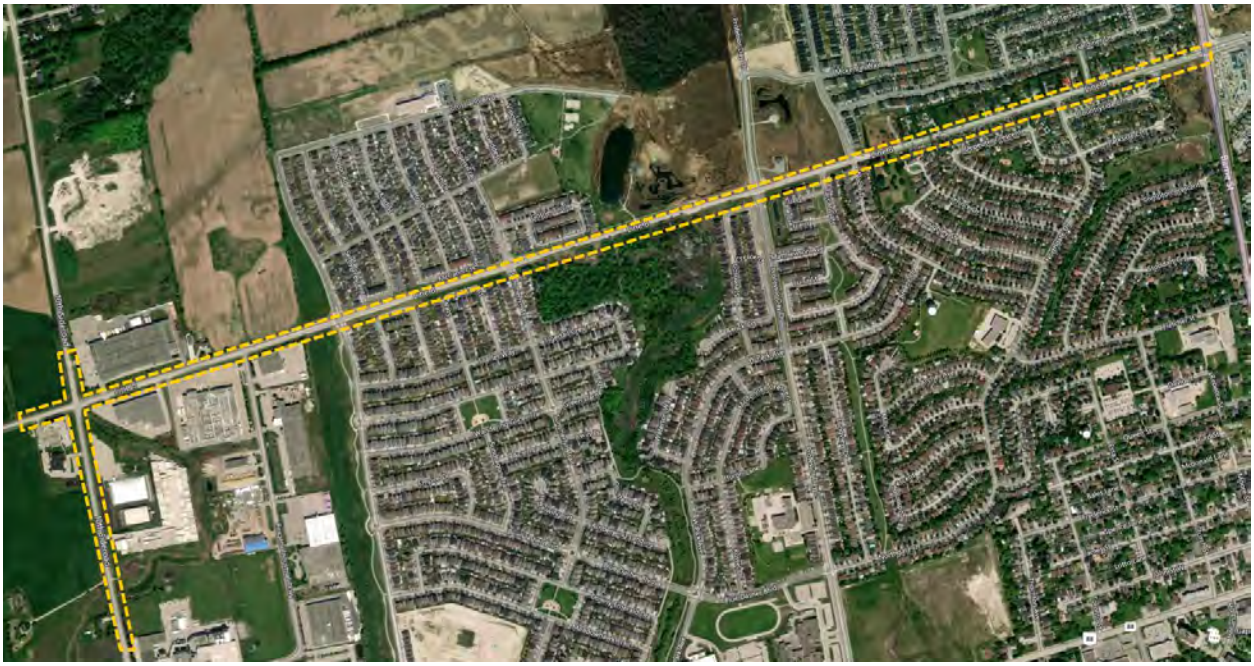

Figure 1.1. Project Location

The intent of this report is to provide a comprehensive stormwater management analysis of the preliminary proposed upgrades to Line 8, including stormwater deficiencies and management solutions. The proposed work includes upgrading the existing 2-lane rural cross section on Line 8 and 10 Sideroad to 2-lane urban cross section complete with intersection improvements involving traffic control measures and auxiliary turn lanes.

The following items comprise this Stormwater Management Report:

- Existing Conditions Drainage assessment including hydrologic and hydraulic modelling;
- Proposed Conditions Drainage assessment of the proposed design including hydrologic and hydraulic modelling, proposed water quantity management system;
- Water Quality Study.

1.2 Stormwater Criteria

Parts of the study area are within the Lake Simcoe Region Conservation Authority's (LSRCA) regulated area, and as such, stormwater management guidelines from the LSRCA must be adhered to for the proposed development project. Based on the LSRCA Technical Guidelines for Stormwater Management Submissions (LSRCA, 2022), this project is considered a Linear Development Project. Further, the Town

of Bradford West Gwillimbury has prepared its Consolidated Linear Infrastructure Environmental Compliance Approval (CLI ECA) document, publicly issued on July 27th, 2022. Under Appendix A of the Town's CLI ECA is a number of additional requirements for various stormwater management criteria, pertaining to new development and retrofit scenarios. Considering the proposed works will result in an increase in direct runoff due to new development within the existing Right of Way, the following stormwater management criteria are required to be met:

- Volume Control - Linear development on sites without restrictions that create 0.5 ha or greater of new and/or fully reconstructed impervious surfaces shall capture and retain / treat on site, the larger of the following:
    - The runoff from a 12.5 mm event from the fully reconstructed impervious surface and newly constructed impervious area.
    - The runoff from a 25 mm event from the net increase in impervious area on the site.
- Quantity Control - The post-development peak flow rates are not to exceed the corresponding pre-development peak flow rates for the 2 year, 5 year, 10 year, 25 year, 50 year and the 100 year design storm events;
- Quality Control - Provide the required improvements in water quality for phosphorus and total suspended solids (TSS), where applicable, including the following:
    a. Suspended solids: Control the 90th percentile storm event and if conventional methods are necessary, then enhanced, normal, or basic levels of protection (80%, 70%, or 60% respectively) for suspended solids removal based on the receiver.
    b. Phosphorus: minimize phosphorus loadings to Lake Simcoe and its tributaries. Evaluate anticipated changes in phosphorus loadings between pre and post development using the approved phosphorus budget tool to meet post to pre phosphorus loading rates;
- Water Balance – Demonstrate via the LSRCA approved water balance estimation method (Thornthwaite-Mather Method) that the site's post to pre-development water balance is maintained;
- Erosion and Sediment Control – In the absence of a guiding study, runoff from the 25mm 4 hour Chicago design storm should be detained and released over a 24 to 48 hour period. If there is a known deficiency or significant erosion in the downstream conveyance system, additional peak flow or volume control may be required.

According to the December 2015 Bradford West Gwillimbury Comprehensive Stormwater Management Plan (Master Plan), the following general criteria shall be incorporated in the project site design for stormwater runoff to protect surface runoff, ground water, and other natural resources:

- Reduce impacts on water
- Decrease runoff volume
- Decrease flow frequency, duration, and peak runoff rates
- Increase infiltration (groundwater recharge)
- Reduce time to peak flows by increasing the time of concentration to and through storm sewers
- Store stormwater runoff on-site
- Maintain existing flow patterns
- Avoid natural channel and steep slope erosion as well as protect in stream habitats and channels.
- Preserve vegetation
- Decrease erosion and sedimentation

- Preserve and replace existing topsoil in an uncompacted manner
- Pollution control measures, such as
    - Use of safer alternative products
    - Salt management measures
    - Snow disposal practices

Furthermore, according to the Master Plan, the following items are required where applicable:

- All roads serviced by ditches (roads with a rural drainage system) be upgraded using exfiltration trench / perforated pipe systems to achieve improved water quality treatment; and
- For roads with urban drainage infrastructure, water quality treatment should be achieved using bioretention units either on the road surface or within the municipal right-of-way (ROW).

2 BACKGROUND INFORMATION

2.1 Available Data

Aquafor has compiled background data from several sources. Data utilized in this study includes:

- Preliminary design drawings provided by Planmac (January 2024);
- Topographic survey completed by Planmac (Received April 2023) showing existing right-of-way configuration, roadway geometry and drainage features;
- High resolution OMAFRA 2022 LiDAR derived DTM converted to the CGVD1928:78 vertical datum (GeoHub);
- LSRCA GIS data including storm sewer manhole, inlet, and storm drain locations;
- Stormwater management studies and design drawings from adjacent properties provided by the Town;
- Geotechnical Investigation Report, 2023 completed by GEMTEC Consulting Engineers and Scientists Limited.

3 EXISTING CONDITIONS

3.1 Road Cross Section and Stormwater Management

There are two existing roadway cross sections on Line 8 within the study area. West of the Taucar Gate intersection, Line 8 has a 2-lane rural cross section with roadside ditches and centreline culverts providing the majority of the drainage for roadway and external runoff. A paved pedestrian pathway travels the north side of Line 8 from Professor Day Drive into McCann Crescent. This walkway is separated from the travelled lanes by a ditch that is drained to the south by centreline corrugated steel pipe culverts. There is no pedestrian access between Langford Boulevard and the western limit of the study area.

East of Taucar Gate, Line 8 has a semi-urban cross section, with curb and gutter drainage to a storm sewer system on the south side of the road. A small roadside swale on the north side of the road outlets into ditch inlet catchbasins at regular intervals.

There is an existing storm sewer system along Professor Day Drive that collects runoff from the Line 8 north ditch east of the intersection and outlets into the southwest ditch.

Similarly, 10 Sideroad south of Line 8 has a rural 2-lane cross section drained by roadside ditches and centreline culverts.

3.2 Land Use

The project area along Line 8 and Sideroad 10 includes a variety of land uses including industrial, agricultural, open space, commercial, and residential. According to the Town of Bradford-West Gwillimbury Official Plan, Line 8 and Sideroad 10 are designated as urban arterial roads with a right of way that varies between 23 and 35 metres.

3.3 Drainage

The project area for this study lies within the West Holland Subwatershed. Existing drainage for the site is split into two general drainage patterns. The divide is located approximately 0.13 km east of the Line 8 and Noble Drive intersection. The western side of the site generally drains to the southwest via two existing watercourses. These watercourses outlet into the North Canal Drain in the Holland Marsh, ultimately draining to the Holland River and Lake Simcoe. The east portion of the site generally drains to the northeast, outletting via a watercourse that flows to the northeast into the Holland River. The existing site drainage conditions are shown in **Figure 3.1**.

Figure 3.1. Drainage Map with Culvert Crossings and Storm Drain for the Project Area

3.3.1 Right-of-Way Drainage Areas

The existing condition right-of-way drainage areas have been delineated based on eight outlet locations, and within that, smaller areas for local drainage systems. These areas are shown in **Figure 3.2** and are summarized in **Table 3.1**. **Appendix B** includes a detailed Existing Condition drainage map.

Table 3.1. Existing Condition ROW Drainage Areas

Catchment ID	Area (ha)	Outfall
10SR_1	0.57	1
10SR_2	0.51	1
10SR_3	0.38	1
10SR_4	0.30	1
8_1	0.47	2
8_2	0.45	2
8_3	0.52	2
8_4	0.44	2
8_5	0.32	3
8_6	0.51	3
8_7	0.61	4
8_8	0.61	4
8_9	0.16	5
8_10	0.60	6
8_11	0.53	6
8_12	0.23	6
8_13	0.18	6
8_14	0.36	6
8_15	0.34	6
8_16	0.62	6
8_17	0.59	6
8_18	0.28	6
8_19	0.29	6
8_20	0.28	6
8_21	0.55	6
8_23	0.17	6
8_22	0.35	7
8_24	0.93	8
8_25	0.46	8
8_26	0.32	8
8_27	0.36	8
8_28	0.19	8

Outfalls 5 and 7 are existing storm sewer and major roadway systems on Professor Day Drive, and Noble Drive and Taucar Gate. Outfalls 2, 3, and 4 are intermediate outfalls, and flows continue downstream to Outfall 1 on 10 Sideroad.

Figure 3.2. Existing Condition ROW Catchment Configuration

3.3.2 External Drainage Areas

Several external catchment areas drain to Line 8 and 10 Sideroad within the project area. Flow from these external areas is conveyed by external stormwater management systems, or by the roadside ditches to the centreline culverts or storm sewer system. A summary of external drainage areas is provided in **Table 3.2**, and the configuration is shown in **Figure 3.3**.

Table 3.2. Existing Condition External Drainage Areas

Catchment	Area (ha)
EXT_1	36.8
EXT_2	8.6
EXT_3	1.6
EXT_4	44.1
EXT_5	0.7
EXT_6	22.2
EXT_7	16.8
EXT_8	1.5
EXT_9	11.0
EXT_10	186.1
EXT_11	28.3
EXT_12	3.3
EXT_13	2.5

The external areas generally drain to the south, with areas west of Taucar Gate (1-11) draining into the two watercourses that cross the site, eventually flowing southwest at Outfall 1. Areas east of Taucar Gate (12 and 13) ultimately drain to the east across the Barrie Street and Line 8 intersection.

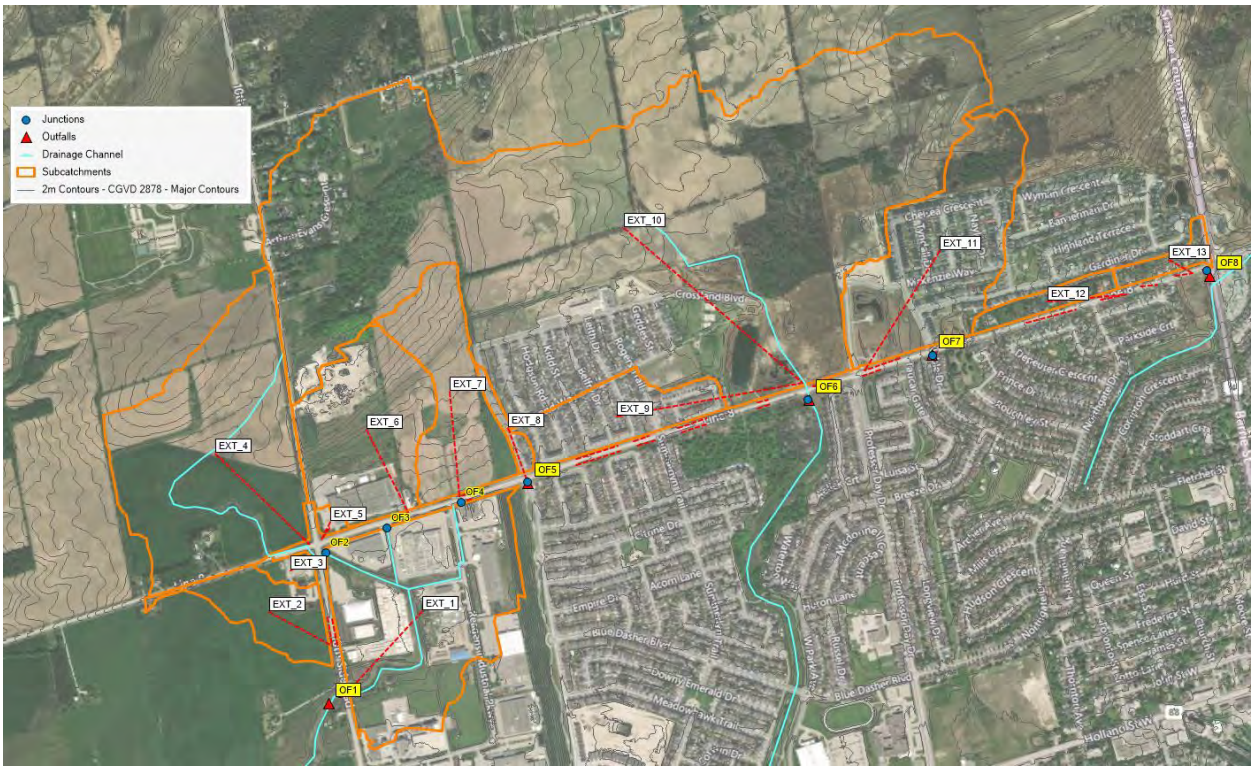

Figure 3.3. External Catchment Configuration

3.4 Centreline Culverts

Several centreline culverts provide conveyance of external and right-of-way flows under Line 8 and 10 Sideroad. A summary of the existing crossings is provided in **Table 3.3**. This summary does not include the culverts that drain the roadside ditch between the Line 8 roadway and pedestrian path.

Table 3.3. Existing Centreline Culvert Summary

	10+420	10+575	10+880	9+976	10+020	10+500	11+700
Roadway	10 Sideroad	10 Sideroad	10 Sideroad	Line 8	Line 8	Line 8	Line 8
# Cells	1	1	1	2	1	1	2
Description	CSP	CSP	CSPA	Twin CSP	CSP	CSP	2 x Rigid Frame Box
Dia. (m) OR Width (m) x Height (m)	0.80	0.60	3.0 x 2.0	0.90	0.60	0.60	2.50 x 1.25 (W) 2.50 x 1.50 (E)
Length (m)	22.9	17.0	27.3	21.4	29.7	19.7	41.5 (W) 44.3 (E)
Upstream Invert Elevation (m)*	262.69	260.82	254.59	263.21	263.78	263.15	257.41 (W) 257.27 (E)
Downstream Invert Elevation (m)*	262.49	260.70	254.41	263.20	263.55	263.09	257.40 (W) 257.09 (E)
Roadway Centreline Elevation (m)	264.70	262.62	259.30	264.60	265.04	264.38	259.44
Design Storm (return period)	50-year	50-year	50-year	50-year	50-year	50-year	50-year

3.5 Soil and Groundwater Conditions

A geotechnical and hydrogeological investigation was completed by GEMTEC and submitted to Planmac as a Draft Report in August 2023 with the purpose of supporting the proposed roadway servicing and reconstruction. This investigation was undertaken in the spring of 2023, with the advancement of 21 boreholes throughout the study area. Monitoring wells were installed at 10 borehole locations to assess groundwater levels and hydraulic conductivity of the underlying soils.

All discussion of soil conditions has been interpreted using the Draft Report prepared by GEMTEC.

Figure 3.4 shows the borehole and monitoring well locations, including groundwater elevation at the time of sampling. The geotechnical investigation found that two types of underlying soil are present in the study area: silty sand and silty clay.

The hydrogeological investigation generally found shallow groundwater elevations at the monitoring wells to be between 1.2 and 4.2 m below ground surface at the time of sampling captured in two sampling events (June 20/21st, and July 11th, 2023). Hydraulic conductivity results for the underlying soils were provided for the two soil types and are summarized in **Table 3.4.**

Table 3.4. Hydraulic Conductivity (K_b) Estimates (GEMTEC, 2023)

Soil Type	Minimum (m/s)	Maximum (m/s)	Geometric Mean (m/s)	Geometric Mean (mm/hr)
Silty Sand	4×10^{-7}	6×10^{-6}	2×10^{-6}	7.2
Silty Clay	2×10^{-9}	2×10^{-6}	1×10^{-7}	0.4

These results have informed the preliminary stormwater management and LID design. Both soils are considered to be in Hydrologic Soil Group C, with low infiltration rates that do not typically support infiltration as a primary treatment option for stormwater (i.e. partial infiltration designs requiring an underdrain to convey excess runoff to a free outlet). The hydraulic conductivity values provided by GEMTEC correspond to infiltration rates of approximately 10-65 mm/hr, or 4-26 mm/hr using a factor of safety of 2.5. The minimum infiltration rate for infiltration to be considered for quantity control credits under LSCRA guidelines is 15 mm/hr.

In addition to low soil permeability, groundwater elevations at the time of monitoring well inspection were found to vary from 1.2 and 4.2m below ground surface. This condition limits the use of subsurface infiltration for quantity control, with zero credits available for any infiltration facility locations in which the facility invert is within 1 m of the groundwater elevation.

Given these results, the underground chambers have been initially modelled conservatively as underground filtration systems to detain and reduce peak flows. Limited amounts of infiltration may be possible at certain locations on the site to assist with water balance and quality control. To better understand seasonal fluctuations in groundwater levels across the site area, additional groundwater monitoring over a minimum time span of 1 year and readings at a minimum bi-monthly frequency is recommended to support detailed design of each proposed LID feature across the site.

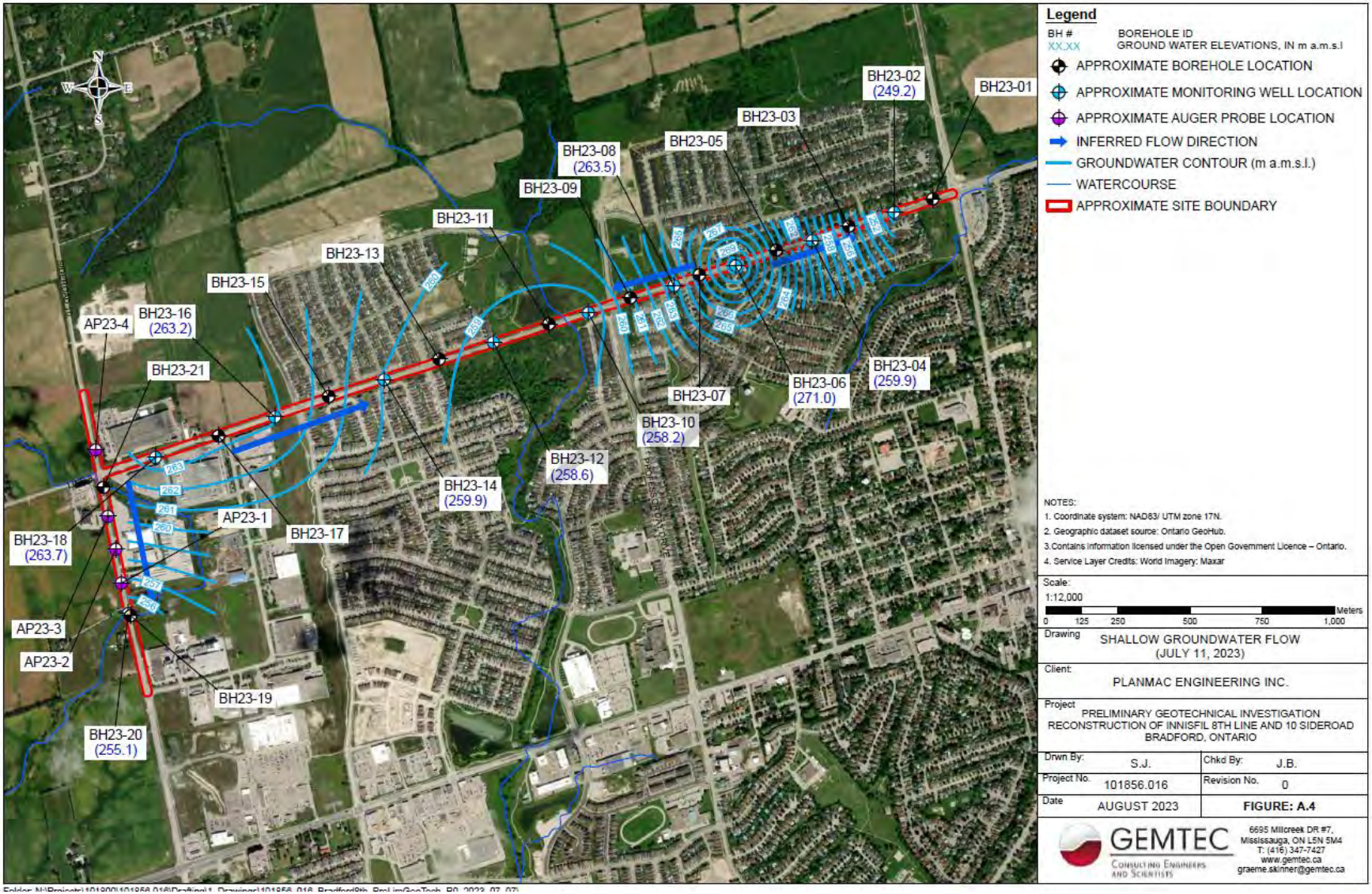

Figure 3.4. Borehole and Monitoring Well Investigation, GEMTEC 2023

4 METHODOLOGY

4.1 Hydrology

Hydrology calculations for this study follow the guidelines within Section C of the Town of Bradford's Engineering Design Criteria Manual. This study used PCSWMM software for the hydrologic modeling, using the catchment areas delineated using topographic survey and LiDAR data. The 4-hour Chicago storm distribution was used for the analysis, with rainfall data taken from the Town's IDF curves for the appropriate storms.

PCSWMM treats each subcatchment surface as a nonlinear reservoir. Inflow comes from precipitation and the runoff from any designated upstream sub-catchments consists of infiltration, evaporation, and surface runoff. The capacity of this "reservoir" is the maximum depression storage, which is the maximum surface storage provided by ponding, surface wetting, and interception. Surface runoff occurs only when the depth of water in the "reservoir" exceeds the maximum depression storage, in which case the outflow is given by Manning's equation. Depth of water over the subcatchment is continuously updated with time by solving numerically a water balance equation over the subcatchment.

The routing portion of SWMM transports this runoff through a system of pipes, channels, and storage/treatment devices. SWMM tracks the quantity of runoff generated within each subcatchment, as well as the flow rate and flow depth in each pipe and channel during a simulation period comprised of multiple time steps.

A, B, and C values for IDF curves were taken from Appendix J from the Bradford Engineering Design Guideline Manual, and are shown in **Table 4.1**.

Table 4.1. A, B, and C Values for IDF Curves for Bradford

Return Period	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
A	789.07	980.848	1118.79	1284.892	1405.794	1443.947
B	6.205	6.013	6.018	6.008	6.012	5.273
C	0.823	0.806	0.800	0.793	0.788	0.766

PCSWMM calculates runoff coefficients internally based on the impervious percentage. The infiltration within the model was based on the Curve Number Method. Based on land use and underlying soil conditions, a weighted average curve number was applied to each subcatchment. For the purpose of assigning curve numbers within the study area, underlying soils are in Hydrologic Soils Group C.

Other subcatchment parameters assigned in the PCSWMM model include slope, width and length, percent impervious, Manning's n coefficients for impervious and pervious areas and percent routed. Hydrologic input parameter details are provided in **Appendix C**.

For the analysis of the proposed centreline culvert replacements, peak flows were determined using the 24hour SCS Type II storm distribution.

4.2 Hydraulics

The hydraulic analysis of the existing condition and preferred alternative design was completed within PCSWMM. The purpose of the hydraulic analysis was to determine peak runoff rates in the existing, proposed, and proposed with LID stormwater management. Detailed design and analysis of existing and proposed storm sewer infrastructure has not been completed at this time and will be addressed during detailed design. This includes minor system inlet capacity. The major system has been assessed for this analysis. The general hydraulic criteria are provided in **Table 4.2**.

Table 4.2. Level of Service for Major and Minor Systems

Item	Level of Service	Comments
Storm Sewers	1:10 year	Use catch basin inlet controls (as required), sized and located such that storm sewers do not surcharge (Analysis not completed as part of this study)
Hydraulic Grade Line	1:100 year	No closer than 0.5m between 1:100 year storm hydraulic grade line and finished basement floor elevations (Analysis not completed as part of this study)
Major System	1:100 year	Large drainage areas may require classification as a floodplain using Regulatory storm criteria (LSRCA and NVCA). Overland flow cannot exceed width or flow capacity of right-of-way
Stormwater Management	1:100 year	Maximum level of control

Hydraulic input parameters have been based on the site survey and preliminary design drawings. Where required, LiDAR data was used to supplement drawings where elevations were unavailable at this stage of the design. For the purpose of the preliminary design analysis, it was assumed that all road profiles will be maintained.

The Dynamic Wave routing method was used for all channel and pipe flow within PCSWMM. Dynamic Wave routing solves the complete one-dimensional Saint Venant flow equation and therefore produces the most theoretically accurate results. These equations consist of the continuity and momentum equations for conduits and a volume continuity equation at nodes.

The hydraulic analysis for the proposed culvert replacements was completed using HY-8 software.

5 PROPOSED CONDITIONS

5.1 Proposed Work

The proposed reconstruction of Line 8 will fully reconstruct and convert the length of Line 8, including 0.6 km of 10 Sideroad, to an urban cross section. The proposed work includes:

- Construction of a 2-lane urban cross section complete with a 3.0m wide multi-use path on both sides of Line 8 from Sideroad 10 to Professor Day Drive;
- Construction of a 4-lane urban cross section complete with sidewalk on both sides of Line 8 from Professor Day Drive to Barrie Street;

- Construction of traffic control measures including turning lanes, traffic lights, and a roundabout at Line 8 and 10 Sideroad
- Construction of a storm sewer drainage system for minor events complete with curb, gutter and catchbasin inlets from Noble Drive to Barrie Street;
- Replacement of existing sewer inlet structures to match design grading in areas with existing storm sewer;
- Installation of subsurface infiltration/filtration and storage systems in the Line 8 and 10 Sideroad boulevards to treat right-of-way runoff in the storm sewer system;
- Construction of additional LID features including permeable pavement on sidewalks and multi-use trail surfaces, an enhanced swale, and bioretention area; and
- Replacement of 3 culvert crossings.

The following sections detail the proposed works, including analysis of the design to the design criteria outlined above.

5.2 Low Impact Development Features

Aquafor Beech has developed a LID concept utilizing a variety of features within the road Right of Way to maximize the ability to treat stormwater runoff near the source while incorporating the proposed road design to avoid alterations to the layout of features. A conceptual design layout of the proposed LID feature locations is provided in **Appendix D** of this report. The following summarizes the features implemented in the LID concept plan.

5.2.1 Enhanced Swales

As per the LID Stormwater Planning and Design Guide, enhanced swales are vegetated open channels designed to convey, treat and attenuate stormwater runoff. Vegetation in the swale allows sedimentation, filtration through root zone and soil matrix, evapotranspiration, and infiltration to the underlying native soil.

Simple grass swales have long been used for conveyance, particularly as roadway drainage. Enhanced grass swales incorporate design features that improve contaminant removal and runoff reduction functions. More recently, their benefits as a stormwater best management practice have been recognized. Vegetated channels are closer in hydrologic properties to natural zero order channels than drainage systems composed of curb and gutter, inlets, and pipes.

They are a preferable alternative to both curb and gutter and storm drains as a stormwater conveyance system. When properly incorporated into an overall site design, enhanced swales can provide stormwater treatment, reduce impervious cover, accent the natural landscape, and provide aesthetic benefits. In addition, they are less hydraulically efficient than curb and gutter conveyance systems. This results in the positive effects of longer travel times and lower peak discharges.

Enhanced Swales have been incorporated into the 10 Sideroad Right of Way where sufficient space is present between the roadway or sidewalk and the adjacent property line and the existing ditch is proposed to remain. In these locations no curb is present and roadway runoff flows directly to the swale.

5.2.2 Permeable Paving

Permeable surfaces are an alternative to traditional impervious pavement such as asphalt. Permeable surfaces utilize techniques such as interlocking concrete pavers, permeable asphalt, or permeable concrete over a crushed, washed (no fines), open graded, angular stone aggregate base. These surfaces allow stormwater to filter through the pavement into an underlying stone reservoir. Water then infiltrates into the native soils or enters an underdrain system. Permeable pavement is ideally suited for low traffic surfaces such as parking lots, driveways, access roads, plazas, and walkways. Permeable pavement is generally discouraged for use in high traffic areas. In this context "High Traffic" commonly refers to both high volume areas and frequent large vehicle use, but are perfectly suitable for roadway islands, sidewalks, and similar low traffic areas.

Permeable paving allows for filtration, storage, or infiltration of runoff, which can reduce stormwater flows compared to traditional impervious paving surfaces like concrete and asphalt. These systems will also provide an aesthetic alternative to traditional paving, and are often applied to smaller drainage areas such as those of a roadway. Due to potential damage to permeable surfaces from high traffic areas, permeable surfaces have only been identified for implementation with the proposed sidewalks and multi-use trail locations, excluding all road and driveway crossing locations. These permeable surfaces will be implemented to control runoff generated on these surfaces and adjacent boulevard areas of the right of way that positively drain towards this LID feature. Subsurface stone reservoir sizing and use of subdrains will be established in detailed design to assist in ensuring the site meets the SWM criteria outlined in Section 1.2 of this report.

5.2.3 Infiltration/Filtration Chambers

The use of infiltration/filtration chambers within the 10 Sideroad and Line 8 Right-of-Ways was the preferred design concept. However, the site soil and groundwater limitations discussed in this report may significantly reduce the feasibility of infiltration. Additionally, seasonal fluctuations in groundwater may permit or prevent infiltration from the chambers at different times throughout any given year. Subsurface infiltration/filtration chambers have been proposed underneath the 3.0m wide multi-use trail in most locations along the Line 8 Right of Way between Sideroad 10 and Professor Day Drive. In locations where it is determined infiltration will not be feasible at any time of year, the chambers will be constructed with an impermeable liner and underdrain featuring a positive outlet to adjacent ditch, sewer system, or watercourse. Pretreatment for roadway runoff needs to pre provided upstream of the infiltration/filtration facilities to limit sediment accumulation. Pre-treatment options to be considered at detailed design include but are not limited to catchbasin inserts and oil and grit separator units.

5.2.4 Perforated Pipes/Etobicoke Exfiltration Systems

Both of these systems rely on the use of linear infiltration incorporated into storm sewer systems to provide some level of water quality treatment. Perforated pipe systems consist of gravel trenches to varying sizes surrounding pipes complete with small perforations that allow runoff moving through the storm sewer system to percolate into the gravel trenches. Etobicoke exfiltration systems operate similarly by adopting a traditional storm sewer system combined with a smaller perforated exfiltration pipe immediately underneath each storm sewer run that are both installed within the same gravel trench. The

perforated exfiltration pipes are open on the upstream end manhole and plugged at the downstream end. Runoff enters a surface drain (ie. catchbasin inlet), then into the solid storm sewer, and ultimately stored in the exfiltration pipe and surrounding gravel trench underneath the solid sewer pipe at the downstream manhole. Captured water is then infiltrated into the native subsoils below.

Both practices can be used in place of almost any conventional storm sewer pipe where topography and water table depths are suitable. The proposed storm sewer network along Line 8 from Professor Day Drive to Barrie Street will adopt one of these system options to provide runoff filtration or infiltration. These systems will be sized in detailed design to address the stormwater management criteria associated with the increase in impervious area resulting from the widened roadway surface, as outlined in Section 1.2 of this report.

5.3 Culvert Crossing Replacement

Three culverts are proposed to be replaced as part of the work. The remaining centreline culverts are to be incorporated into the storm sewer system using ditch inlet catchbasins. For this analysis, only the culvert replacements have been assessed, as the detailed storm sewer design is outside the scope of this study.

The analysis of the replacement culvert performance under the design flow was completed using HY-8 culvert analysis software. Peak flow data was taken from the existing condition PCSWMM model, and the 24-hour SCS Type II storm distribution was applied to the analysis, as it was found to govern the larger external catchment areas. The objective of the analysis was to confirm sizing for design progression. All culverts and crossings have been assessed based on the MTO standard for an urban arterial road as defined in **Table 5.1**. All culverts are on Urban Arterial Roads with a span of less than 6 m, and they should therefore convey the 50-Year flow event with 1.0 m or greater of freeboard to the Edge of Travelled Lane (ETL). Final sizing will be confirmed during detailed design with the completion of roadway profiles.

Table 5.1. Level of Service for Bridges and Culverts (per MTO Directive)

Road Classification	Conveyance Criteria (Span ≤ 6.0 m)	Freeboard To ETL
Freeway, Urban Arterial	1:50 year	≥ 1.0 m
Rural Arterial, Collector Road	1:25 year	≥0.30 m
Local Road	1:5 year	≥0.30 m

The proposed culvert replacements are described in **Table 5.2**. It was assumed that the roadway elevations will not change from the existing to proposed condition. To provide a conservative analysis, culverts were analyzed using the peak 50-Year flow rate without stormwater storage or LID features.

Table 5.2. Existing vs. Proposed Centreline Culvert Summary

	10+420	10+575	10+880	9+976	10+020	10+500	11+700
Roadway	10 Sideroad	10 Sideroad	10 Sideroad	Line 8	Line 8	Line 8	Line 8
Existing Structure	800 mm CSP	600 mm CSP	3000 mm x 2000 mm CSPA	Twin 900 mm CSP	600 mm CSP	600 mm CSP	2.50 m x 1.25 m RFB 2.50 m x 1.50 m RFB
Proposed Structure	Precast Concrete Box	Storm Sewer	Precast Concrete Box	Precast Concrete Box with 90d bend	Storm Sewer	Existing to Remain	Existing to Remain
Dia. (m) or Span (m) x Rise (m)	2.4 x 1.2		4.2 x 2.4	2.4 x 1.2			
Embedment (mm)	0.30		0.30	0.30			
Proposed Structure	262.39		254.29	262.91			
Downstream Invert Elevation (m)*	262.19		254.11	262.90			
Roadway Centreline Elevation (m)	264.70		259.30	264.60			

A summary of the proposed culvert hydraulic performance is shown in **Table 5.3**.

Table 5.3. Proposed Culvert Hydraulic Performance in 50 Year Design Event

	10+420	10+880	9+976
Roadway	10 Sideroad	10 Sideroad	Line 8
50-Year Peak Flow Rate (m^3/s)	3.33	16.65	3.33
Headwater Elevation (m)	264.88	256.69	264.37
Edge of Travelled Lane Elevation (m)	264.79	259.09	264.67
Freeboard to ETL (m)	**1.05**	**2.40**	**0.30**

The hydraulic analysis of the proposed replacement culverts found that while the crossings at 10 Sideroad 10+880 and 10+420 meet all MTO criteria for the design flow event, the culvert on Line 8 at Sta. 9+976 does not. It is noted that there is limited cover available at this crossing, and the freeboard criteria of 1.0 m or greater may be impractical to reach.

5.4 Stormwater Management

The proposed widening and addition of sidewalk and turning lanes will result in an increase in the overall impervious area for the site. The work would therefore require the implementation of stormwater management practices to treat runoff for quality, quantity and water balance, as well as provide erosion and sediment control. This increase in roadway impervious area was estimated by multiplying the affected roadway length by the proposed widths of roadway and sidewalk. For the analysis of the existing condition, gravel shoulders were considered impervious area, as the compaction over time allows for little infiltration.

At the detailed design stage, storm drain design will be assessed in greater detail. Increases in peak flow rates due to increased impervious areas will be mitigated with the incorporation of infiltration/filtration chambers as a LID feature. **Table 5.4** shows the existing and proposed impermeable section widths for the project. The proposed impermeable widths were taken from the proposed design provided by Planmac (January 2024). Overall, the impervious area within the site is expected to increase by 0.7 ha, and stormwater management is therefore required.

Table 5.4. Existing and Proposed Road Section Impermeable Widths

Segment	Existing Condition (m)	Proposed Condition (m)	Length (m)
West Limit to Reagans Industrial Way	13	15	490
Reagans Industrial Way to East of Langford	16	16.5	475
East of Langford to West of Taucar	12.5	13	1,125
West of Taucar to east of Noble	16.5	21	165
East of Noble to West of Barrie Drive	13.5	16	750
East Limit	11.8	18	160
10 Sideroad (south of Line 8)	11	11.5	630
10 Sideroad (north of Line 8)	13	15	85

5.4.1 Right-of-Way Drainage Areas

The existing right-of-way drainage boundaries are generally maintained in the proposed condition. In some cases, boundaries have been sifted due to the elimination of the roadside ditches. Some existing catchments have been divided based on individual infiltration/filtration chamber locations. A summary of the existing and propose right-of-way drainage areas is provided in **Table 5.5**.

Table 5.5. Existing vs Proposed Right-of-Way Catchment Areas

Existing ID	Proposed ID	Existing Area (ha)	Proposed Area (ha)	Existing % Impervious	Proposed % Impervious
10SR_1	10SR_1	0.57	0.57	37	38
10SR_2	10SR_2_1	0.51	0.28	37	72
	10SR_2_2		0.23		0
10SR_3	10SR_3	0.38	0.38	37	38
10SR_4	10SR_4	0.30	0.30	37	38
8_1	8_1	0.47	0.47	43	50
8_2	8_2	0.45	0.45	43	50
8_3	8_3_1	0.52	0.19	43	50
	8_3_2		0.33		50
8_4	8_4	0.44	0.44	43	50
8_5	8_5	0.32	0.32	43	50
8_6	8_6	0.51	0.51	43	50
8_7	8_7	0.61	0.60	53	55
8_8	8_8	0.61	0.60	53	55
8_9	8_9	0.16	0.15	87	90
8_10	8_10_1	0.60	0.14	37	38
	8_10_2		0.46		38
8_11	8_11_1	0.53	0.13	37	38
	8_11_2		0.42		38
8_12	8_12	0.23	0.15	37	38

Existing ID	Proposed ID	Existing Area (ha)	Proposed Area (ha)	Existing % Impervious	Proposed % Impervious
8_13	8_13	0.18	0.13	37	38
8_14	8_14	0.36	0.26	37	38
8_15	8_15	0.34	0.23	37	38
8_16	8_16	0.62	0.81	37	38
8_17	8_17	0.59	0.76	37	38
8_18	8_18	0.28	0.29	37	38
8_19	8_19	0.29	0.31	37	38
8_20	8_20	0.28	0.26	37	38
8_21	8_21	0.55	0.35	41	38
8_23	8_23	0.17	0.30	55	62
8_22	8_22	0.35	0.35	55	81
8_24	8_24	0.93	0.93	52	62
8_25	8_25	0.46	0.46	52	62
8_26	8_26	0.32	0.32	45	69
8_27	8_27	0.36	0.36	45	69
8_28	8_28	0.19	0.19	45	69

5.5 Quantity Control

Quantity control for the Line 8 and 10 Sideroad reconstruction will be provided using subsurface LID infiltration/filtration chambers within the Line 8 and 10 Sideroad Boulevards. The chambers will be constructed as a linear system with catchbasin inlets to collect surface runoff from Line 8 and 10 Sideroad. The final design of the infiltration/filtration and storage systems, including chamber product used, will be completed during detailed design, but for the purpose of this analysis, the CULTEC Recharger 360HD system was used to approximate dimensions and storage capacity. CULTEC details are provided in **Appendix A**. A sample roadway cross section with boulevard chambers is shown in **Figure 5.1.**

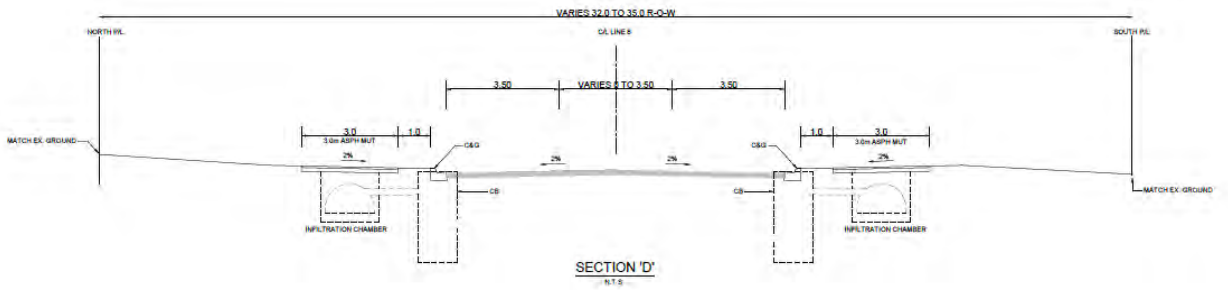

Figure 5.1. Proposed Line 8 Cross Section with Infiltration/Filtration Chambers

The chambers were modelled as storage nodes in the PCSWMM model. Given the relatively low permeability of the soils on site, particularly the silty clay, the storage capacity of the chambers is expected to provide the majority of the flow control during storm events. A summary of the proposed

chambers, including the measured depth to the groundwater during monitoring, is provided in **Table 5.6**.

Table 5.6. Infiltration/Filtration Chamber Characteristics

Catchments Draining	North Boulevard Length (m)	South Boulevard Length (m)	Storage Volume (m^3)	Approx. Depth to Groundwater (m)	Infiltration Possible
8_6		150	237	1.7	No
8_7	264		417	1.5	No
8_8		230	363	1.5	No
8_11_1	70		111	1.9	No
8_10_1		70	111	1.9	No
8_11_2	198		313	1.5	No
8_10_2		198	313	1.5	No
8_13	50		79	1.2	No
8_12		50	79	1.2	No
8_15	55		87	0.8	No
8_14		55	87	0.8	No
8_17	340		537	1.3	No
8_16		340	537	1.3	No
8_19	130		205	1.2	No
8_18		130	205	1.2	No
8_21	120		190	-0.1	No
8_20		60	95	-0.1	No
8_25	75		119	3.3	**Yes**
8_28		150	237	Unknown	Unknown
10SR_2_2	70	85	245	4.8	**Yes**

Where possible, the depth to groundwater shown in **Table 5.6** was calculated using monitoring well elevations. However, in areas where no monitoring well was present, groundwater elevations were taken from the interpolated groundwater contours shown in **Figure 3.4.** As outlined in Section 3.5, groundwater monitoring over a minimum 1-year duration will be completed to aid detailed design such that infiltration potential can be quantified for each proposed location (ex. no infiltration ability, seasonal, or year-round).

For infiltration to be considered effective, a minimum of 1.0 m of separation between the groundwater elevation and bottom of the chamber is recommended. The approximate depth of the storage chambers currently sized is 1.9 m (Note: lower profile chamber units may permit additonal areas to be infiltrated and will be evaluated at the detailed design stage). Given these results, there are few locations where infiltration can currently be considered adequate for stormwater quantity management. The chambers in catchments 8_25 and 10SR_2_2 have groundwater elevations low enough to support some infiltration, and these chambers will be designed infiltration chambers. The chambers on 10 Sideroad are in an area of silty sand subsoils, with estimated factored infiltration rates

of 14-26 mm/hr, further indicating suitability for infiltration. The chambers at catchment 8_25, however, have silty clay subsoils with much lower infiltration rates ranging from 4-22 mm/hr.

Table 5.7. Additional LID Characteristics

Catchments Draining	LID	Area (m^3)	Storage Volume (m^3)	Approx. Depth to Groundwater (m)	Infiltration Possible
8_1, 8_2, 8_3, 8_4	Infiltration Chamber	490	588	3.1	Yes
	Bioretention Area	490	N/A	3.3	Yes (to chamber beneath)
10SR_3	Enhanced Swale	370	94	1.5	No

Table 5.7 provides a summary of additional LID features proposed for the site. In addition to the linear chambers, a cylindrical basin is proposed under the centre of the roundabout at the Line 8 and 10 Sideroad roundabout to detain and treat runoff from the intersection. This basin will have an area of approximately 490 m^2, and a bioretention area over filter media will be constructed above it to provide pre-treatment of roadway runoff. Finally, the enhanced swale providing control for the west side of Sideroad 10 was modelled as a bioretention basin LID control in the PCSWMM model. Groundwater elevations and soil conditions at both additional LID locations indicate infiltration is possible.

5.5.1 Peak Flow Events

Results of the existing and proposed hydraulic analysis for the various return periods are provided in **Table 5.8**. Peak flows were extracted at the 8 outfall locations within the model where flows leave the site. External catchment areas have been included in the analysis, as flows from the external catchments interact with and impact the right-of-way drainage systems.

Table 5.8. Peak Flow Results

	Peak Flow (m^3/s)			
Return Period	Existing Condition	Proposed Condition	Proposed Controlled Condition	Net Change (Existing vs Controlled)
OF1				
2-Yr	5.51	5.63	5.33	-0.18
5-Yr	7.02	7.02	6.84	-0.18
10-Yr	7.76	7.79	7.50	-0.26
25-Yr	9.18	9.22	8.77	-0.41
50-Yr	10.31	10.30	9.80	-0.50
100-Yr	11.32	11.28	10.76	-0.56
OF2				
2-Yr	0.01	0.01	0.01	0.00
5-Yr	0.02	0.02	0.02	-0.01
10-Yr	0.03	0.02	0.02	-0.01

	Peak Flow (m^3/s)			
Return Period	**Existing Condition**	**Proposed Condition**	**Proposed Controlled Condition**	**Net Change (Existing vs Controlled)**
25-Yr	0.03	0.02	0.02	-0.01
50-Yr	0.04	0.02	0.02	-0.01
100-Yr	0.04	0.03	0.03	-0.01
OF3				
2-Yr	2.45	1.66	1.52	-0.93
5-Yr	3.72	2.77	2.61	-1.11
10-Yr	4.85	3.81	3.57	-1.27
25-Yr	6.47	5.34	5.13	-1.34
50-Yr	7.92	6.94	6.31	-1.62
100-Yr	9.16	8.28	7.70	-1.46
OF4				
2-Yr	0.06	0.07	0.07	0.01
5-Yr	0.08	0.09	0.09	0.01
10-Yr	0.10	0.11	0.11	0.01
25-Yr	0.12	0.13	0.13	0.01
50-Yr	0.14	0.15	0.15	0.01
100-Yr	0.16	0.16	0.16	0.01
OF5				
2-Yr	3.35	3.43	3.43	0.00
5-Yr	4.60	4.69	4.69	0.00
10-Yr	5.51	5.61	5.61	0.00
25-Yr	6.90	7.04	7.04	0.00
50-Yr	8.13	8.27	8.27	0.00
100-Yr	9.46	9.58	9.58	0.00
OF6				
2-Yr	3.41	3.52	3.40	-0.01
5-Yr	4.83	5.02	4.89	0.06
10-Yr	6.01	6.27	5.95	-0.07
25-Yr	7.44	7.80	7.41	-0.04
50-Yr	8.82	9.15	8.71	-0.11
100-Yr	10.07	10.43	9.95	-0.12
OF7				
2-Yr	0.05	0.07	0.07	0.02
5-Yr	0.08	0.09	0.09	0.01
10-Yr	0.10	0.11	0.11	0.01
25-Yr	0.12	0.13	0.13	0.01
50-Yr	0.14	0.15	0.15	0.01
100-Yr	0.15	0.16	0.16	0.01
OF8				
2-Yr	0.69	0.72	0.33	-0.35

	Peak Flow (m^3/s)			
Return Period	**Existing Condition**	**Proposed Condition**	**Proposed Controlled Condition**	**Net Change (Existing vs Controlled)**
5-Yr	0.98	1.16	0.95	-0.03
10-Yr	1.31	1.54	1.30	-0.01
25-Yr	1.77	2.05	1.75	-0.01
50-Yr	2.17	2.45	2.12	-0.05
100-Yr	2.57	2.85	2.58	0.01
Total				
2-Yr				-0.72
5-Yr				-0.40
10-Yr				-0.61
25-Yr				-0.79
50-Yr				-1.09
100-Yr				-1.11

As shown in **Table 5.8**, net peak flow reductions were observed in all flow events. Peak flows were found to decrease or remain the same (+/- 0.05 m^3/s) for all events at all outfall locations. This indicates the proposed stormwater detention systems provide water quantity control for the proposed works.

5.5.2 12.5 mm and 25 mm Events

In addition to reducing or maintaining peak flows from the site, as a linear development site proposed to create 0.5 ha of new and/or fully reconstructed impervious surface, the proposed stormwater system should retain/treat the larger of:

- The runoff from a 12.5 mm event from the fully reconstructed impervious surface and newly constructed impervious area, and
- The runoff from a 25 mm event from the net increase in impervious area on the site.

The proposed PCSWMM model with LID storage was first modified for the 12.5 mm event over only the right-of-way catchment areas, with areas reduced according to impervious percentages. External catchments were removed from the model. Second, the 25 mm event was run with right-of-way sub-catchments reduced to only the increase in impervious area between the existing and proposed condition. The 12.5 mm model results were found to govern, as the 25 mm model returned a total runoff volume too small to be recorded by PCSWMM.

The cumulative runoff volume from all catchments in the 12.5 mm event was 100 m^3. The initial sizing for the proposed LID features (infiltration/filtration facilities, bioretention, underground storage chamber, and bioswale) allow capture and treatment for the 100m3 of runoff generated across the catchments. This indicates that the proposed storage will provide adequate volume control to meet

LSRCA requirements for the proposed linear works. Refined sizing and function of the LID storage will be performed at the detailed design stage.

5.6 Quality Control

The proposed work will result in a 0.7 ha increase in overall impervious area, and various LID features including bioretention, bioswales, perforated pipe systems, and underground storage chambers with limited infiltration will be utilized to improve water quality and mitigate for increases in runoff volumes for the project area.

According to the LSRCA (2022), the following water quality considerations should be included in the proposed design:

- TSS
- Phosphorus
- Winter Salt
- Temperature
- Other Contaminants

5.6.1 TSS

With limited infiltration potential for the underlying soils, pretreatment will be required to provide adequate TSS removal for the site. Pre-treatment options include manufactured treatment devices (MTDs) such as oil-grit separator (OGS) or CB Shield units and other LID practices such as bioretention swales in the boulevards. All catchbasins should include sumps to allow for settlement of solids.

5.6.2 Phosphorus

The LSRCA Technical Guidelines for Stormwater Management identify phosphus as a significant concern to the Lake Simcoe and West Holland watersheds The LSRCA's Phosphorus Offsetting Policy (LSRCA, 2023) shall be consulted during detailed design to determine the compliance requirements with respect to the preparation of a Phosphorus Budget. Regardless, it is recommended that the Low Impact Development Treatment Train Tool be used during the detailed design to assess phosphorus removal on-site.

5.6.3 Winter Salt

Given that salt when dissolved in water is a conservative contaminant, there are currently no strategies for its removal for linear projects such as the Line 8 reconstruction. Salt reduction in the site runoff should be achieved through a salt management plan.

5.6.4 Temperature

The underground storage and infiltration/filtration LID techniques proposed for this site will both provide thermal mitigation of site runoff.

5.6.5 Other Contaminants

Other contaminants that are a consideration in the treatment of runoff from this site include oil, grease and gas, and heavy metals. Pretreatment designs should consider the possible presence of these contaminants.

5.7 Water Balance

With the approximately 0.7 ha increase in impervious area throughout the site, it is anticipated that there will be a reduction in annual infiltration. To mitigate this recharge reduction, 0.43 ha of infiltration/filtration facilities with varying amounts of infiltration potential have been proposed as part of the stormwater management system. With low site soil permeability, and high groundwater elevations it is not feasible to infiltrate all stormwater runoff, and groundwater elevations may limit the possibility of infiltration entirely at some locations. However, the subsurface storage outlets will be set above the invert of the stone beneath the chambers, creating a semi-permanent pool that will allow for infiltration and recharge over longer periods of time. Where the roadside ditches are to remain, a bioswale has been proposed to promote infiltration of roadway runoff along 10 Sideroad. A detailed water balance assessment shall be completed during the detailed design.

5.8 Erosion and Sediment Control

For erosion control, LSRCA guidelines require that the 25mm 4-hour Chicago storm event be detained and released over at least 24 hours. An Erosion Study may also be required by the LSRCA. The outlet configuration of each filtration-based storage system will be completed during detailed design. At this time, in addition to maintain outflows to existing peak flows, outflows will be controlled to release the 25mm storm over 24 hours. Control of the 25mm storm runoff will be achieved via capture and filtration or infiltration within the various proposed LID features described in Section 5.2 of this report and shown in **Appendix D**. Storage capacity will be sized to ensure the runoff can be stored and drained within 24 to 48 hours.

6 SUMMARY AND CONCLUSIONS

This study provides an analysis of the existing conditions along the Line 8 and 10 Sideroad urbanization and reconstruction area. The proposed works include the urbanization of the road cross section, watercourse crossing replacement, construction of a storm sewer system with catchbasin and curb and gutter inlets, and a stormwater management system. The roadway improvements will increase the overall impervious area of the site, and quantity and quality control, as well as water balance considerations were required.

A hydrologic and hydraulic model was built using PCSWMM to assess the existing and proposed conditions for the urbanization, stormwater management system and culvert crossing replacements. The culvert crossing analysis found that the proposed replacements will improve conveyance for all crossings and meet MTO criteria for conveyance and freeboard.

The proposed stormwater management strategy will incorporate LID measures where possible, including the installation of infiltration chambers in the Line 8 boulevards. Low soil permeability found

during the geotechnical investigation indicated that the use of full infiltration was not feasible. Instead, the chambers are designed as an underground storage system that can infiltrate retained flows at a slower rate to improve the water balance deficit, and provide some quality control of runoff for the site. The PCSWMM analysis found that peak flow rates in the proposed condition with SWM control were similar to existing peak rates leaving the area.

Additional analysis will be required in the detailed design stage with respect to the minor system design including storm sewers and inlets, phosphorus management and water balance.

7 CONCLUDING REMARKS

We trust that the information in this report satisfies the requirements of the Class EA. Should you have any questions or wish to discuss, do not hesitate to contact the undersigned.

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8 REFERENCES

Aquafor Beech Limited (2016). Bradford West Gwillimbury Comprehensive Stormwater Management Master Plan. Town of Bradford West Gwillimbury.

Lake Simcoe Regional Conservation Authority (2022). LSRCA Technical Guidelines for Stormwater Management Submissions. Lake Simcoe Region.

Lake Simcoe Regional Conservation Authority (2009). Lake Simcoe Protection Plan. Lake Simcoe Region.

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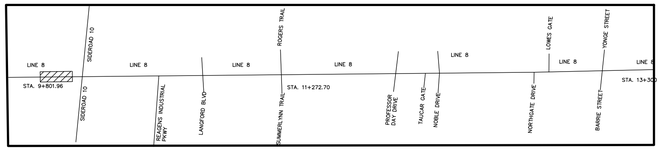
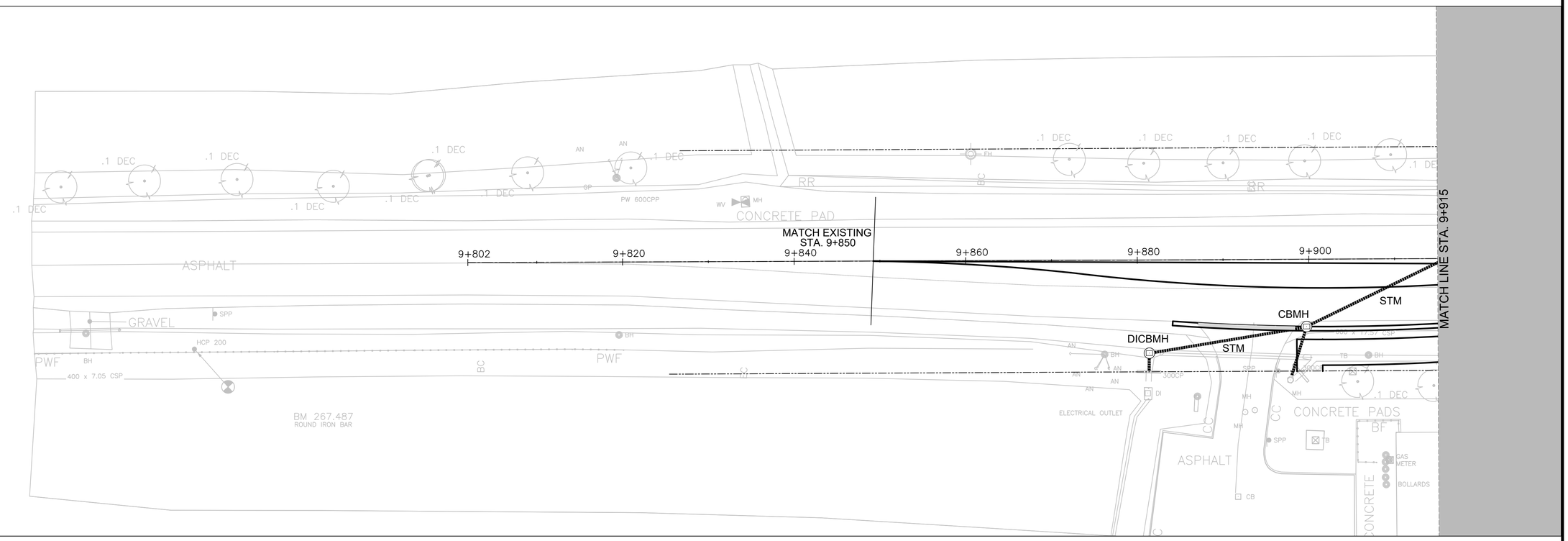
Trow Associates Inc (2005). Functional Servicing Report, Town of Bradford West Gwillimbury.

Appendix A: Background Information





LEGEND:

SILT FENCE (OPSD 219.130)

FIBRE ROLL FLOW CHECK DAM (OPSD 219.191)

NOTE: LOCATION OF SILT FENCE TO BE VERIFIED IN THE FIELD IN CONSULTATION WITH THE CONTRACT ADMINISTRATOR.

PLANMAC ENGINEERING INC.

NO.	REVISIONS	DATE	BY
1			
2			
3			
4			
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6			

Bradford West Gwillimbury
A Growing Tradition

LINE 8 NEW CONSTRUCTION

STA. 9+850 TO STA. 9+915

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 1
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg

REFER TO SHEET 18

MATCH LINE STA. 9+915

MATCH LINE STA. 10+096

2.5m - 2400mm x 1200mm
PRECAST BEND

ROUND STONE DITCH TREATMENT

3.0m ASPH. MUT

30.0m - 2400mm x 1200mm
PRECAST CONC BOX CULVERT

ROUND STONE DITCH TREATMENT

25.0m - 2400mm x 1200mm
PRECAST CONC BOX CULVERT

REFER TO SHEET 19

NO.	REVISIONS	DATE	BY
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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

LINE 8 NEW CONSTRUCTION

STA. 9+915 TO STA. 10+096

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 2
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

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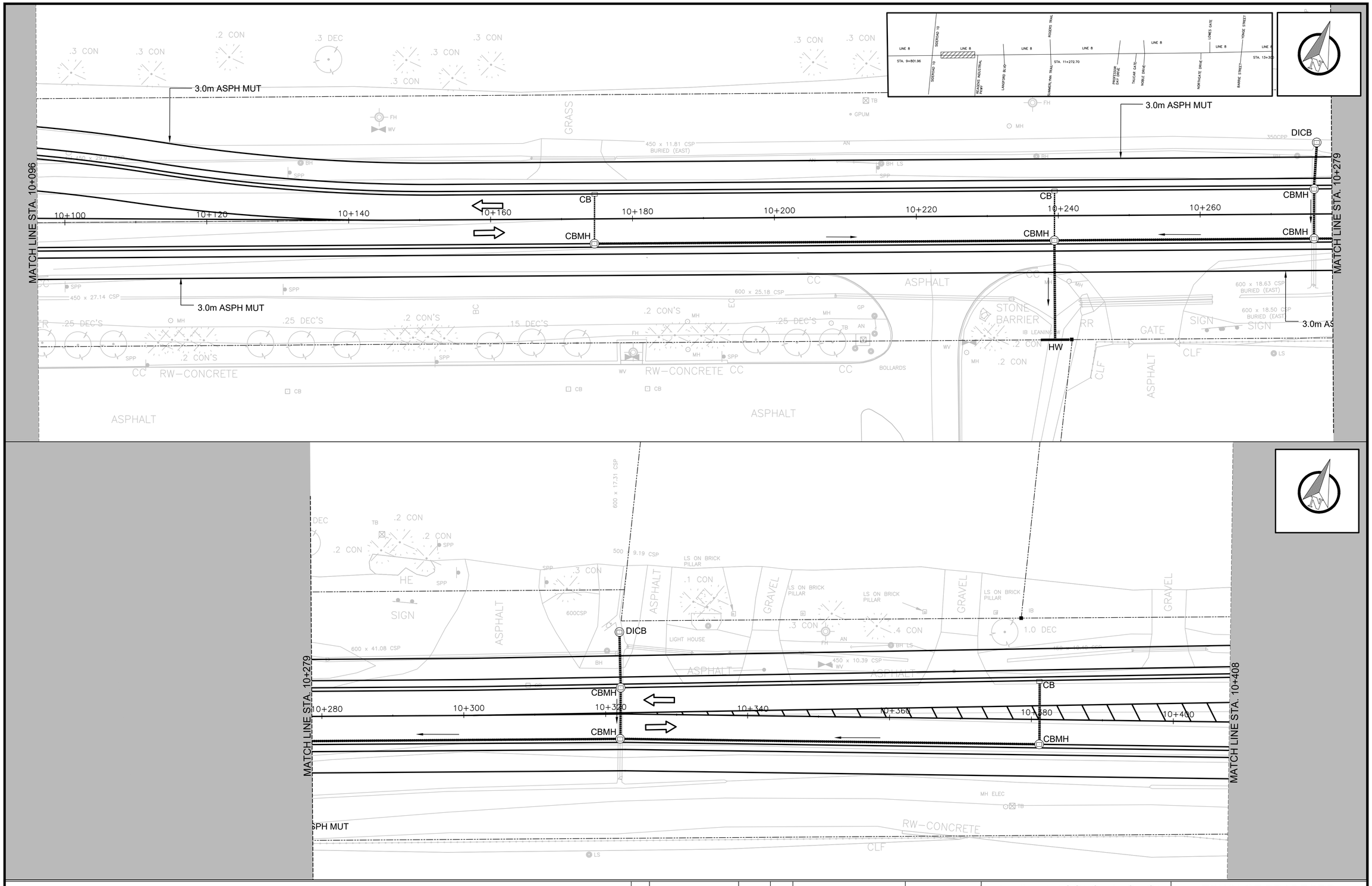

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PLANMAC ENGINEERING INC.

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Bradford West Gwillimbury
A Growing Tradition

LINE 8 NEW CONSTRUCTION

STA. 10+096 TO STA. 10+408

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

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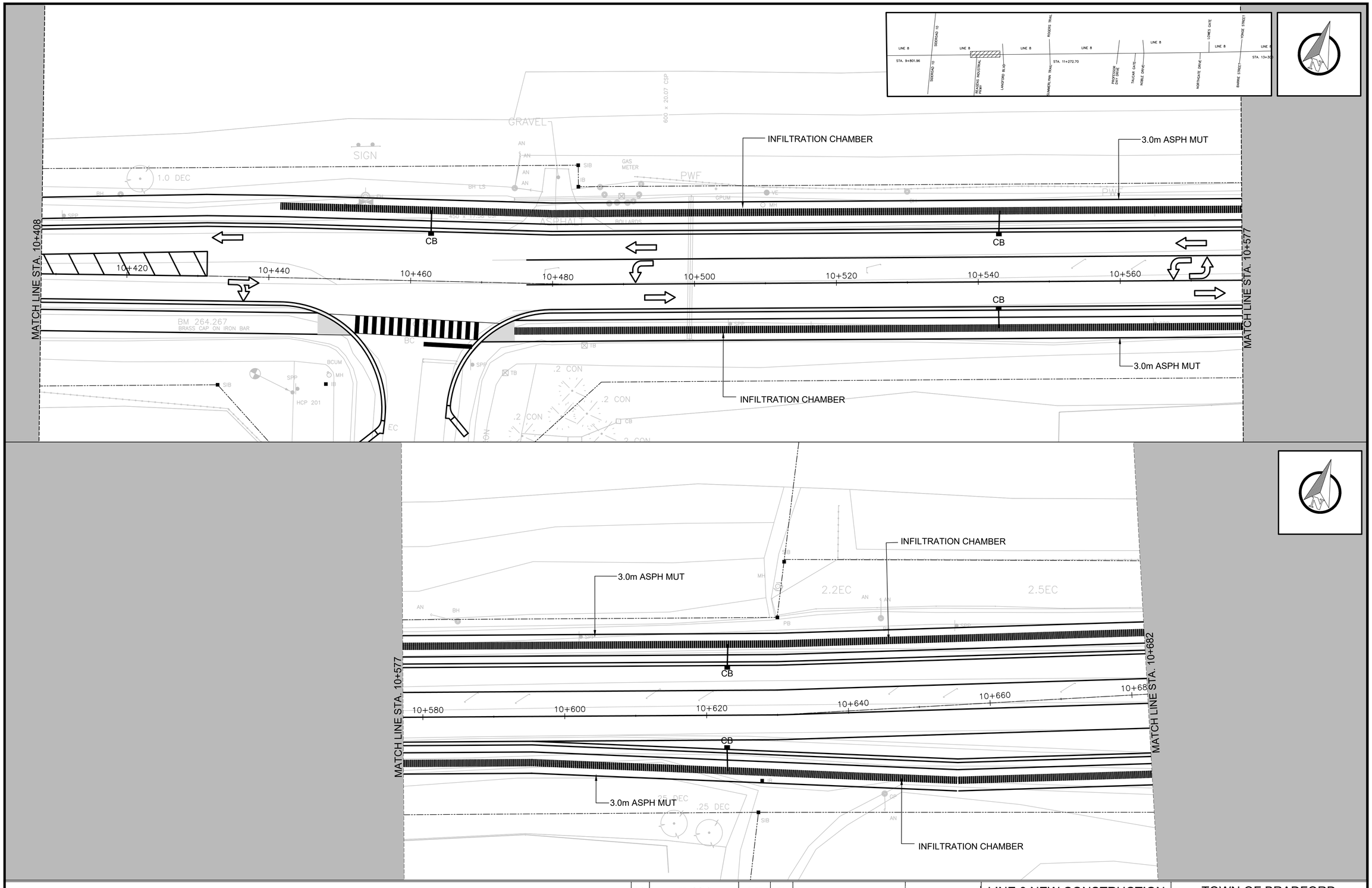
REVIEWED BK	DATE 4/11/2025	



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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

LINE 8 NEW CONSTRUCTION

STA. 10+408 TO STA. 10+682

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 4
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

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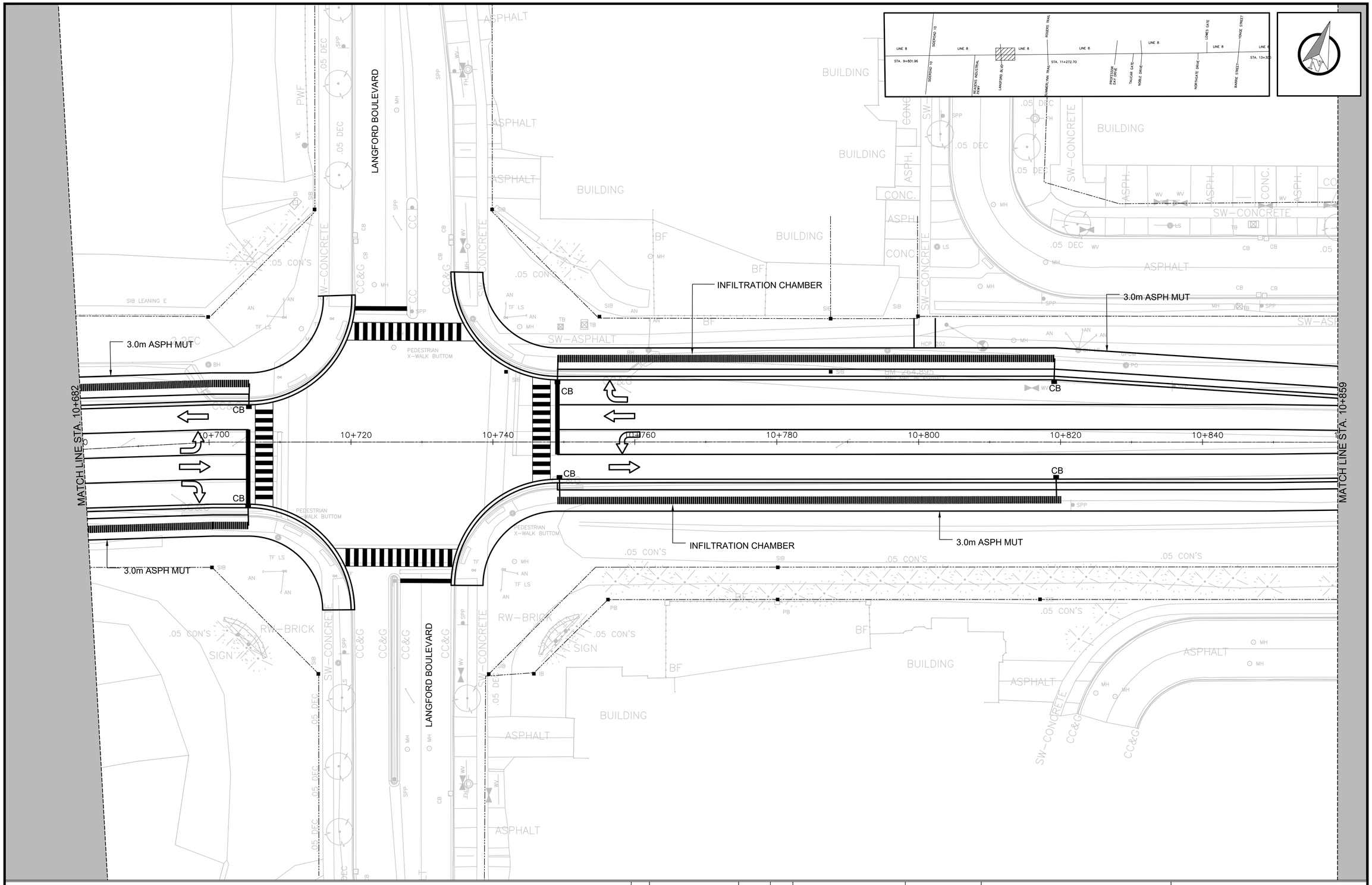

PLANMAC ENGINEERING INC.

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Bradford West Gwillimbury — A Growing Tradition

LINE 8 NEW CONSTRUCTION

STA. 10+682 TO STA. 10+859

TOWN OF BRADFORD LINE 8 AND SIDEROAD 10 RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A	SHEET NO. 5	
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

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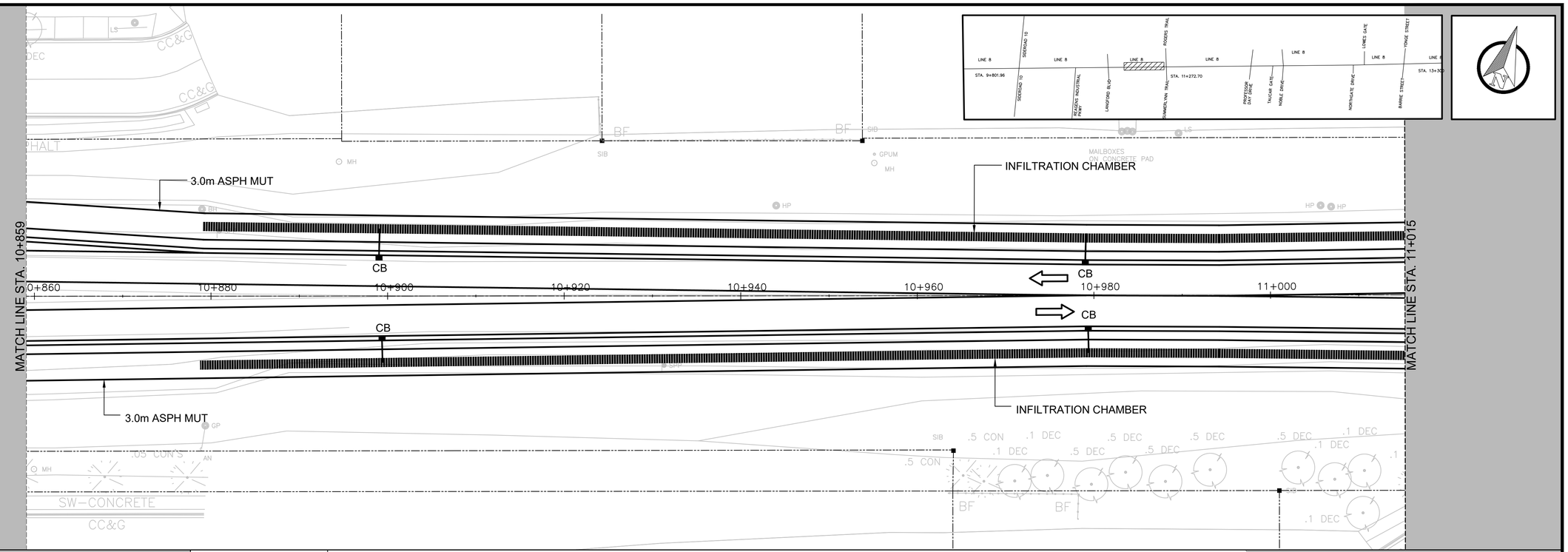

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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

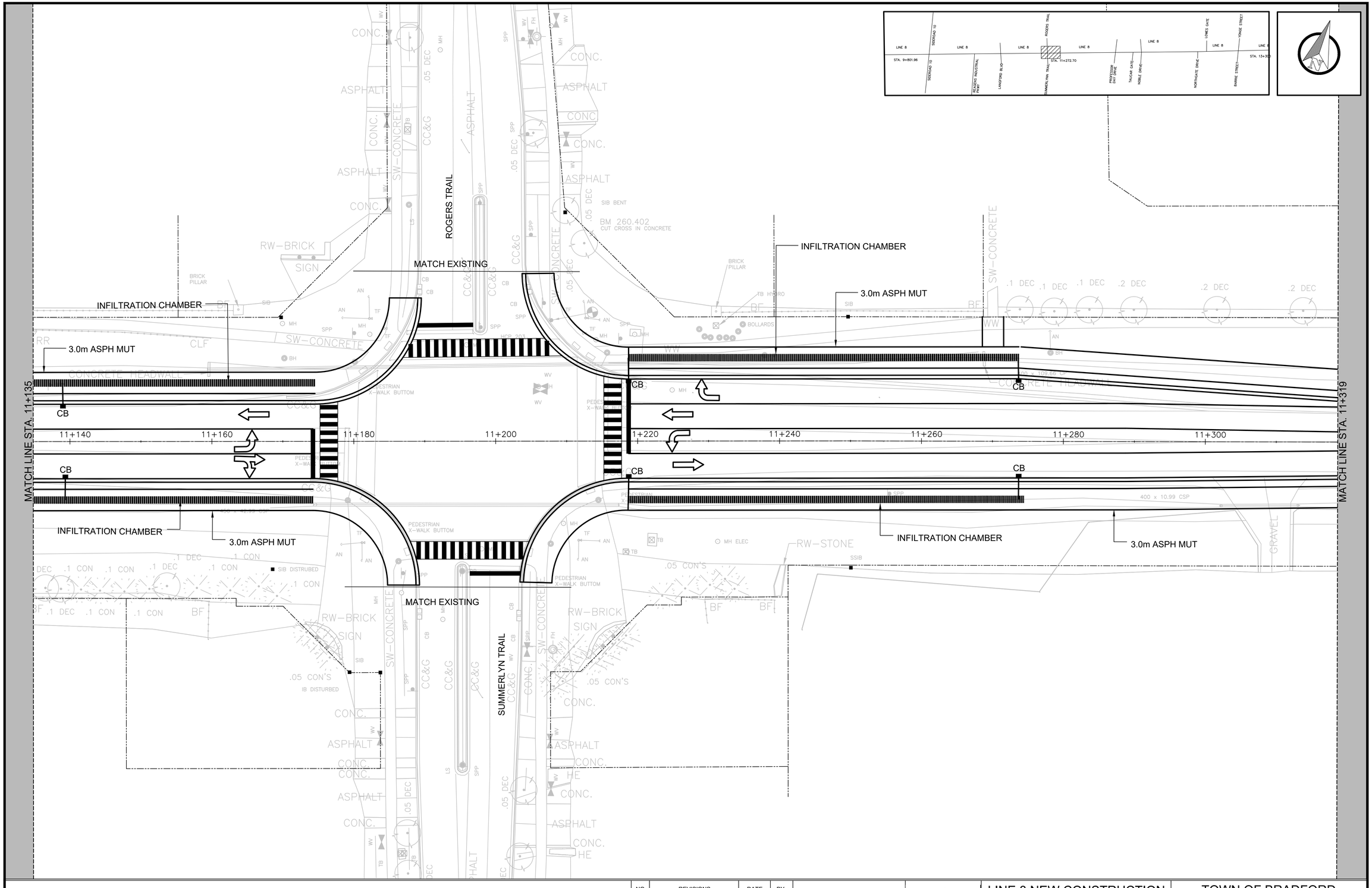
LINE 8 NEW CONSTRUCTION

STA. 10+859 TO STA. 11+135

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 6
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg



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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

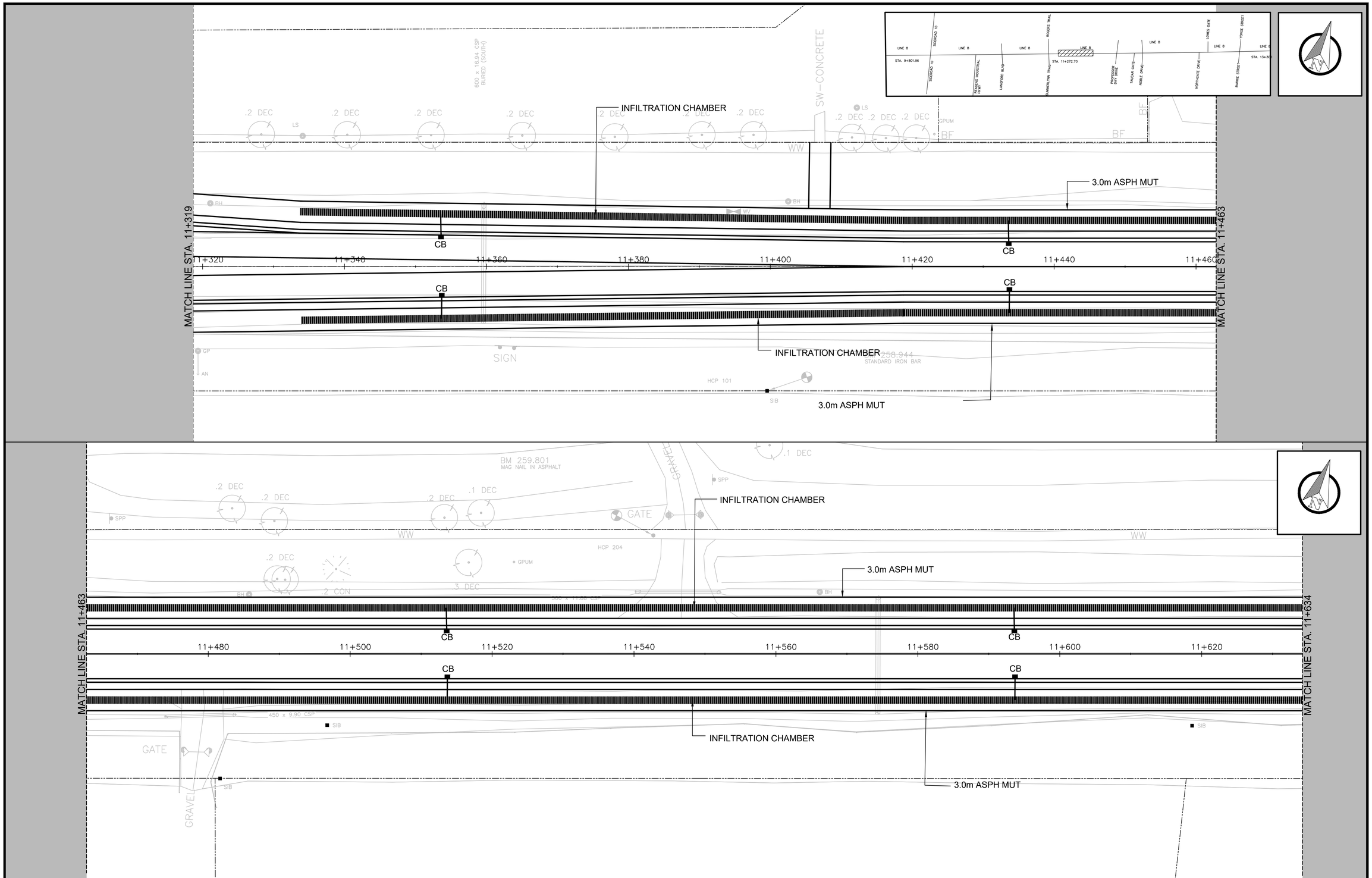
LINE 8 NEW CONSTRUCTION

STA. 11+135 TO STA. 11+319

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 7
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg



PLANMAC ENGINEERING INC.

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Bradford West Gwillimbury
A Growing Tradition

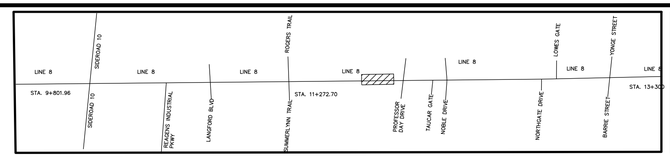
LINE 8 NEW CONSTRUCTION

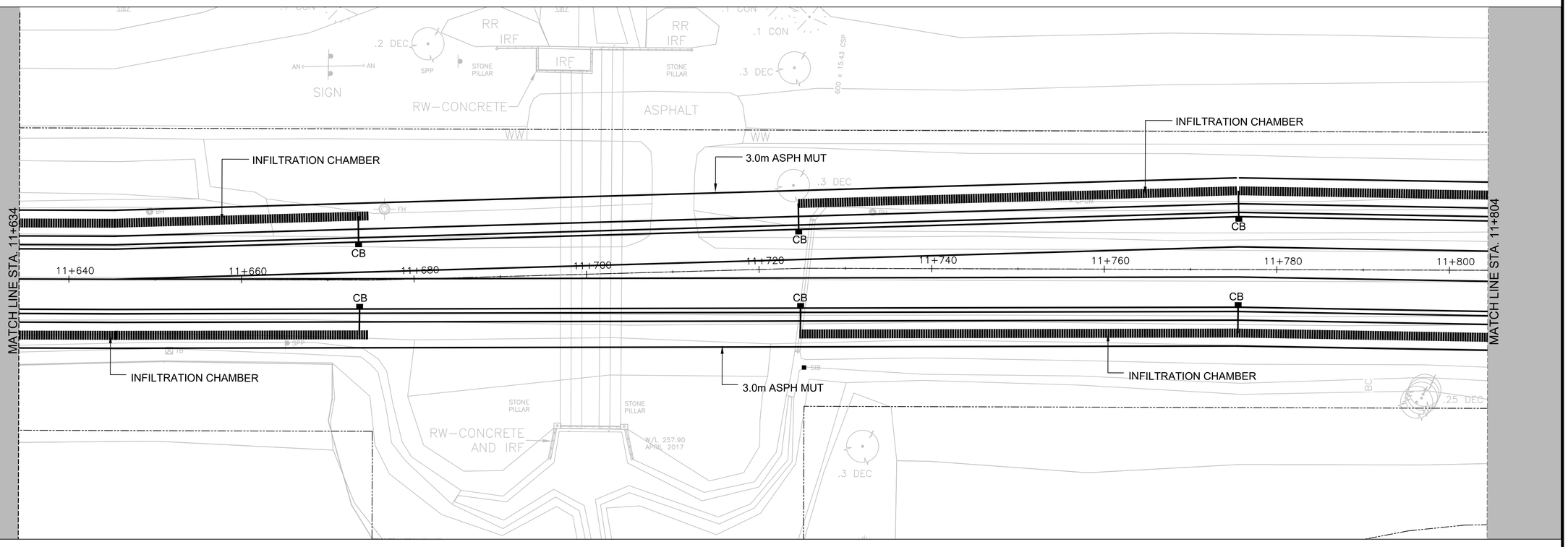
STA. 11+319 TO STA. 11+634

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 8
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg





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Bradford West Gwillimbury
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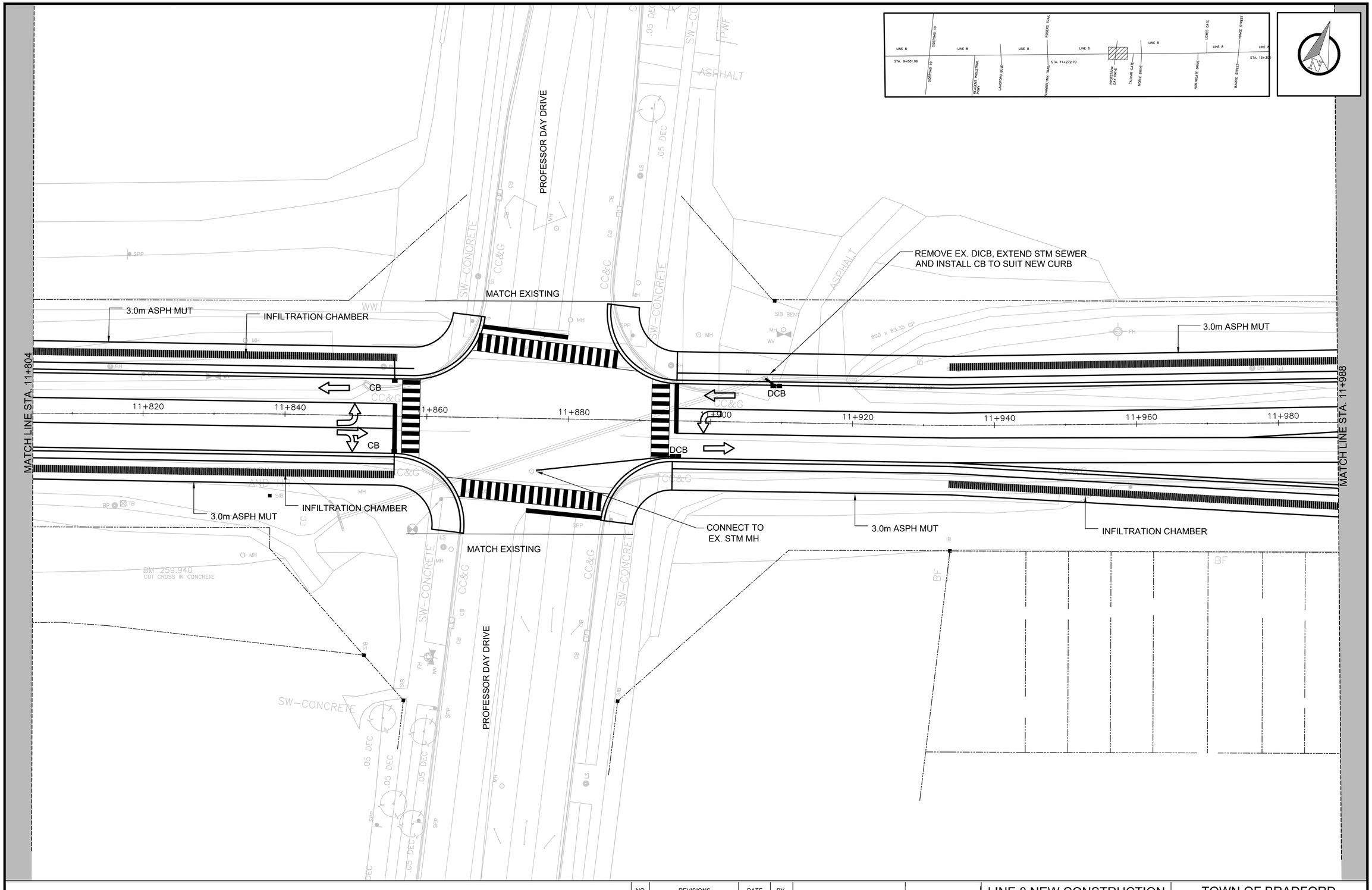
LINE 8 NEW CONSTRUCTION

STA. 11+634 TO STA. 11+804

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 9
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg



PLANMAC ENGINEERING INC.

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Bradford West Gwillimbury
A Growing Tradition

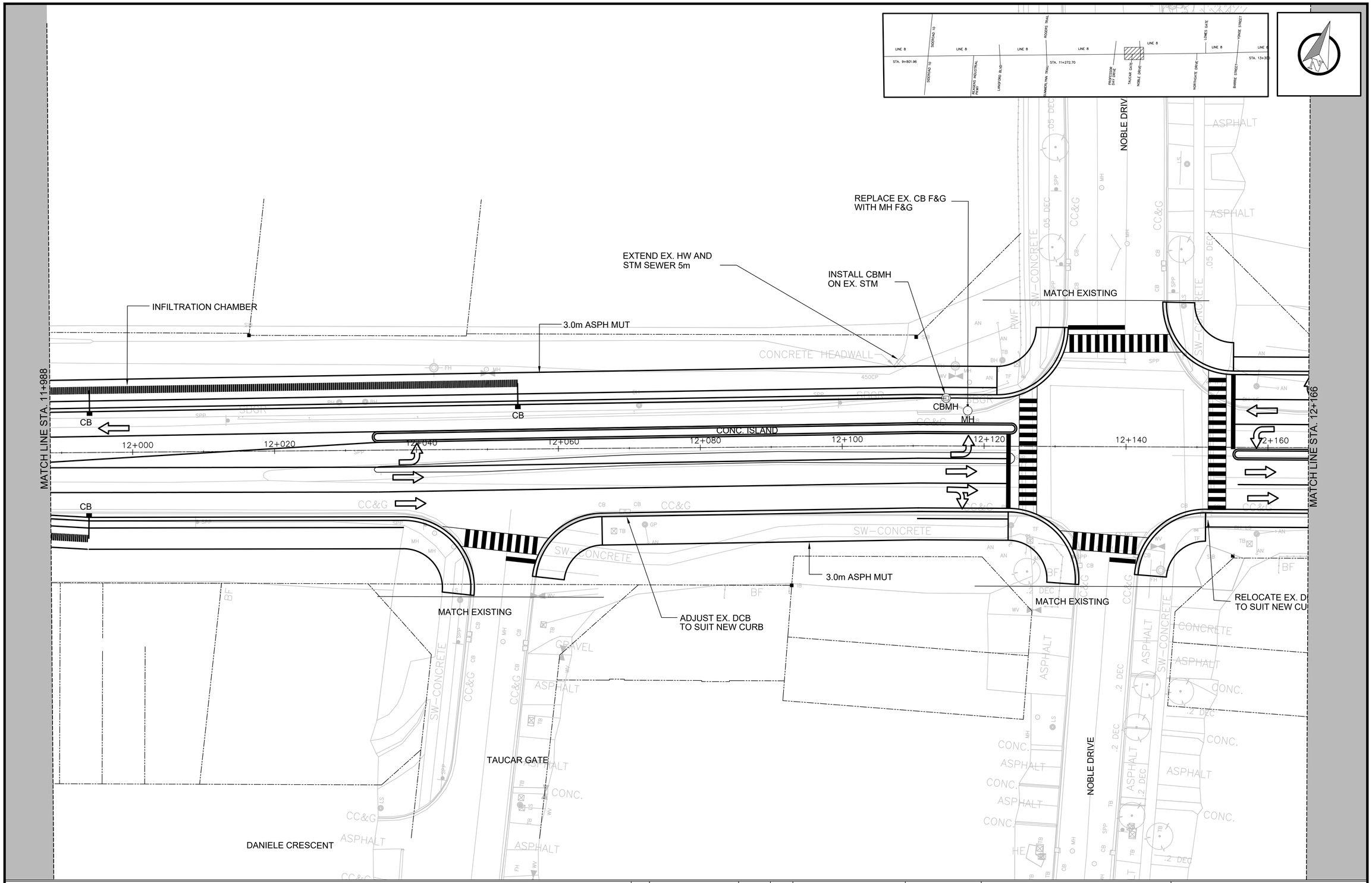
LINE 8 NEW CONSTRUCTION

STA. 11+804 TO STA. 11+988

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A	SHEET NO. 10	
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg



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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

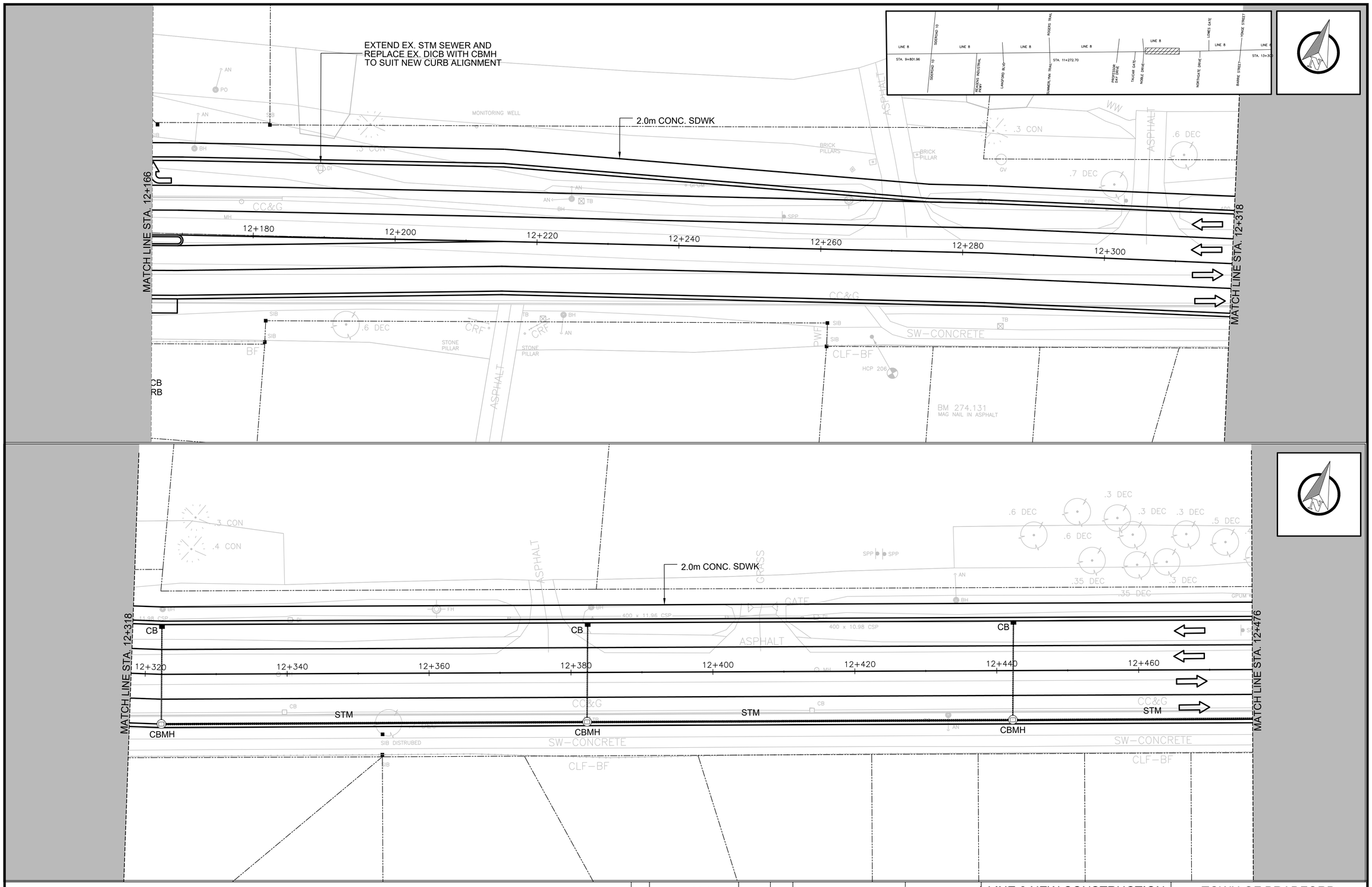
LINE 8 NEW CONSTRUCTION

STA. 11+988 TO STA. 12+166

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10 RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A	SHEET NO.	11
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg



FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg

PLANMAC ENGINEERING INC.

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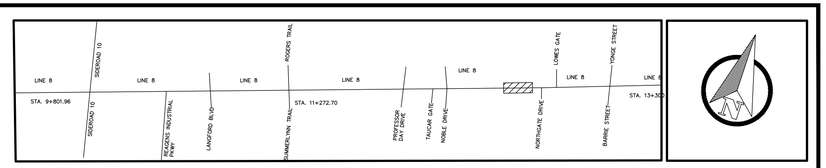
Bradford West Gwillimbury
A Growing Tradition

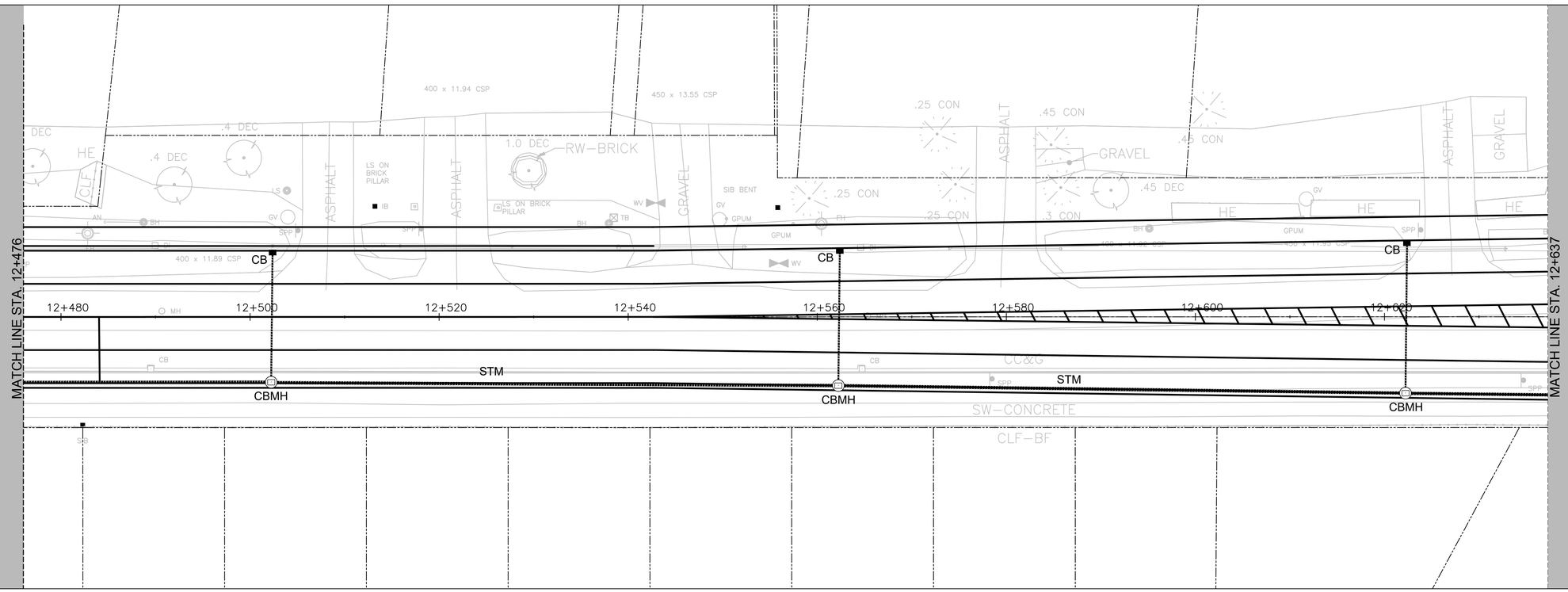
LINE 8 NEW CONSTRUCTION

STA. 12+166 TO STA. 12+476

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 12
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		





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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

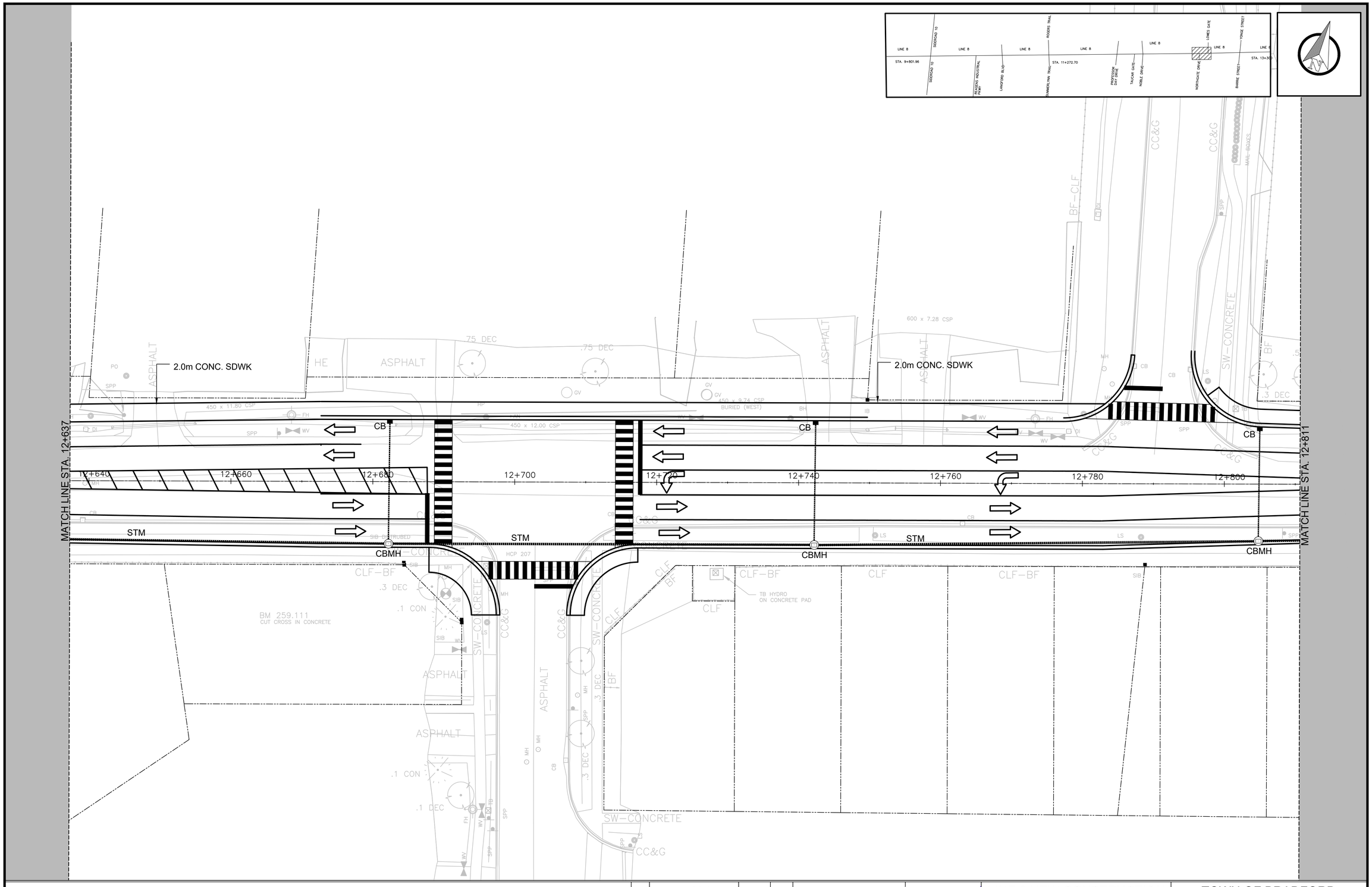
LINE 8 NEW CONSTRUCTION

STA. 12+476 TO STA. 12+637

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 13
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg



FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg

PLANMAC ENGINEERING INC.

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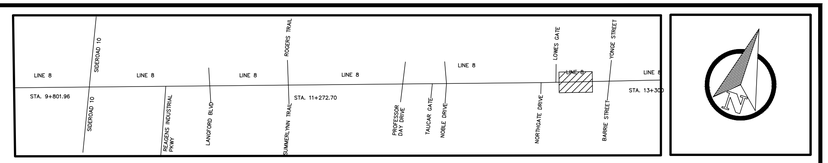
Bradford West Gwillimbury
A Growing Tradition

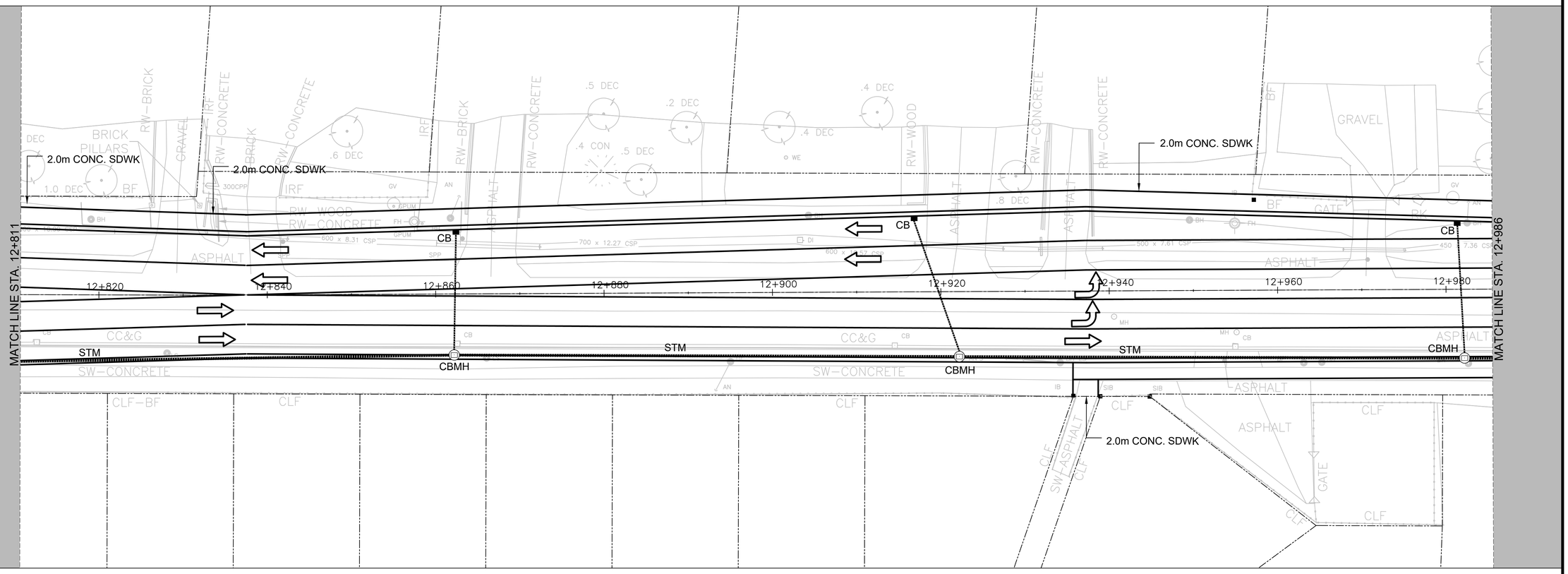
LINE 8 NEW CONSTRUCTION

STA. 12+637 TO STA. 12+811

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 14
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		





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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

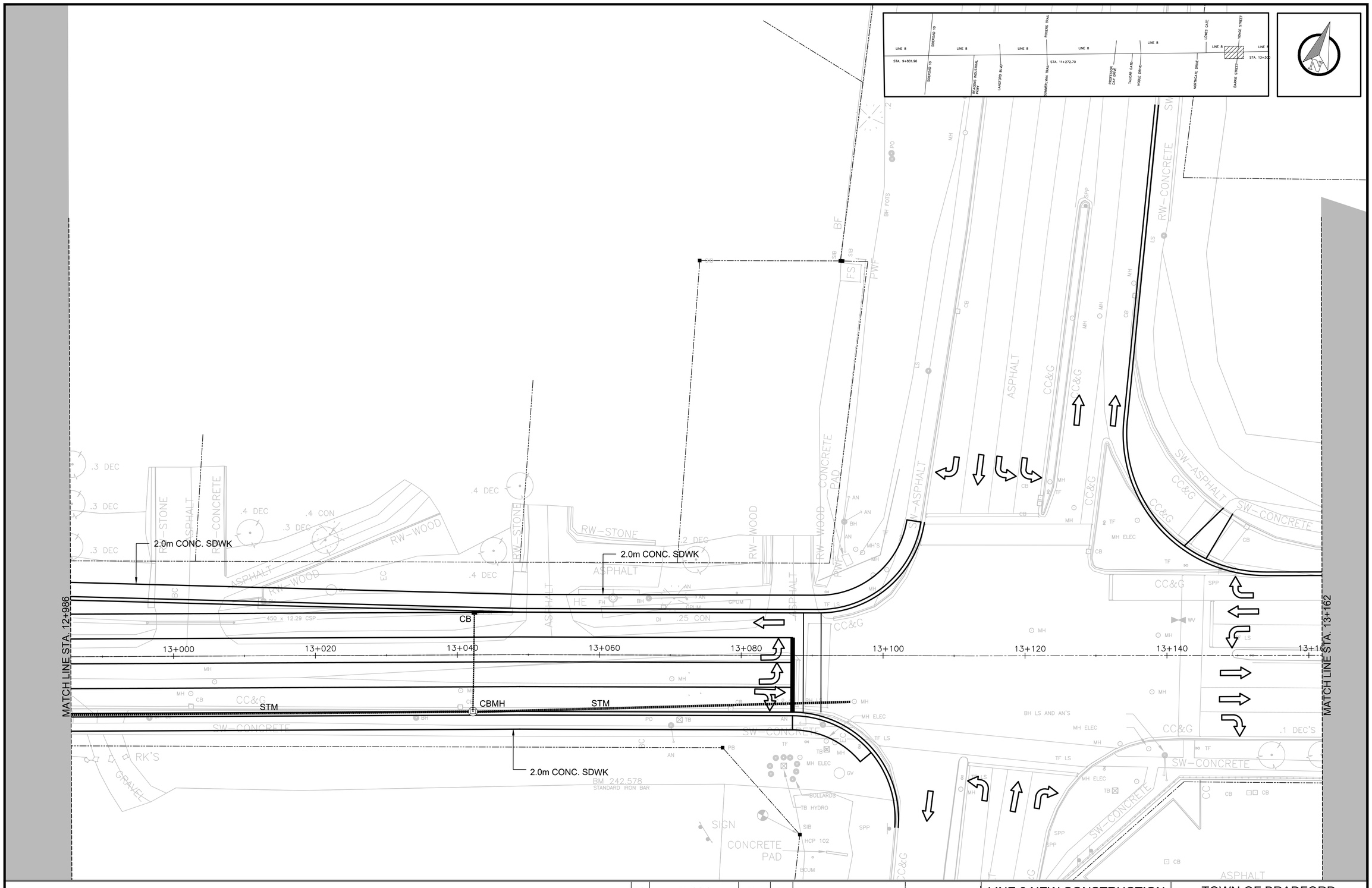
LINE 8 NEW CONSTRUCTION

STA. 12+811 TO STA. 12+986

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 15
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg



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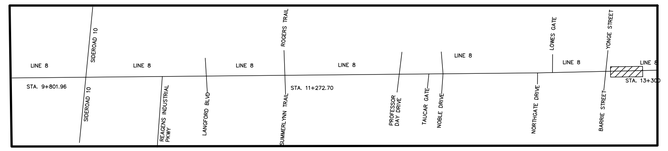
Bradford West Gwillimbury
A Growing Tradition

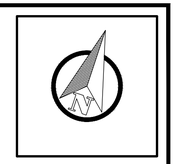
LINE 8 NEW CONSTRUCTION

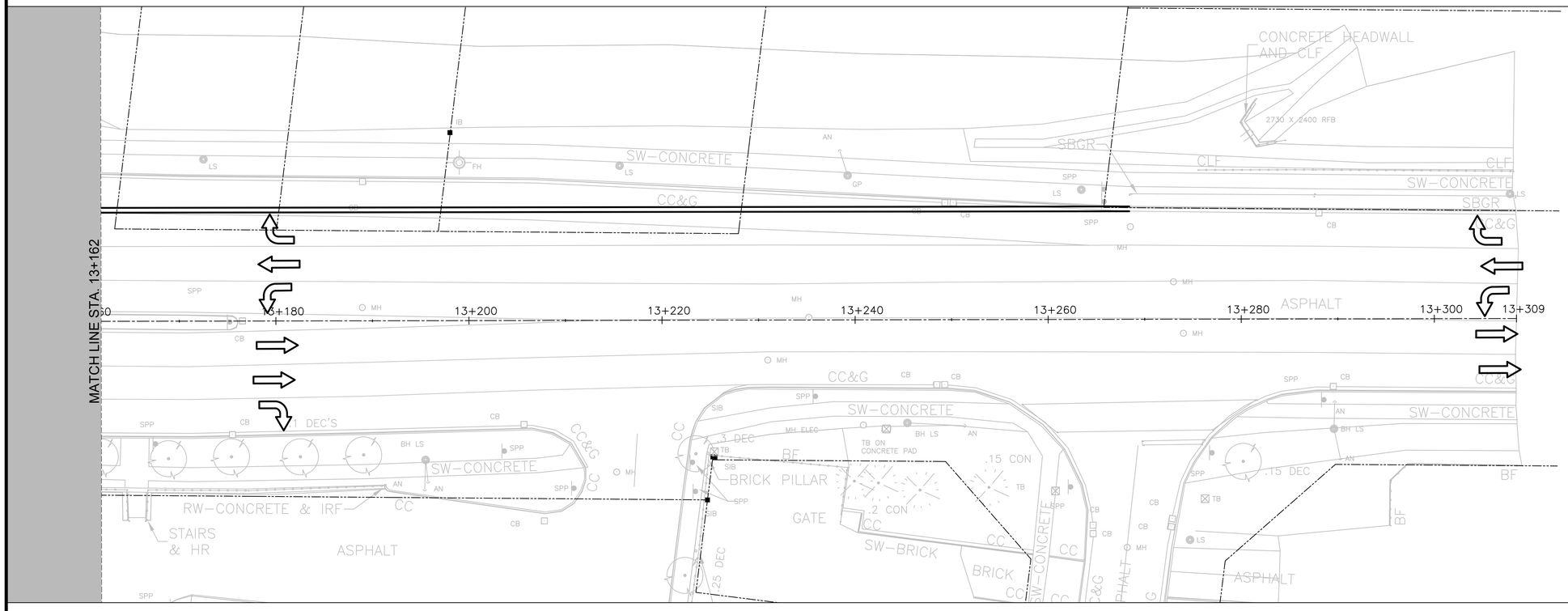
STA. 12+986 TO STA. 13+162

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 16
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		







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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

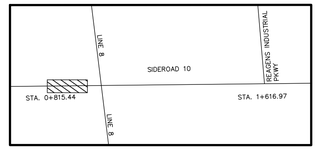
LINE 8 NEW CONSTRUCTION

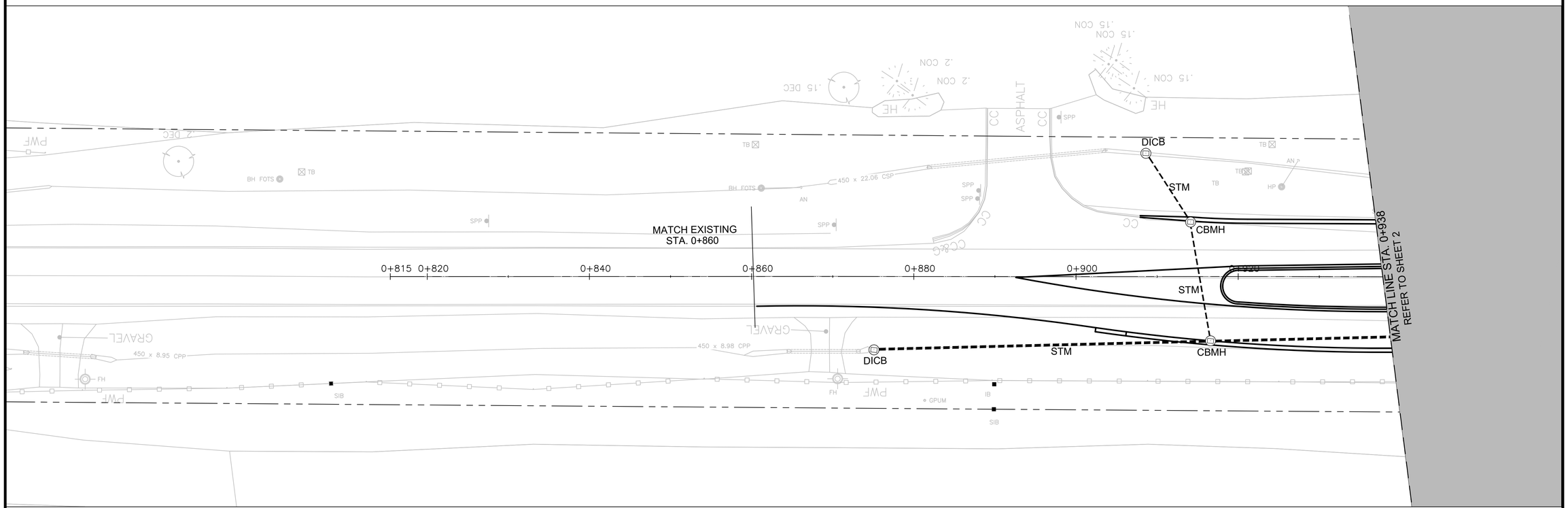
STA. 13+162 TO STA. 13+268

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 17
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Line 8 New Construction.dwg





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PLANMAC ENGINEERING INC.

Bradford West Gwillimbury
A Growing Tradition

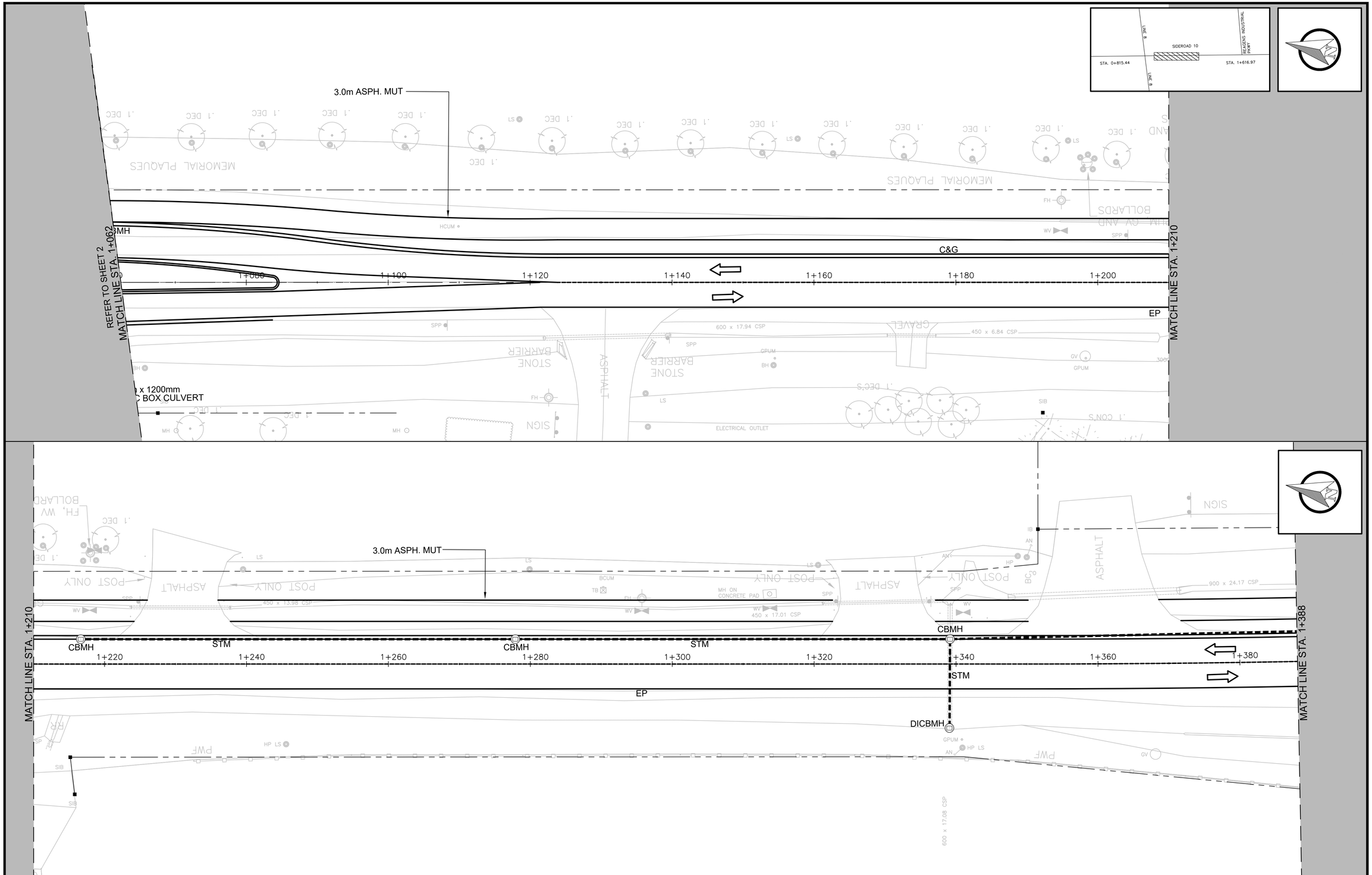
SIDEROAD 10 NEW CONSTRUCTION

STA. 0+815 TO STA. 0+938

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 18
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

FILE: \\172.31.0.10\Planmac\Project-design\Current Projects\2016\1640 Bradford W Gwillimbury Line 8 2022\8 Working Drawings\D. Long Active Design - Line 8\CADD\Sheets\Sideroad 10 New Construction.dwg



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PLANMAC ENGINEERING INC.

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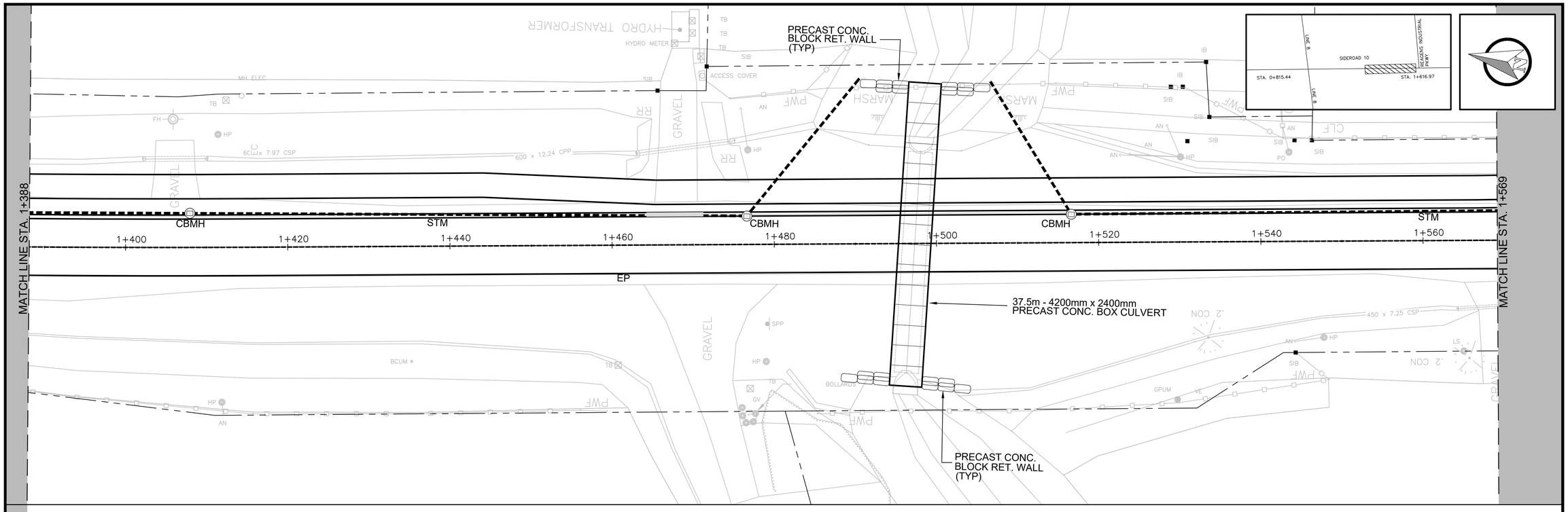
Bradford West Gwillimbury
A Growing Tradition

SIDEROAD 10 NEW CONSTRUCTION

STA. 1+062 TO STA. 1+388

TOWN OF BRADFORD
LINE 8 AND SIDEROAD 10
RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 19
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		



PLANMAC ENGINEERING INC.

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Bradford West Gwillimbury — A Growing Tradition

SIDEROAD 10 NEW CONSTRUCTION

STA. 1+388 TO STA. 1+745

TOWN OF BRADFORD LINE 8 AND SIDEROAD 10 RECONSTRUCTION

SCALE HOR. 1:250	VERT. N/A		SHEET NO. 20
DESIGNED MS	DRAWN DL		
REVIEWED BK	DATE 4/11/2025		

CULTEC Recharger® 360HD Stormwater Chamber

The Recharger® 360HD is a 36" (914 mm) tall, high capacity chamber. Typically when using this model, fewer chambers are required resulting in less labor and a smaller installation area. The Recharger® 360HD has the side portal internal manifold feature. HVLV® FC-48 Feed Connectors are inserted into the side portals to create the internal manifold.

Recharger 360HD Chamber

Recharger 360HD End Cap

Recharger 360HD Chamber	
Size (L x W x H)	4.17' x 60" x 36"
	1.27 m x 1525 mm x 914 mm
Installed Length	3.67'
	1.12 m
Length Adjustment per Row - with two end caps installed	2.5'
	0.76 m
Length Adjustment per Row - when not using end caps	0.5'
	0.15 m
Chamber Storage	10.00 ft^3/ft
	0.929 m^3/m
	36.66 ft^3/unit
	1.038 m^3/unit
Min. Installed Storage	15.199 ft^3/ft
	1.412 m^3/m
	55.73 ft^3/unit
	1.58 m^3/unit
Min. Area Required	21.08 ft^2
	1.96 m^2
Chamber Weight	57.0 lbs
	25.85 kg
Shipping	20 chambers/skid
	1,265 lbs/skid
	11 skids/48' flatbed
Min. Center-to-Center Spacing	5.75'
	1.75 m
Max. Allowable Cover	12'
	3.66 m
Max. Allowable O.D. in Side Portal	10" HDPE, 12" PVC
	250 mm HDPE, 300 mm PVC
Compatible Feed Connector	HVLV FC-48 Feed Connector

Calculations are based on installed chamber length.
All above values are nominal.
Min. installed storage includes 6" (152 mm) stone base, 6" (152 mm) stone above crown of chamber and typical stone surround at 5.75 (1.75 m) center-to-center spacing.

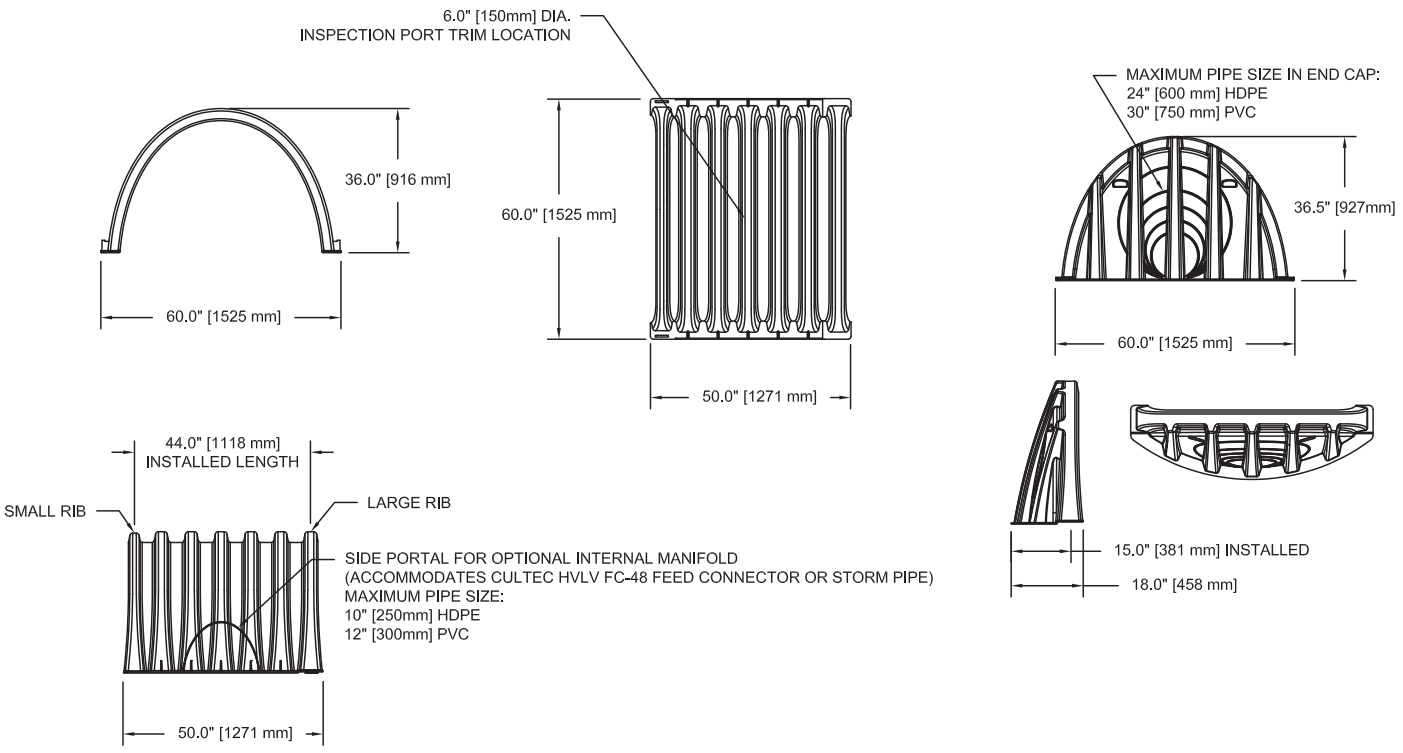
	Stone Foundation Depth		
	6"	12"	18"
	152 mm	305 mm	457 mm
Chamber and Stone Storage Per Chamber	55.73 ft^3	59.95 ft^3	64.17 ft^3
	1.58 m^3	1.70 m^3	1.82 m^3
Min. Effective Depth	4.00'	4.50'	5.0'
	1.22 m	1.37 m	1.52 m
Stone Required Per Chamber	1.77 yd^3	2.16 yd^3	2.55 yd^3
	1.35 m^3	1.65 m^3	1.95 m^3

Recharger 360HD End Cap	
Size (L x W x H)	18" x 60" x 36.5"
	458 mm x 1525 mm x 927 mm
Installed Length	15"
	381 mm
End Cap Storage	5.17 ft^3/ft
	0.48 m^3/m
	6.46 ft^3/unit (interlocked)
	0.183 m^3/unit (interlocked)
Min. Installed Storage	12.40 ft^3/ft
	1.15 m^3/m
	15.50 ft^3/unit
	0.44 m^3/unit
End Cap Weight	22.0 lbs
	9.98 kg
Shipping	20 end caps/skid
	565 lbs/skid
	11 skids/48' flatbed
Max. Inlet Opening in End Cap	24" HDPE, 30" PVC
	600 mm HDPE, 750 mm PVC

Calculations are based on installed chamber length.
Includes 6" (305 mm) stone above crown of chamber and typical stone surround at. 5.75' (1.75 m) center-to-center spacing and stone foundation as listed in table.
Stone void calculated at 40%.

For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

Three View Drawing



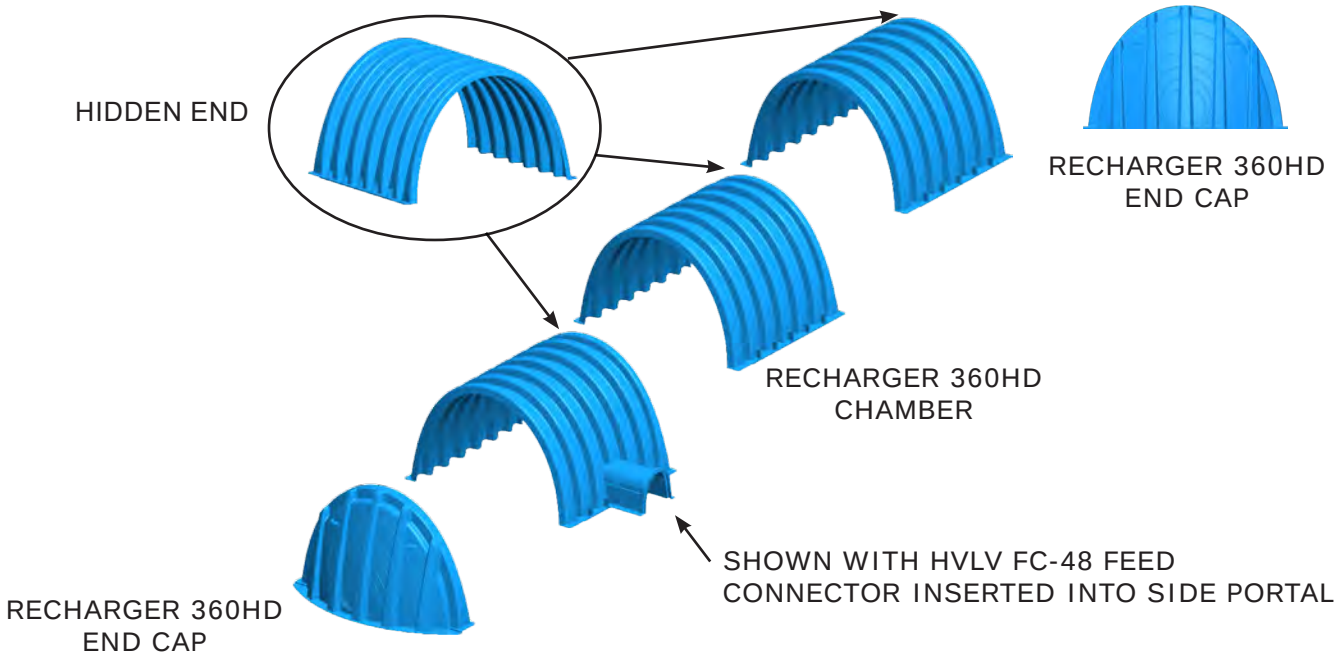
CULTEC RECHARGER 360HD CHAMBER STORAGE = 10.0 CF/FT [.928m³/m]
CHAMBER STORAGE VOLUME = 36.66 CF [1.038m³]
INSTALLED LENGTH ADJUSTMENT = 0.50' [0.15m]
SIDE PORTAL ACCEPTS CULTEC HVLV FC-48 FEED CONNECTOR

Recharger 360HD Chamber

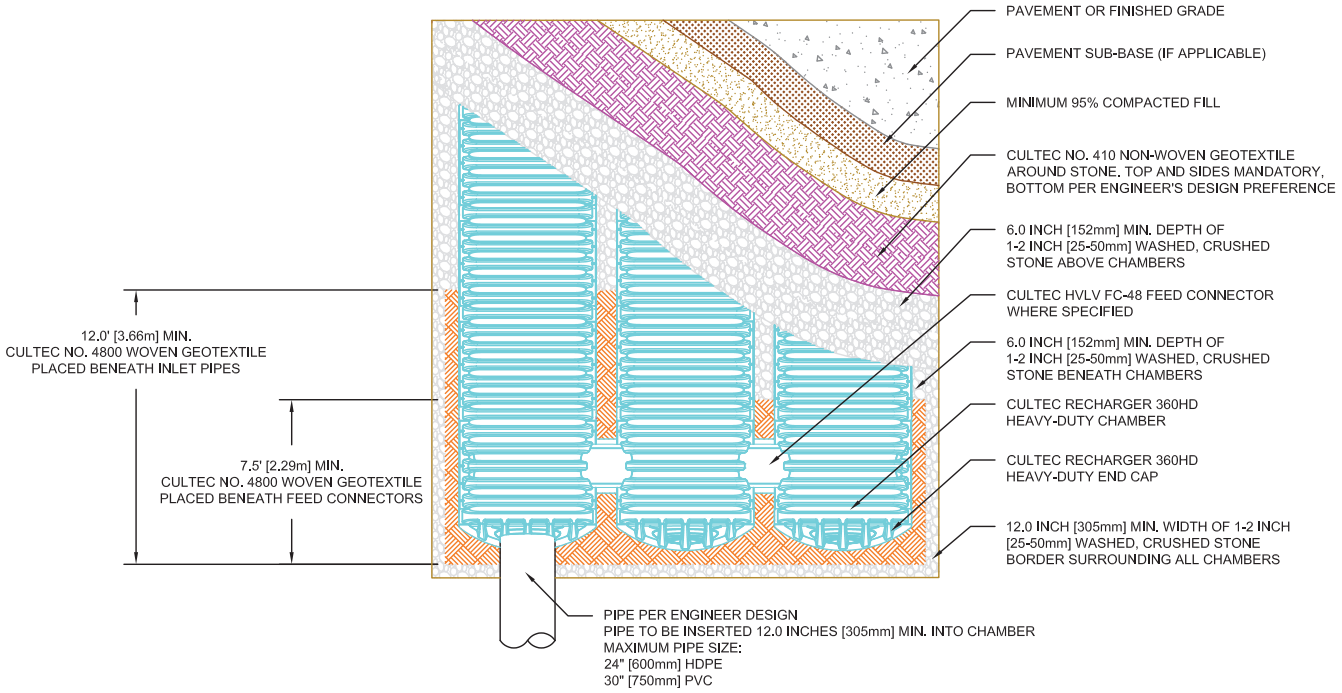
CULTEC RECHARGER 360HD END CAP
STORAGE = 5.17 CF/FT [0.48 m³/m]
END CAP STORAGE VOLUME = 6.46 CF [0.183 m3]
INSTALLED LENGTH ADJUSTMENT = 0.25' [0.08 m]

Recharger 360HD End Cap

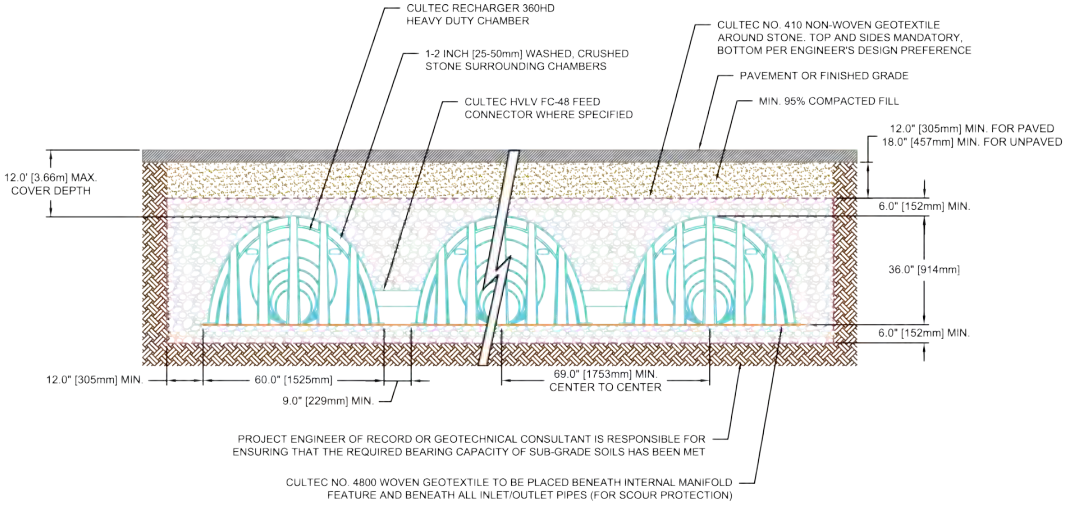
Typical Interlock Installation



Plan View Drawing



Typical Cross Section for Traffic Application



NOTES:
1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
   1.a. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   1.b. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
   1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3430-20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
3. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
   3.a. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
   3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

Recharger® 360HD Bare Chamber Storage Volumes

Elevation		Incremental Storage Volume				Cumulative Storage	
in.	mm	ft³/ft	m³/m	ft³	m³	ft³	m³
36	914	0.022	0.002	0.08	0.002	3.3658	1.038
35	889	0.046	0.004	0.17	0.005	36.577	1.036
34	864	0.069	0.006	0.25	0.007	36.407	1.031
33	838	0.117	0.011	0.43	0.012	36.154	1.024
32	813	0.148	0.014	0.54	0.015	35.726	1.012
31	787	0.171	0.016	0.63	0.018	35.185	0.996
30	762	0.190	0.018	0.70	0.020	34.560	0.979
29	737	0.206	0.019	0.76	0.021	33.864	0.959
28	711	0.221	0.021	0.81	0.023	33.108	0.938
27	686	0.234	0.022	0.86	0.024	32.298	0.915
26	660	0.246	0.023	0.90	0.026	31.441	0.890
25	635	0.257	0.024	0.94	0.027	30.539	0.865
24	609	0.267	0.025	0.98	0.028	29.598	0.838
23	584	0.276	0.026	1.01	0.029	28.620	0.811
22	559	0.284	0.026	1.04	0.030	27.608	0.782
21	533	0.292	0.027	1.07	0.031	26.565	0.752
20	508	0.300	0.028	1.10	0.032	25.493	0.722
19	483	0.307	0.028	1.12	0.033	24.394	0.691
18	457	0.313	0.029	1.15	0.033	23.239	0.659
17	432	0.319	0.030	1.17	0.033	22.121	0.626
16	406	0.325	0.030	1.19	0.034	20.950	0.593
15	381	0.331	0.031	1.21	0.034	19.757	0.560
14	356	0.336	0.031	1.23	0.035	18.545	0.525
13	330	0.341	0.032	1.25	0.035	17.313	0.490
12	305	0.345	0.032	1.27	0.036	16.064	0.455
11	279	0.350	0.032	1.28	0.036	14.798	0.419
10	254	0.354	0.033	1.30	0.037	13.516	0.383
9	229	0.358	0.033	1.31	0.037	12.219	0.346
8	203	0.361	0.034	1.32	0.038	10.908	0.309
7	178	0.365	0.034	1.34	0.038	9.584	0.271
6	152	0.368	0.034	1.35	0.038	8.247	0.234
5	127	0.371	0.034	1.36	0.039	6.898	0.195
4	102	0.374	0.035	1.37	0.039	5.538	0.157
3	76	0.376	0.035	1.38	0.039	4.168	0.118
2	51	0.379	0.035	1.39	0.039	2.787	0.079
1	25	0.381	0.035	1.40	0.040	1.398	0.040
Total		9.998	0.929	36.66	1.038	36.658	1.038

Calculations are based on installed chamber length of 3.67' (1.12 m).

Recharger® 360HD Bare End Cap Storage Volumes

Elevation		Incremental Storage Volume				Cumulative Storage	
in.	mm	ft³/ft	m³/m	ft³	m³	ft³	m³
36	914	0.008	0.0007	0.01	0.000	6.460	0.183
35	889	0.016	0.0015	0.02	0.001	6.450	0.183
34	864	0.024	0.0022	0.03	0.001	6.430	0.182
33	838	0.032	0.0030	0.04	0.001	6.400	0.181
32	813	0.040	0.0037	0.05	0.001	6.360	0.180
31	787	0.048	0.0045	0.06	0.002	6.310	0.179
30	762	0.056	0.0052	0.07	0.002	6.250	0.177
29	737	0.064	0.0059	0.08	0.002	6.180	0.175
28	711	0.072	0.0067	0.09	0.003	6.100	0.173
27	686	0.080	0.0074	0.10	0.003	6.010	0.170
26	660	0.088	0.0082	0.11	0.003	5.910	0.167
25	635	0.096	0.0089	0.12	0.003	5.800	0.164
24	609	0.112	0.0104	0.14	0.004	5.680	0.161
23	584	0.120	0.0111	0.15	0.004	5.540	0.157
22	559	0.128	0.0119	0.16	0.005	5.390	0.153
21	533	0.136	0.0126	0.17	0.005	5.230	0.148
20	508	0.144	0.0134	0.18	0.005	5.060	0.143
19	483	0.152	0.0141	0.19	0.005	4.880	0.138
18	457	0.160	0.0149	0.20	0.006	4.690	0.133
17	432	0.160	0.0149	0.20	0.006	4.490	0.127
16	406	0.168	0.0156	0.21	0.006	4.290	0.121
15	381	0.176	0.0164	0.22	0.006	4.080	0.116
14	356	0.184	0.0171	0.23	0.007	3.860	0.109
13	330	0.192	0.0178	0.24	0.007	3.630	0.103
12	305	0.192	0.0178	0.24	0.007	3.390	0.096
11	279	0.200	0.0186	0.25	0.007	3.150	0.089
10	254	0.208	0.0193	0.26	0.007	2.900	0.082
9	229	0.208	0.0193	0.26	0.007	2.640	0.075
8	203	0.216	0.0201	0.27	0.008	2.380	0.067
7	178	0.224	0.0208	0.28	0.008	2.110	0.060
6	152	0.232	0.0216	0.29	0.008	1.830	0.052
5	127	0.232	0.0216	0.29	0.008	1.540	0.044
4	102	0.240	0.0223	0.30	0.008	1.250	0.035
3	76	0.240	0.0223	0.30	0.008	0.950	0.027
2	51	0.248	0.0230	0.31	0.009	0.650	0.018
1	25	0.272	0.0253	0.34	0.010	0.340	0.010
Total		5.168	0.480	6.46	0.183	6.460	0.183

Calculations are based on installed end cap length of 15" (381 mm).

CULTEC Recharger® 360HD Specifications

GENERAL

CULTEC Recharger® 360HD chambers are designed for underground stormwater management. The chambers may be used for retention, recharging, detention or controlling the flow of on-site stormwater runoff.

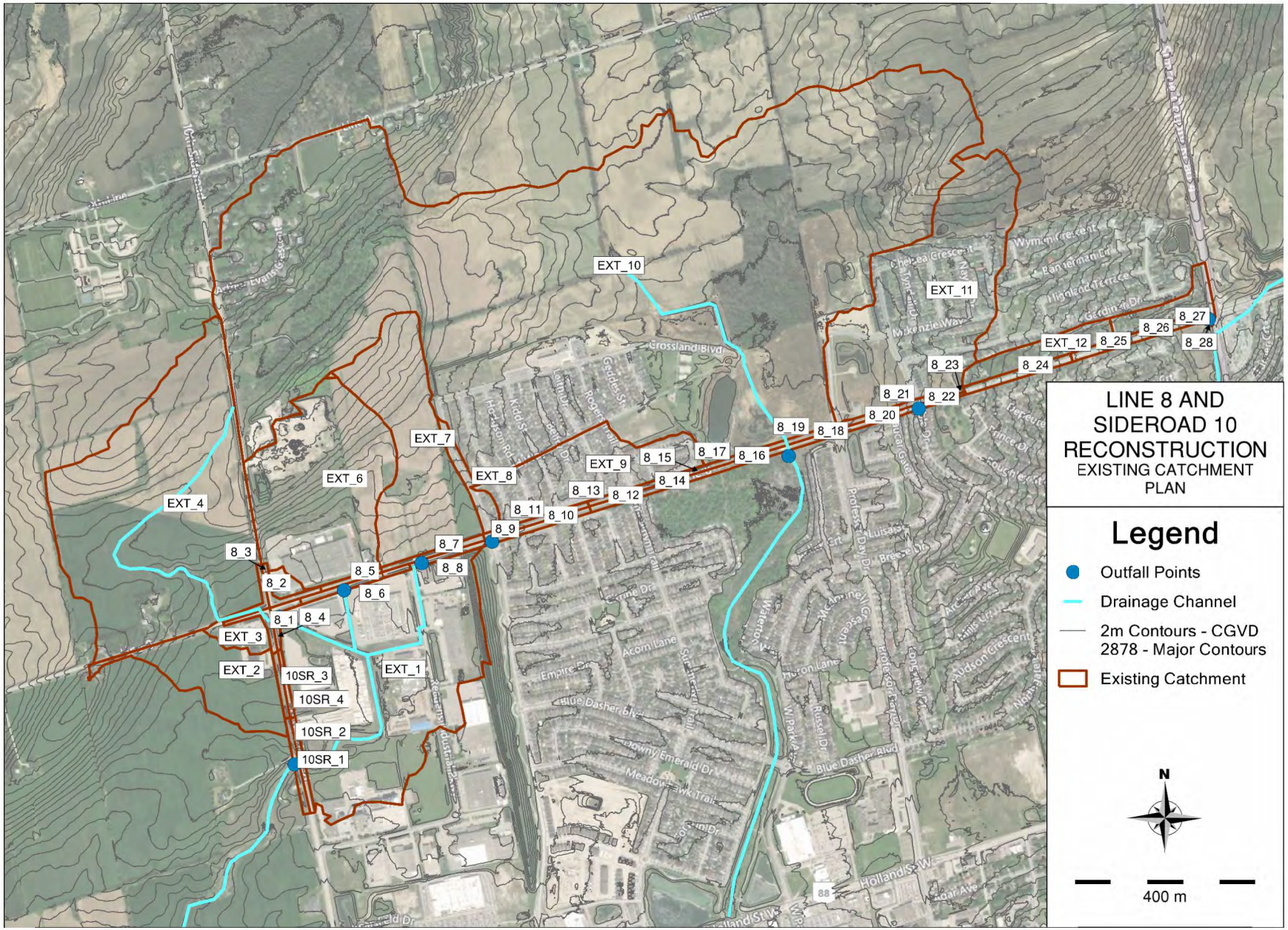
CHAMBER PARAMETERS

1. The chambers shall be manufactured in the U.S.A. or Canada by CULTEC, Inc. of Brookfield, CT (cultec.com, 203-775-4416).
2. The chambers shall be designed and tested in accordance with ASTM F2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers". The load configuration shall include:
    a. Instantaneous AASHTO Design Truck live load at minimum cover
    b. Maximum permanent (50-year) cover load
    c. 1-week parked AASHTO design truck load
3. The chambers shall meet the requirements of ASTM F3430-20 "Standard Specification for Cellular Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers".
4. The installed chamber system shall provide resistance to the loads and load factors as defined in the AASHTO LRFD Bridge Design Specifications Section 12.12, when installed according to CULTEC's recommended installation instructions. The structural design of the chambers shall include the following:
    a. The Creep Modulus shall be 50-year as specified in ASTM F3430
    b. The minimum safety factor for live loads shall be 1.75
    c. The minimum safety factor for dead loads shall be 1.95
5. The chamber shall be structural foam injection molded of blue virgin high molecular weight impact-modified polypropylene.
6. The chamber shall be arched in shape.
7. The chamber shall be open-bottomed.
8. The chamber shall be joined using an interlocking overlapping rib method. Connections must be fully shouldered overlapping ribs, having no separate couplings.
9. The nominal chamber dimensions of the CULTEC Recharger® 360HD shall be 36 inches (915 mm) tall, 60 inches (1525 mm) wide and 50 inches (1275 m) long. The installed length of a joined Recharger 360HD shall be 3.67 feet (1.12 m).
10. Multiple chambers may be connected to form different length rows. Each row shall begin and end with a separately formed CULTEC Recharger® 360HD End Cap. Maximum inlet opening on the end cap is 24 inches (600 mm) HDPE or 30 inches (750 mm) PVC.
11. The chamber shall have two side portals to accept CULTEC HVLV™ FC-48 Feed Connectors to create an internal manifold. Maximum allowable pipe size in the side portal is 10 inches (250 mm) HDPE or 12 inches (300 mm) PVC.
12. The nominal chamber dimensions of the CULTEC HVLV™ FC-48 Feed Connector shall be 12 inches (305 mm) tall, 16 inches (406 mm) wide and 49 inches (1245 mm) long.
13. The nominal storage volume of the Recharger 360HD chamber shall be 10.0 ft^3 / ft (0.928 m^3 / m) - without stone.
    The nominal storage volume of a joined Recharger 360HD shall be 36.66 ft^3 / unit (1.038 m^3 / unit) - without stone.
14. The nominal storage volume of the HVLV™ FC-48 Feed Connector shall be 0.913 ft^3 / ft (0.085 m^3 / m) - without stone.
15. The Recharger 360HD chamber shall have 7 corrugations.
16. The chamber shall be manufactured in a facility employing CULTEC's Quality Control and Assurance Procedures.
17. Maximum allowable cover over the top of the chamber shall be 12 feet (3.66 m).

END CAP PARAMETERS

1. The CULTEC Recharger® 360HD End Cap (referred to as 'end cap') shall be manufactured in the U.S.A. or Canada by CULTEC, Inc. of Brookfield, CT (cultec.com, 203-775-4416).
2. The end cap shall be structural foam injection molded of blue virgin high molecular weight impact-modified polypropylene.
3. The end cap shall be arched in shape.
4. The end cap shall be open-bottomed.
5. The end cap shall be joined at the beginning and end of each row of chambers using an interlocking overlapping rib method. Connections must be fully shouldered overlapping ribs, having no separate couplings.
6. The end cap shall have 5 corrugations.
7. The nominal dimensions of the end cap shall be 36.5 inches (927 mm) tall, 60 inches (1525 mm) wide and 18 inches (458 mm) long. When joined with a Recharger 360HD Chamber, the installed length of the end cap shall be 15 inches (381 mm).
8. The nominal storage volume of the end cap shall be 5.17 ft^3 / ft (0.48 m^3 / m) - without stone. The nominal storage volume of an interlocked end cap shall be 6.46 ft^3 / unit (0.183 m^3 / unit) - without stone.
9. Maximum inlet opening on the end cap is 24 inches (600 mm) HDPE or 30 inches (750 mm) PVC.
10. The end cap shall be manufactured in a facility employing CULTEC's Quality Control and Assurance Procedures.
11. The end cap shall provide resistance to the loads and load factors as defined in the AASHTO LRFD Bridge Design Specifications Section 12.12.

Appendix B: Project Drainage Map


LINE 8 AND SIDEROAD 10 RECONSTRUCTION
EXISTING CATCHMENT PLAN
Legend
Outfall Points
Drainage Channel
2m Contours - CGVD 2878 - Major Contours
Existing Catchment
N
400 m
EXT_1
EXT_2
EXT_3
EXT_4
EXT_6
EXT_7
EXT_8
EXT_9
EXT_10
EXT_11
EXT_12
8_1
8_2
8_3
8_4
8_5
8_6
8_7
8_8
8_9
8_10
8_11
8_12
8_13
8_14
8_15
8_16
8_17
8_18
8_19
8_20
8_21
8_22
8_23
8_24
8_25
8_26
8_27
8_28
10SR_1
10SR_2
10SR_3
10SR_4
Grossland Blvd
Blue Dasher Blvd
Holland St W

Appendix C: PCSWMM Input Parameters and Results

Project Name	Line 8 and 10 Sideroad Reconstruction
Project No:	66054
Completed by:	N. Connell, P.Eng
Date:	19-Apr-24

Existing Catchment Input Data

Name	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	Curve Number
10SR_1	0.57	40.9	139.8	14.7	37	88
10SR_2	0.51	37.3	137.1	15.9	37	88
10SR_3	0.38	19.4	193.2	10.9	37	88
10SR_4	0.30	15.0	198.5	11.1	37	88
8_1	0.47	45.4	104.1	9.9	43	88
8_10	0.60	19.7	303.8	12.3	37	87
8_11	0.53	18.7	284.7	15.4	37	87
8_12	0.23	20.1	113.6	12.1	37	87
8_13	0.18	18.3	95.9	20.2	37	87
8_14	0.36	19.6	181.8	9.2	37	87
8_15	0.34	18.4	186.0	13.5	37	87
8_16	0.62	28.9	216.0	10.3	37	87
8_17	0.59	27.9	210.4	13.4	37	87
8_18	0.28	19.4	142.6	12.5	37	87
8_19	0.29	19.6	146.0	10.5	37	87
8_2	0.45	35.6	126.7	13.8	43	89
8_20	0.28	19.5	142.3	6.7	37	86
8_21	0.55	20.9	263.0	9.8	41	86
8_22	0.35	43.2	80.9	7.6	55	91
8_23	0.17	17.2	98.7	7.8	55	91
8_24	0.93	26.9	345.9	9.4	52	89
8_25	0.46	27.5	167.9	7.8	52	89
8_26	0.32	31.2	101.5	15.6	45	88
8_27	0.36	30.6	117.6	12.4	45	88
8_28	0.19	74.7	26.1	9.5	45	88
8_3	0.52	41.6	125.1	12.0	43	89
8_4	0.44	46.6	93.3	9.2	43	89
8_5	0.32	21.3	148.1	10.6	43	89
8_6	0.51	30.7	166.2	12.1	43	89
8_7	0.61	29.3	208.9	10.7	53	90
8_8	0.61	23.7	256.5	10.9	53	90
8_9	0.16	105.7	15.4	4.7	87	88
EXT_1	36.81	775.9	474.4	4.0	60	91
EXT_10	186.12	1006.8	1848.6	2.2	10	82
EXT_11	28.30	269.2	1051.5	1.8	43	81
EXT_12	3.28	410.2	79.9	4.4	30	85
EXT_13	2.55	293.8	86.7	4.4	30	85
EXT_2	8.61	324.2	265.7	1.4	16	83
EXT_3	1.57	93.6	168.0	1.8	16	82
EXT_4	44.05	473.4	930.6	2.5	5	79
EXT_5	0.70	62.6	111.4	0.5	16	80
EXT_6	22.20	386.3	574.6	4.9	30	87
EXT_7	16.80	272.0	617.8	3.5	0	82
EXT_8	1.51	403.3	37.6	2.1	45.3	85
EXT_9	11.05	468.8	235.7	0.9	70	95

Project Name	Line 8 and 10 Sideroad Reconstruction
Project No:	66054
Completed by:	N. Connell, P.Eng
Date:	19-Apr-24

Existing vs Proposed Catchment Areas

Existing ID	Proposed ID	Existing Area (ha)	Proposed Area (ha)	Existing % Impervious	Proposed % Impervious	Existing Impervious Area	Proposed Impervious Area (12.5 mm storm)
10SR_1	10SR_1	0.57	0.57	37	38	0.21	0.22
10SR_2	10SR_2_1	0.51	0.28	37	72	0.19	0.20
	10SR_2_2		0.23		0	0.00	0.00
10SR_3	10SR_3	0.38	0.38	37	38	0.14	0.14
10SR_4	10SR_4	0.30	0.30	37	38	0.11	0.11
8_1	8_1	0.47	0.47	43	50	0.20	0.24
8_2	8_2	0.45	0.45	43	50	0.19	0.23
8_3	8_3_1	0.52	0.19	43	50	0.22	0.09
	8_3_2		0.33		50	0.00	0.17
8_4	8_4	0.44	0.44	43	50	0.19	0.22
8_5	8_5	0.32	0.32	43	50	0.14	0.16
8_6	8_6	0.51	0.51	43	50	0.22	0.25
8_7	8_7	0.61	0.60	53	55	0.32	0.33
8_8	8_8	0.61	0.60	53	55	0.32	0.33
8_9	8_9	0.16	0.15	87	90	0.14	0.13
8_10	8_10_1	0.60	0.14	37	38	0.22	0.05
	8_10_2		0.46		38	0.00	0.17
8_11	8_11_1	0.53	0.13	37	38	0.20	0.05
	8_11_2		0.42		38	0.00	0.16
8_12	8_12	0.23	0.15	37	38	0.08	0.06
8_13	8_13	0.18	0.13	37	38	0.07	0.05
8_14	8_14	0.36	0.26	37	38	0.13	0.10
8_15	8_15	0.34	0.23	37	38	0.13	0.09
8_16	8_16	0.62	0.81	37	38	0.23	0.31
8_17	8_17	0.59	0.76	37	38	0.22	0.29
8_18	8_18	0.28	0.29	37	38	0.10	0.11
8_19	8_19	0.29	0.31	37	38	0.11	0.12
8_20	8_20	0.28	0.26	37	38	0.10	0.10
8_21	8_21	0.55	0.35	41	38	0.22	0.13
8_23	8_23	0.17	0.30	55	62	0.09	0.19
8_22	8_22	0.35	0.35	55	81	0.19	0.28
8_24	8_24	0.93	0.93	52	62	0.48	0.58
8_25	8_25	0.46	0.46	52	62	0.24	0.29
8_26	8_26	0.32	0.32	45	69	0.14	0.22
8_27	8_27	0.36	0.36	45	69	0.16	0.25
8_28	8_28	0.19	0.19	45	69	0.09	0.13

Project Name	Line 8 and 10 Sideroad Reconstruction
Project No:	66054
Completed by:	N. Connell, P.Eng
Date:	19-Apr-24

Existing PCSWMM Output Results

Name	Area (ha)	OF	Peak Runoff (m^3/s)					
			2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
10SR_1	0.57	1	0.05	0.09	0.12	0.15	0.18	0.21
10SR_2	0.51	1	0.05	0.08	0.11	0.14	0.16	0.19
10SR_3	0.38	1	0.03	0.05	0.07	0.09	0.11	0.12
10SR_4	0.30	1	0.03	0.04	0.05	0.07	0.08	0.1
8_1	0.47	2	0.05	0.08	0.11	0.14	0.16	0.18
8_10	0.60	6	0.02	0.04	0.05	0.07	0.08	0.1
8_11	0.53	6	0.03	0.04	0.05	0.07	0.08	0.1
8_12	0.23	6	0.05	0.08	0.1	0.13	0.16	0.18
8_13	0.18	6	0.02	0.04	0.05	0.06	0.08	0.09
8_14	0.36	6	0.05	0.08	0.09	0.12	0.14	0.17
8_15	0.34	6	0.05	0.08	0.1	0.12	0.14	0.15
8_16	0.62	6	0.02	0.04	0.05	0.06	0.07	0.07
8_17	0.59	6	0.11	0.16	0.2	0.25	0.28	0.32
8_18	0.28	6	0.06	0.09	0.11	0.14	0.16	0.18
8_19	0.29	6	0.04	0.06	0.08	0.1	0.11	0.13
8_2	0.45	2	0.05	0.08	0.1	0.13	0.15	0.17
8_20	0.28	6	0.04	0.06	0.08	0.11	0.12	0.14
8_21	0.55	6	0.03	0.04	0.05	0.07	0.07	0.08
8_22	0.35	7	0.05	0.08	0.1	0.13	0.15	0.17
8_23	0.17	6	0.06	0.09	0.12	0.15	0.18	0.2
8_24	0.93	8	0.03	0.05	0.07	0.09	0.1	0.12
8_25	0.46	8	0.05	0.09	0.11	0.14	0.17	0.19
8_26	0.32	8	0.08	0.12	0.15	0.18	0.21	0.24
8_27	0.36	8	0.08	0.11	0.14	0.18	0.2	0.23
8_28	0.19	8	0.03	0.05	0.05	0.06	0.07	0.08
8_3	0.52	2	0.05	0.07	0.09	0.12	0.14	0.16
8_4	0.44	2	0.02	0.04	0.05	0.06	0.07	0.08
8_5	0.32	3	0.02	0.03	0.04	0.05	0.06	0.07
8_6	0.51	3	0.03	0.05	0.06	0.08	0.1	0.11
8_7	0.61	4	0.03	0.05	0.06	0.08	0.1	0.11
8_8	0.61	4	0.05	0.08	0.11	0.14	0.17	0.19
8_9	0.16	5	0.05	0.08	0.1	0.14	0.16	0.19

Project Name	Line 8 and 10 Sideroad Reconstruction
Project No:	66054
Completed by:	N. Connell, P.Eng
Date:	19-Apr-24

Proposed Uncontrolled PCSWMM Output Results

Name	Area (ha)	OF	Peak Runoff (m^3/s)					
			2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
10SR_1	0.57	1	0.04	0.06	0.08	0.09	0.11	0.12
10SR_2_1	0.28	1	0.05	0.07	0.08	0.1	0.11	0.13
10SR_2_2	0.23	1	0	0.01	0.02	0.03	0.04	0.05
10SR_3	0.38	1	0.03	0.05	0.06	0.07	0.09	0.1
10SR_4	0.30	1	0.02	0.04	0.04	0.06	0.07	0.08
8_1	0.47	2	0.06	0.1	0.12	0.15	0.17	0.2
8_10_1	0.14	6	0.01	0.02	0.03	0.03	0.04	0.05
8_10_2	0.46	6	0.04	0.06	0.08	0.11	0.13	0.15
8_11_1	0.13	6	0.01	0.02	0.02	0.03	0.04	0.04
8_11_2	0.42	6	0.04	0.06	0.07	0.1	0.12	0.13
8_12	0.15	6	0.01	0.02	0.03	0.03	0.04	0.05
8_13	0.13	6	0.01	0.02	0.02	0.03	0.04	0.04
8_14	0.26	6	0.02	0.04	0.05	0.06	0.07	0.08
8_15	0.23	6	0.02	0.03	0.04	0.05	0.06	0.07
8_16	0.81	6	0.08	0.14	0.19	0.24	0.28	0.32
8_17	0.76	6	0.08	0.14	0.18	0.23	0.27	0.3
8_18	0.29	6	0.03	0.04	0.05	0.06	0.08	0.09
8_19	0.31	6	0.03	0.04	0.05	0.07	0.08	0.1
8_2	0.45	2	0.06	0.09	0.12	0.15	0.17	0.19
8_20	0.26	6	0.02	0.04	0.05	0.07	0.08	0.09
8_21	0.35	6	0.03	0.05	0.07	0.09	0.11	0.13
8_22	0.35	7	0.07	0.09	0.11	0.13	0.15	0.16
8_23	0.30	6	0.05	0.07	0.09	0.1	0.12	0.13
8_24	0.93	8	0.15	0.22	0.27	0.33	0.37	0.42
8_25	0.46	8	0.07	0.11	0.13	0.16	0.18	0.2
8_26	0.32	8	0.06	0.08	0.1	0.12	0.13	0.15
8_27	0.36	8	0.06	0.09	0.11	0.13	0.15	0.17
8_28	0.19	8	0.03	0.05	0.06	0.07	0.08	0.09
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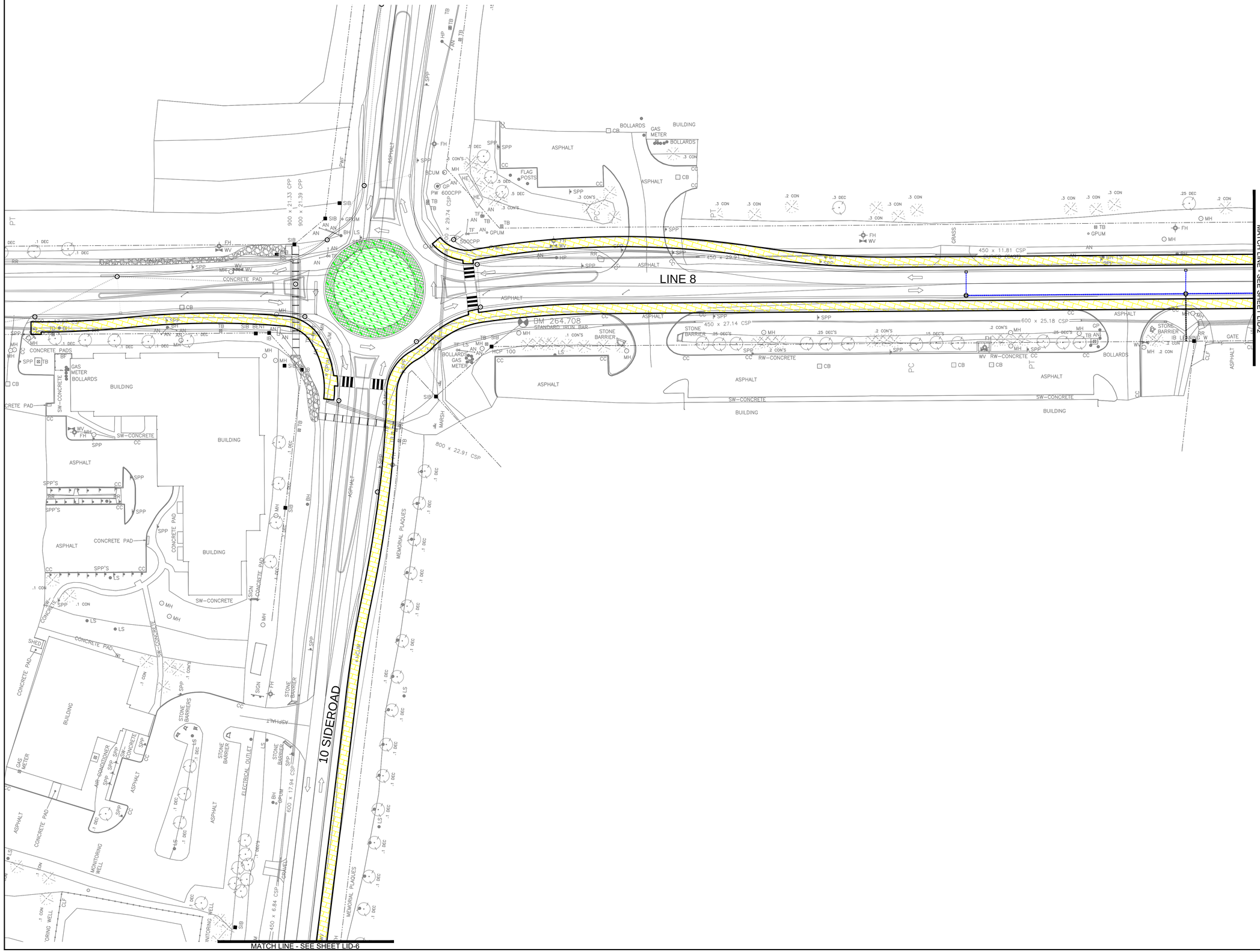
8_3_2	0.33	2	0.04	0.07	0.08	0.1	0.12	0.14
8_4	0.44	2	0.05	0.08	0.1	0.13	0.15	0.17
8_5	0.32	3	0.04	0.06	0.07	0.09	0.1	0.12
8_6	0.51	3	0.05	0.08	0.09	0.12	0.13	0.15
8_7	0.60	4	0.09	0.14	0.17	0.21	0.24	0.26
8_8	0.60	4	0.08	0.13	0.16	0.2	0.23	0.26
8_9	0.15	5	0.03	0.04	0.05	0.06	0.06	0.07

Appendix D: LID Conceptual Layout Figures



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LINE 8 BRADFORD - WEST GWILLIMBURY

PRELIMINARY LID LAYOUT PLAN

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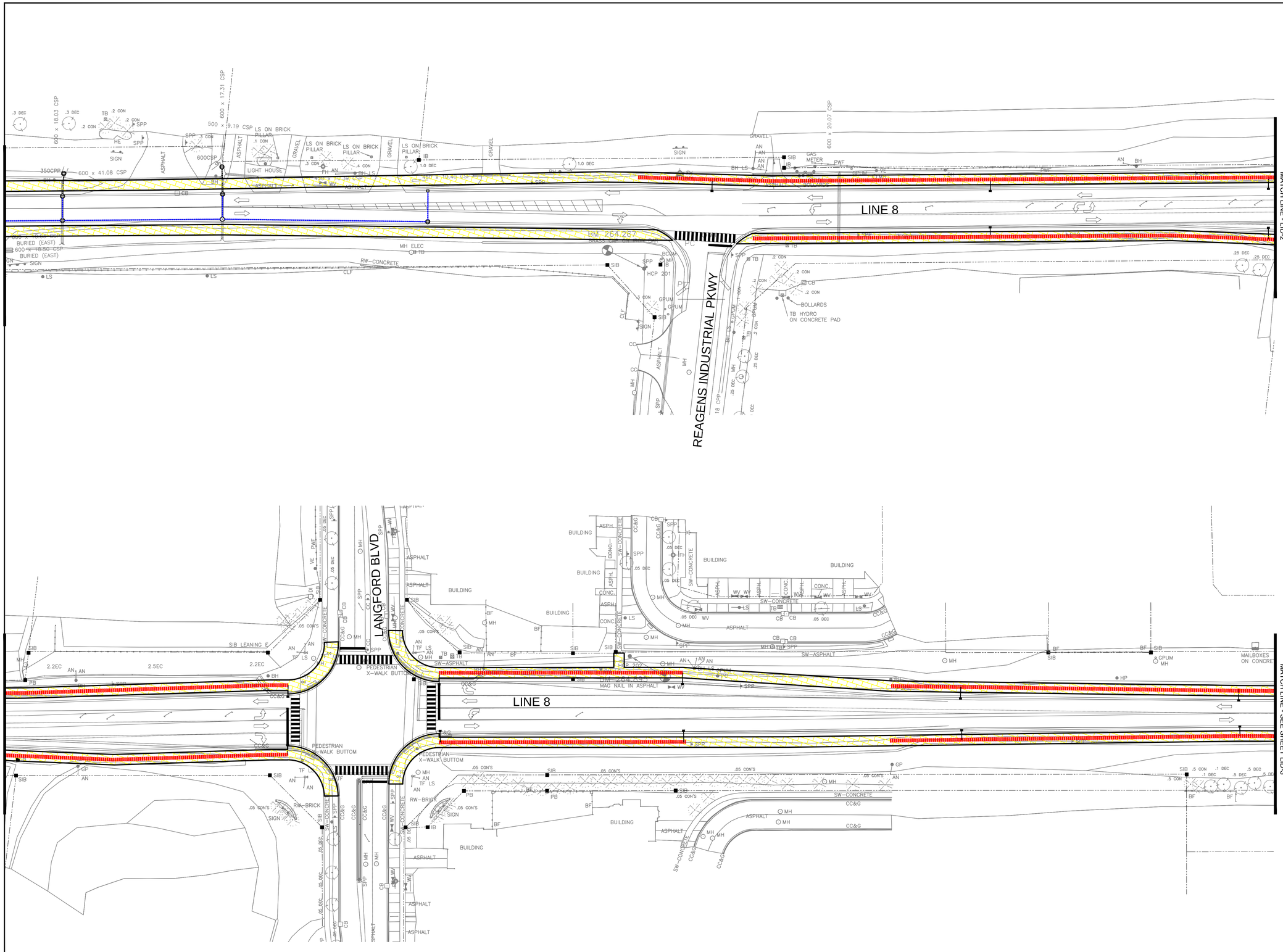

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LINE 8 BRADFORD - WEST GWILLIMBURY

PRELIMINARY LID LAYOUT PLAN

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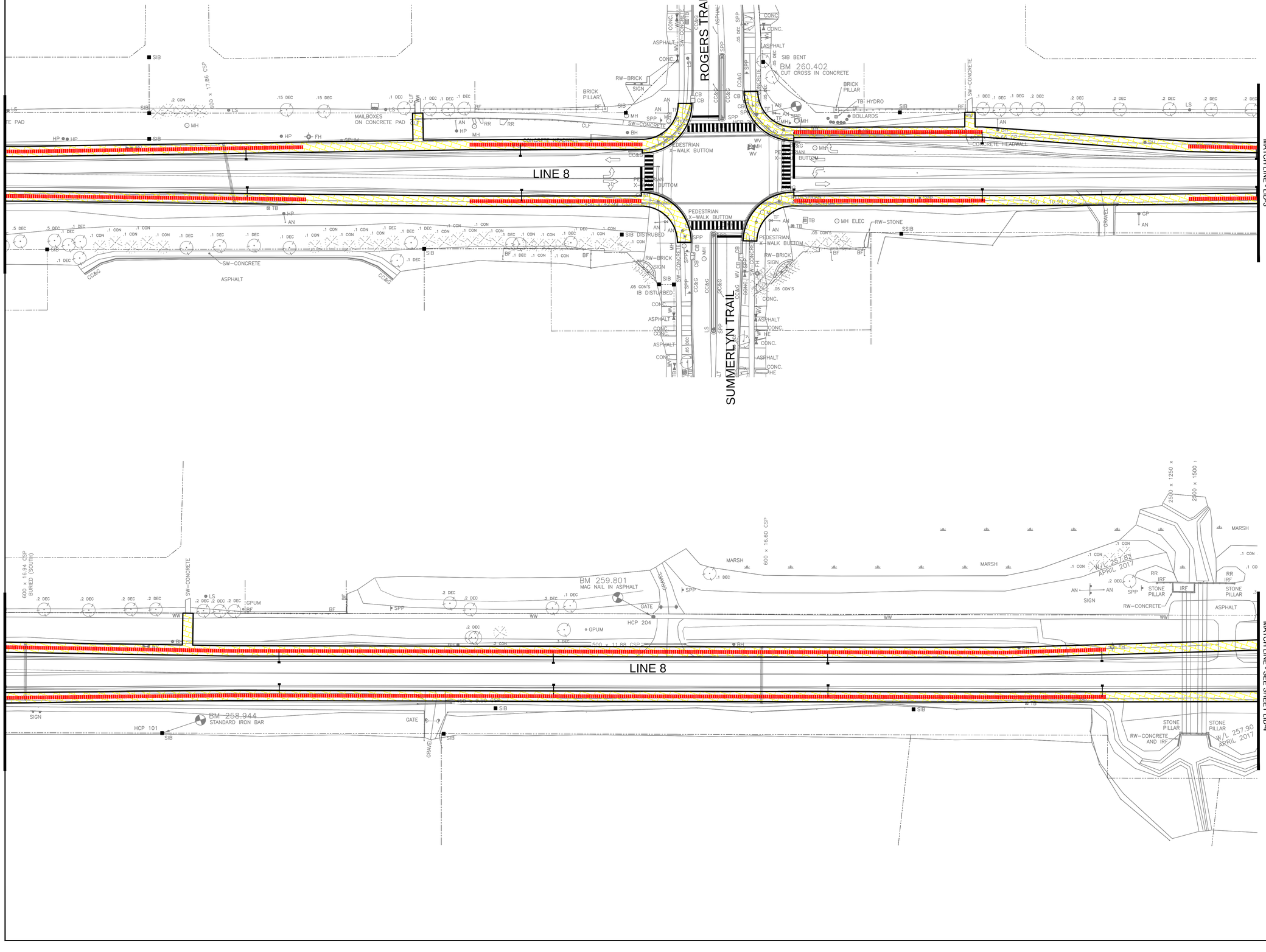

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LINE 8 BRADFORD - WEST GWILLIMBURY

PRELIMINARY LID LAYOUT PLAN

DESIGNED BY:	APPROVED BY:	DRAWN BY: YL
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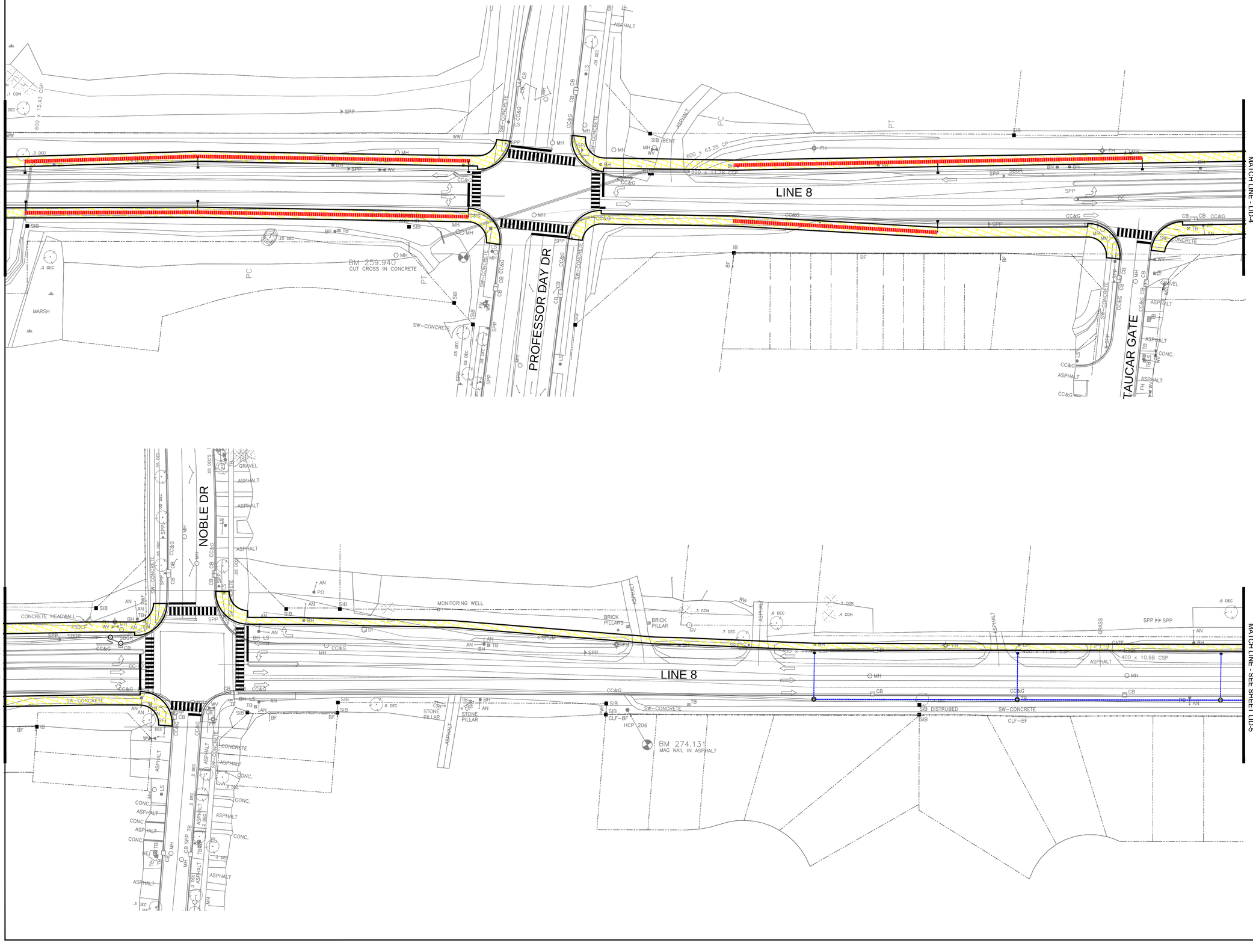
		SCALE: **1:500**
		SHEET No. **3**
		DWG. No. **LID-3**



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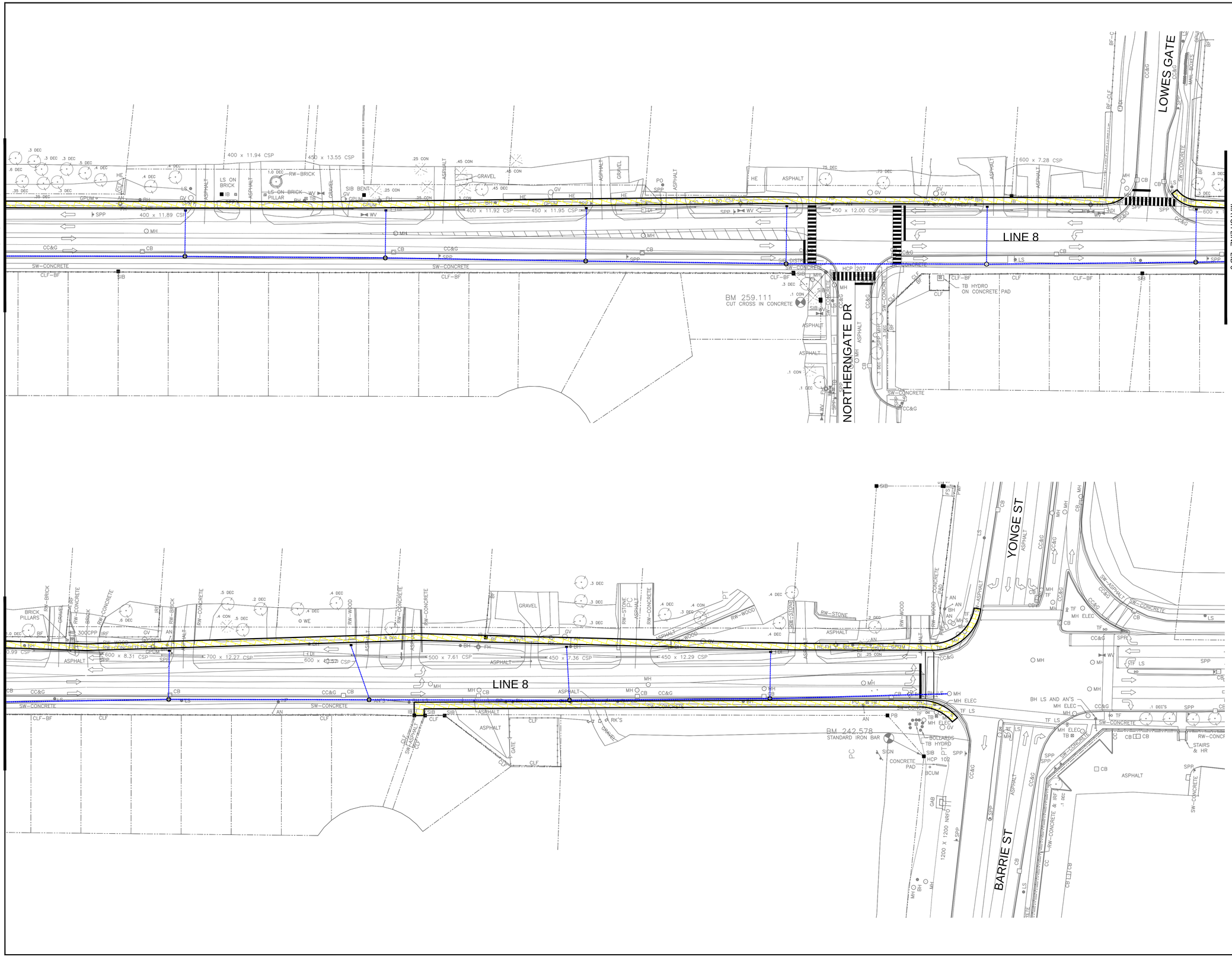

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8. ALL SITE RESTORATION TO BE IN ACCORDANCE WITH THE LANDSCAPE PLANS AND DETAILS.
9. THE CONTRACTOR IS TO PROVIDE TOWN OF NEWMARKET WITH 7 DAYS ADVANCE NOTICE PRIOR TO INITIATION OF CONSTRUCTION.
10. THE CONTRACTOR IS RESPONSIBLE FOR REMOVAL AND DISPOSAL OF ALL DEBRIS.
11. ALL SEDIMENTS AND EROSION CONTROL MEASURES SHALL BE INSPECTED DAILY TO ENSURE THAT THEY ARE FUNCTIONING PROPERLY AND ARE MAINTAINED AND/OR UPGRADED AS REQUIRED

ISSUED FOR REVIEW	JM	04/28/25
REVISION	BY	MM/DD/YY

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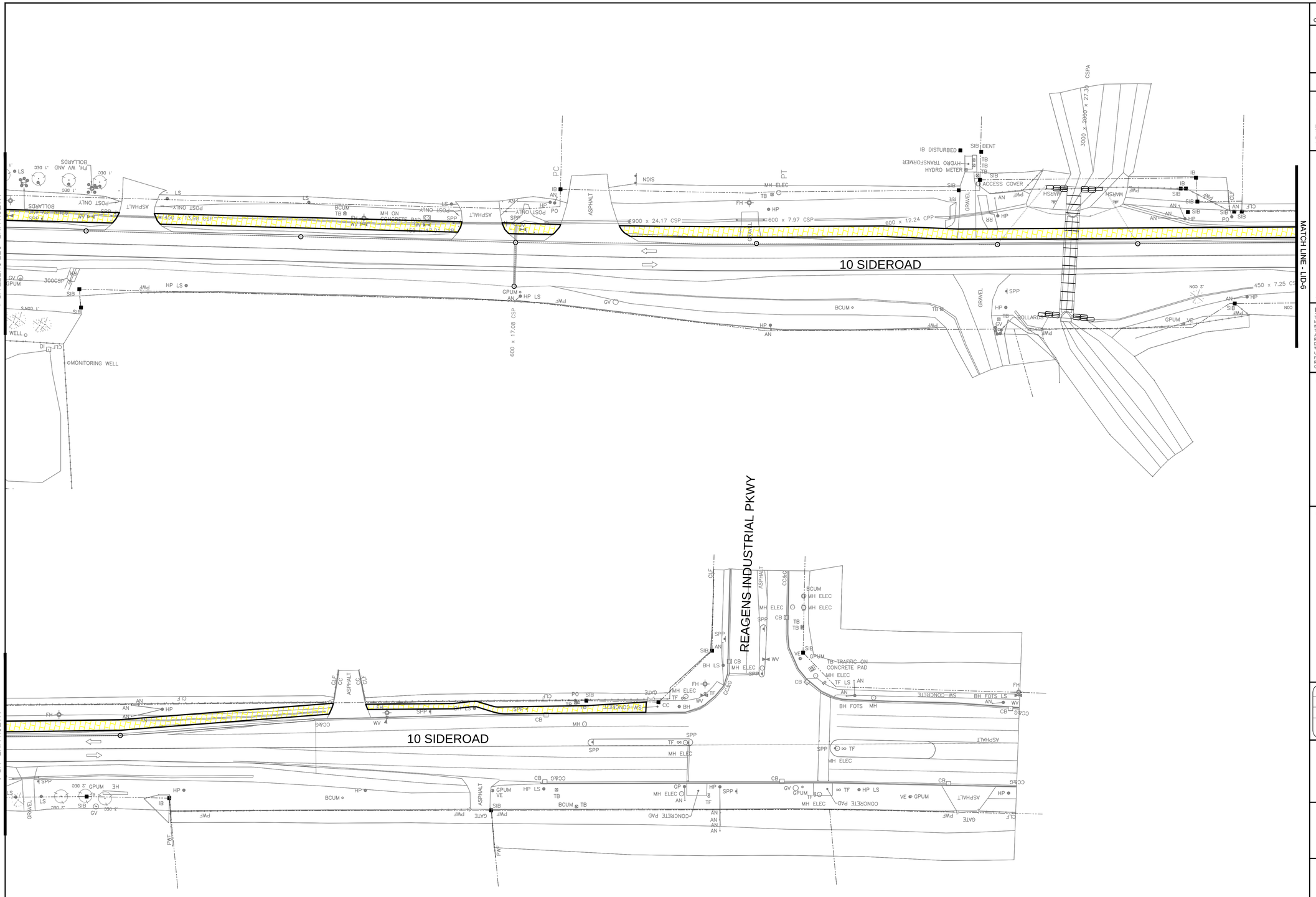
LINE 8 BRADFORD - WEST GWILLIMBURY

PRELIMINARY LID LAYOUT PLAN

DESIGNED BY:	APPROVED BY:	DRAWN BY: YL
		DATE: (MM.DD.YY) 04.28.25
		SCALE: 1:500
		SHEET No. 5
		DWG. No. LID-5



construction NORTH

true NORTH

THE POSITION OF THE POLE LINES, CONDUITS, WATERMAINS, SEWERS, AND OTHER UTILITIES AND STRUCTURES ARE N O T NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK

THE CONTRACTOR SHALL CONFIRM THE POSITION AND EXACT LOCATION OF ALL SUCH UTILITIES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE TO THEM MADE DURING THE COURSE OF THE CONTRACT WORK.

KEY PLAN

DISCLAIMER

THESE DRAWINGS WERE PREPARED BY AQUAFOR BEECH LTD FOR THE ACCOUNT OF THE TOWN OF NEWMARKET. THE MATERIAL CONTAINED HEREIN REFLECTS AQUAFOR BEECH LTD BEST JUDGEMENT IN LIGHT OF THE INFORMATION AVAILABLE TO IT AT THE TIME OF PREPARATION. ANY USE WHICH A THIRD PARTY MAKES OF THESE DRAWINGS, OR ANY RELIANCE ON OR DECISION TO BE MADE ON IT, ARE THE RESPONSIBILITY OF SUCH THIRD PARTIES. AQUAFOR BEECH LTD ACCEPTS NO RESPONSIBILITY FOR DAMAGES, IF ANY, SUFFERED BY ANY THIRD PARTY AS A RESULT OF DECISIONS MADE OR ACTIONS BASED ON THESE DRAWINGS. THIRD PARTY USE OF THESE DRAWINGS WITHOUT THE WRITTEN CONSENT OF AQUAFOR BEECH LTD IS STRICTLY PROHIBITED. THE INTENDED USE OF THESE DRAWINGS ARE STRICTLY LIMITED TO THE PURPOSE AS LISTED WITHIN THE "ISSUED FOR" AND "REVISION" TITLE BLOCK OF THESE DRAWINGS. AQUAFOR BEECH LTD ACCEPTS NO RESPONSIBILITY FOR DAMAGES, IF ANY, SUFFERED AS A RESULT OF THE USE OF THESE DRAWINGS OUTSIDE THE INTENDED USE AND AFOREMENTIONED LIMITATIONS.

LEGEND

- BIORETENTION CELL/ UNDERGROUND STORAGE
- PERMEABLE PAVEMENT
- INFILTRATION/FILTRATION CHAMBER
- PERFORATED PIPE/ ETOBICOKE EXFILTRATION SYSTEM

GENERAL NOTES

1. THIS SET OF DRAWINGS TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT.
2. ALL ELEVATIONS ARE IN METRES AND REFERENCED TO LOCAL DATUM. ALL DIMENSIONS ARE IN METRIC UNITS.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LAYOUT AND SURVEY CONTROL DURING CONSTRUCTION.
4. THE CONTRACTOR IS RESPONSIBLE FOR LOCATION OF ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION.
5. THE CONTRACTOR SHALL DELINEATE THE REQUIRED WORKING AREA ON-SITE PRIOR TO THE START OF WORK AND SHALL CONFINE OPERATIONS WITHIN THE DEFINED AREA. ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE OR OTHER DELETERIOUS SUBSTANCES INTO ANY WATER/WATERCOURSE/WETLAND NATURAL FEATURE, STORM SEWER OR SANITARY SEWER.
6. EROSION AND SEDIMENT CONTROL MEASURES (AND TREE/SHRUB PROTECTION BARRIERS) WILL BE IMPLEMENTED PRIOR TO AND MAINTAINED DURING THE CONSTRUCTION PHASES TO PREVENT ENTRY OF SEDIMENT INTO THE FACILITY. THESE EROSION AND SEDIMENT CONTROL MEASURES WILL BE REMOVED FOLLOWING CONSTRUCTION COMPLETION AND WHEN DISTURBED AREAS HAVE BEEN STABILIZED AND VEGETATION ESTABLISHED.
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PRELIMINARY LID LAYOUT PLAN

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