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Credit Valley Conservation inspired by nature

GREEN ROADS AHEAD: LOW IMPACT DEVELOPMENT FOR SUSTAINABLE STORMWATER MANAGEMENT IN YORK REGION

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SECTIONS

01 The Effects of Urbanization and Climate Change on Drainage Infrastructure

02 Best Management Practices for Drainage Infrastructure Including the Implementation of LIDs

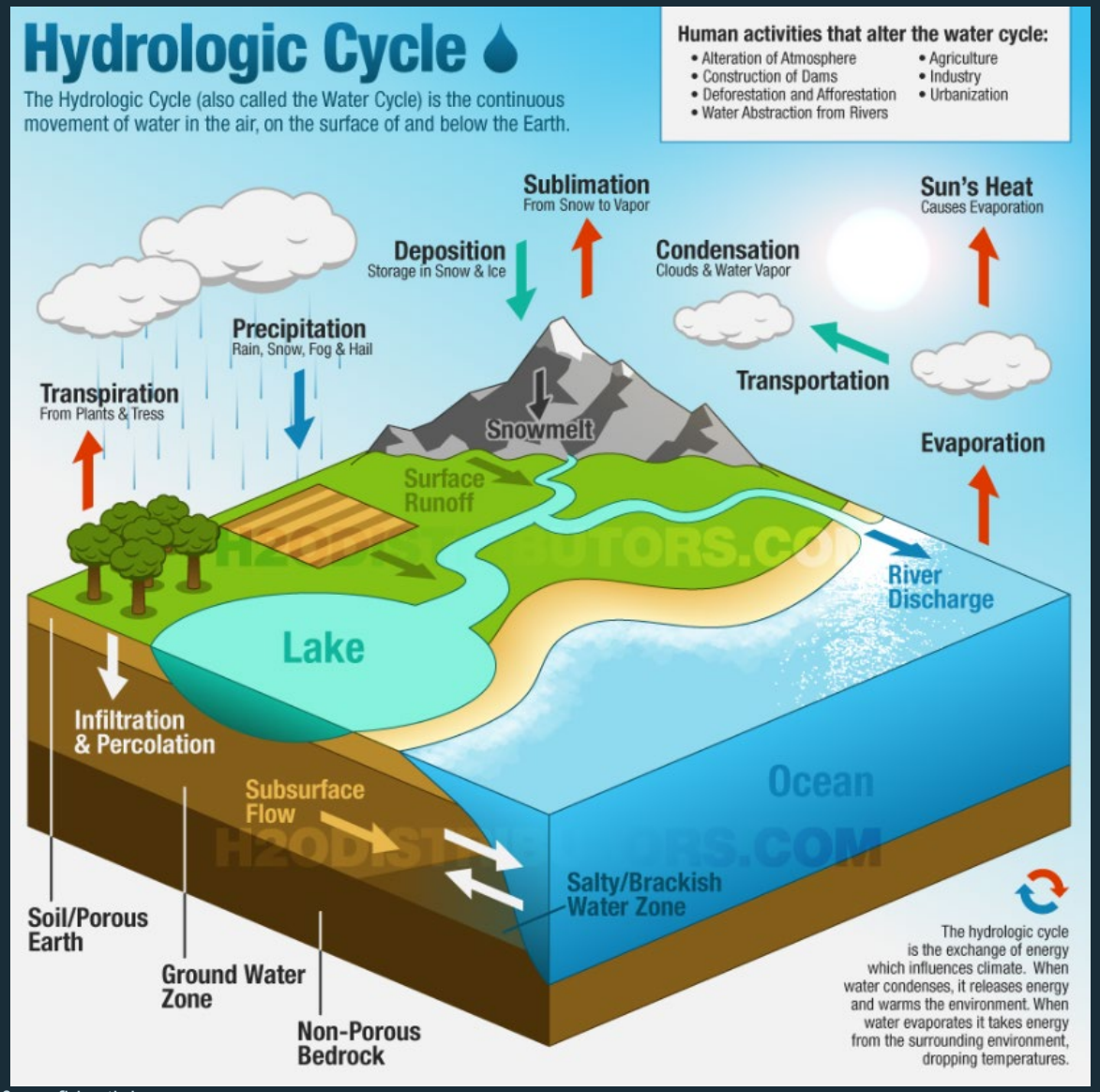
03 Government Guidelines and Requirements Related to Stormwater Management and LIDs

04 LID Implementation – Warden Avenue Road Widening Case Study

05 LID Implementation – 16th Avenue Road Widening Case Study

06 Conclusion

Urbanization Impact



Urbanization

↓

Surface runoff increases

↓

Infiltration/ evapotranspiration decreases

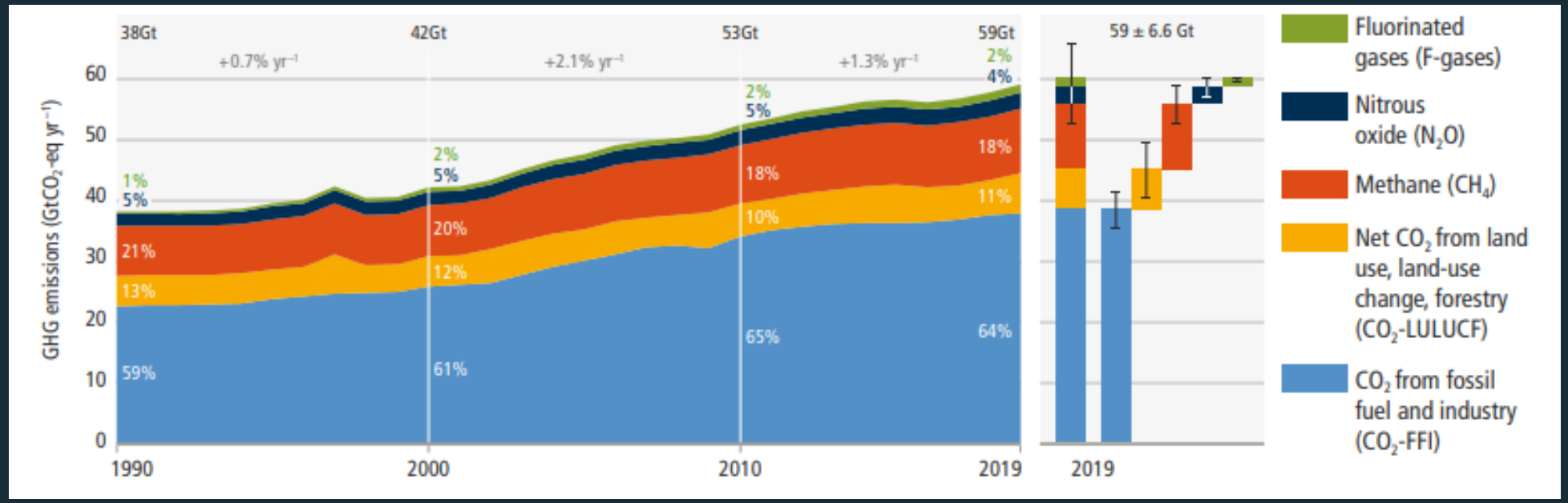
↓

Flooding, more severe erosion and sedimentation

Source from H2O Distributer, 2023 (https://www.h2odistributors.com/info/info-water-cycle/)

Climate Change Impact

- The Intergovernmental Panel on Climate Change (IPCC) issued 6th Assessment Report (AR6) in March 2023 regarding the physical science basis of climate change, the global impact of climate change and the mitigation strategies
- IPCC Key Findings: The impacts of climate change on urban infrastructure, particularly drainage systems.
- Focus on Adaptation Measures to enhance the resilience of drainage infrastructure.



Global net anthropogenic emissions have continued to rise across all major groups of greenhouse gases (Source: IPCC_AR6)

Urban Transportation Challenges

- Increased Congestion
- Vulnerability to Extreme Weather
- Urban Flooding
- Drainage Infrastructure Stress

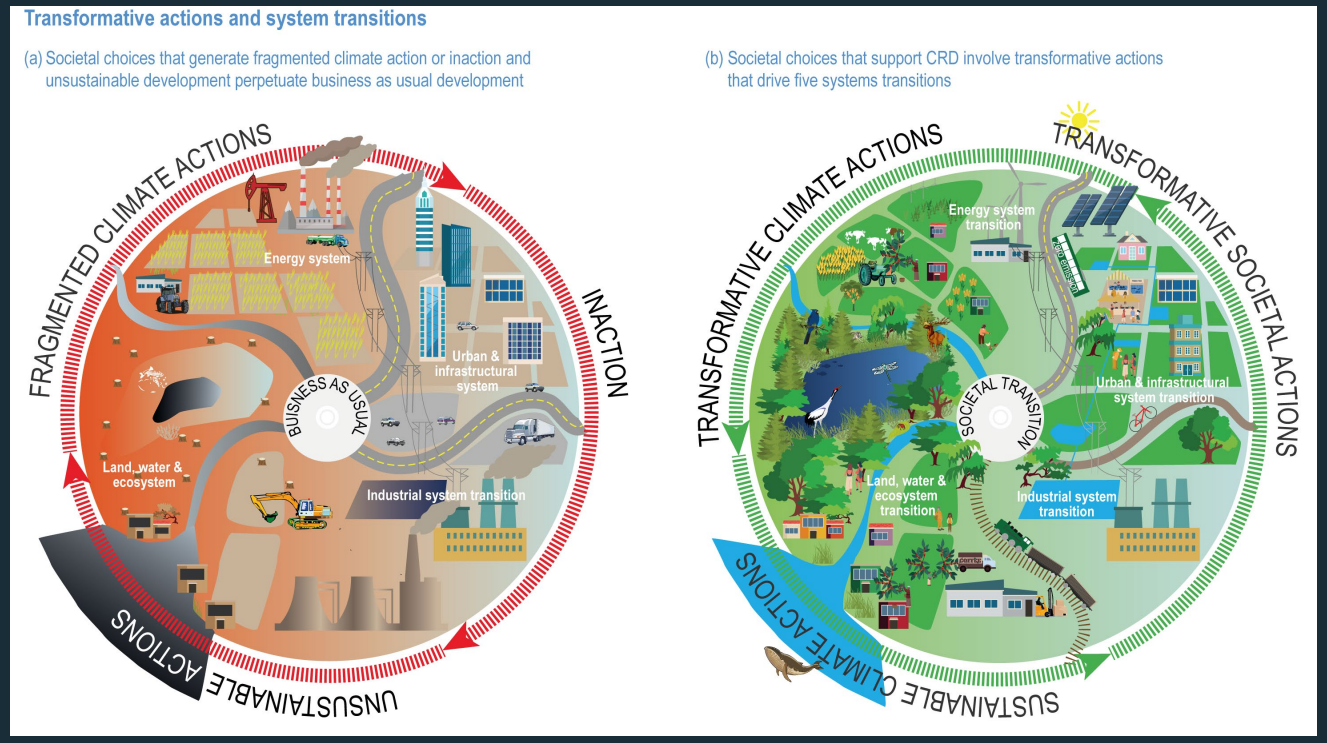
View of flooded New Orleans in the aftermath of Hurricane Katrina (Source Mark Moran/NOAA)

Finch Ave. W., west of Keele St., is seen from a helicopter in August, 2005 (Source: Toronto STAR)

Flooding in Hoboken, NJ in April 2007Credit:"Hoboken 4/16/07: (Source: Environmental Health Perspectives Volume 119, Issue 12)

Best Management Practices for Drainage Infrastructure

- Best management practices include maintenance protocols, floodplain management, and community engagement strategies.
- Adaptive Management: Importance of adaptive management approaches that allow for flexibility in responding to changing climate conditions.

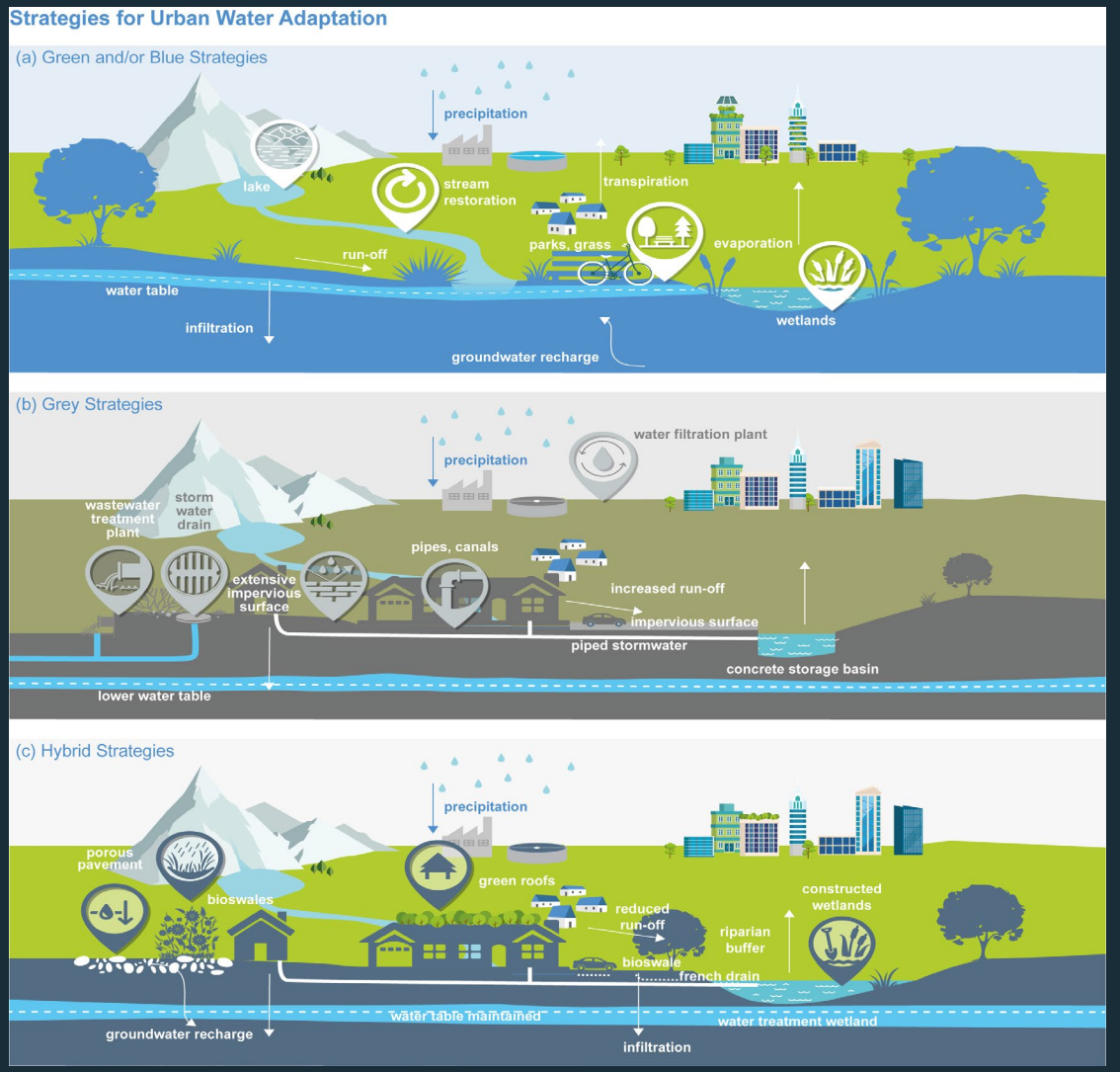


Source: IPCC Sixth Assessment Report

Urban Water Management Adaptation Responses

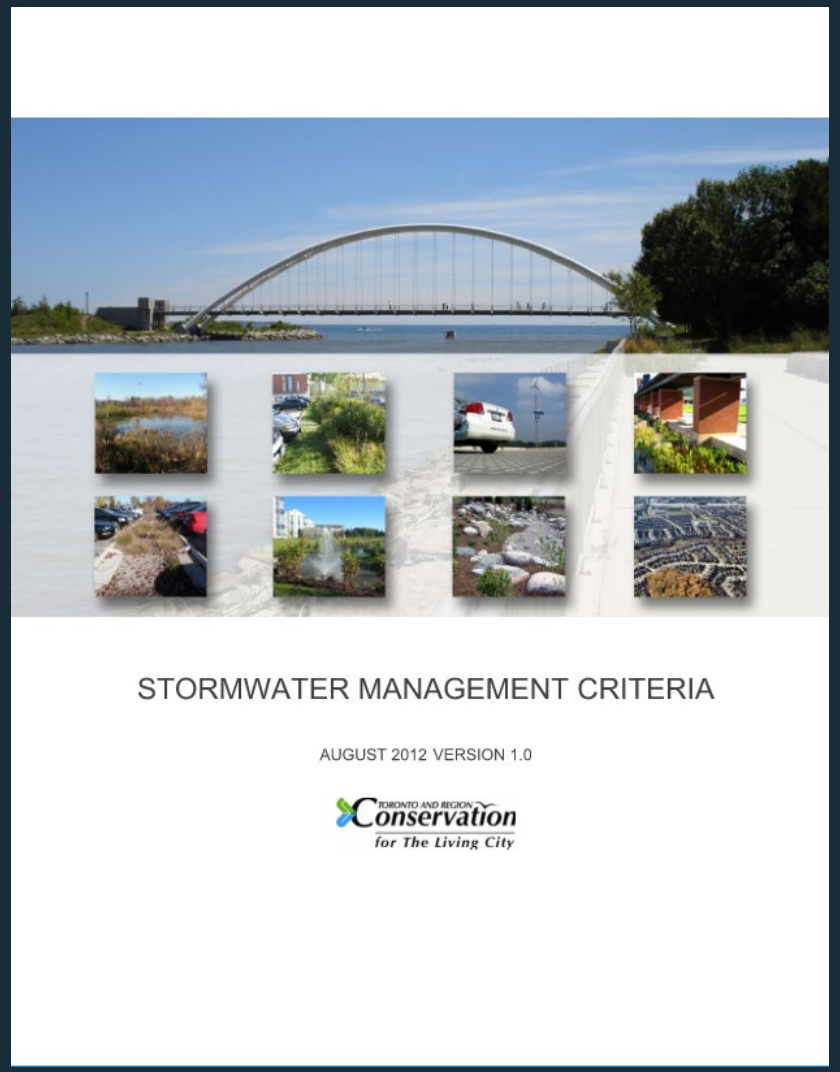
- Green Infrastructure
- Adaptive Drainage Systems
- Low-Impact Development (LID) Techniques: green roofs, permeable pavements, rain gardens, infiltration chambers, bioswales, etc
- Integration into Transportation Projects

Source: IPCC 2023



Source: IPCC 2023

Government Guidelines & Requirements



Stormwater Management Criteria from TRCA:

- **Water Quality**: Minimize stormwater contaminant loads and maintain or increase the extent of vegetative and pervious surfaces
- **Water Quantity**: Reduce stormwater peak flow runoff from developing sites
- **Water Balance**: Criteria on groundwater recharge and natural feature protection
  - e.g. post development recharge of the first 5mm for any precipitation event and maintain hydrologic regimes and hydroperiods of woodlands, wetlands, watercourses, etc

Government Guidelines & Requirements

LOW IMPACT DEVELOPMENT STORMWATER MANAGEMENT PLANNING AND DESIGN GUIDE

Version 1.0

2010

CVC CREDIT VALLEY CONSERVATION

TORONTO AND REGION Conservation for The Living City

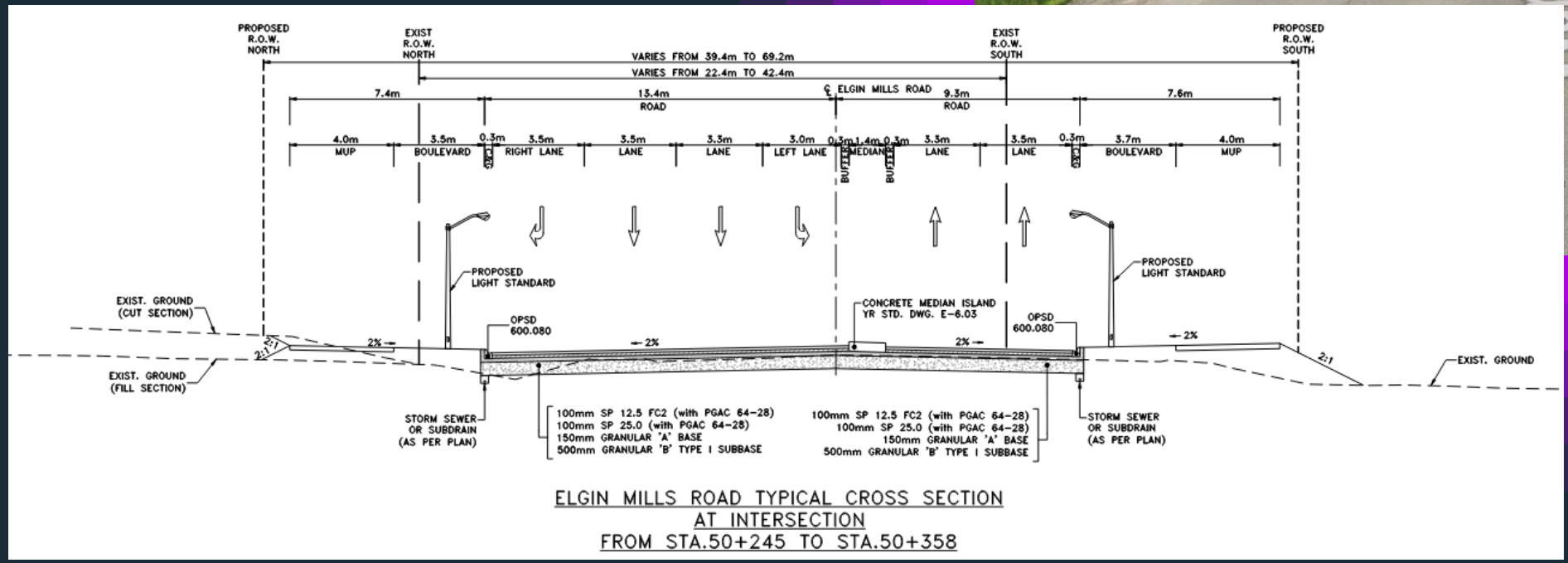
LID Design Guide from Credit Valley Conservation (CVC):

- **Introduces various types of LIDs, detailing**
  - Physical suitability and constraints
  - Typical performance
  - Design templates and layouts
  - LID sizing
  - Specifications
  - Construction considerations
  - Maintenance and construction costs

Sustainable Technologies EVALUATION PROGRAM

WARDEN AVENUE ROAD WIDENING

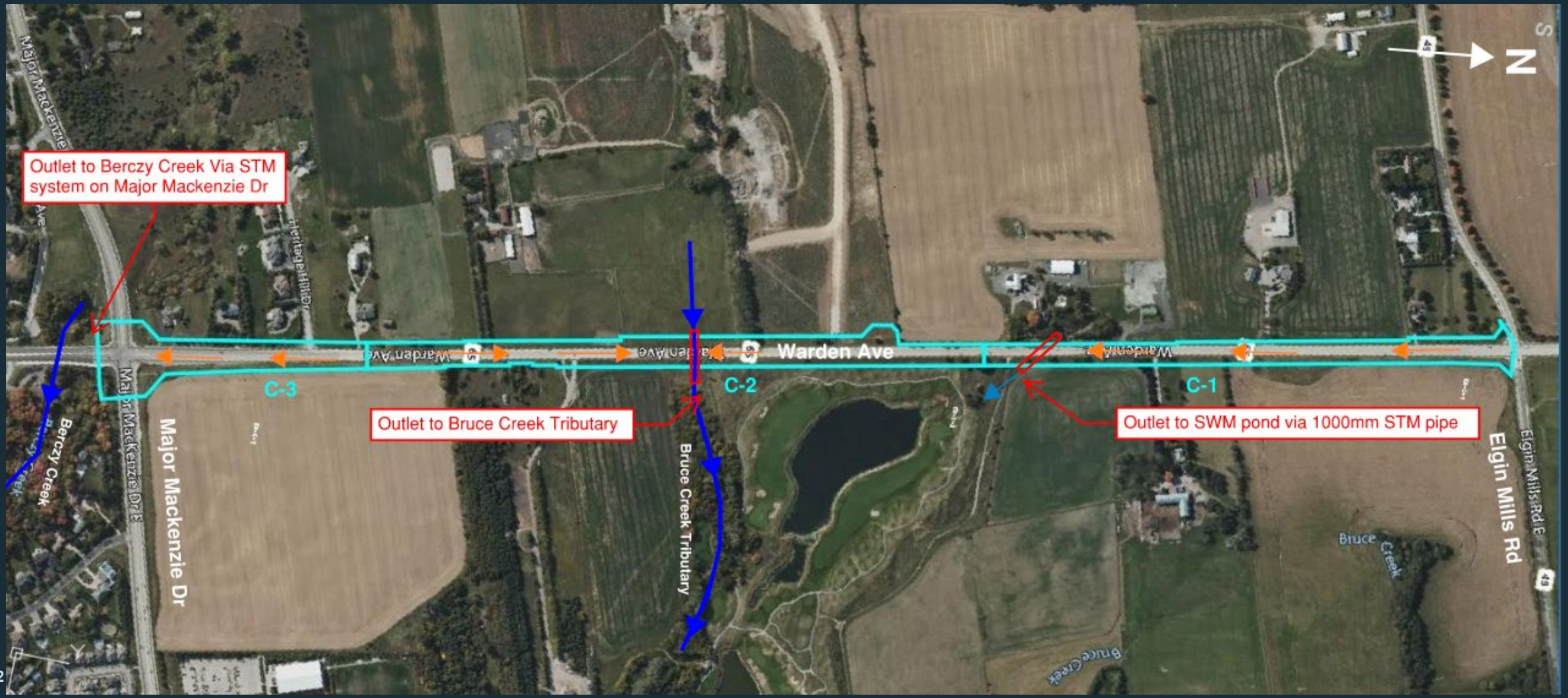
-Detailed Design of the reconstruction and widening of Warden Avenue from a two-lane rural cross section to a four-lane urban cross section with sidewalk and multi-use paths (MUPs)



ELGIN MILLS ROAD TYPICAL CROSS SECTION
AT INTERSECTION
FROM STA.50+245 TO STA.50+358

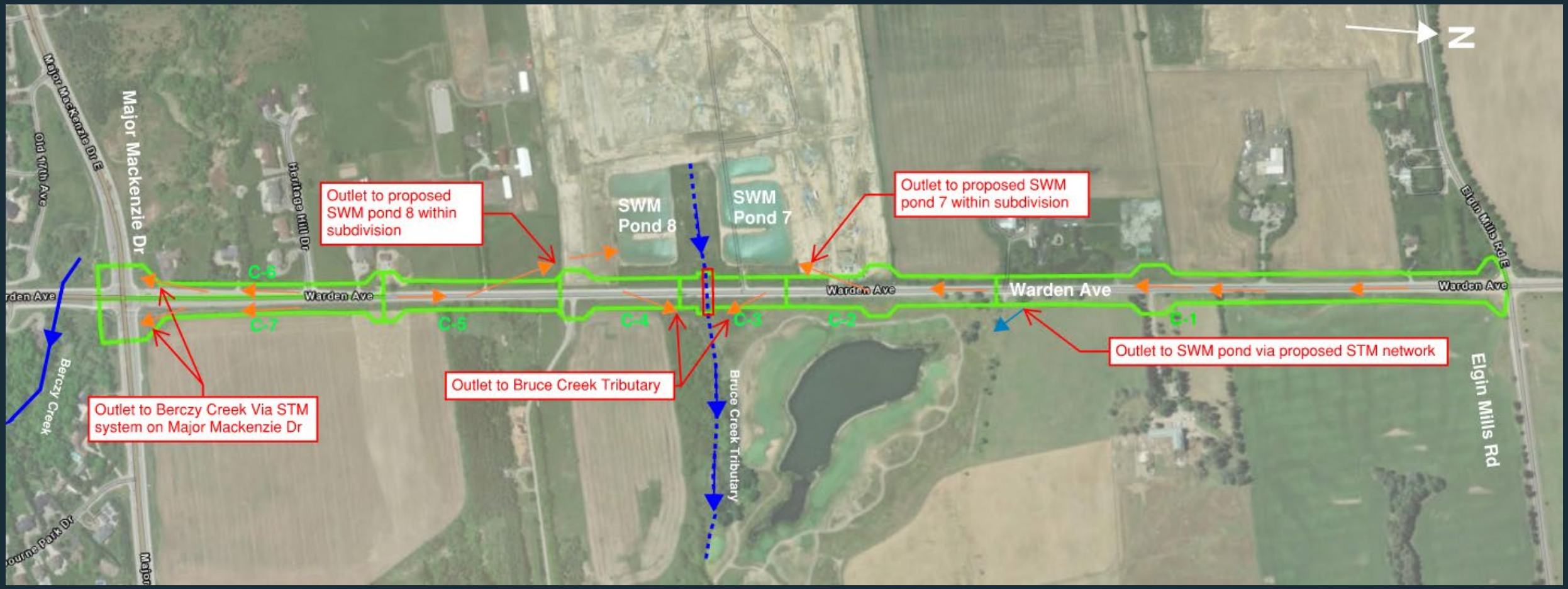
Existing Conditions

- Within Rouge River under TRCA jurisdiction
- Existing road and external areas conveyed by roadside ditches to three overall outlets



Proposed Conditions

- Road drainage conveyed by brand-new storm sewer networks with catch basins
- Residential housing will be developed on lands adjacent to Warden Avenue



Design Criteria

- **Design Criteria set out in EA based on York Region and TRCA design criteria:**
  - Water Quality: enhanced level 1 treatment with 80% TSS removal
  - Water Quantity: control post-development peak flows to pre-development levels
  - Water Balance: retention of the first 5mm rainfall

Site Opportunities and Constraints:

- 3.5m-5.8m wide boulevard
- Low infiltration rates with silty sand soil type
- High groundwater tables observed in certain areas and near the Bruce Creek Tributary Culvert (<3m depth)
- Utilization of proposed SWM ponds within Berczy Warden Subdivision

LID Screening

Table 4.3.8: LID options for the major arterial road

ROW Construction Type	Bioretention Planter	Curb Extension	Boulevard Bioretention	Bioswale	Enhanced Grass Swales	Perforated Pipe	Permeable Pavement (sidewalk)	Prefabricated Modules
Rural Resurfacing	○	○	◎	◎	●	◎	◎	◎
Rural Reconstruction	○	○	◎	◎	●	◎	◎	◎
Rural to Urban Reconstruction	○	○	◎	◎	○	●	●	●
Urban Resurfacing	○	○	◎	◎	○	◎	◎	●
Urban Reconstruction	●	○	◎	◎	○	●	●	●
Urban Reduction	●	○	◎	◎	○	●	◎	●

○ Unlikely Option ◎ Possible Option ● Common Option

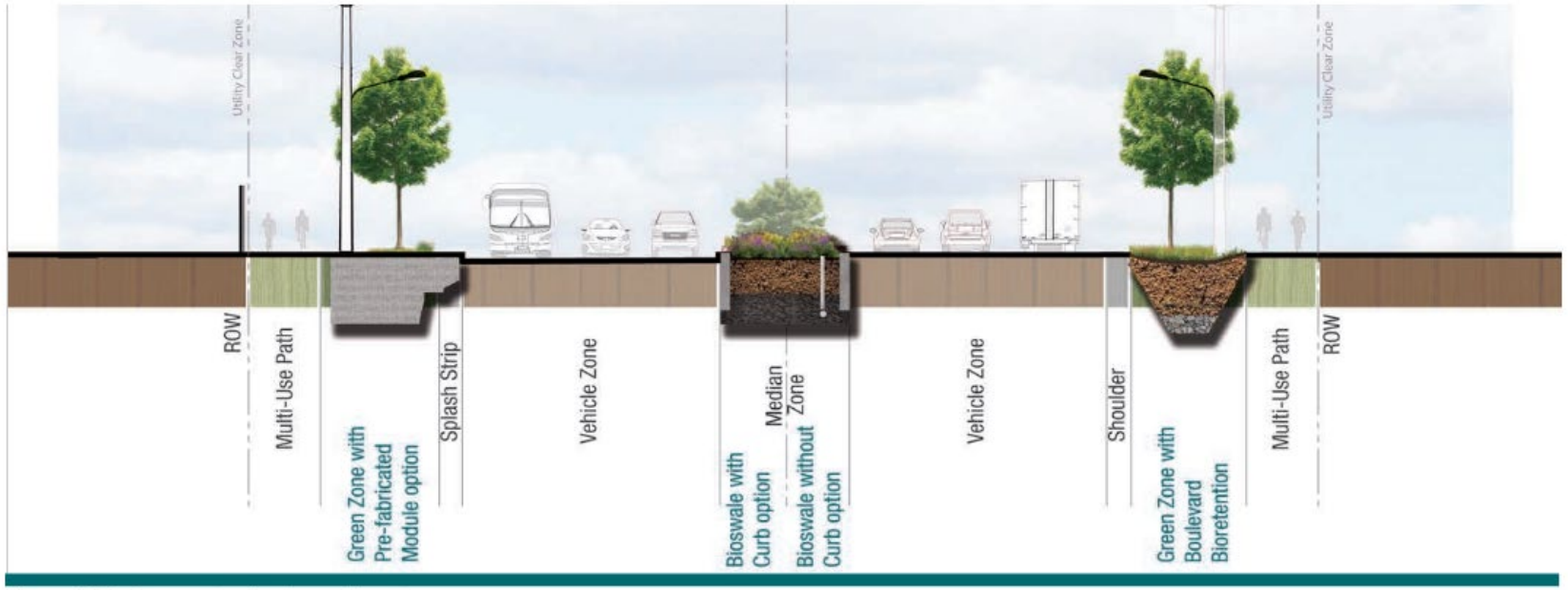


Figure 4.3.29: Cross section of major arterial road

Source: Low Impact Development Road Retrofits (CVC)

LID Design - Bioswales

- Suitable for roadway applications featuring wide boulevards
- Achieve stormwater quality control and water balance
- Easy to maintain
- Integration with landscaping

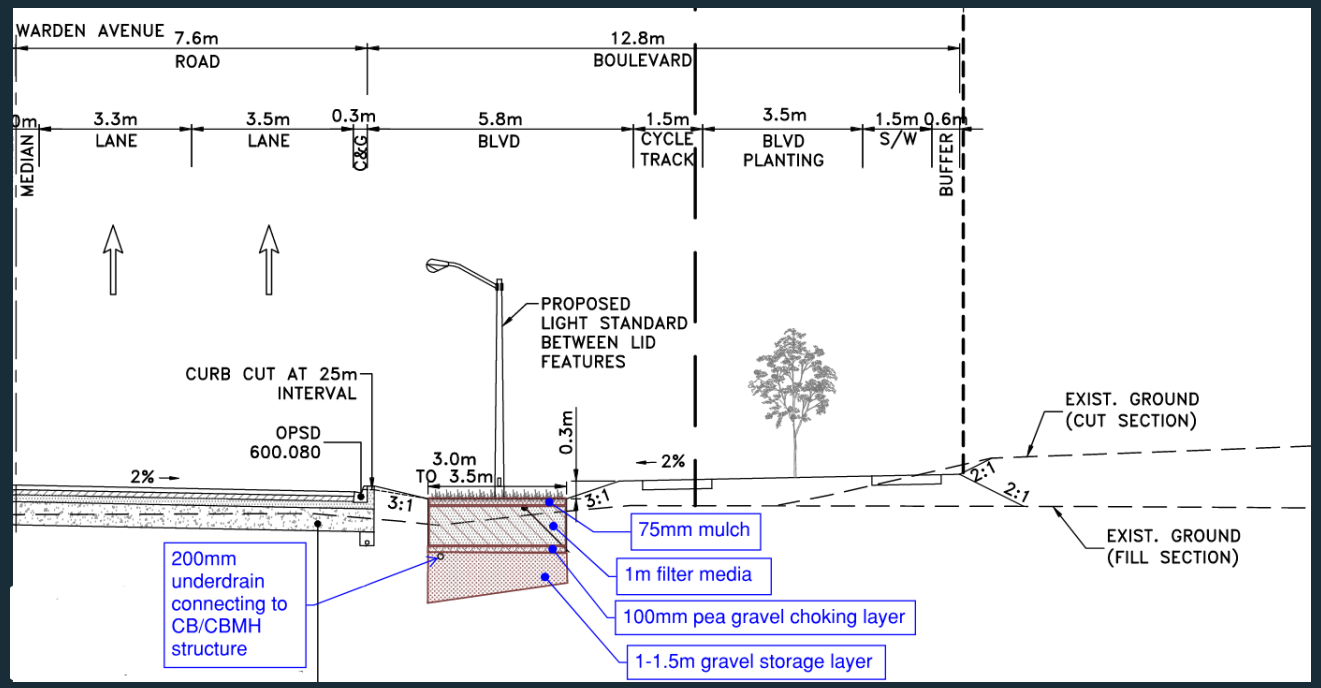
Source: Low Impact Development Road Retrofits (CVC)

Benefits	
○	Flood risk reduction (water quantity)*
●	Pollutant removal (water quality)
●	Groundwater recharge (water balance)*
●	Stream channel erosion control
○	Amenity & aesthetic value
○	Traffic calming
○	Urban tree canopy
●	High profile with community & media

○ Low Benefits ○ Moderate ● High

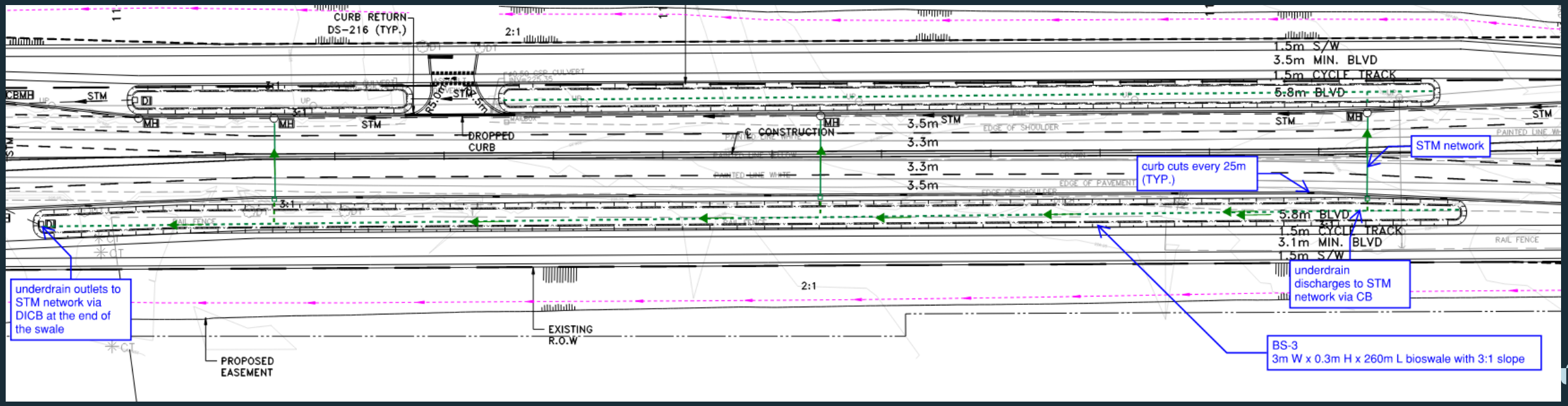
Source: Low Impact Development Road Retrofits (CVC)

Bioswales- Design Layout



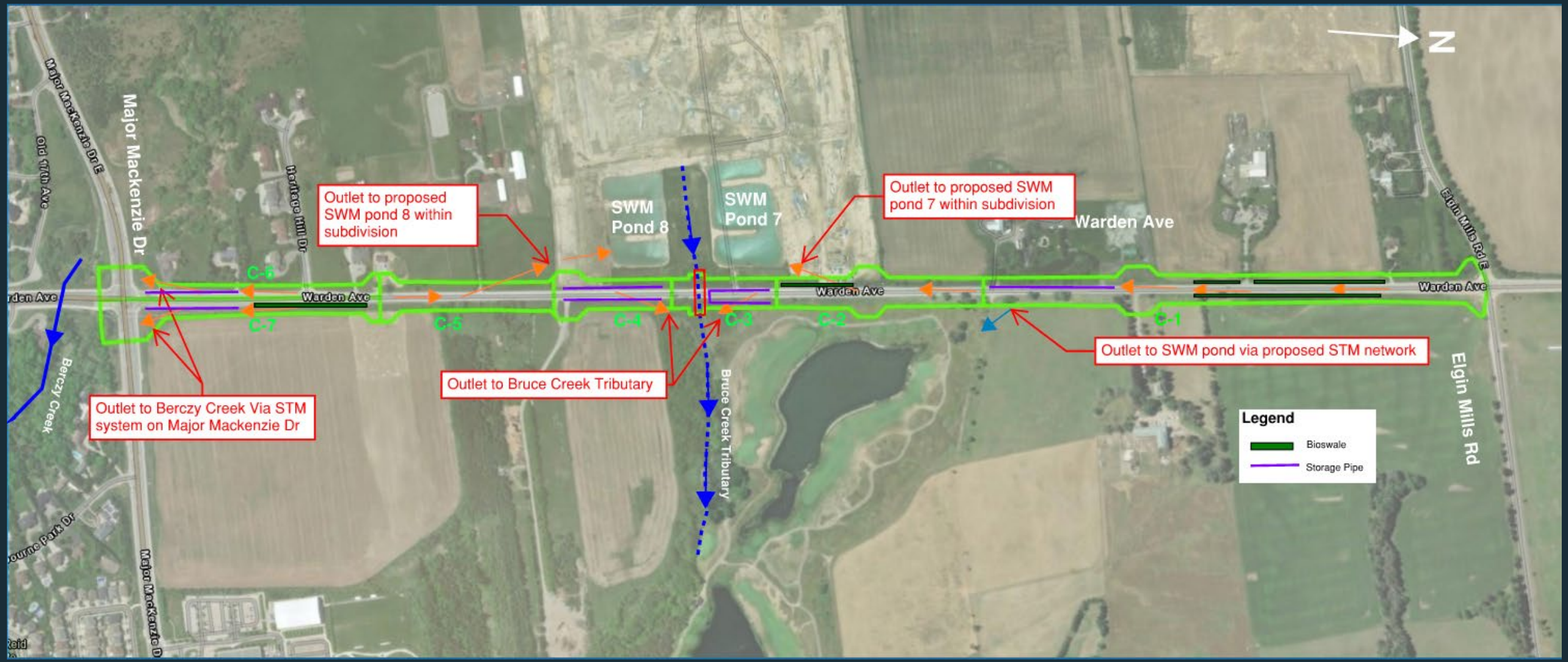
Cross Section View

Plan View



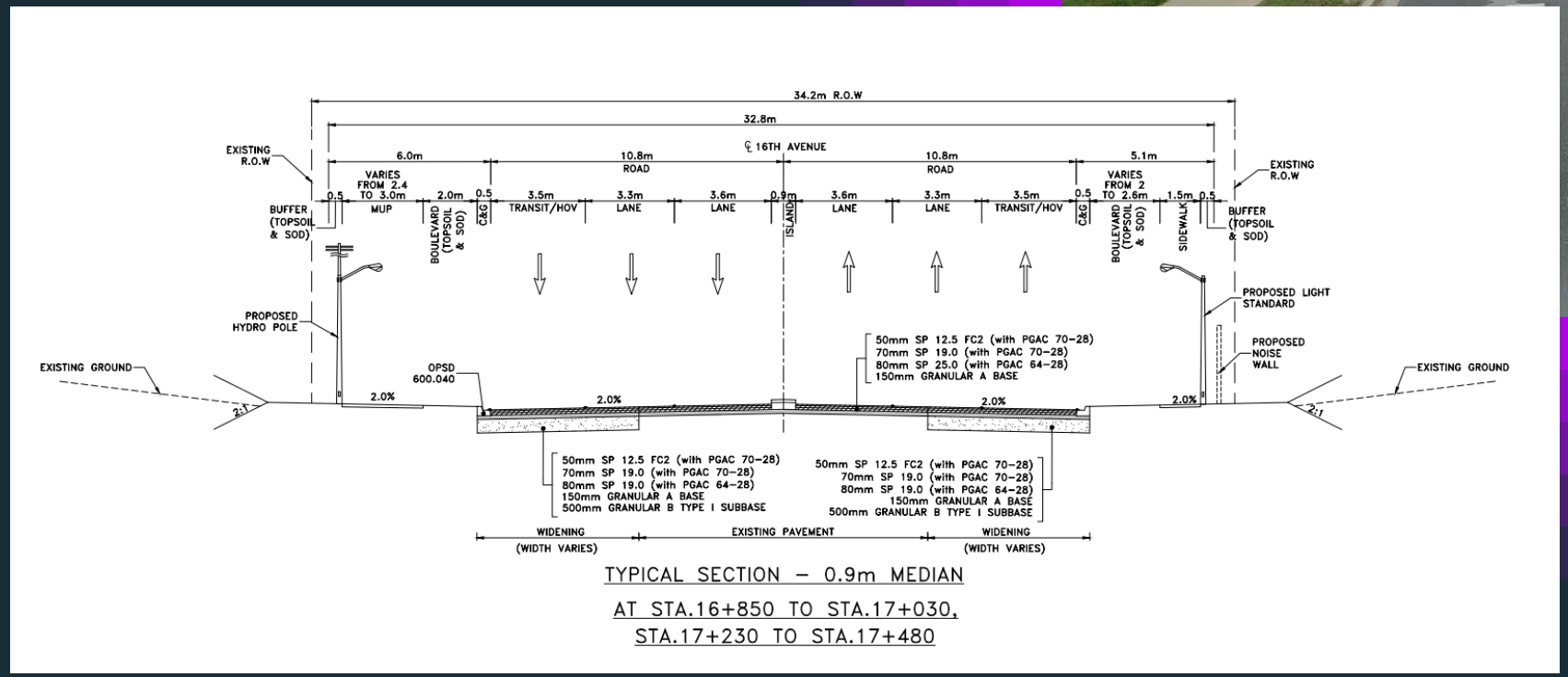
Integration of LID into Overall Drainage Design

- Water Balance: bioswales
- Water Quality Control: OGS and bioswales
- Water Quantity Control: storage pipes



16 AVENUE ROAD WIDENING

-Detailed Design of the widening of 16th Avenue from a four-lane to a six-lane urban cross section with multi-use paths (MUPs)



TYPICAL SECTION – 0.9m MEDIAN

AT STA.16+850 TO STA.17+030,
STA.17+230 TO STA.17+480

Existing Conditions

- Within Rouge River Watershed under TRCA jurisdiction
- Existing road conveyed by storm sewers to four overall outlets

Proposed Conditions

- Road drainage conveyed by new storm sewer networks with catch basins
- The surrounding areas are predominantly residential and are located close to the Region ROW

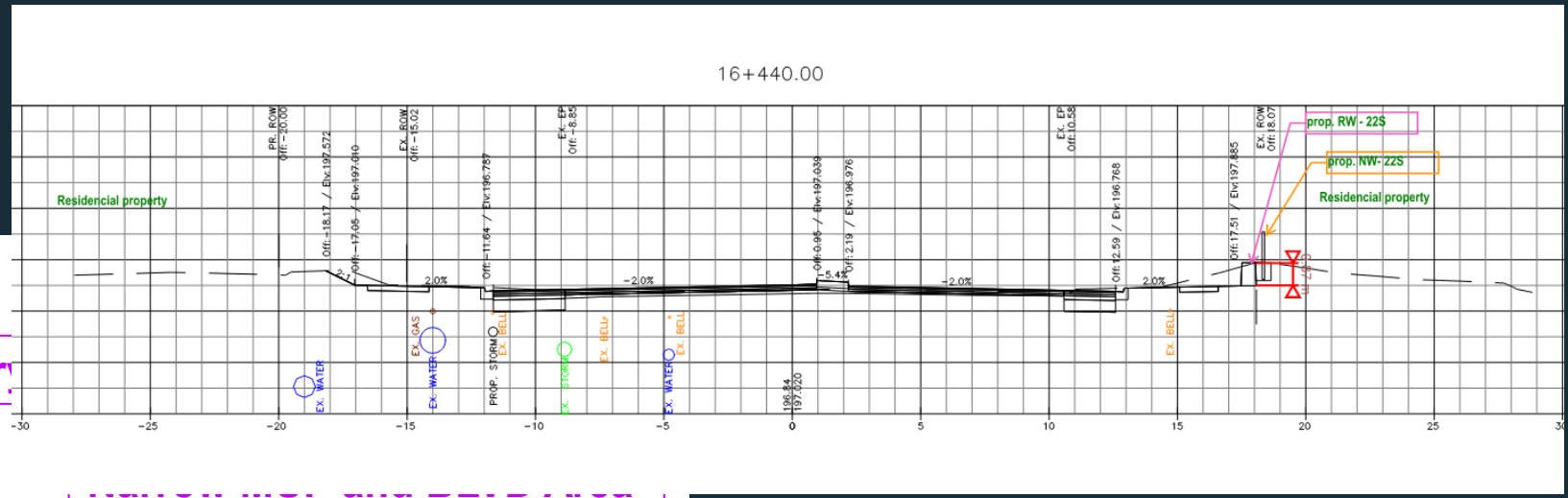
Design Criteria

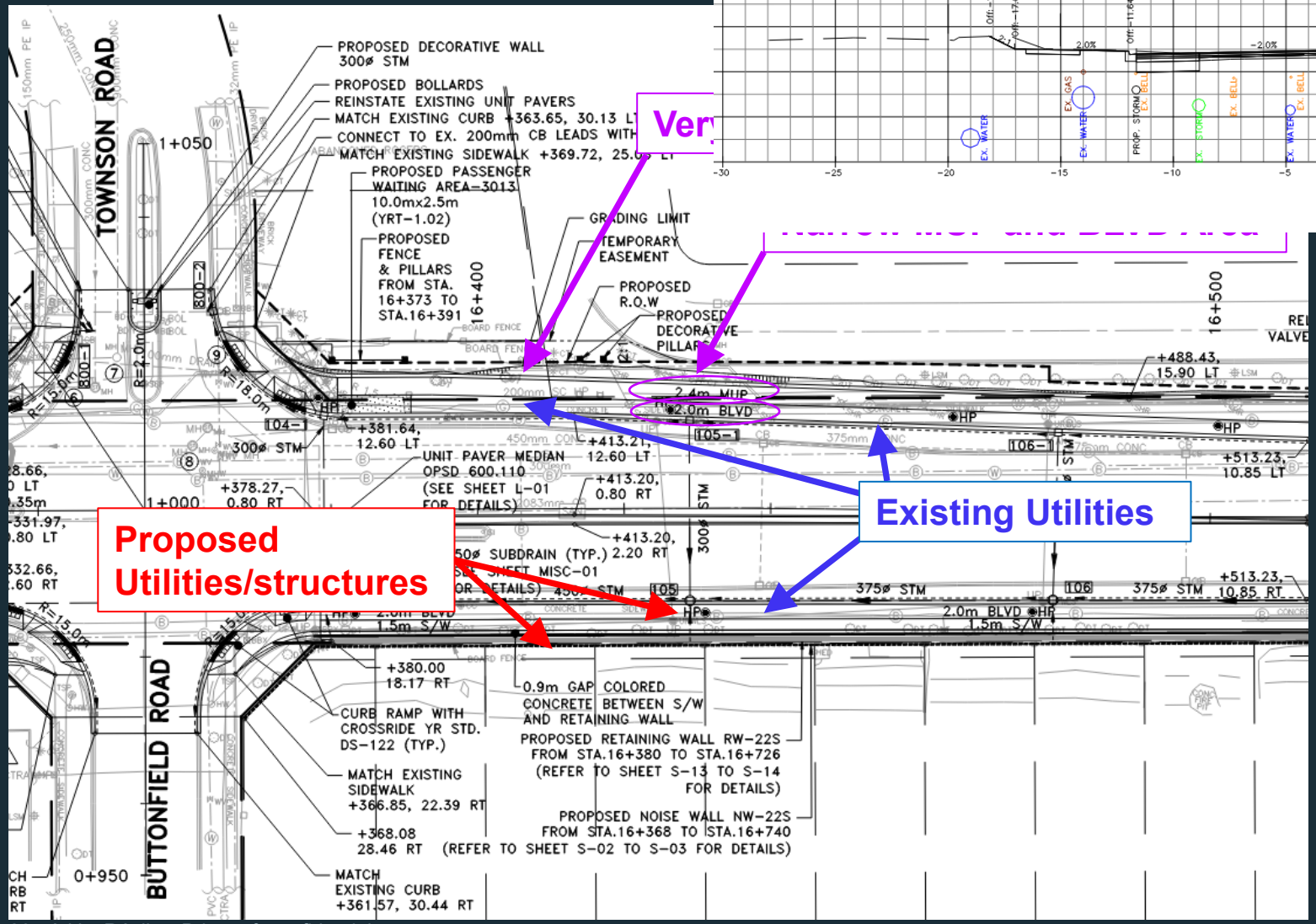
- **Design Criteria set out in EA based on York Region and TRCA design criteria:**
  - Water Quality: enhanced level 1 with 80% TSS removal
  - Water Quantity: for the catchment discharging to Apple Creek, no quantity control is required. For catchments discharging to existing STM systems, the proposed 10-year minor system peak flows are controlled to the 5-year existing peak flows
  - Water Balance: retention of the first 5mm rainfall

Site Opportunities and Constraints:

- Narrow boulevard area: 1.5-3m width available
- Low infiltration rates with silty clay/silt loam soil type
- High groundwater table near Apple Creek outlet
- Road corridor heavily occupied with existing and proposed utilities
- Limited road embankment/ROW areas with steep grade
- Interference with the future-proofing plans for 16th Avenue

Design Considerations





Proposed Utilities/structures

Existing Utilities

No LIDs can be implemented

Warden Avenue VS 16th Avenue

	Warden Avenue	16th Avenue
Project Type	Road widening from rural to urban cross sections	Road widening for urban cross sections
Design Criteria	Water quantity, water quality, and water balance	Water quantity, water quality, and water balance
Site characteristics and constraints	Wide boulevard, low infiltration rates, high groundwater tables for certain areas, utilization of proposed SWM ponds	Narrow boulevard and ROW areas, low infiltration rates, relatively high groundwater tables for certain areas, many existing and proposed utilities
Selected LID	Bioswales	None

Summary

- Urbanization and climate change necessitate best practices for drainage infrastructure, including the implementation of LIDs.
- TRCA and CVC have published specific stormwater management criteria and guidelines related to LID design.
- When evaluating LID options, consider:
  - Project site conditions such as groundwater tables and infiltration rates
  - Available space and utilities
  - Suitability, constraints, and maintenance requirements of the LIDs and how they fit into the project overall
- It is recommended that conservation authorities publish detailed guidelines on LIDs, with general agreements from local municipalities

thank you

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