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2025
Conference

Canada's Premier
Stormwater and Erosion
and Sediment Control
Conference

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Unmaintained Stormwater Outfalls: Draining Water or Draining Resources?



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OVERVIEW & BACKGROUND

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CONSEQUENCES OF OUTFALL FAILURE

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SUMMARY OF LEARNING OBJECTIVES

Overview & Background

- Abundant throughout urbanized areas, stormwater outfalls are capable of extreme failure, causing mass erosion and risks to property and infrastructure



Numerous Drastically Failed Stormwater Outfalls Across Toronto

Consequences of Outfall Failure

Loss of Conveyance Potential within Storm Sewer

- Flooding and drainage concerns in sewer shed
- Potential water damage to properties and assets



Destabilization of Riverbank and Valley Slope

- Risks to buildings, infrastructure, utilities at top of slope
- Hazard to trail systems within valley corridor



Increased Sediment Loading within Downstream Watercourse

- Degraded aquatic habitat
- Decreased flow conveyance capacity during flood events



Key Failure Mechanisms

Undermining

Insufficient Erosion Protection → Scour → Collapse of Headwall → Failure of Upstream Pipe



*Undermined Stormwater Headwall Structure
at Risk of Collapse*



*Collapsed Concrete Headwall Structure and
Failed Upstream Pipe Segments*

Key Failure Mechanisms

Outflanking

Erosive Watercourse Flows → Lateral Erosion → Outflanked Outfall



*Outflanked Concrete Headwall
Structure and Upstream Pipe*



*Outflanked Headwall Structure and
Upstream Pipe Segment*

Key Failure Mechanisms

Corrosion

Corrosion of Upstream Pipe → Flows Bypass Headwall Structure → Erosion Gully Formation



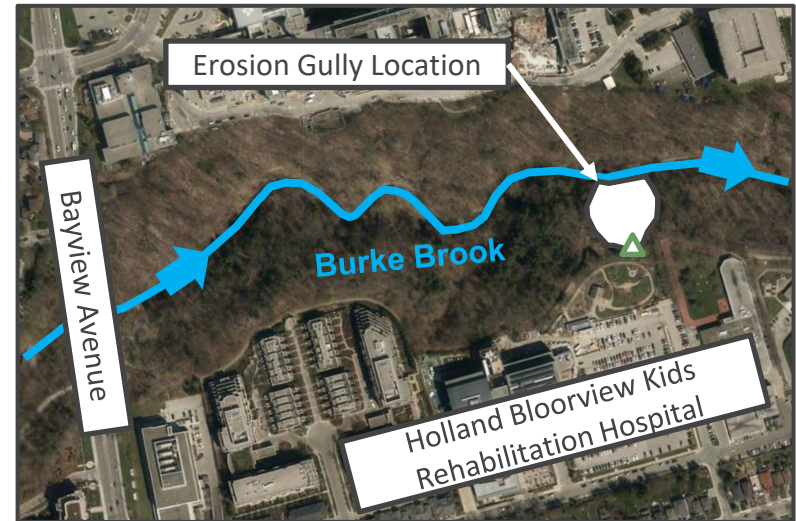
Erosion Gully Formation Along Stormwater Outfall



Erosion Gully Formation Along Valley Slope

Case Study: Holland Bloorview Outfall

- Extreme example of stormwater outfall failure leading to mass erosion gully
- Located in Burke Brook Ravine, within the Don River Watershed
- Over 5750 m³ of soil released across a 10-year timeline
- Mature vegetation loss and severely degraded aquatic habitat
- Risks to top of slope infrastructure, including Canada's Largest Children's Rehabilitation hospital
- Rapid Failure Progression over less than 14 years



Stormwater Outfall Failure Location

Outfall Failure Progression



2010
0 m³

1000 m³
2018



2020
3000 m³

5750 m³
2023

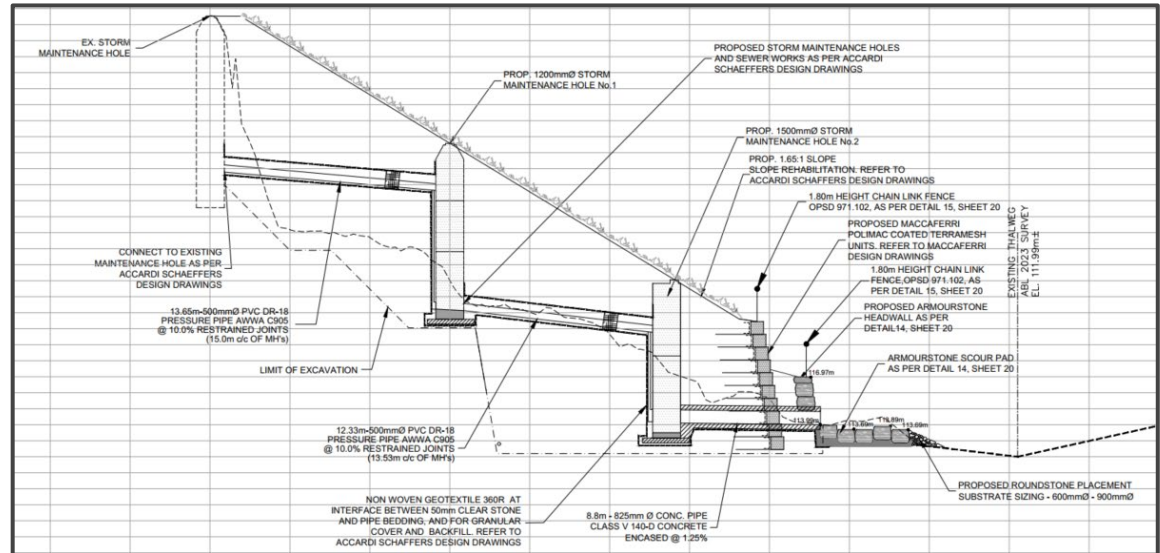


Restoration Design

- Installation a new storm sewer network, with a series of maintenance hole drop structures
- Reconstruction of the slope with imported material to fill in erosion gully
- Slope stabilization through armourstone retaining walls and vegetated gabion baskets



Manhole at Imminent Risk of Failure



Profile of Completed Outfall Restoration Works

Permitting and Approvals

- Permits were applied for under an emergency framework, as this outfall failure posed an imminent risk to public safety and the environment.
- Emergency approvals included permissions from:
 - Toronto Ravine and Nature Feature Protection (RNFP) 
 - Toronto and Region Conservation Authority Emergency Works Permit (TRCA) 
 - Ministry of the Environment, Conservation and Parks (MECP) 
Ministry of the Environment,
Conservation and Parks
 - Ministry of Natural Resources (MNR) 
Ministry of Natural Resources and Forestry
 - Letter of Advice from Fisheries and Oceans Canada (DFO)  Fisheries and Oceans
Canada

Watercourse Design Considerations

- Installation of new headwall structure with enhanced scour protection provided by a grouted armourstone scour pad
- Vegetated buttress bank protection downstream of headwall to mitigate lateral erosion within the watercourse



Grouted Armourstone Scour Pad



Vegetated Buttress and Channel Substrate Integrated into Armourstone Retaining Wall

Access Considerations

- Access to this outfall location was highly constrained, due to steep slopes, environmentally significant areas, existing utilities, and mature vegetation



Sanitary Sewer Network Present Along Access Route



Steep Entrance into the Valley Corridor

Construction Phasing

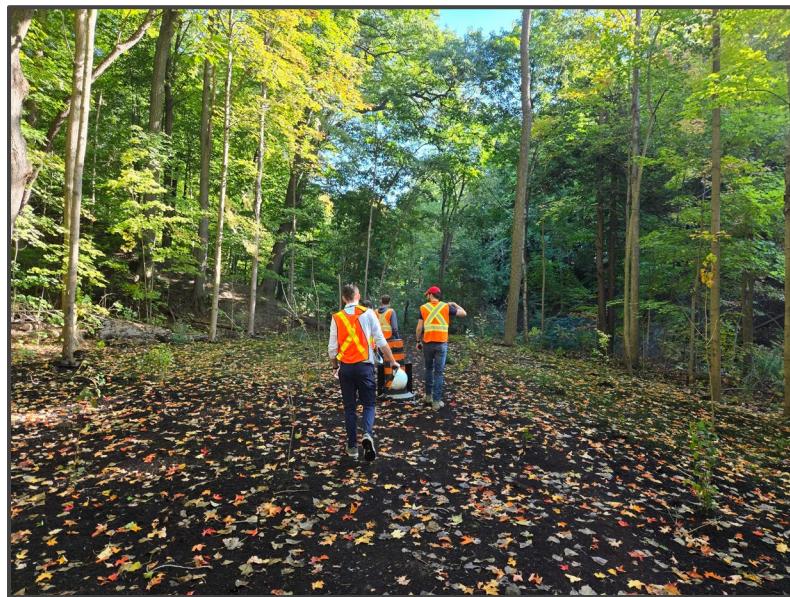


Site Restoration

- Comprehensive site restoration was completed across the entire area of disturbance, including native wildflowers, shrubs and trees



Heavy Duty Access Route During Construction



Restored Construction Access Route with Native Plantings

Design Build Process



- Innovative Design-Build process utilized to streamline design and construction timelines (entire design-build project completed in under 12 months)
- Contractor directly interacted with Client, with support from complete suite of technical engineering disciplines
- Including the contractor's perspective in the design phase ultimately created a more constructable design, with less unexpected delays throughout the construction project

Design-Tender-Build



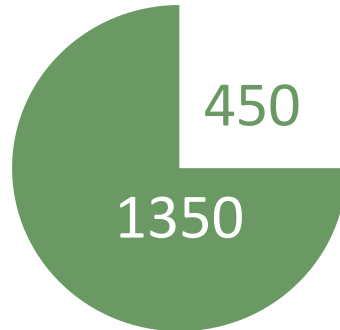
Design Build



Learning Objective #1

Effective Data Base Management

- The City of Toronto has over 1800 stormwater outfalls, with over 75% of them having identified visible erosion risks
- To prevent extreme cases of failure, comprehensive inspection and maintenance programs must be undertaken
- After rapidly progressing failures are identified, a rapid response is critical



Learning Objective #2

Value of Preventative Maintenance



Learning Objective #3

Design Considerations of Outfalls



Incorporation of Climate
Change Resilient Materials



Robust Energy Dissipation



Selection of Pipe Materials



Accounting for
Maintenance Access



Comprehensive Monitoring &
Maintenance Program

Questions?

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