Resilience in the Design and Construction of Highland Creek Valley Segment 4a

Harry Reinders¹
John Parish², Chris Cummings,²
W J Snodgrass³, K Sivakumaran³

R & M Construction¹
Matrix Solutions²
City of Toronto³
Please join us in a reflective moment

JP was the inspiration for this project
Valley Segment 4A
Sanitary Trunk Sewer and stream crossings shown
East Highland Creek – Valley Segment 4/4A
Restoration Unit 7

BEFORE

AFTER

BEFORE

AFTER
East Highland Creek – Valley Segment 4/4A
Restoration Units 3 & 4

BEFORE

AFTER

BEFORE

AFTER
HIGHLAND CREEK VALLEY

REHABILITATION OF EROSION CONTROL STRUCTURES FOR MARKHAM BRANCH CREEK SEGMENT (PROGRESS AT MARKHAM ROAD)

CONTRACT No. 1079-2008-59

Matrix Solutions Inc.
Design Summary

- Approximately 1,650m total channel length
- 8 Sanitary Trunk Sewer Crossings, multiple stormwater outfalls & watermains, one bridge (Markham Road)
- Approximate 19m drop from Upstream tie-in to Downstream tie-in (1.15%)
- Calculated Design Discharge (Bankfull) = 32m³/sec
- Based on principles of Natural Channel Design with Engineered features for infrastructure protection
October, 2012

Matrix Solutions Inc.
May, 2015

Matrix Solutions Inc.
Design Approach

- Existing channel was highly dynamic and in a constant state of adjustment

- Channel was designed to accommodate ‘bankfull’ flows
  - Resulted in a significant increase in channel width (~12m increased to ~26m)
  - Connectivity to floodplain

- Infrastructure in the valley was lowered, shifted or concrete encased to protect from future adjustments

- Substrate size was increased significantly over existing materials
Design Approach

• Channel bed was designed and constructed using two different bed forms:
  – Bed level weir structures for channel upstream of Markham Road
  – A riffle - pool bedform downstream of Markham Road

• Design emphasized the placement of riffles over sanitary sewer crossings for long-term protection

• Banks were a variety of treatments ranging from:
  - Vegetated Soils
  - Brush Mattress
  - Vegetated Rip-rap
  - Engineered Armourstone Walls
Additional Design Features

- Creation of three off-channel wetland areas (former stream bends)
- Disconnection of active channel from valley slope contacts has allowed for the natural re-stabilization of the scarps and stabilization of habitat
- Embedded Woody Roughness in Floodplain
- Valley Restoration Planting Plan
- Access routes for sewer maintenance
Channel Character

- The wider channel design resulted in a larger channel footprint, requiring a net loss of valley floor forest cover.
- The channel is developing a ‘nested’ low flow channel within the greater ‘bankfull’ channel.
- Bar features store sediment, likely to be partially flushed during significant storm events.
Highland Creek Channel Restoration Project
Valley Segment 4A

A restoration project is currently underway in the Highland Creek Valley to address several urgent problems that were identified in a detailed Class Environmental Assessment (EA) completed by the City of Toronto in 2006. Several sanitary sewer crossings have been exposed and erosion of the valley slopes is threatening property and structures. This restoration project will protect infrastructure and the environment by creating a dynamically stable, natural channel system.

To achieve a stable creek in the Highland Valley, the channel will be enlarged to better handle stormwater flows and will be moved away from the eroding valley walls. These works will provide long term protection to both the sewer and the natural environment.

For further enquiries about this project, please call 311 or visit our website at www.toronto.ca/improvements

Research and Development Authority's Greening Strategy for the Highland Creek Watershed, and as required by the City's Ravine & Natural Feature Protection bylaw.

This project is working under approvals issued by Toronto and Region Conservation Authority, Fisheries and Oceans Canada, and the Ontario Ministry of Natural Resources. Through routine inspections by these agencies and on-site inspectors during construction, the protection of the valley's environmental features, and the infrastructure within the valley will be ensured.

Starting in January 2012, it will take about three months to construct Restoration Units 3 and 4.
Construction Phasing

• The construction project was built in four successive winter construction periods (2012-2015), which:
  – Accommodated City budget constraints
  – Permitted monitoring, learning and design adaptation
  – Allowed for the use of dormant vegetation during construction
Construction Challenges / Design Adaptation

- Infrastructure (i.e. sewers) did not always match original as-built plans
  - Required design revisions to address discrepancies.

- Weather, flow management and site access challenges

- Due to construction phasing and design modifications, two banks experienced scour after 2012 construction requiring repair of banks
Construction Challenges / Design Adaptation

- Winnowing of fines from riffles after 2012 construction period created gravel bar formations which affected channel thalweg alignment

- Design modifications were implemented which included:
  - Use of a denser rock material in riffles
  - Rib structures in select riffles
  - Modification of fines in select riffles
Restoration Units 1&2

January, 2014
Restoration Units 3&4

February, 2012
Restoration Units 3&4

February, 2012
Restoration Units 1&2

February, 2014
Restoration Units 1&2

April, 2014

Matrix Solutions Inc.
Restoration Units 1&2

May, 2014
Restoration Units 5&6

March, 2015
Questions?