

Woodward Avenue
Wastewater Treatment Plant
Red Hill Creek Outfall Modification Works
Joint Stewardship Board
City of Hamilton

June 30, 2015



Presentation Outline



1. Background
2. Environmental Assessment and Conceptual Design Findings
3. Predesign of Red Hill Creek Outfall Modification Works (2010)
4. Predesign since restart in 2014
5. Next Steps

1. Background



1. Background

Project Benefits – *Woodward Upgrades Project*

The Woodward Plant has a significant influence on the status and health of Hamilton Harbour. Improved effluent quality under the Woodward Upgrades Project will benefit the local area in a number of ways :

1. A direct contribution towards delisting Hamilton Harbour as an Area of Concern.
2. Improving the *green image* of Hamilton by providing future environmental protection through advanced wastewater treatment.
3. Improved conditions supporting healthy development of diverse populations of fish and wildlife.
4. Contributions to a more desirable Harbour by significantly reducing nutrient loadings, to lower algae growth, and reducing suspended solids, to improve the clarity of local waters.
5. Contributions to a healthier environment for people that live here and for those that visit the City of Hamilton. A future improved ability to attract tourists.

1. Background

- ▶ As part of the City of Hamilton's Wastewater Treatment Plant Master Plan and its Wet Weather Flow Master Plan, a number of system improvements were defined including:
 - ▶ Increased average day flow capacity of WWTP
 - ▶ Upgraded level of tertiary treatment at WWTP
 - ▶ Expanded primary treatment capacity for Woodward Avenue Plant
 - ▶ Upgraded collection system to minimize Combined Sewer Overflows (CSO) discharge to receiving systems

1. Background

- ▶ The City of Hamilton's Environmental Assessment (EA) study (2007/2008) identified a number of elements associated with the preferred strategy of reaching these objectives including:
 - ▶ Disinfection (new chlorine contact tanks)
 - ▶ New Pumping Station
 - ▶ Power upgrades
 - ▶ Additional system capacity
 - ▶ Tertiary Treatment Facility

1. Background

- ▶ The EA identified that *Hydraulic Improvements* were required to accommodate the proposed Wastewater Treatment Plant Upgrades (i.e. related to flow capacity).
- ▶ Current plant discharge is to the Red Hill Creek downstream of the Burlington Street Interchange ramps.
- ▶ Upstream maintenance/emergency outfall considered as an alternative long term measure to avoid costly internal hydraulic upgrades to the existing outfall.

1. Background



1. Background

- ▶ By introducing 5.8 m³/s (average) and 11.6 m³/s (peak) of Wastewater Treatment Plant effluent about 0.9 to 1 km (+/-) upstream of the existing outfall, several environmental factors needed to be considered including:
 - ▶ Stream stability,
 - ▶ Flood risk,
 - ▶ Fisheries habitat,
 - ▶ Terrestrial habitat.

1. Background

- ▶ To conduct these assessments, the City, through its prime consultant, engaged the services of the Red Hill Valley Project Team including:
 - ▶ Amec Foster Wheeler: *Water Resource Engineering*
 - ▶ Dr. Annable: *Stream Morphology*
 - ▶ C. Portt & Associates: *Fisheries*
 - ▶ Dougan & Associates: *Terrestrial Ecology*
- to specifically investigate and prepare a Conceptual Design for the subject reach.
- ▶ The purpose of this assessment was to:
 - ▶ Establish feasibility for outfall improvements
 - ▶ Better define the scope, process and anticipated costs associated with implementation of a long term solution.

2. Environmental Assessment and Conceptual Design Findings



2. Environmental Assessment and Conceptual Design Findings



- ▶ The change (increase) in flows will change the formative/stable conditions for the creek including:
 - ▶ Base flow rate,
 - ▶ Sediment transport,
 - ▶ Temperature.

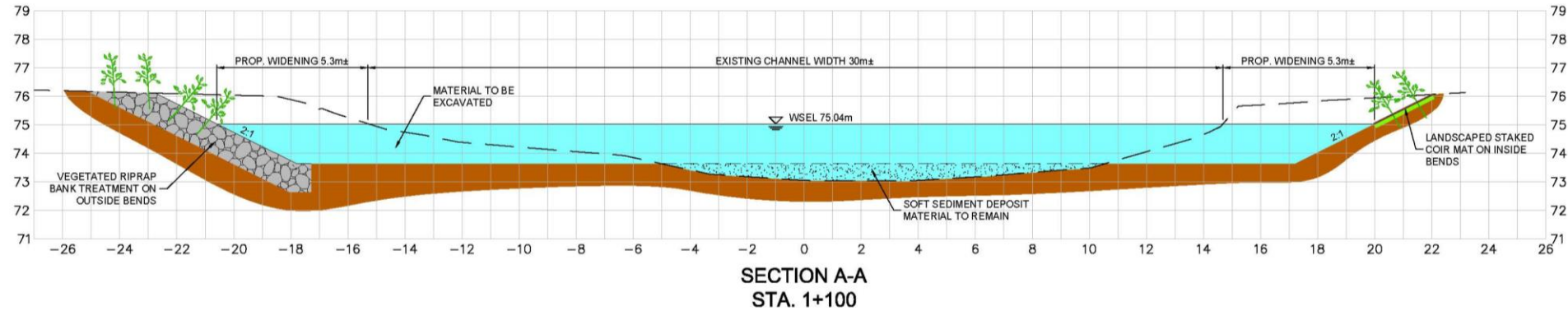
- ▶ Due to backwater from the Hamilton Harbour, the only way to bring the creek into equilibrium / balance is by widening the cross-section (i.e. can't go deeper or use combinations).

2. Environmental Assessment and Conceptual Design Findings



- ▶ The hydraulic and fluvial analysis determined the need to widen cross-section by some 35% (+/-).
- ▶ Due to existing infrastructure (roadway embankments, bridges, treatment plant), widening could not be accommodated in all locations, hence strategic and alternate bank treatment would be required.
- ▶ Any works will need to address Fisheries Act requirements of “no net loss” of fisheries habitat or protection – “net gain” was the objective.

2. Environmental Assessment and Conceptual Design Findings



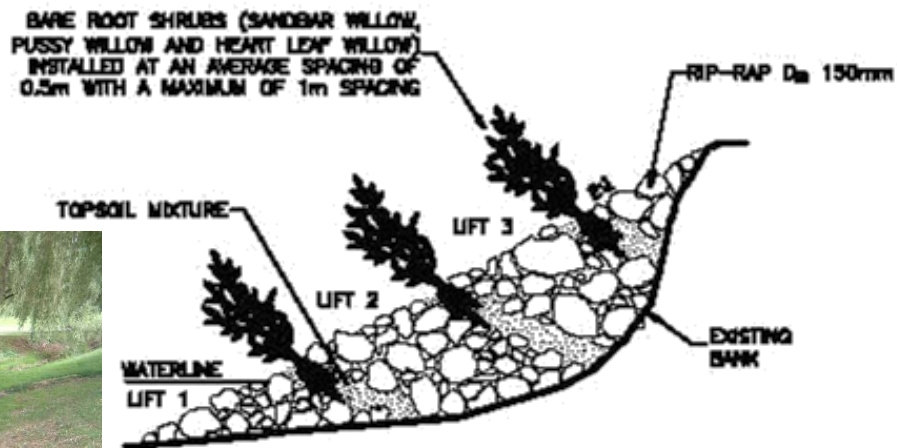
2. Environmental Assessment and Conceptual Design Findings



- ▶ The Red Hill Creek Valley Project Team recommended three (3) forms of creek bank treatment:
 - ▶ Widening and lining with Vegetative Rip-Rap.
 - ▶ Crib Walls (or equivalent) in constrained locations at bridge.
 - ▶ Luncker™ bank structure (or equivalent) at outside bends.

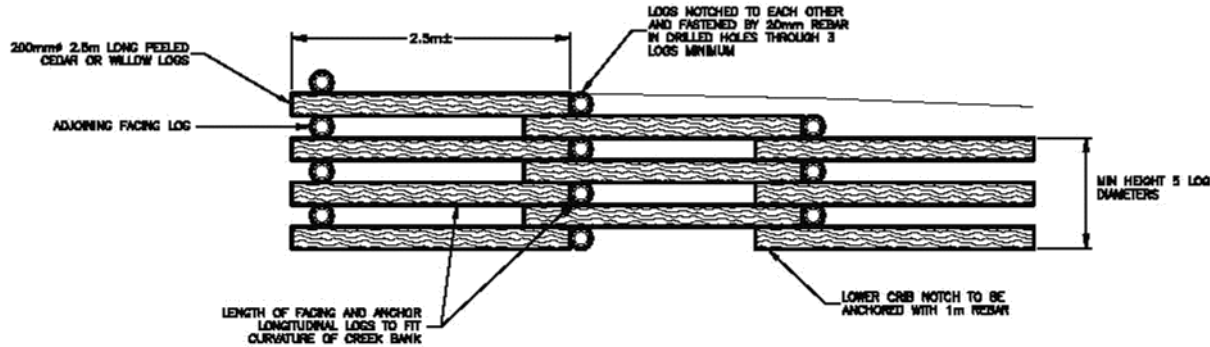
2. Environmental Assessment and Conceptual Design Findings

Example of Vegetated Rip-Rap Detail



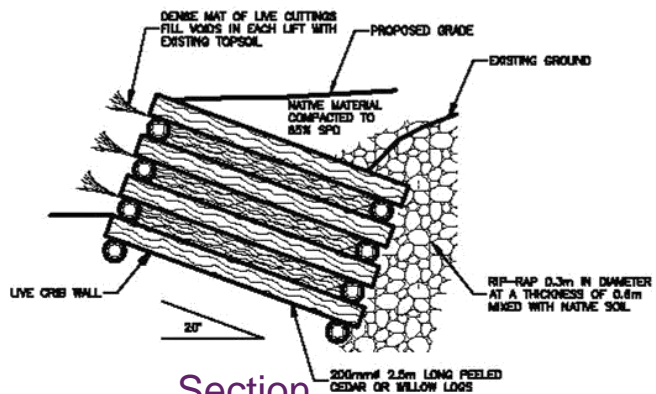
2. Environmental Assessment and Conceptual Design Findings

Example of Live Crib Wall Detail



NOTE:
BACKFILL TO BE COMPACTED TO 85% SFD. THE INTERIOR OF THE CRIB SHALL BE FIRM UNDER FOOT AND FREE OF AIR POCKETS

Elevation



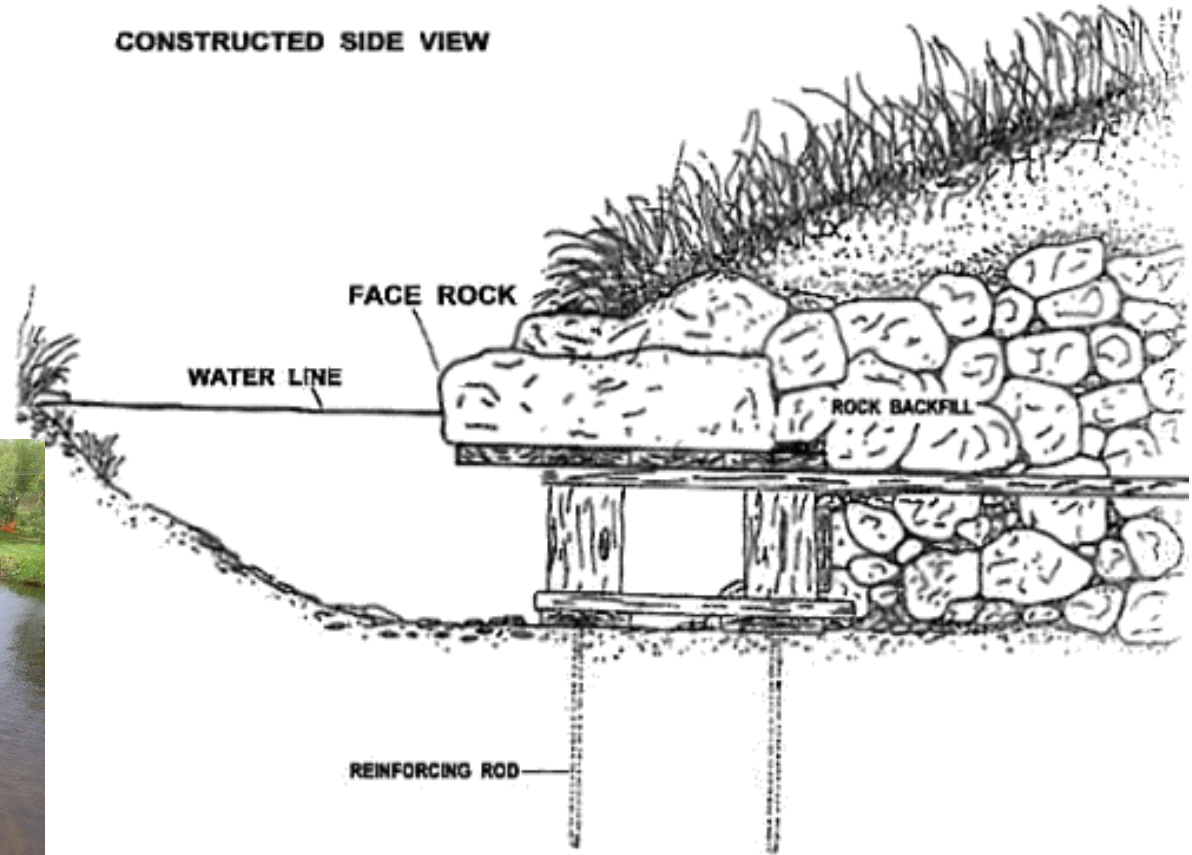
Section



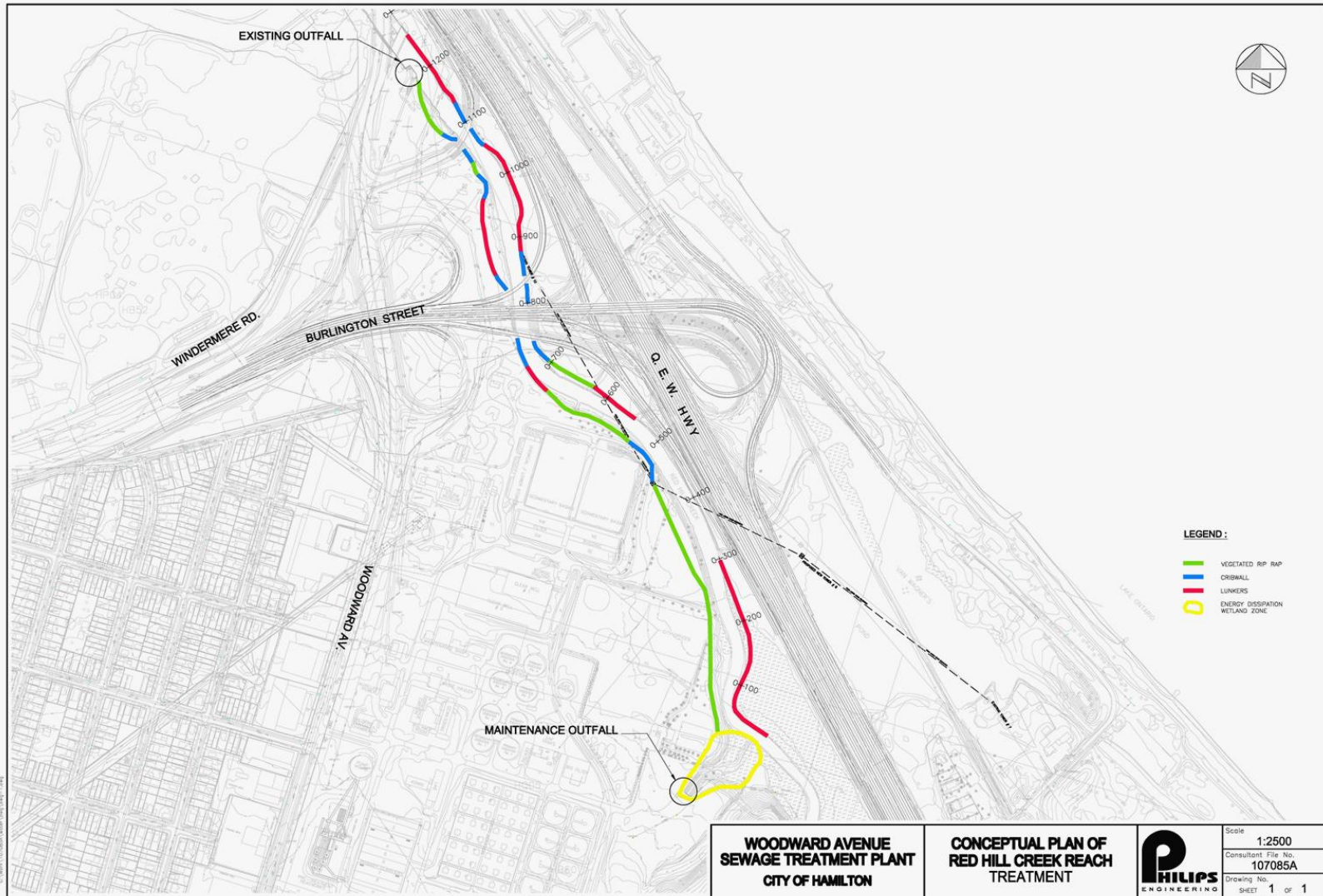
2. Environmental Assessment and Conceptual Design Findings

Example of Lunkers™ Construction Side View

CONSTRUCTED SIDE VIEW



2. Environmental Assessment and Conceptual Design Findings



2. Environmental Assessment and Conceptual Design Findings



- ▶ The EA identified a number of factors associated with the next stages of planning and design including, the need to consider:
 - ▶ Fluctuating Harbour/Lake levels.
 - ▶ Windermere Basin Rehabilitation.
 - ▶ Dewatering, material management, fisheries window for construction.
 - ▶ Approvals (HCA, DFO, MNRF, MTO, MOECC).

EA concluded that project could result in several benefits:

- ▶ Naturalized watercourse
- ▶ Improved water quality
- ▶ Enhanced aquatic habitat
- ▶ Sustainable riparian zone

3. Predesign of Red Hill Creek Outfall Modification Works (2010)



3. Predesign

In 2009/2010, the Red Hill Valley Project Team was engaged to prepare the *Predesign* for the outfall improvement works recommended by the EA; the scope included the following:

- ▶ Bathymetric Survey of Creek
- ▶ Geotechnical & Environmental Investigation of Area soils
- ▶ Terrestrial Habitat Assessment
- ▶ Fisheries Investigation
- ▶ Velocity Profiling
- ▶ Temperature Gauging
- ▶ Supplemental Turtle Survey
- ▶ Hydrologic/Hydraulic Analyses

3. Predesign



Key background data / information included:

- ▶ Woodward Avenue WWTP Existing layout / grading
- ▶ Outfall modifications works, Conceptual Design Assessment
- ▶ Red Hill Valley Parkway Impact Assessment Design Process (IADP) and Permitting Compliance reporting
- ▶ Red Hill Valley Environmental Monitoring Plan
- ▶ Windermere Basin Upgrades / Improvements

3. Predesign

Geotechnical / Materials

- ▶ Sampled soils and subsurface conditions by way of:
 - ▶ Boreholes (20)
 - ▶ Auger probes (9)
 - ▶ Sediment samples (13)

- ▶ Objective to better understand the quality of the materials for:
 - ▶ Management / disposal
 - ▶ Construction / Engineering

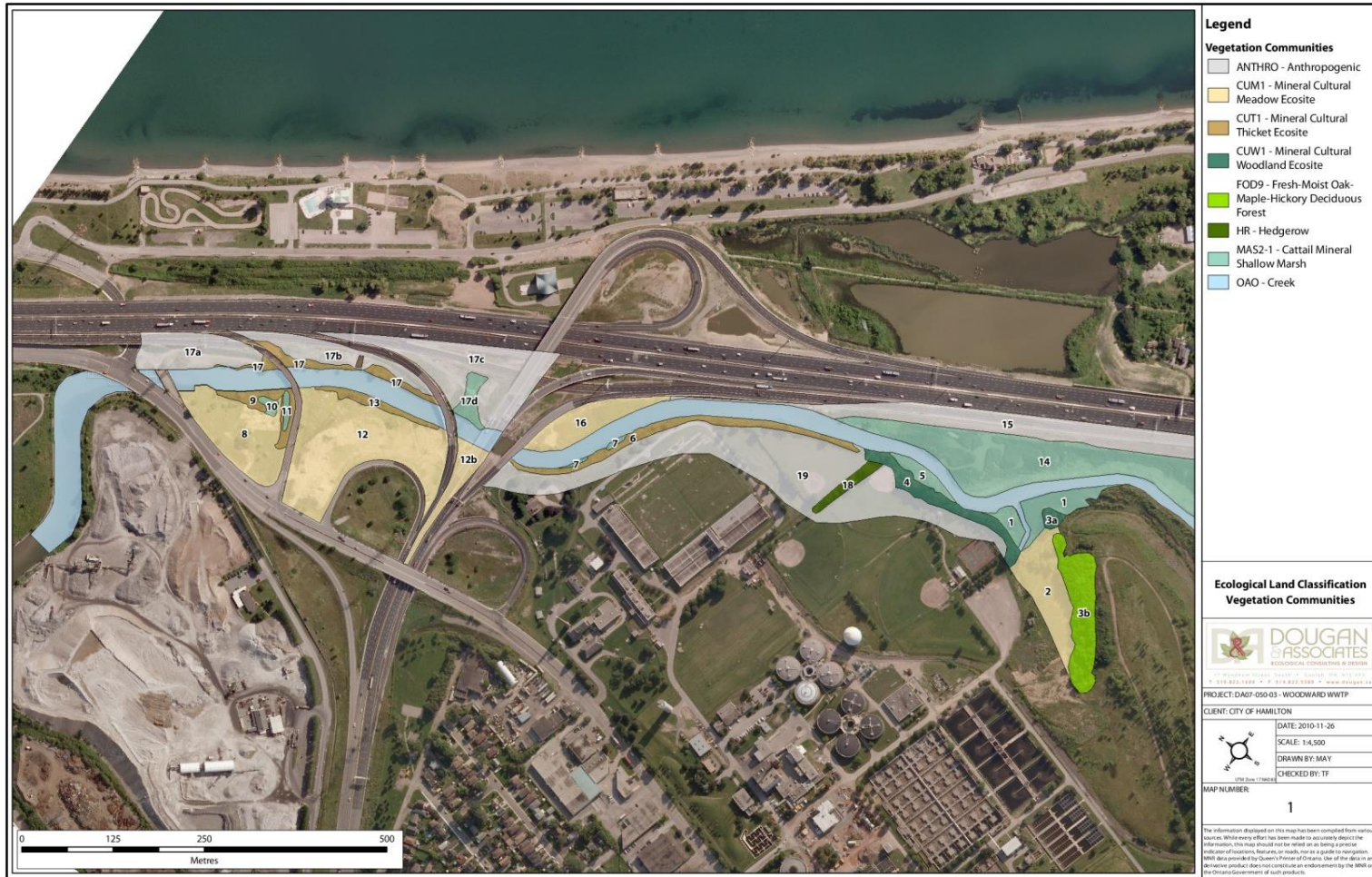
3. Predesign

Terrestrial – Existing Conditions Summary

- ▶ Vegetation surveys were conducted in June 2010 including community classification according to ELC and vascular plant species list to confirm composition, abundance and species of conservation concern.
- ▶ The field survey recorded a total of twenty three (23) polygons representing five (5) ELC vegetation community types.
- ▶ A total of 118 species of vascular plants were observed with 71 (60%) considered native in Ontario.

3. Predesign

Terrestrial – Existing Conditions Summary



3. Predesign

Terrestrial – Existing Conditions Summary



3. Predesign

Fisheries – Existing Conditions

- ▶ Red Hill Creek within the study area is low-gradient, and at times in backwater condition.
- ▶ Creek width ranges from about 42 m near the mouth, to 30 m in the vicinity of the existing WWTP outfall, and 20 m in the vicinity of the secondary outfall at Globe Park.
- ▶ Maximum depth is approximately 2.5 m near the mouth, 1.8 m at the existing STP outfall, and 0.7 m in the vicinity of Globe Park.

3. Predesign

Fisheries – Overview of Potential Issues

- ▶ The outfall of the upgraded Woodward Ave WWTP will be moved about 1km upstream of the present location, exposing a greater length of Red Hill Creek to treated effluent.
- ▶ Effluent quality from the upgraded WWTP is projected to be dramatically improved over the existing condition, with summer effluent temperatures of approximately 20°C.
- ▶ Thermal mixing and possible barrier effects of temperature to be considered.
- ▶ The location of the proposed outfall is marsh habitat, that may be utilized by spawning Red Hill Creek fishes. The wetland habitat there will be eliminated.

3. Predesign

River Mechanics and Morphology – Existing Conditions and Previous Monitoring

- ▶ Downstream of existing WWTP outfall, the creek is significantly wider relative to upstream.
- ▶ The creek is in the backwater hydraulic of Lake Ontario.
- ▶ From the emergency (maintenance) discharge location downstream the creek is bordered by significant infrastructure.
- ▶ Discharge monitoring has been ongoing by Environment Canada since the 1980's which will support design.
- ▶ River monitoring below Barton Street has been on-going since 2002 (cross sections, sediment inventory).

3. Predesign

River Mechanics and Morphology – Potential Issues

- ▶ Moving the permanent outfall upstream to the current emergency outfall location will alter the channel morphology – specifically:
 - ▶ Sustained increase in discharge will widen stream,
 - ▶ Clear water discharge will further contribute to channel widening, and
 - ▶ Channel migration will result.
- ▶ Adjacent infrastructure could be compromised from an increase in channel width.
- ▶ Vertical adjustments in the stream should not occur due to low channel slope.

3. Predesign



Hydrology and Hydraulics – Existing Conditions Hydrology

- ▶ Flow rates within the Red Hill Creek in the vicinity of the Woodward Avenue WWTP have been estimated based upon observed flows at the Queenston gauge, as well as the approved HSP-F hydrologic model for the Red Hill Creek Watershed.

3. Predesign

Hydrology and Hydraulics – Existing Conditions Hydrology

- ▶ The following “background” flow rates have been used for this assessment:
 - ▶ Baseflow of 0.1 m³/s.
 - ▶ Observed instantaneous maximum flow rate of 57 m³/s (at Queenston gauge)
 - ▶ Simulated instantaneous maximum flow rate of 79.9 m³/s (using HSP-F)
- ▶ An assessment of the hydraulic impacts of the existing and proposed discharge conditions for the WWTP under low, moderate, and high flow conditions was conducted.

3. Predesign

Hydrology and Hydraulics – Existing Conditions Hydrology

- ▶ The hydraulics within Red Hill Creek in the vicinity of the WWTP are influenced
 - ▶ By the backwater from Hamilton Harbour,
 - ▶ Base flow rate within Red Hill Creek,
 - ▶ Geometry of Red Hill Creek (i.e. channel cross-section),
 - ▶ Location of discharge from the Woodward Avenue WWTP itself.
- ▶ A total of 24 flow scenarios were evaluated to determine the hydraulic impacts of the proposed WWTP outlet to Red Hill Creek.

3. Predesign

Summary

- ▶ Shallow creek system (0.7 m+/-).
- ▶ Creek bed sediment of poor quality (geotechnical and environmental) 0.3 to 0.6 m thick.
- ▶ High density of breeding birds – likely need a pre-clearing contract (September 15 to February 28).
- ▶ No species at risk, 5 species of local concern, none are a constraint.
- ▶ Use of buried seed bank considered excellent restoration opportunity.

3. Predesign

Summary

- ▶ Predominant species of fish include: fathead minnows, green sunfish, pumpkinseed and round goby; limited pike habitat.
- ▶ Baseflow very low 0.1 to 1.0 m³/s (Note: proposed WWTP peaks at 11.6 m³/s).
- ▶ Average July/August 2010 water temperature was 24.2°C, with a maximum of 30.6°C.
- ▶ Study reach is currently an important nursery area for young-of-the-year white sucker.
- ▶ Geo/environmental assessment shows a range of poor to good quality soil; disposal and re-use opportunities requires careful examination to maintain construction cost effectiveness.

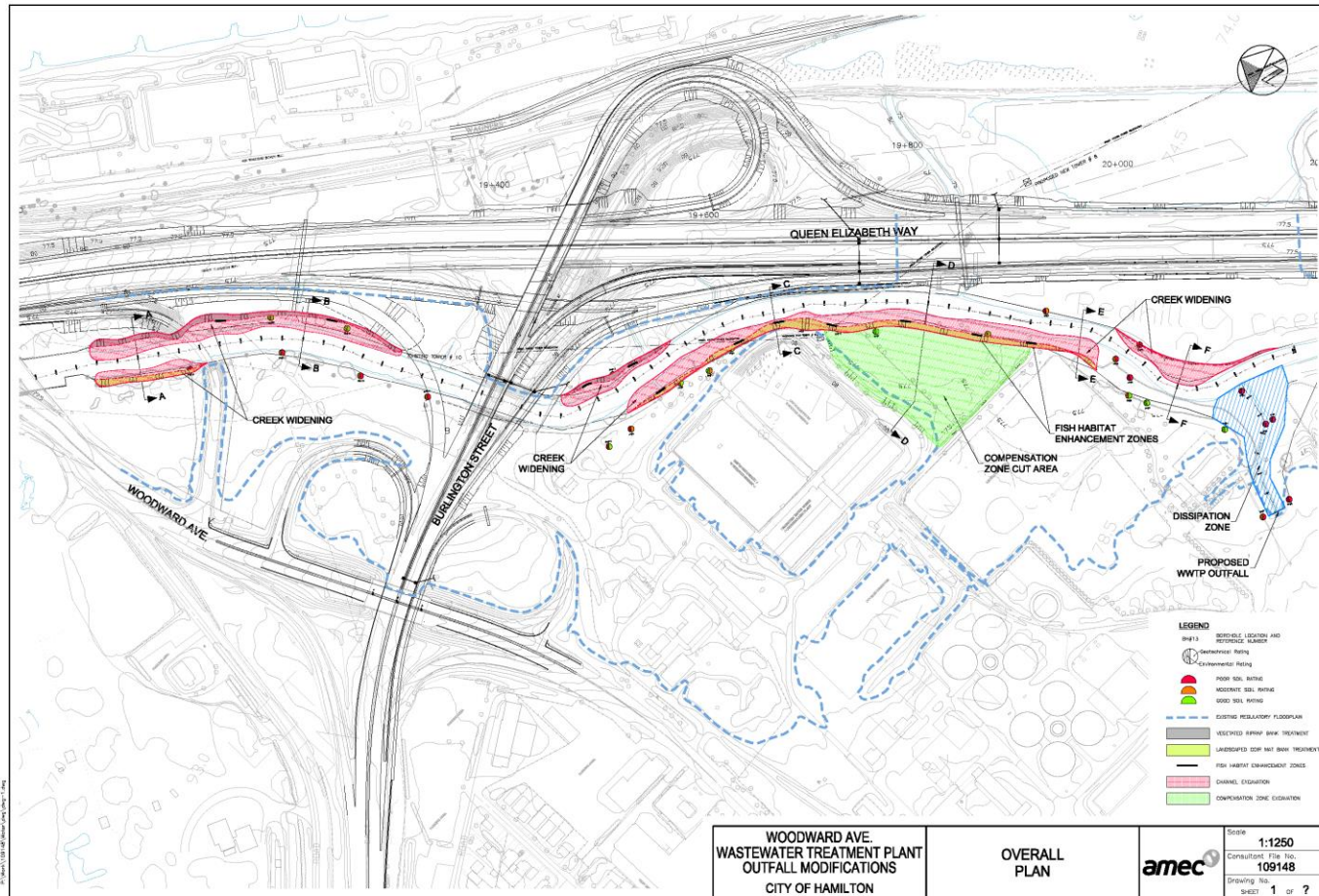
3. Predesign

Summary

- ▶ WWTP expansion site completely covered by Regulatory (Hurricane Hazel) Flood.
- ▶ 100 year flood limits do not extend onto table lands; July 26, 2009 storm caused flows to be 50% higher than 100 year storm peaks
- ▶ Flood protection for development site can be addressed by way of two berm systems;
 - ▶ Redesigned railway berm (designed to water retention standards)
 - ▶ Backwater prevention berm through the Hamilton Steam Museum lands.
- ▶ Concern with displacement of flood storage due to WWTP expansion advanced to HCA for consideration.

3. Predesign

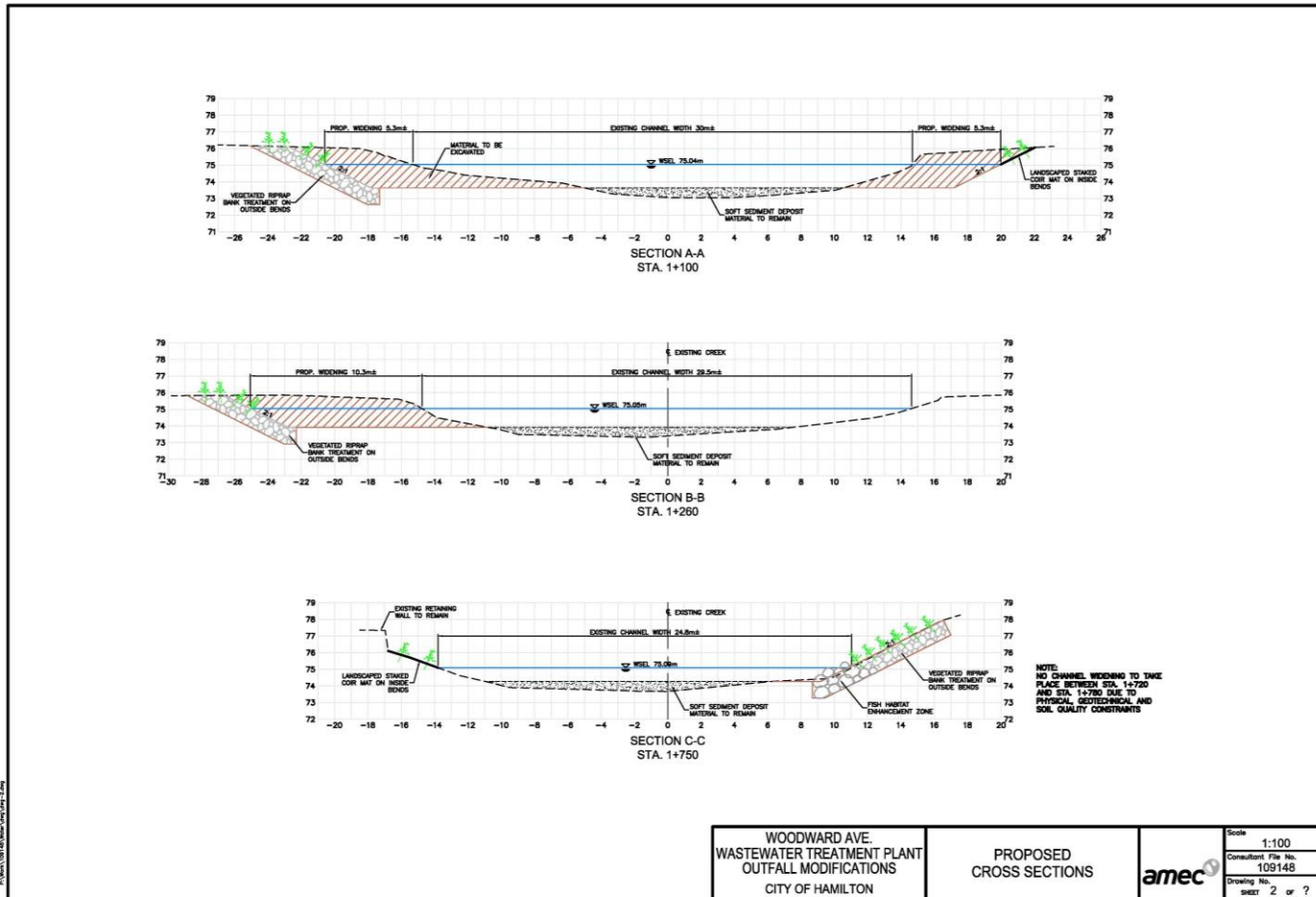
70 % Design



3. Predesign



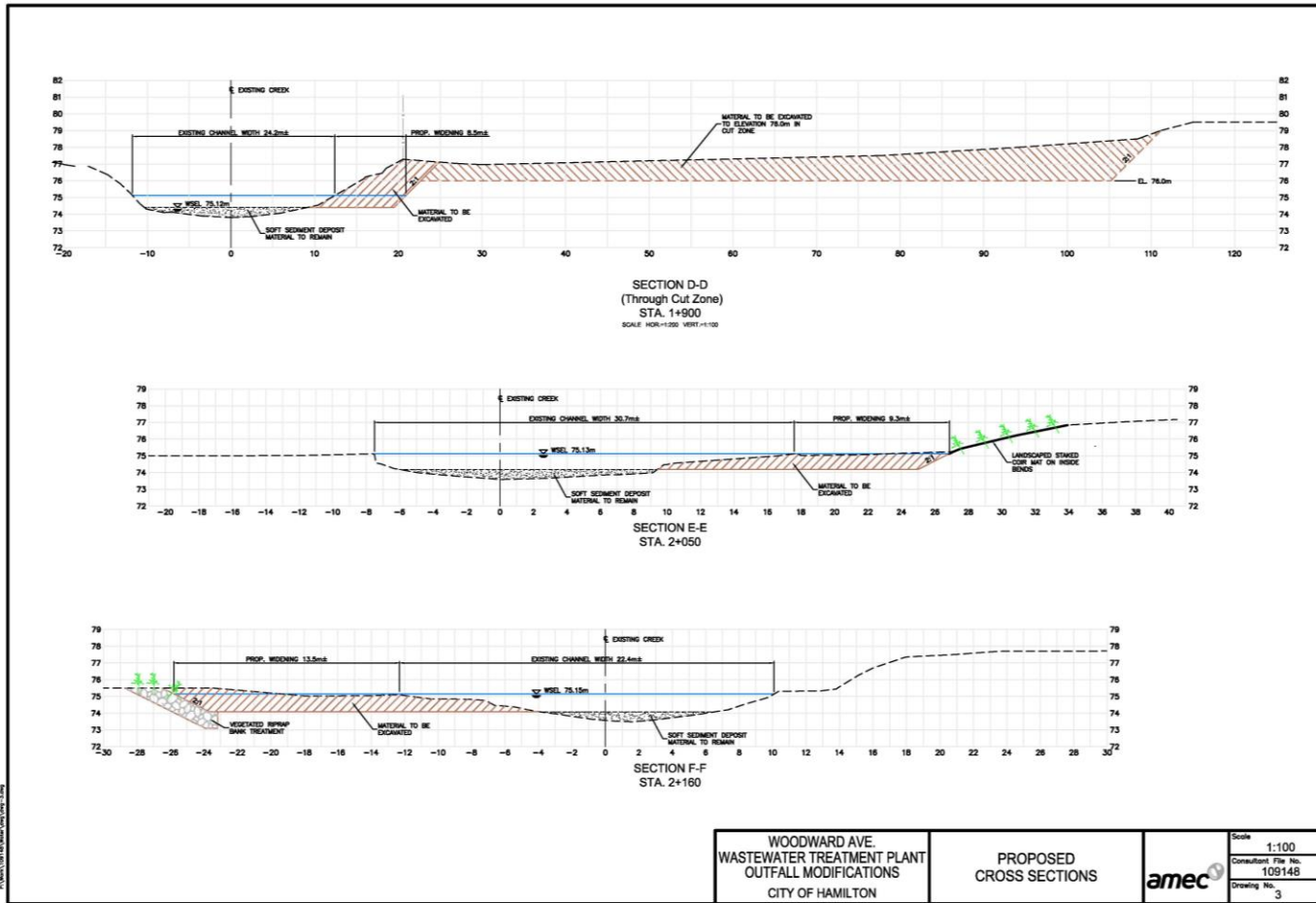
70 % Design



3. Predesign

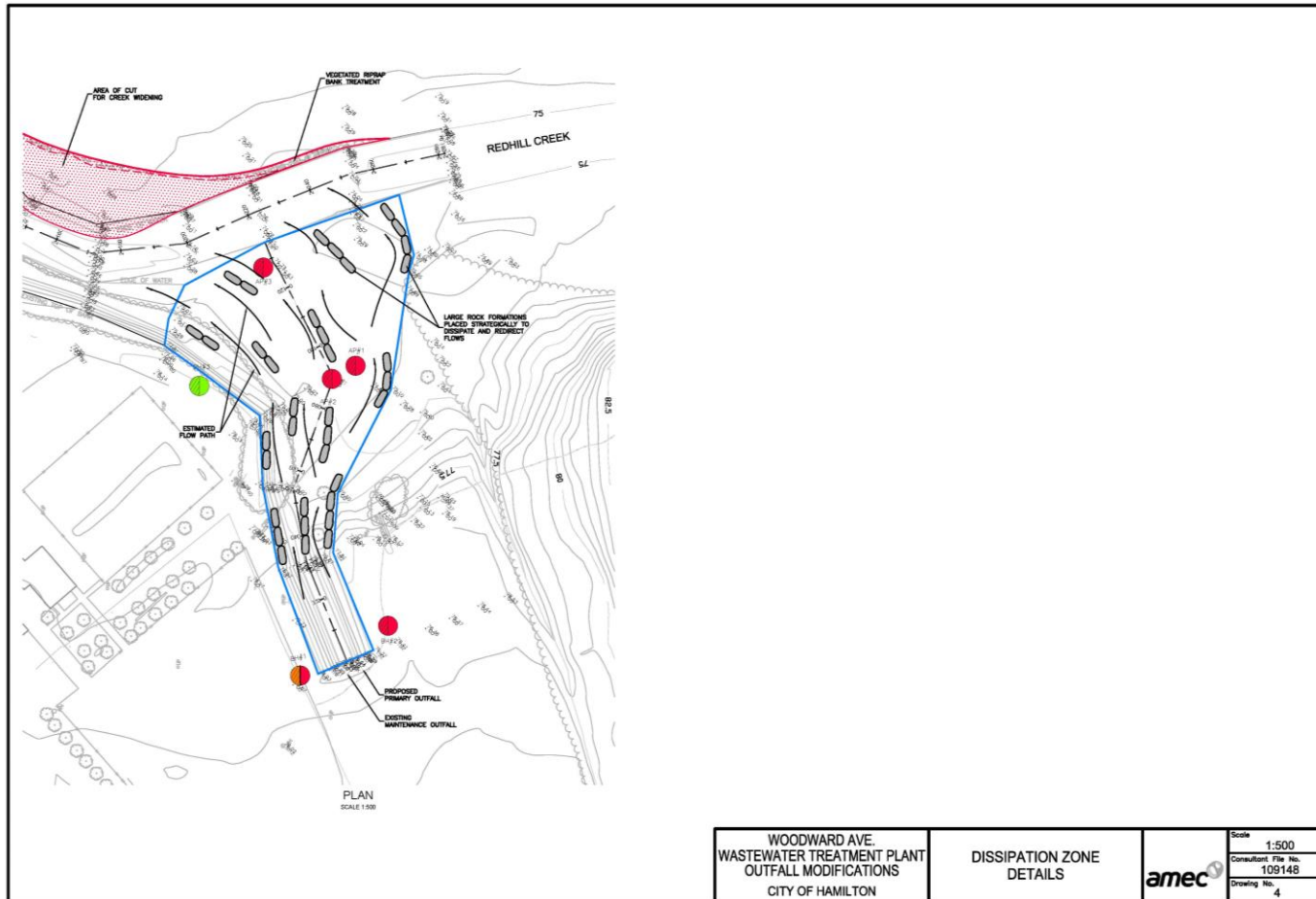


70 % Design



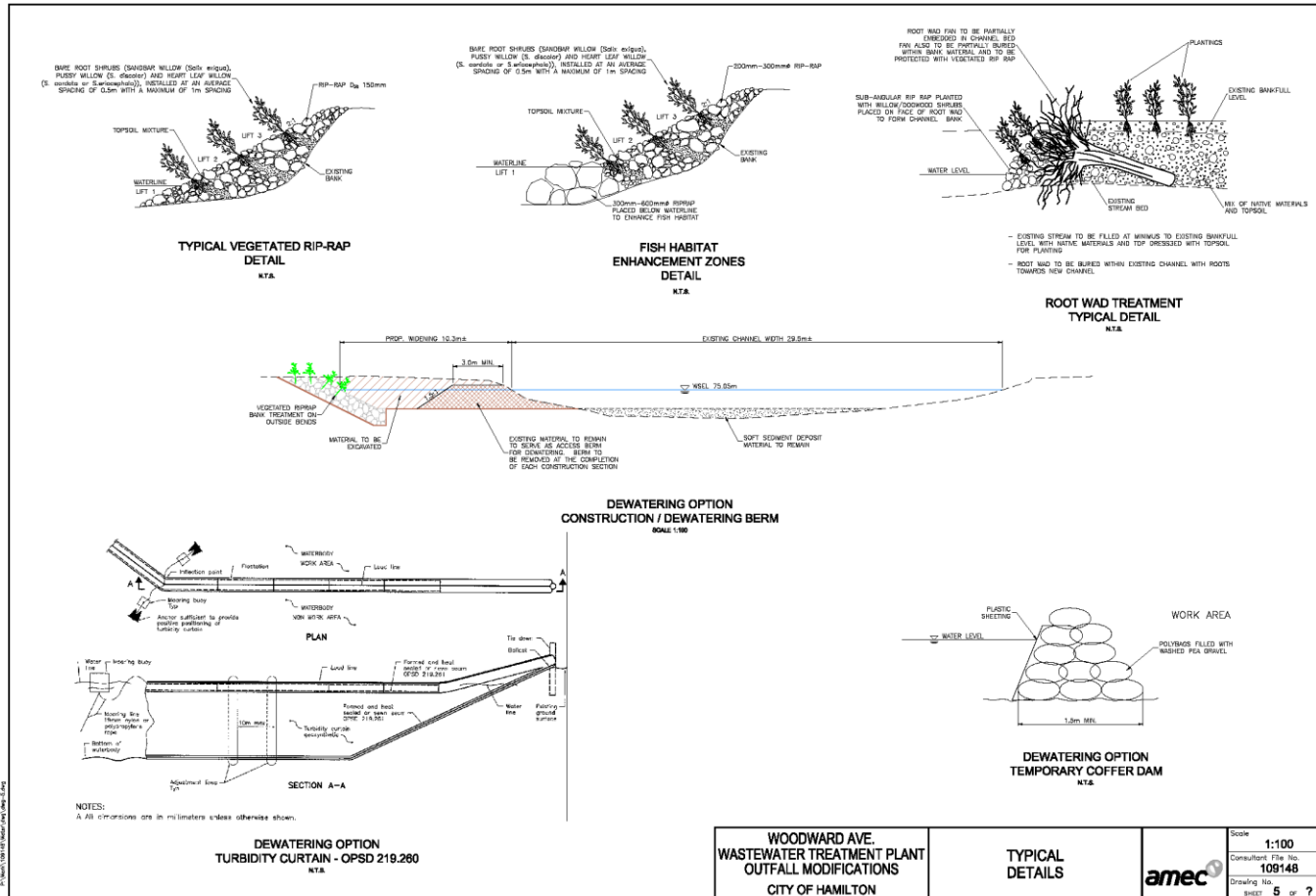
3. Predesign

70 % Design



3. Predesign

70 % Design



4. Predesign since Restart in 2014



4. Predesign Since Re-start in 2014

- ▶ Early 2011 overall water quality project placed 'on hold' due to variety of factors including:
 - ▶ Slower anticipated urban growth (deferral)
 - ▶ Reduction in industrial needs
 - ▶ Financing / funding

4. Predesign Since Re-start in 2014



- ▶ Mid 2014 project re-started
- ▶ Need to re-visit a number of base considerations in the *Predesign* including:
 - ▶ Species at Risk (SAR) to 2015 expectations
 - ▶ Fisheries Window for construction
 - ▶ Revised flow projections / phasing period for creek system design
 - ▶ Flood protection backwater berm
 - ▶ “Compensatory Triangle”

4. Predesign Since Re-start in 2014

Species-at-Risk (SAR)

- ▶ Additional surveys conducted over 2014 specific to:
 - ▶ Amphibians
 - ▶ Breeding birds
 - ▶ Turtles

- ▶ Two (2) avian SAR observed in 2014
 - ▶ Chimney Swift
 - ▶ Barn Swallow

neither was nesting in the area; *WWTP works deemed not to adversely cause impacts*

4. Predesign Since Re-start in 2014

Species-at-Risk (SAR)

- ▶ Search for snapping turtles resulted in no findings: deemed to be further upstream; *WWTP works deemed not to adversely cause impacts*
- ▶ No amphibian species detected during nocturnal surveys; Green Frog observed during diurnal surveys; due to habitat conditions *no impacts anticipated*
- ▶ Species-at-Risk screening
 - ▶ Only other species potential – Monarch Butterfly
 - ▶ Uses common milkweed as host hence *no impacts to this is anticipated*

4. Predesign Since Re-start in 2014



Fisheries Window

- ▶ Status of Red Hill Creek as “warmwater” was potentially being considered to be modified through MNRF.
- ▶ City team engaged MNRF in dialogue concluding that:
 - ▶ Red Hill Creek does not support resident salmonid habitat

4. Predesign Since Re-start in 2014



Fisheries Window

As such

“Given the biological and physical evidence available – a fall timing restriction for ‘in-water’ works for Red Hill Creek seems overly prohibitive. However, the fall migration movement of pacific salmon through the construction site should be monitored at all times”

4. Predesign Since Re-start in 2014

Revised flow Projections / Phasing for Creek System

i. Original (2010 +/-)

- ▶ Dry Weather 500 mL/day (5.78 m³/s)
- ▶ Maximum Wet Weather 1000 mL/day (11.57 m³/s)
- ▶ 5 to 6 year phase-in period (2013/2014 to 2019)

ii. Current (2015)

- ▶ Dry Weather 409 mL/day (4.72 m³/s)
- ▶ Maximum Wet Weather 614 mL/day (7.09 m³/s)
- ▶ 10+ year phase-in period (2015/2016 to 2025)

4. Predesign Since Re-start in 2014



Revised flow Projections / Phasing for Creek System

Three (3) options for consideration:

Option 1: Continue to advance 2010 design based on 1000 mL/day maximum (**oversize the system short term**)

Option 2: Consider some proactive measures to allow the current design to adjust over time to allow for the watercourse to be stable over the extended implementation timeframe. (**size to ultimate and allow for adjustments**)

Option 3: Redesign the creek improvements to 2015 flow condition and consider either proactive or reactive measures to transition the system to ultimate flows (**allow system to actively erode**)

4. Predesign Since Re-start in 2014



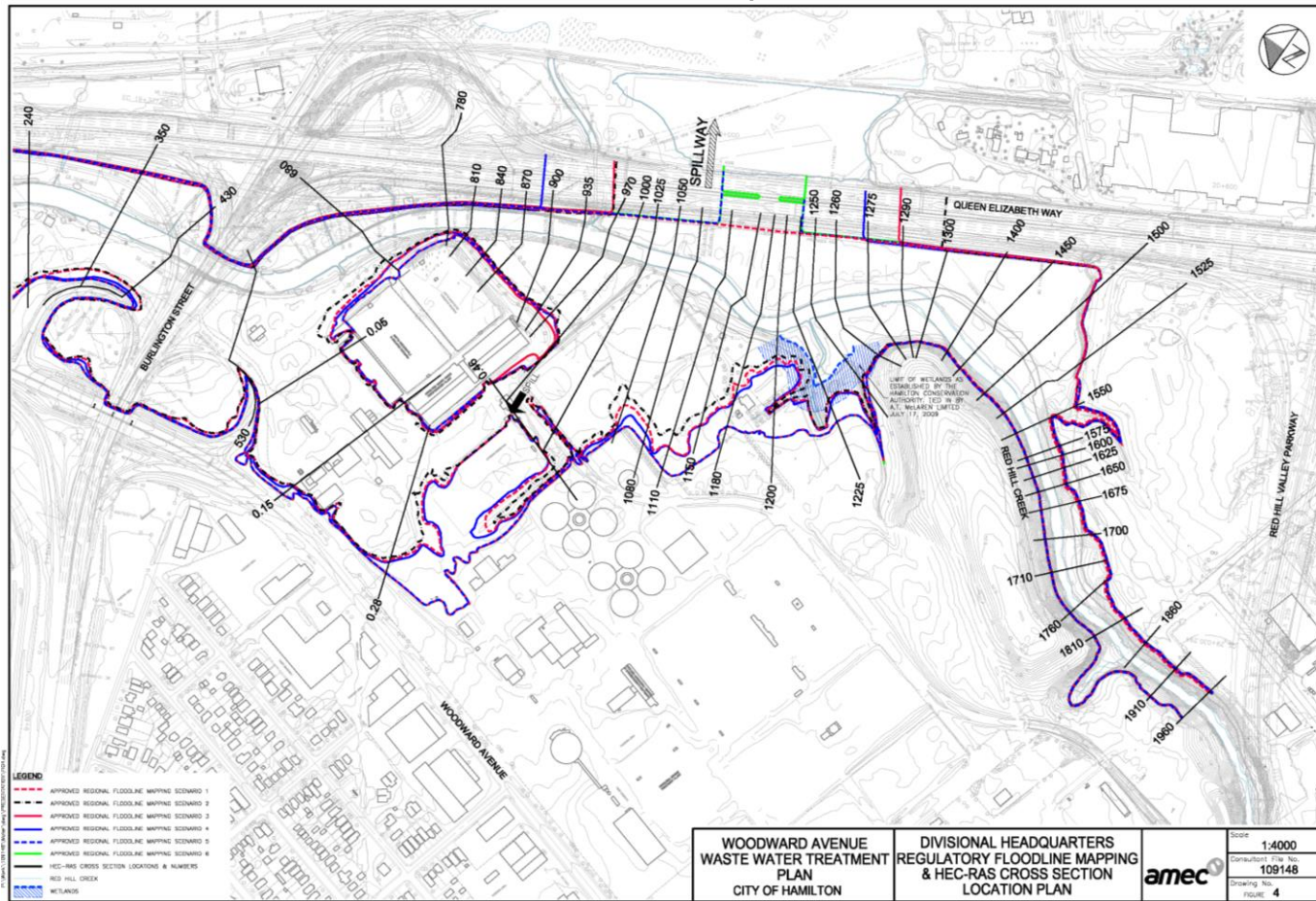
Revised flow Projections / Phasing for Creek System

Proactive Approach (Option 2) Preferred

- ▶ Maintains bank stability during the WWTP flow transition period,
- ▶ Lowest of construction costs of the three (3) options considered
- ▶ Ecologically preferable (less sediment deposition and less erosion)
- ▶ More stable than overbuilding the creek

4. Predesign Since Re-start in 2014

Flood Protection Backwater Berm Current Floodplain



4. Predesign Since Re-start in 2014

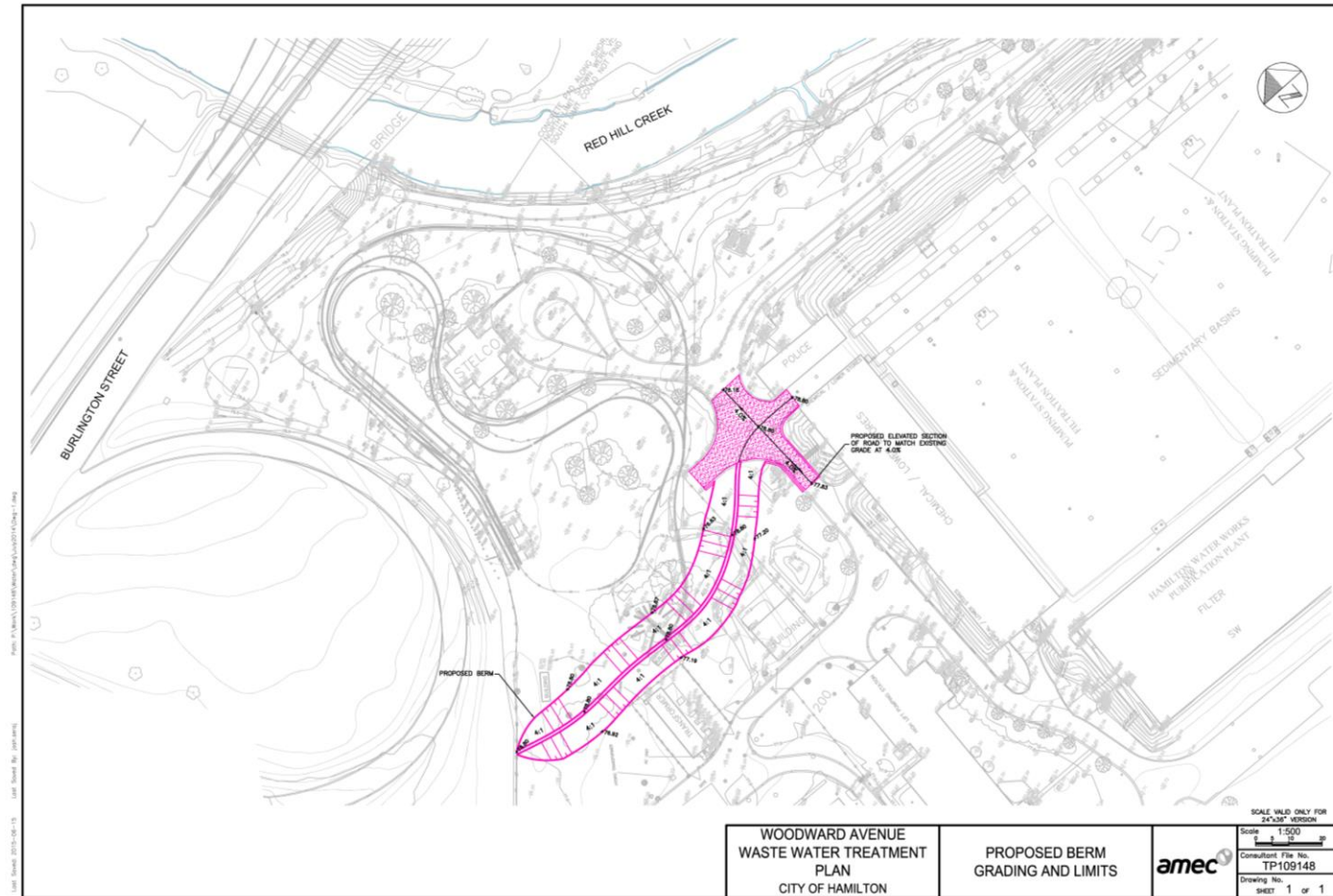


Flood Protection Backwater Berm Design

- ▶ Objective to protect whole of WWTP site to Regulatory standard
- ▶ The proposed berm (which would protect the WWTP during a Regulatory event) may have impacts on adjacent flood levels and spill flows across the QEW.
- ▶ Design developed which requires no manual intervention and avoids impacts to Steam Museum.

4. Predesign Since Re-start in 2014

Flood Protection Backwater Berm



4. Predesign Since Re-start in 2014



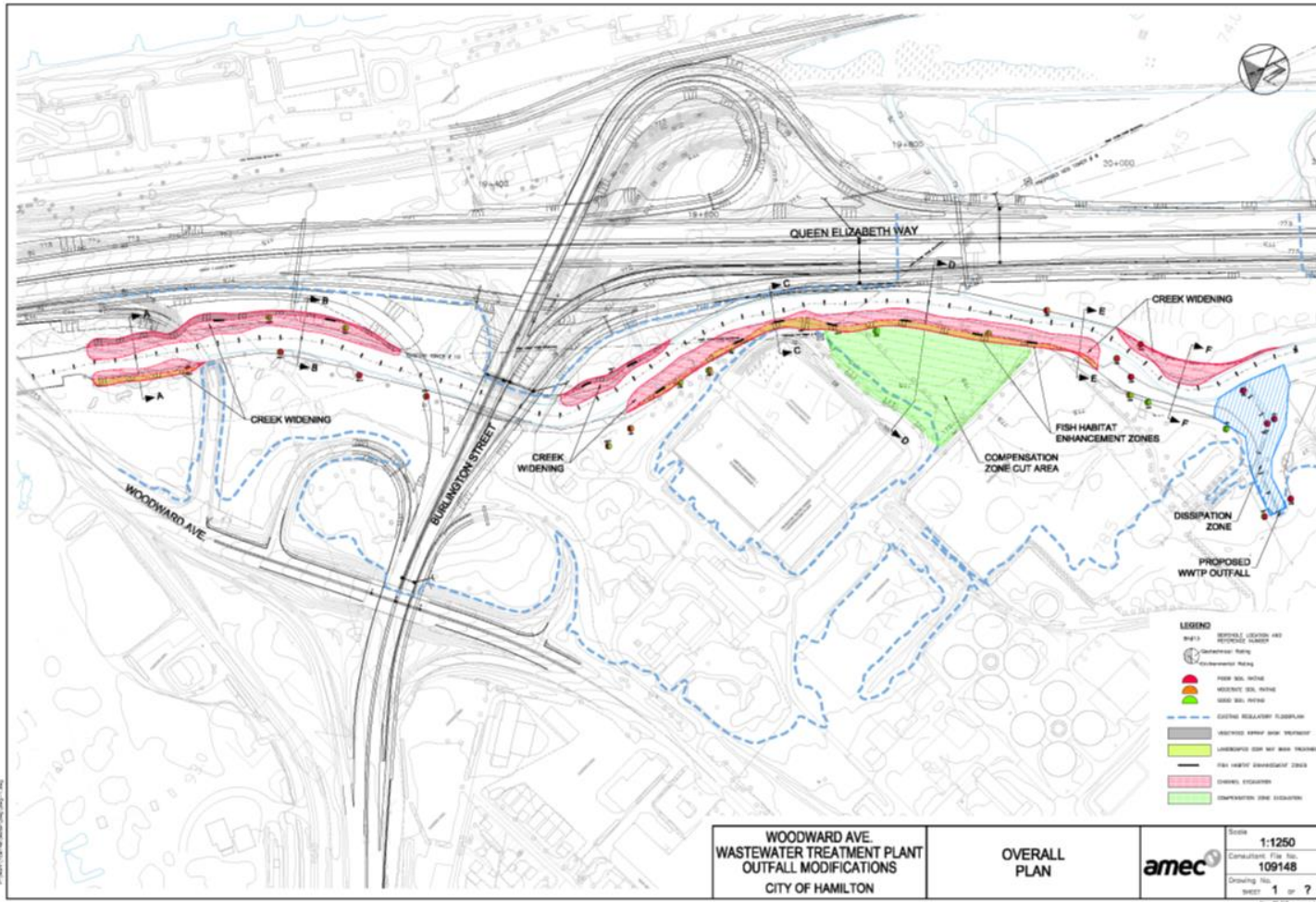
Compensatory Triangle (Floodplain Optimization)

- ▶ Upon restart, City staff identified a new potential land use constraint associated with the need to possibly protect a portion of the overall land area, previously identified for compensatory cut, for future water plant expansion.
- ▶ As such, new hydraulic analyses were required to assess the impact on flood levels both on-site and off-site.

4. Predesign Since Re-start in 2014



Compensatory Triangle (Floodplain Optimization)



4. Predesign Since Re-start in 2014

Compensatory Triangle (Floodplain Optimization)

- ▶ confirms need/requirement for backwater berms
- ▶ limited influence of filling on adjacent flood levels or spill across the QEW
- ▶ continued loss of riparian flood storage, however impact on peak flows <1%
- ▶ need for further consideration of compensation wetland in other locations should this site be utilized for other purposes

5. Next Steps



5. Next Steps

- ▶ 2010 Predesign is being updated to reflect supplemental work
- ▶ Agency / Regulator Consultation
 - ▶ Hamilton Conservation Authority
 - ▶ Ministry of Natural Resources and Forestry
 - ▶ City
 - ▶ Ministry of Transportation Ontario
 - ▶ Others
- ▶ Initiate Detailed Design

Thank you

