

The Living Infrastructure of Lower Spencer Creek – Restoring the Future



Lower Spencer Integrated Subwatershed EA - Purpose

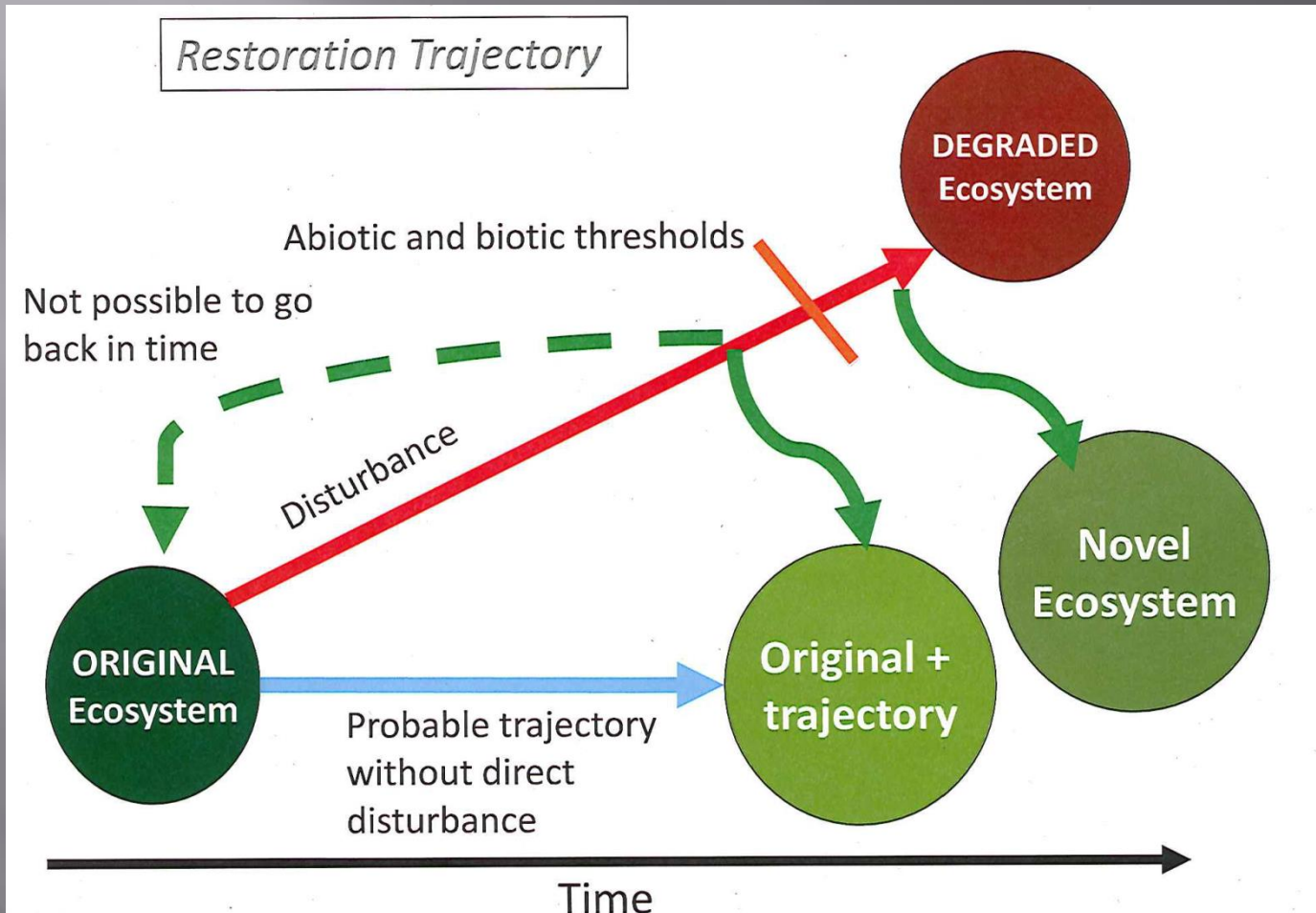
Purpose:

This project is being undertaken in order to assess the overall health of the creek system and will incorporate considerations for flooding, erosion, surface and groundwater flow patterns, fish habitat and migration, the terrestrial environment, and water quality as well as how these aspects interact with each other. It will also examine future stresses and opportunities to the Lower Spencer Creek system and develop an adaptive management approach to improve the health of the watershed and the residents that live within.



Restore to What?

Source: EPA GLPO

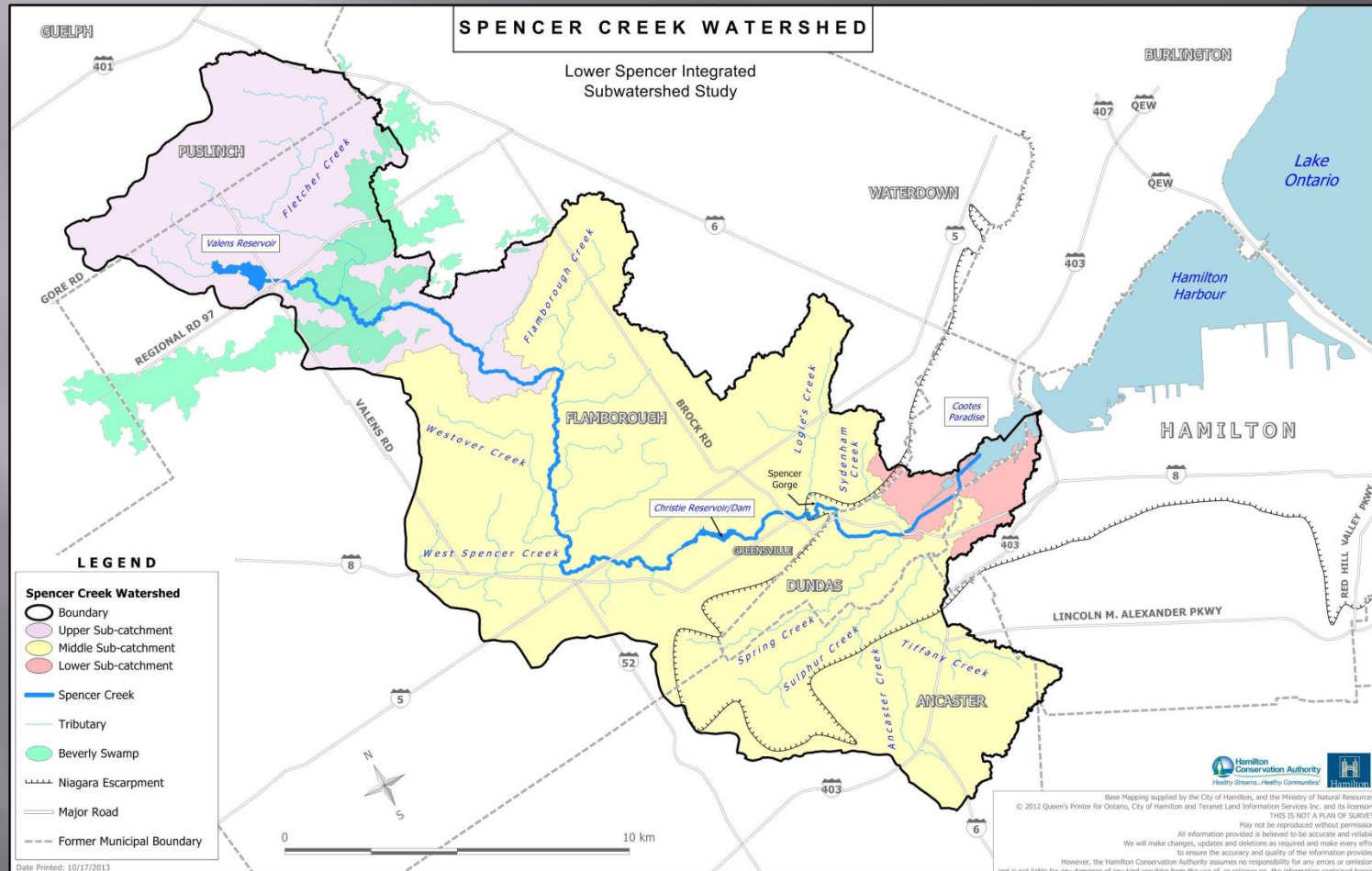


HOW?

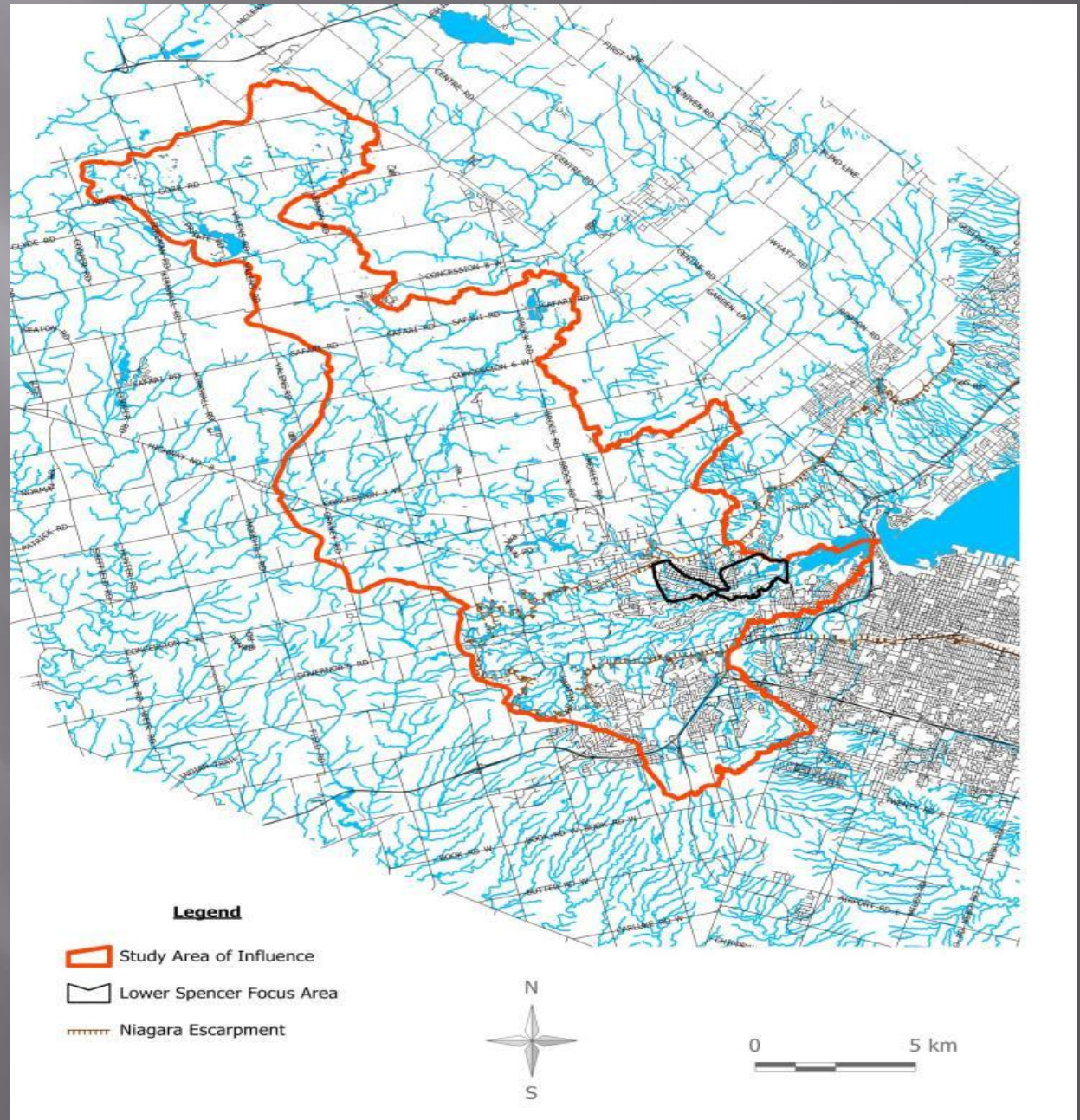
1. Whole Systems
– Nested
Scales
2. Adaptive
Management
3. Sound Science
4. Community
Needs
5. Shift in
Paradigms



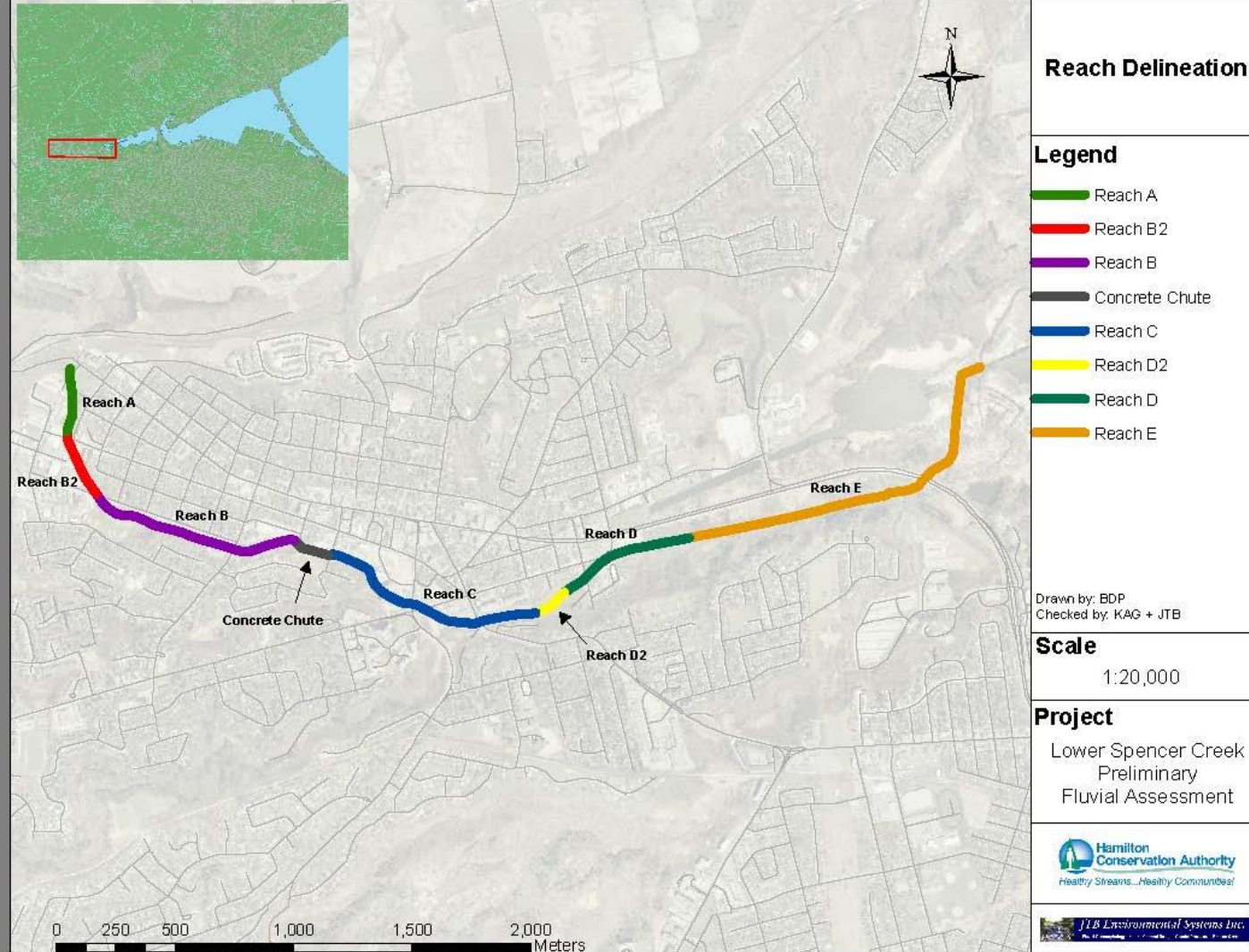
Spencer Creek Watershed



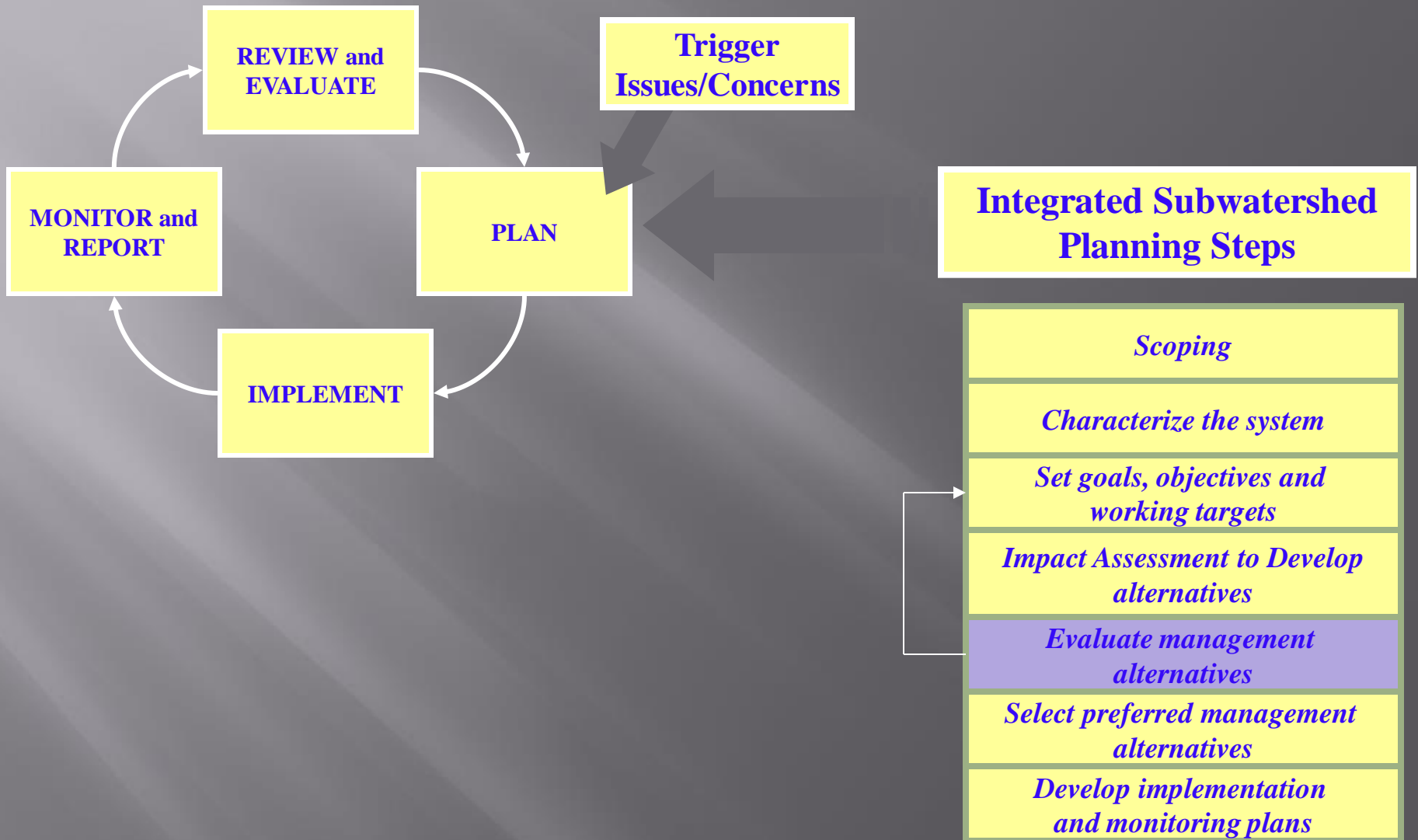
Scale Of Assessment



Reach Delineation



Integrated Subwatershed Process



Defining The Problem

1. Flooding
2. Erosion
3. Water Quality
4. Aquatic and Terrestrial Habitat



Study Components

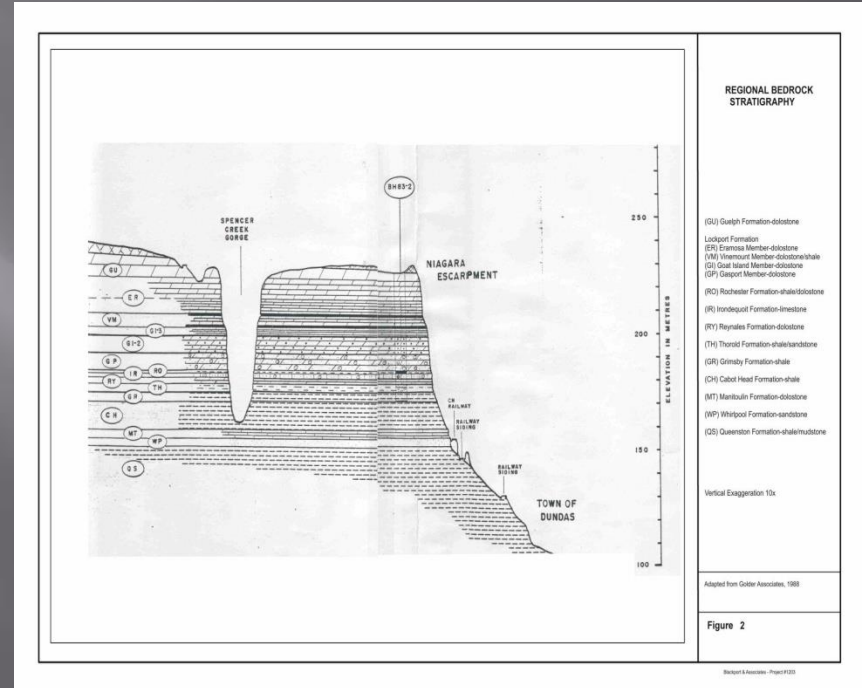
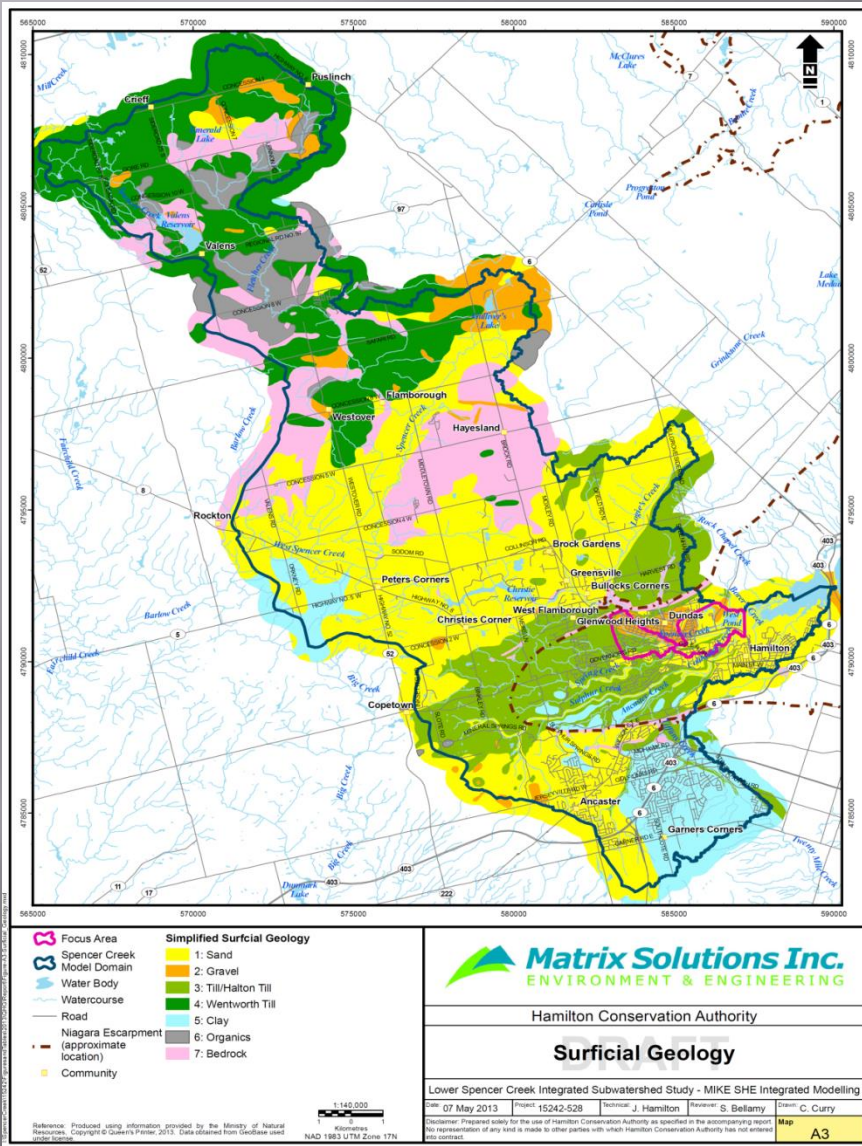
- ▣ Hydrogeology
- ▣ Hydrology
- ▣ Hydraulics
- ▣ Fluvial Geomorphology
- ▣ Water Quality
- ▣ Terrestrial
- ▣ Aquatics



Characterizing the System

- ▣ Review Background Material
- ▣ Develop and carry out Monitoring Program
- ▣ Characterize by discipline
- ▣ Perform Integration to Characterize Watershed System

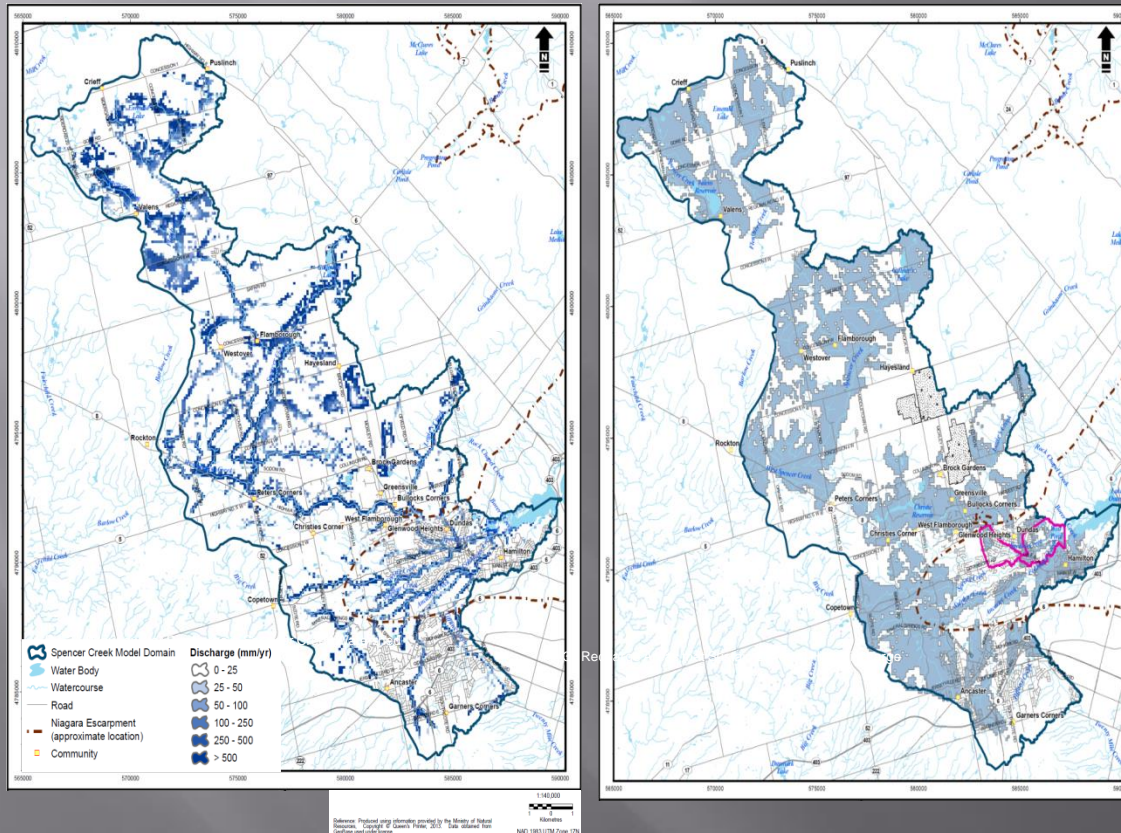
Lower Spencer Integrated Subwatershed EA – Hydrogeology



Lower Spencer Integrated Subwatershed EA – Hydrology

Spencer Creek Watershed Hydrologic Characterization

In support of the Lower Spencer Integrated Subwatershed Study, an integrated surface water and groundwater computer model was developed for the Spencer Creek Watershed to characterize existing flow conditions in Lower Spencer Creek.



Lower Spencer Integrated Subwatershed EA – Watercourse Hydraulics

Phase I – Characterization



Cootes Drive



Ogilvie Street



John Street



McMurray Street



Market Street



Webster's Falls



Webster's Falls Park

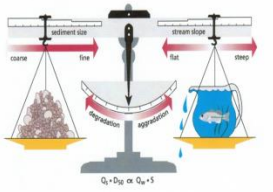
The flood plain along Lower Spencer Creek is a function of the channel hydraulics and backwater from the outlet of Cootes Paradise at Highway 403. Channel hydraulics has been significantly modified over the decades to accommodate urban land uses.

- Topographic maps were developed to help build computer models and show land use within the flood plain.

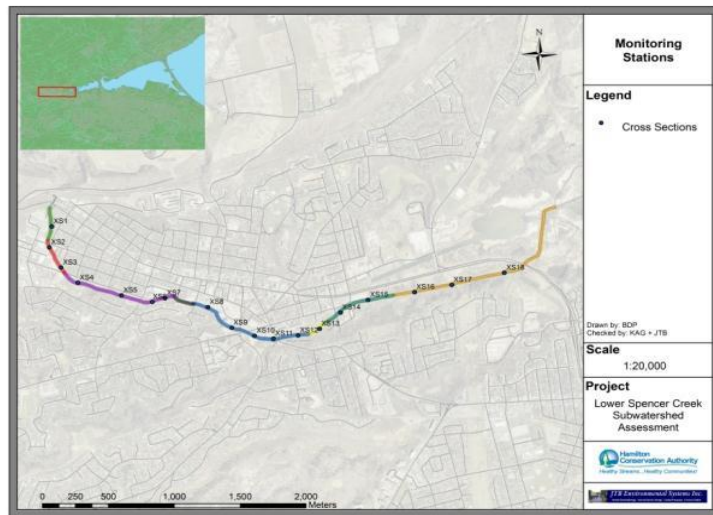
- Computer models were developed to estimate flood depths, flood velocities, and structure capacities.

- Floodlines were delineated on the topographic maps from downstream of Cootes Drive to upstream of Brock Road.

Lower Spencer Integrated Subwatershed EA – Fluvial Geomorphology



Changes within a watershed due to human influences can result in significant impacts on rivers. The Lower Spencer Creek is a river system which has been highly altered by human influences as the Town of Dundas grew and urbanized the surrounding landscape.



SUMMARY

Lower Spencer Creek has been altered a number of times in order to accommodate land use change. In its current configuration it is severely confined in a tight urban corridor, entrenched and disconnected from any possible floodplain. A consequence of that positioning is stream energy is confined for most return period storms to the channel, resulting in high concentrations of energy which results in erosion.

Lower Spencer Integrated Subwatershed EA – Water Quality

SUMMARY

Water quality in Spencer Creek is generally acceptable, and reflects its transition from wetland and agriculture dominance in the upper watershed to urban influences, most notably stormwater inputs, in the lower watershed.

WATER QUALITY BY REACH

The Canadian Council of Ministers of the Environment Water Quality Index changed from “Good” far upstream of Dundas (Safari Rd., Highway 5), to “Fair” immediately upstream of Dundas (King St.) and within Dundas (Market St.), to “Marginal” downstream of the town (Cootes Dr.).

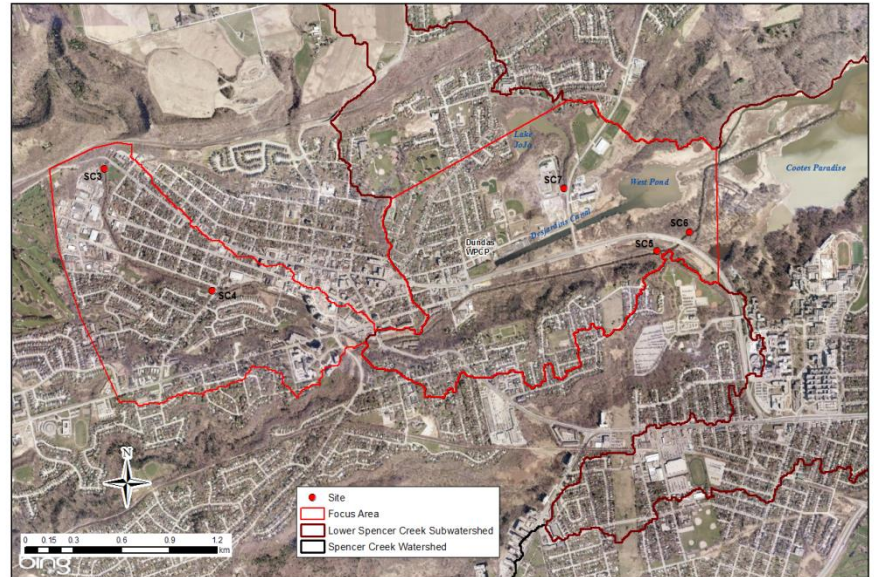
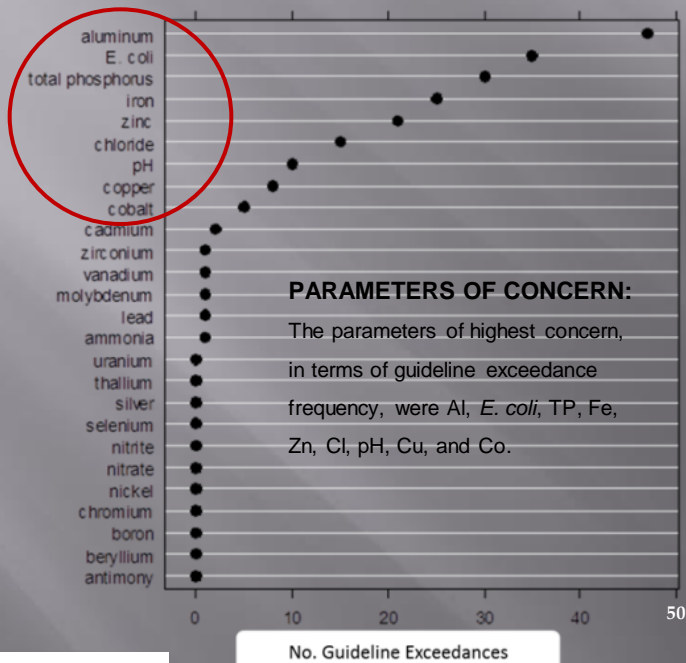


Figure 2: The Lower Spencer Creek Integrated Subwatershed Study Area
 Prepared by: Eric Dilligard
 Date: Feb 24, 2013
 Data Source: Hamilton Conservation Authority, © 2010 DigitalGlobe Image courtesy of USGS © 2013 Microsoft Corporation
 Coordinate System: UTM Zone 17, NAD83



TOTAL SUSPENDED SOLIDS (TSS)

Most parameters that frequently exceeded Provincial Water Quality Objectives were correlated with TSS, indicating the influence of erosion and surface runoff from agricultural (upper watershed) and urban (lower watershed) areas.



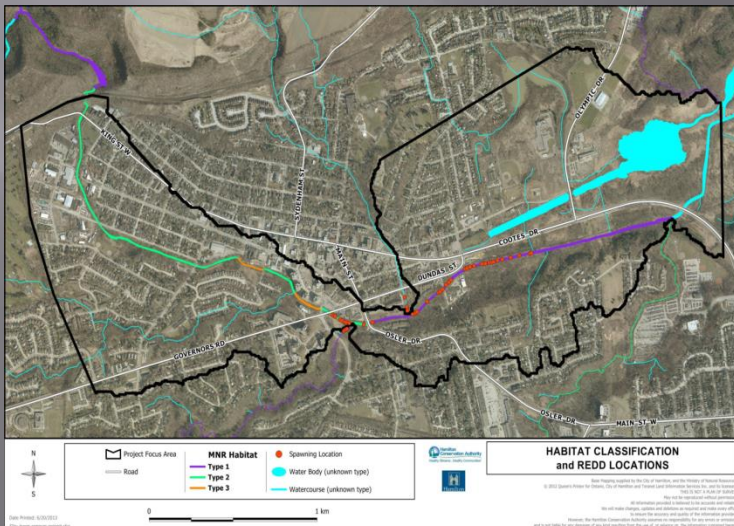
STORMWATER

High concentrations of some metals (Al, Fe, Zn), TSS, Total Phosphorus, and bacteria (*E. coli*) were found in the stormwater coming from Dundas.

Lower Spencer Integrated Subwatershed EA – Aquatics

Phase 1 – Characterization Summary

Lower Spencer Creek subwatershed supports a cool/coldwater fish community and the lower portion of the subwatershed provides critical spawning for Rainbow Trout and Chinook salmon populations that migrated from the Hamilton Harbour through Cootes Paradise. Although this system supports a cool/coldwater fishery, there is limited available habitat due to man-made barriers and limited variable habitats such as pools. Impacts related to urbanization and agriculture areas may also be evident in fish communities quantitatively scored from poor to fair in terms of a Index of Biotic Integrity applied to Spencer Creek watershed. The lower portion of the creek provides recreational opportunity for fishing and passive observation of fish spawning. An investigation and feasibility study into the removal of the barriers, or appropriate mitigation approach will be undertaken in the restoration of this creek system, as well as an investigation into the impacts related to urbanization that surrounds this system.



Station	Total Abundance	Family Richness	Hilsenhoff FBI	% EPT	EPT/Chironomidae	Site Condition
ANC377-A1	237	1.3	6.16	2.11	0.03	Impaired
LSP378-A1	292	3.3	5.16	21.2	0.46	Potentially impaired
LSP378-A2	287	4.3	5.42	15.56	0.23	Potentially impaired
LSP378-A3	310	4.39	4.39	75.16	5.06	Unimpaired
LSP378-A4	306	5.19	5.19	32.67	1.15	Unimpaired
MSP339-A1	317	4	4.11	86.75	21.15	Unimpaired
MSP342-A1	320	2.7	7.29	1.9	0.46	Impaired
MSP-MILL	No data					

Why do we need to restore for the future?



Figure 2: The Lower Spencer Creek Integrated Subwatershed Study Area

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Lower Spencer Integrated Subwatershed EA

Goals:

- Control flooding within the subwatershed through remedial works and land use controls;
- Minimize soil loss through land management practices and remedial control measures.
- Protect, maintain and enhance aquatic communities, with special regard for fish and fish habitat;
- Maintain or restore water quality to a level which maintains ecological integrity and permits desired uses including recreational activities;
- Protect and maintain groundwater recharge/discharge areas and baseflow to a level which ensures adequate supply for desired uses;
- Protect and maintain self-sustaining natural ecosystems and significant natural features;
- Protect diverse recreational opportunities that are in harmony with the environment;
- Protect and enhance the environment in a manner which is in harmony with the natural features of the subwatershed;

Impact Assessment

- ▣ Test the system for identified Stressors
- ▣ Identify Impacts
- ▣ Identify Long List of Alternative Solutions for Novel Ecosystem (Do Nothing, Structural, Non Structural)
- ▣ Evaluate Alternatives against Goals and Objectives
- ▣ Select Preferred Alternatives

Watershed/Subwatershed Stressors

- ▣ Impact Scenario #1 – Increase in naturalization by Implementation of Low Impact Development Techniques at the subwatershed scale in Dundas
- ▣ Impact Scenario #2 – Increase in Irrigation Demand and Quarrying in upper watershed
- ▣ Impact Scenario #3 – Drought Condition at the watershed scale

Approach to Impact Assessment

Discipline	Scale of Analysis	Tools Used	Indicators for Measuring Change
Hydrology	Watershed, subwatershed	Stormwater Modeling	Peak flows, base flows
Hydraulics	Reach	Hydraulic Modeling	Flood elevation, velocities, structures in floodplain
Fluvial Geomorphology	Reach	Stream metrics e.g. slope, substrate	Flow regime, velocities
Water Quality	Watershed, Subwatershed	Export Coefficient Modeling, Flow Based Loading	Phosphorus and TSS concentrations
Terrestrial	Landscape , Watershed, Subwatershed	Corridor Analysis ELC Faunal Surveys	Floristic Quality Index Shannon Diversity Index Bird Communities by Type Connectivity
Aquatics	Reach	All of the above	Species Diversity, Richness, Abundance, Fish Life Stages

Lower Spencer Integrated Subwatershed EA – Hydrology

Impact Scenario #1 Preliminary Results – Low Impact Development Implementation in Dundas

A representative hydrograph downstream of Dundas was selected in August 1995 to show the local impacts of LID implementation (Figure 1). The results on the local storm hydrograph are threefold:

- *Reduction in Peak Flow:* The hydrograph shows 12% reduction of the highest peak flow, 30% of the lower peak
- *Reduction in Hydrograph Volume:* The overall hydrograph has 10% reduction in runoff volume
- *Increase in Time to Peak:* Slight delay in the time to peak of the initial peak – increases from 8 hours to 9 hours; there is no delay in the time to peak of the higher peak flow

Impact Scenario #2 Preliminary Results – Increased Irrigation Demand

- An increase in irrigation to the “maximum irrigated lands” scenario results in slight decreases to the average Summer Low Flows in the Lower Spencer Creek.

Impact Scenario #3 Preliminary Results – Drought Condition Testing for Resilience

- Recovery of groundwater levels in Beverly Swamp area and Westover Creek subwatershed was better than those around Greenville and near Fletcher Creek. In the drought scenario, there was no major reduction in low flows due to an extended drought period. There was a slight decrease in summer low flows from 1998 to 2003, but low flows are relatively stable at the 7Q10. This suggests that the storage available in Spencer Creek is sufficient to maintain the 7Q10 streamflow in spite of drought.

Lower Spencer Integrated Subwatershed EA – Watercourse Hydraulics



Environmental Water
Resources Group Ltd.



Alternative 1 – Do Nothing

The Do Nothing Alternative assumes current practices of flood plain management are maintained.

Alternative 2 – Non Structural

Alternative 2 enhances current management practices along Lower Spencer Creek. Alternative 2 includes the following:

- Continue to provide flood warnings to the City of Hamilton;
- Continue to Regulate flood plain lands in Dundas;
- Review and update the Special Policy Area through Dundas; and
- Develop an Emergency Preparedness Plan to deal with potential flooding.

Alternative 3 – Structural

Increase the level of flood protection to the Regional Storm by:

- Providing a spillway from the CN Railway to downstream of King Street to convey the Regional Storm;
- Providing a sufficient channel and crossings to convey the Regional Storm from King Street to Thorpe Street; and
- Providing additional capacity at the Cootes Paradise outlet to alleviate potential flooding in Dundas.

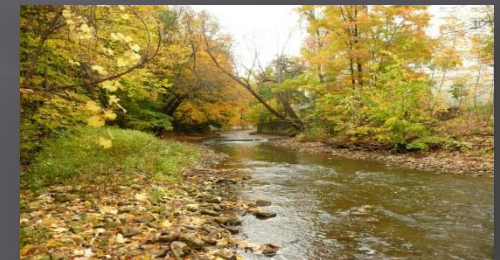
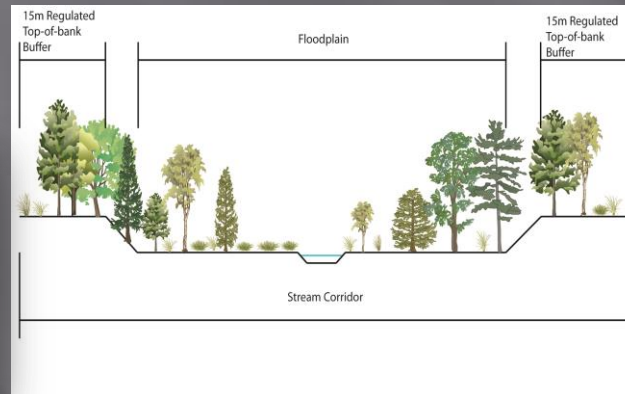
Lower Spencer Integrated Subwatershed EA – Fluvial Geomorphology

Plan Form Adjustment

The goal is to reduce channel slope and provide floodplain access. Both measures will lower flow velocity under flood conditions and increase channel stability.



Drawn by: BDP
Checked by: KAG + JTB



Lower Spencer Integrated Subwatershed EA – Water Quality

Impact Assessment Scenarios

Scenario #1

Where	Lower Watershed – Town of Dundas
What	Implement Best Management Practices (BMPs) and Low Impact Development (LID) Techniques in 50% of urban area to reduce runoff and pollutant export
How	Calibrated export coefficient modelling
Results	Reduced pollutant export and estimated improvements in water quality in Lower Spencer Creek

Scenario #2

Where	Upper watershed
What	Increased irrigation on agricultural lands will result in more intensive agriculture (exposed soils and increased runoff sensitivity with no BMPs) + increased runoff with 50 % increase in quarry size and dewatering.
How	Export coefficient modelling
Results	Degraded water quality

Scenario #3

Where	Entire watershed
What	Increased drought conditions on a warmer climate. Longer periods of baseflow/ low flow and same summer precipitation volume delivered in fewer more intense storms .
How	Partition measured pollutant loading (2011-2012) into low flow and storm flow events. Model longer periods of low flow and fewer more intense storms based on measured loadings
Results	Degraded water quality

Lower Spencer Integrated Subwatershed EA – Terrestrial Impact Assessment

•Do nothing

System will continue to degrade as non-native invasive species expand, human impacts continue and connectivity remains limited

• Structural - Corridors and connectivity (subwatershed and site level)

Improve connectivity through the subwatershed and site level
Recommendations include bridge replacements to improve wildlife passage and increasing the width of corridors.

• Structural - Trail design and (site level)

Move current pedestrian trail to the edge habitat of the current corridor

•Non-Structural - Habitat quality (site level)

Removal of aggressive non-native invasive species (dog-strangling vine, Japanese knotweed, tree of heaven and black locust).

Landscape remediation with native species, tree and understory plantings.

Education of landowners in regards to feral and household pets.

•Non-structural - Human impacts (site level)

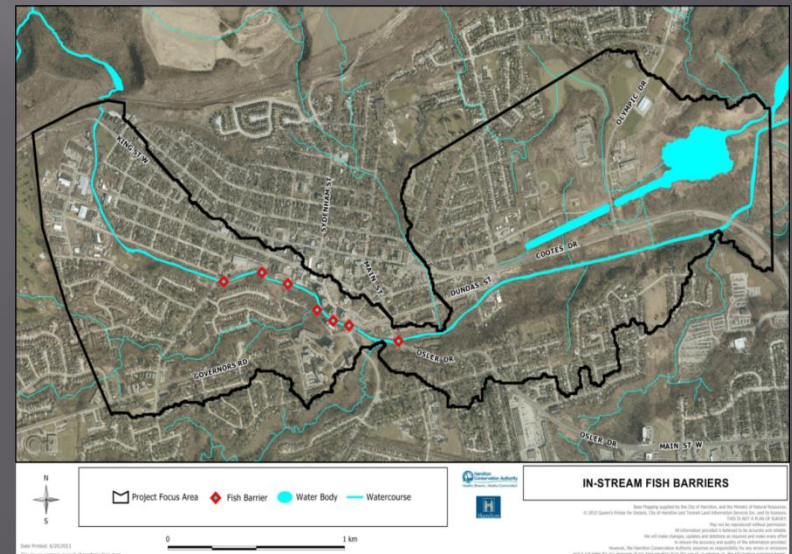
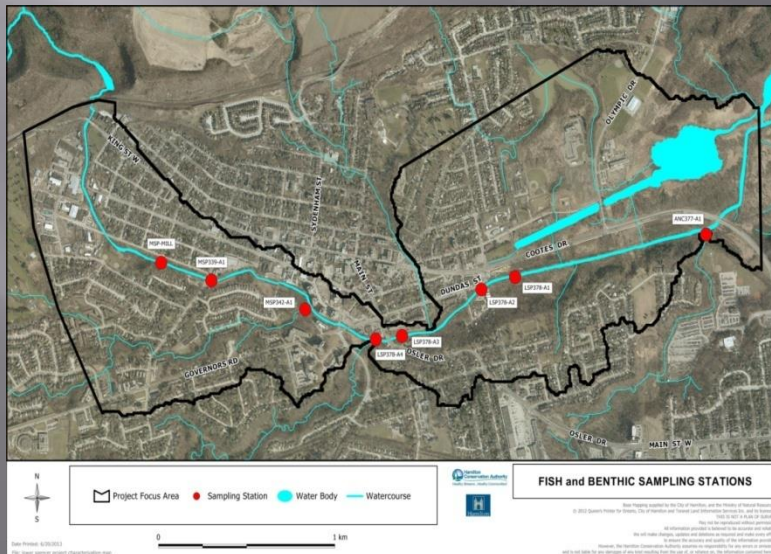
Work with local interest groups to lower human impacts through garbage clean ups and other events.
Education of trail users on sensitive areas in the Lower Spencer.



Lower Spencer Integrated Subwatershed EA – Aquatics Impact Assessment

Impact Assessment Process

Following impact prediction based on proposed changes, fish communities will be assessed based on their sensitivity and stream classification. Impacts relate to key parameter changes identified from hydrology, hydrogeology, geomorphology, terrestrial or riparian ecology, and water quality components. Indicators such as changes in peak flows related to urbanization will be considered. Thermal impacts from stormwater management is also a concern requiring analysis. Sewage treatment and water taking may also be considered for assessment. Targets for fish life processes will be established for the various fish species in Lower Spencer Creek and integrated with the stream morphology component to establish barrier remediation objectives. An analysis of the proposed creek improvements will be completed and benefits to fish habitat quantified.



Evaluation of Alternatives

Alternative	Meets S/W Goals	Environmental	Social	Economic
Flooding				
Do Nothing				
Structural				
Floodplain/ Channel Improvements				
Stormwater Management – At source (Low impact development), conveyance, end-of-pipe				
Non Structural				
Flood Forecasting and Warning				
Creek Maintenance Plan				
Erosion				

Lower Spencer Integrated Subwatershed EA Low Impact Development



Lower Spencer Integrated Subwatershed EA

Next Steps

- **Complete Characterization Report**
- **Complete Impact Assessment**
- **Evaluate Alternatives and Select Preferred Alternatives**
- **Prepare Implementation Report**
- **Host Public Information Centre in 2014**
- **File final Integrated Subwatershed Study Report for 30 day public review period.**

Thank You

