Testing summary

- Ordinal: Results have been shown to 6 different individuals or groups over the past year; feedback incorporated if possible
- Methodological: Input on-going with specific attention from Cornell Profs and outside groups
- Quantitative: Initial results good but test datasets lack robustness; more quantitative testing needed especially at the module level



Study areas

Land use in watersheds



Disturbance gradient



Disturbance gradient spatially



Soils in watersheds



Riparian degradation: results



Riparian degradation: results

Twelve Mile Creek

Salmon River







Riparian degradation: conclusions

- Pattern of degradation across watersheds generally follows disturbance gradient with outliers Twelve Mile Creek and Sandy Creek
- Even the most degraded watershed (Twelve Mile) had less than 20% habitat in need of riparian restoration
- Stream segments seem well buffered by forest and wetlands but still patchy
- Particular attention should be paid to Twelve Mile Creek in terms of restoration

Strategies for improving riparian conditions

Restore native vegetation in riparian areas



1995

2000

Manage and protect natural flood plains



Stream degradation: results



Stream degradation: results

Duffins Creek

Black Creek





Stream degradation: conclusions

- Pattern of degradation across watersheds roughly follows disturbance gradient with outlier Duffins Creek
- Degree of degradation ranges from ~30-70% across all watersheds with Black Creek the most degraded watershed
- Stream segments marked as highly altered were largely driven by predictions of open canopy and/or fine sediments
- Particular attention should be paid to Black Creek in terms of possible restoration opportunities

Strategies for Improving stream quality

Restore instream features such as large woody debris

Maintain natural stream channels

Restore sinuosity







Barriers to migration: results



Barriers to migration: results



Twelve Mile

Napanee Creek







Barriers to migration: results

Sandy Creek

Salmon River

Lakeshore marshes



Barriers to migration: conclusions

- Pattern of fragmentation differs across watersheds based on density and height of dams
- Degree of blockage ranges from ~11-90% with Sandy Creek most blocked and Twelve Mile Creek blocked very little
- Many of the watersheds (Sandy, Salmon) have sizeable dams at the downstream end of the watershed blocking most upstream movement by migrating fish
- Efforts should be made to keep relatively unblocked watersheds free of downstream dams and restoration strategies should be considered for the others

Strategies for reducing barriers to migration

Design infrastructure for aquatic organism passage

Remove dams and barriers to fish migration





Stream flow alteration: results



Streamflow alteration: results

Credit River

Napanee Creek



Lakeshore marshes

Stream flow alteration: conclusions

- Pattern of alteration follows the disturbance gradient except for Black Creek which is much higher than the others
- Degree of alteration ranges from 13% (Sandy) to over 90% (Black)
- Forested land use seems to be a driving factor separating high alteration streams from low alteration

Strategies for reducing stream flow alteration

Decrease impervious surface

Conserve lands important to hydrologic function

Remove dams or operate them to mimic natural cycles

Protect, restore, or enhance existing wetlands



Nutrients & sediment: Results



Nutrients and sediment: Results





Nutrients & sediment: conclusions

- Pattern of alteration follows the disturbance gradient very well
- Many of the more disturbed watersheds potentially have a high degree of EPA criteria exceedence
- More testing would be useful to see if predictions are accurate

Strategies for reducing nutrient enrichment

Construct a wetland

Implement agricultural and urban nutrient management practices

Buffer stream banks







Strategies for reducing sedimentation

Stabilize stream banks

Reduce construction





Implement sediment barriers

Use soil bioengineering techniques (geotextiles)





Summary

•Disturbances generally follow a west to east pattern of decreasing impairment. Overall, the most degraded watersheds were Credit, Twelve Mile and Black; least degraded were Sandy and Salmon

•In terms of percentage of stream reaches affected, riparian degradation seems to be less of an impairment in the study watersheds while water quality issues seem to be quite prevalent

•There is a wide range of blocked habitat with some watersheds almost entirely blocked and others not blocked much at all. Canadian watersheds possibly considerably less blocked than US watersheds

•Tool provides a spatially-oriented, coarse, watershed level assessment on a variety of impairments

•Can be used to guide conservation actions (protection/restoration)

Future tasks

- Incorporate feedback from meeting
- Restoration costs
- Webserver: http://glrestoration.cfe.cornell.edu



Acknowledgments

Funders and partners:

- Great Lakes Protection Fund
- Natural Heritage Institute
- The Nature Conservancy
- Toronto and Region Conservation Authority

Technical assistants:

Rodrigo de Almeida, Melissa Kalverstrand, Michael Brown, Jordan Gass, Paloma League-Pike

Thank you!