TRIECA 2016 CONFERENCE

Thank you to all of our 2016 sponsors:

AQUATECH™ PUMP AND POWER

CVC | Credit Valley Conservation

ECHELON ENVIRONMENTAL

filtrexx® CANADA LAND IMPROVEMENT SYSTEMS let nature do it.

GEMS

GEOSTORM

Hydro International®

Lake Simcoe Region conservation authority

RM CONSTRUCTION

Ontario Professional Planners Institute

terrafix® geosynthetics inc.

UNILOCK® DESIGNED TO CONNECT.

York Region

MEDIA SPONSOR

WATER CANADA
THE COMPLETE WATER MAGAZINE

HOSTS

Toronto and Region Conservation *for* The Living City®

IECA Great Lakes CHAPTER

Natural Channel Systems Initiative: A Primer
and
2016 International Natural Channel Systems Conference Overview (Sept 26-27)

Jeff Hirvonen
GeoProcess Research Associates Inc.

Natural Channel Systems Initiative

- **Definition** for Management and Design:

An approach by which existing stable channels, or new and rehabilitated stream channels and their associated floodplain systems, are managed and designed to be naturally ***functional, stable, healthy, productive and sustainable***.

Natural Channel Systems Initiative

Presentation Outline:

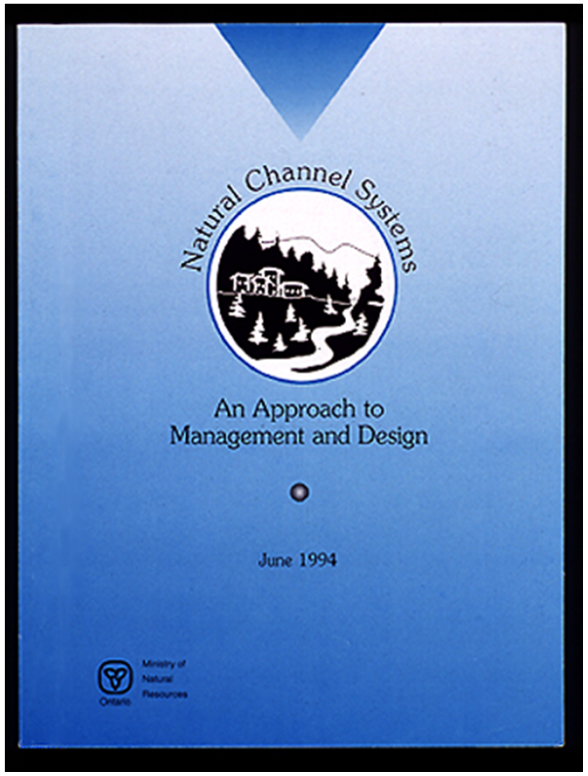
- NCS Initiative: Who are we?
- NCS Initiative: The Origin Story
  - Science and Application Context / History in Ontario
- Overview of Core Philosophy: "Adaptive Management to Stream Corridors in Ontario"
- Principal NCS Initiative objectives:
  - Fostering ideas in support of process-based, river and stream corridor management;
  - Disseminating information (via training, congresses and publications) in support of this philosophy.

Natural Channel Systems Initiative

- Some Precursor Moments:
  - 1964 Fluvial Processes in Geomorphology (Leopold, Wolman and Miller)
  - 1967 – Introduction to Fluvial Geomorphology in White and Bryndilson
  - 1990 – 6th North American Trout Stream Improvement workshop
  - 1991-1993 – Rosgen Introduction Course to River Dynamics
  - 1995 – Newbury Courses established
- Some Regulatory Context:
  - Biologist and engineers historically at odds
  - 1988 Floodplain Management Policy
  - MNR role in Fisheries Act (Section 35)
  - LRIA and CA Act applications

Natural Channel Systems Initiative

- Evolution of the Initiative:
  - 1992- MNR creation of public/private professional committee to develop the initiative.
  - 1994 – Publication of “Blue Book”.
  - 1994 – Phase II initiated.
  - 1994 - 1st International Natural Channel Systems Conference.
  - 1996 – Phase II Status Report.
  - 1999 – 2nd International Natural Channel Systems Conference.
  - 2002 – Stream Corridor Manual.
  - 2004 – 3rd International Natural Channel Systems Conference.



Natural Channel Systems Initiative

- Moving Forward:
  - 2016 International Natural Channel Systems Conference September 26-27, 2016 (Niagara Falls, ON)
  - Conference Themes:
    - Current Science and Understanding
    - Applied River Management and Rehabilitation
    - Governance, Asset Management and Education
    - What We Have Learned / Knowledge Sharing

www.naturalchannels.ca

Beyond 2016:
- Solicitation of new participant members
- Re-invigoration of the Institute for Watershed Science
- Training and publications

Performance of Natural Channel Designs Over the Medium Term – Highlights From Ten Years of Monitoring

Dean Young
Toronto and Region Conservation Authority
Sustainable Technologies Evaluation Program

TRIECA 2016 conference
March 23, 2016

The Living City Foundation

Toronto and Region Conservation for The Living City

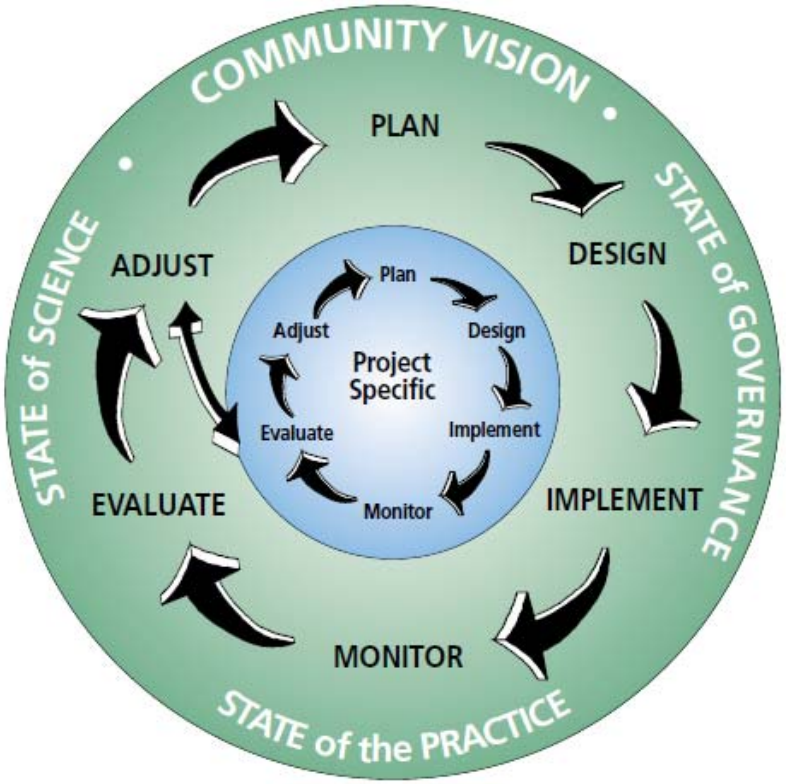
Natural Channel Design (NCD)

- Reconstruction or rehabilitation of a stream channel and floodplain using techniques to restore or replicate natural channel system form and functions;
- Principal objectives are:
  - Mimic the self-sustaining geomorphic forms and processes of an undisturbed watercourse subject to the same catchment-scale influences and local conditions;
  - Support aquatic and riparian ecosystems of composition and quality that are reflective of an undisturbed watercourse subject to the same catchment-scale influences and local conditions.

Evolving the practice requires monitoring and evaluation

- NCD involves complex and inter-related processes;
- In practice for 20+ years in Ontario with few systematic evaluations of performance;
- Limits the ability of practitioners and regulators to apply an AEM process.

Adaptive Environmental Management Process



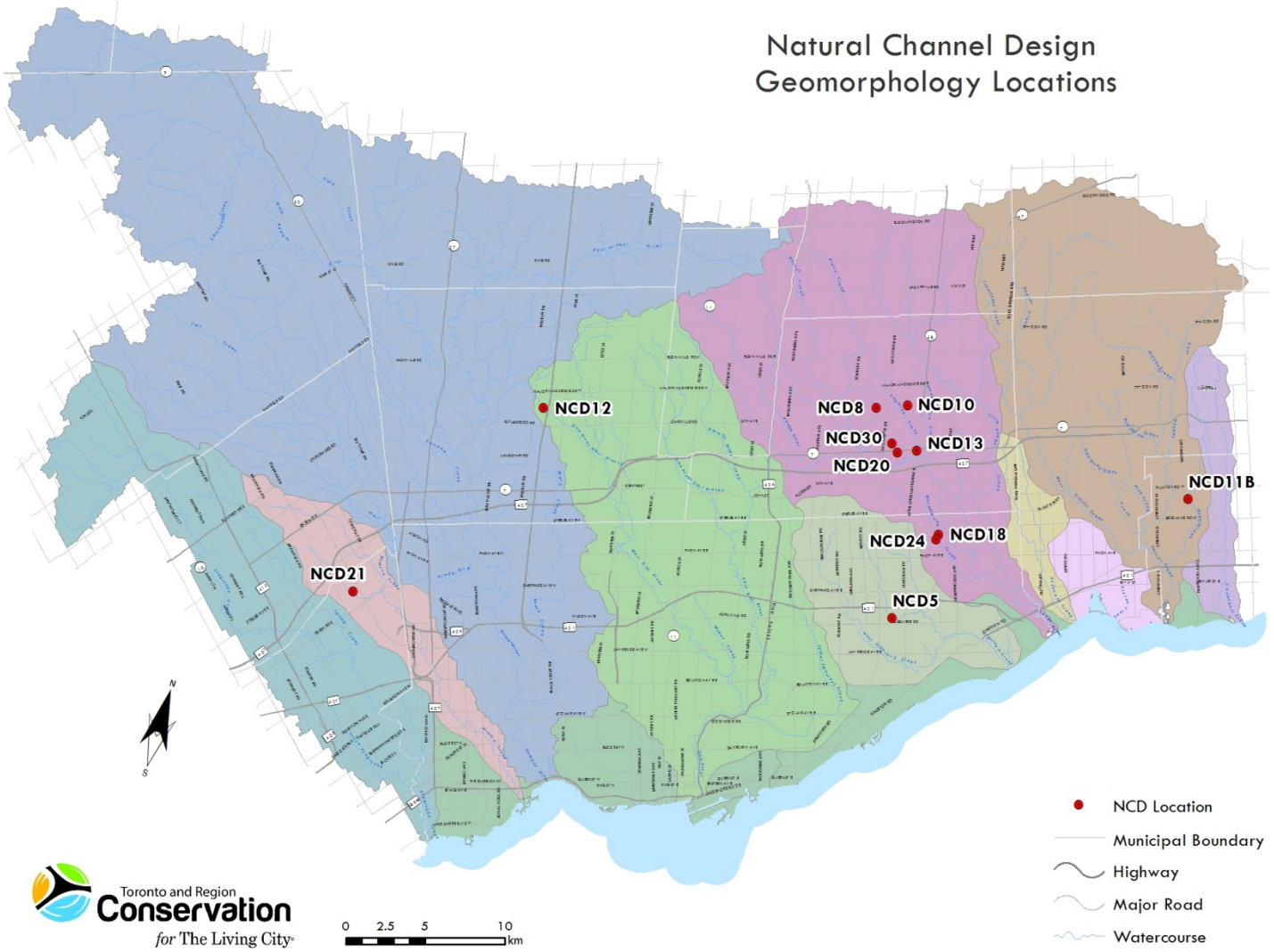
Natural Channel Design Monitoring Program - 2005 to 2014

10 year workplan to:

- Develop guidance on the design of monitoring programs for stream rehabilitation projects;
- Implement programs at 10 NCD sites around the GTA to evaluate if design objectives are being achieved in the 5 to 15 years post-construction time frame;
- Adapt the monitoring program design guidance as warranted based on experiences gained through program implementation.

Available at http://sustainabletechnologies.ca

NCD Monitoring Program 2005 - 2014

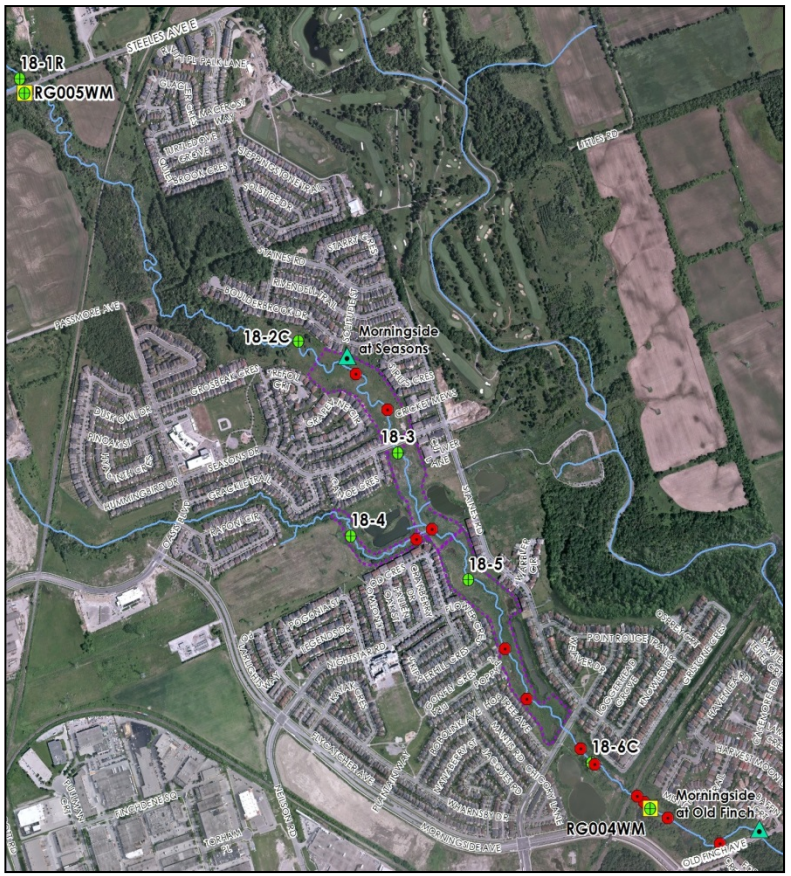


Monitoring Program Components

Catchment Characteristics	Size; Land use & Road density; SWM quantity/quality control.
Geomorphic System	Rapid Geomorphic Assessment; Long-profile; Cross-sections (riffle/pool/run); Bank/substrate characterization; Erosion pins.
Aquatic System	Fish & Benthic Macroinvertebrates (BMI) sampling; Aquatic habitat survey (OSAP).
Terrestrial System	Vegetation Communities (ELC); Flora; Breeding birds; Amphibians.

Monitoring Program Design

- Comparing reconstructed reaches (treated) to preconstruction data or an upstream or downstream untreated control reach;
- Pre-construction biological data often unavailable or inadequate;
- Geomorphic surveys 5 - 9 yrs. apart;
- Aquatic surveys 2 - 5 yrs. apart;
- Terrestrial surveys 5 - 7 yrs. apart;
- Fish Barriers survey;
- Catchment characteristics;
- Aerial photo analysis.



NCD Site Evaluation Dashboard

- Used a “key indicators dashboard” approach to developing and integrated understanding of site conditions, temporal trends & evaluate performance;
- Simple three category classification system for classifying indicator conditions & temporal trends;
- Helped with developing an integrated understanding of site conditions and making comparisons between components and sites.

Good	Fair	Poor
In regime	In transition	In adjustment
More	Similar	Less
Better	Similar	Worse
Objectives achieved	Inconclusive	Needs work
Stable	Aggrading	Degrading
Similar	Finer	Coarser

Summary - Fluvial Geomorphology

Site	SWM Controls	Age*	Channel State (RGA)	Active Processes	Substrate - Temporal
NCD 5	**No**	14	**In Adjustment; Entrenched**	Widening; Degradation & Aggradation	Similar
NCD 8	Yes	13	**In Transition**	Widening; Aggradation;	Similar
NCD 10	Yes	12	In Regime	Stable; Aggradation;	Finer
NCD 11	Yes	10	In Regime	Widening; Aggradation	Finer
NCD 12	Yes	13	In Regime	Widening; Aggradation	Similar
NCD 13	**Part**	11	**In Transition; Entrenched**	Widening; Degradation	Coarser
NCD 18	Yes	11	In Regime	Stable/Narrowing; Aggradation	Similar
NCD 20	**No**	10	**In Transition; Entrenched**	Widening; Degradation	Coarser
NCD 21	**No**	10	**In Adjustment; Entrenched**	Widening: Degradation	Similar
NCD 30	**No**	8	**In Transition; Entrenched**	Widening; Degradation & Aggradation	Finer

Summary – Aquatic System

Site	SWM Controls	Age*	Channel State (RGA)	Fish Community (Mean Species Richness)	Fish Species Treated vs. Control (Trend)	BMI Treated vs. Control (Trend)
NCD 5	**No**	13	In Adjustment	**Warm water (4)**	Similar (↕)	Worse (↓)
NCD 8	Yes	15	In Transition	Warm water (5)	**More (↑)**	Similar (↓)
NCD 10	Yes	12	In Regime	Warm water (3)	Inconclusive (↓)	Worse (↓)
NCD 11	Yes	11	In Regime	Warm water (9)	Similar	Better (↓)
NCD 12	Yes	15	In Regime	Warm water (6)	Similar (↕)	Worse (↕)
NCD 13	**Part**	11	In Transition	Cool water (12)	**More (↑)**	Worse (↓)
NCD 18	Yes	9	In Regime	Cool water (9)	Similar (↑)	Better (↓)
NCD 20	**No**	7	In Transition	None**	Less**	Better (↑)
NCD 21	**No**	10	In Adjustment	**Warm water (3)**	Similar (↕)	Better (↓)
NCD 30	**No**	8	In Transition	None**	Less**	Inconclusive (↓)

Summary – Terrestrial System

Site	Age*	Treated Area (ha.)	Vegetation Communities #	Exotic Invasives (moderate to severe)	Flora Species # (# L1-L4)	Breeding Birds # (# L1-L4)	Amphibian Species (#)
NCD 5	10	**11.2**	19	**64%; ↑**	**203 (24)**	31 (8)	1
NCD 8	13	**5.1**	13	**72%; ↑**	**160 (12)**	19 (3)	3
NCD 10	12	**3.6**	7	**95%; ↑**	**141 (9)**	17 (4)	3
NCD 11	11	**7.4**	15	**75%; ↑**	**163 (17)**	17 (4)	3
NCD 12	15	**6.7**	12	**67%; ↑**	**219 (23)**	25 (6)	2
NCD 13	12	**1.5**	17	**85%; ↑**	**217 (20)**	12 (1)	2
NCD 18	11	**12.3**	18	**77%; ↑**	**308 (34)**	21 (5)	4
NCD 20	10	**0.7**	3	**64%; ↑**	**165 (7)**	7 (0)	0
NCD 21	11	**5.6**	10	**82%; ↑**	**165 (15)**	19 (4)	1
NCD 30	8	**0.9**	5	**71%; ↑**	**136 (5)**	9 (1)	0

Geomorphic System conclusions

- All (4) channels with no SWM quantity & quality controls upstream were found to be still in transition & entrenched, or in adjustment 10 to 15 years post-construction;
- Bank failures more common where herbs & grasses are the only vegetation cover types;
  - Supplemental bank treatments/plantings to establish deeply rooting shrubs & trees in problem areas;
- All (5) channels with catchments serviced by SWM quantity & quality controls were found to be in-regime or in-transition but not entrenched 10 to 15 years post-construction;

Aquatic System conclusions

- 8 of 10 sites had similar or more diverse fish communities compared to control reaches;
- Observations of low fish diversity more likely due to lack of u/s SWM controls than in-stream habitat;
- No fish observed at 2 of 10 sites, both due to presence of unmitigated structural fish barriers;
- Beaver activity at 5 of 10 sites is affecting success of woody vegetation plantings, and contributing to the evolution of the channel/site;

Terrestrial System overall conclusions

- Sites are shifting from mostly terrestrial natural cover to include more wetland & aquatic natural cover;
- Observed a corresponding shift in breeding bird communities to more wetland-associated species;
- **Designs that included wetland features and allowed the stream to interact with its floodplain, and beaver activity contributed to this increase in urban wetland habitat;**
- Larger sites contained more flora and fauna species and species of regional concern and greater number of vegetation community types.

Terrestrial System overall conclusions

- Maintaining and rehabilitating urban stream channels provides habitat for flora and fauna species of urban and regional concern;
- Larger & more contiguous natural areas within the urban matrix allow space for more species;
- Disturbance by exotic invasive plants is present and increasing in severity at all sites – use survey data to prioritize eradication/control efforts;
- Willow flycatcher recorded at 7 of 10 NCD sites, total of 17 territories;
- Northern leopard frogs, green frogs, (wood frogs) and American toads observed (all are local rank L3).

Lessons learned about monitoring program design…

- Future NCD projects need more clearly stated design objectives, ideally for each system component, to provide a better basis for evaluations of performance;
- Pre-construction biological data, as-built geomorphic surveys and concurrent surveys of control and impacted (i.e. treated) reaches (BACI study design) provides optimal data for performance evaluations;
- Consistent use of standard monitoring methods and protocols, and timing of data collection is essential for comparisons between sampling events and project sites
  - Conduct Geomorphic and Aquatic System surveys at the same time, or in the same month/season each event.

Lessons learned about monitoring program design…

- Use aerial photo analysis to scan for planform changes or evidence of damming, ponding or beaver activity;
- As part of assumption inspections require as-built drawings and repeat Geomorphic & Aquatic System surveys at years 1, 2 & 3 post-construction, Terrestrial System survey at year 3 post-construction;
- For performance monitoring repeat Geomorphic, Aquatic System & Terrestrial System surveys at 5 and 10 years post-construction at a minimum.

Project supporters

Thank you

Dean Young
Phone: 289-268-3904
Email: dyoung@trca.on.ca

STEP website:
www.sustainabletechnologies.ca
TRCA website:
www.trca.on.ca

Toronto and Region Conservation for The Living City

Sustainable Technologies Evaluation Program