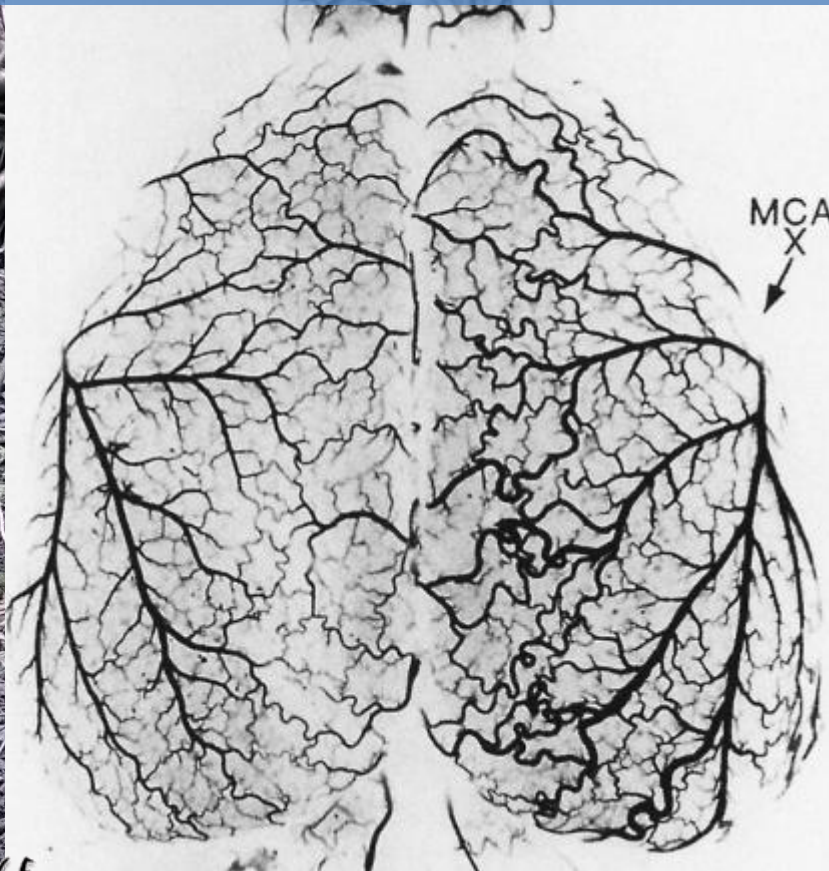


Clogged Arteries: Headwater Drainage Features

Bev Wicks Ph.D.

RIVERSTONE ENVIRONMENTAL SOLUTIONS



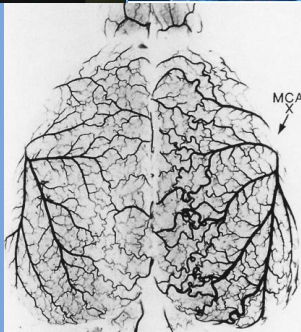
Circulation



Parts of the System(s)

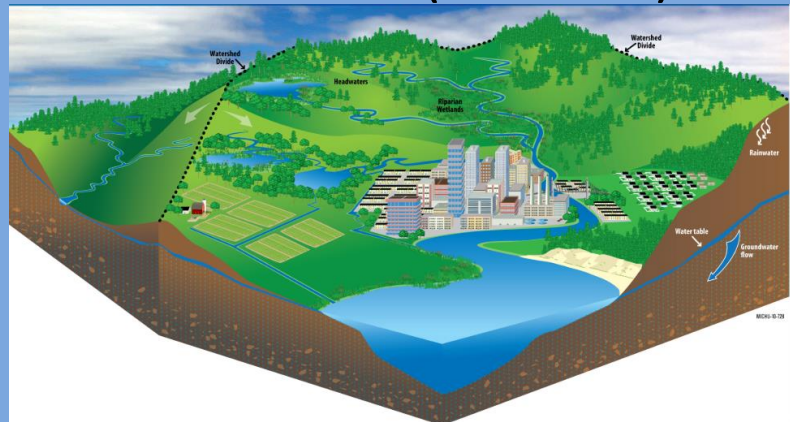
Circulatory System

- Heart
- Veins in hands
- Arteries and capillaries



The Watershed

- Lakes
- Rivers
- Streams
- Wetlands
- Headwater (features)



The Heart-Lake Muskoka-Georgian Bay



Where does it begin-the Headwaters

- Wetlands
- Seeps and springs
- Swales
- Ephemeral and Intermittent Streams
- Ditches
- Tile Drains

A famous quote “headwaters are more complicated than arteries”they “get no respect” ...Les Stanfield



What does a headwater drainage feature look like?

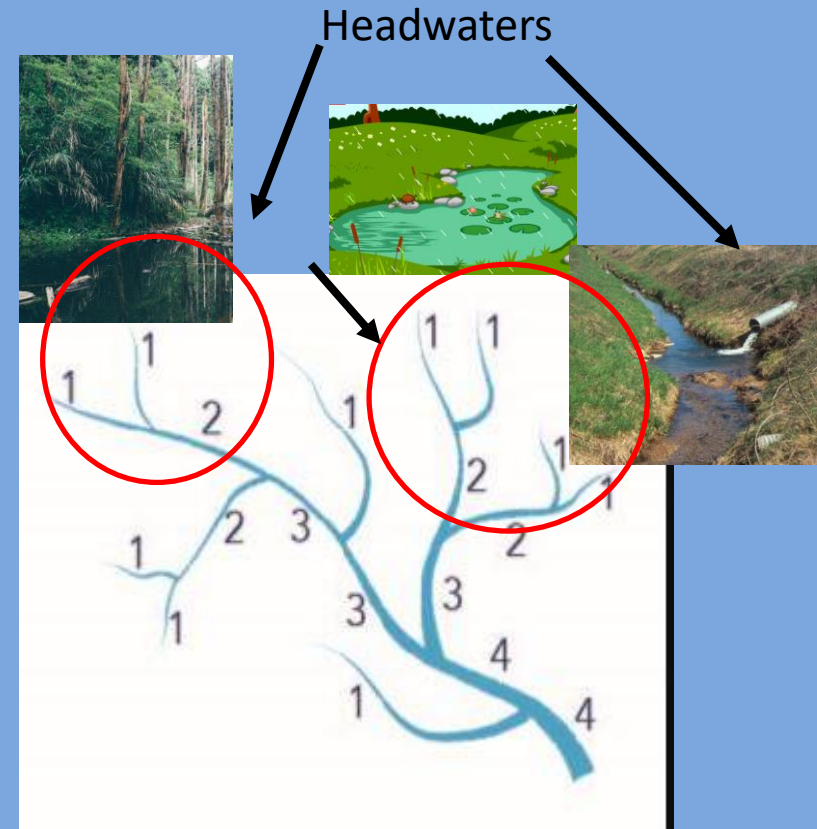
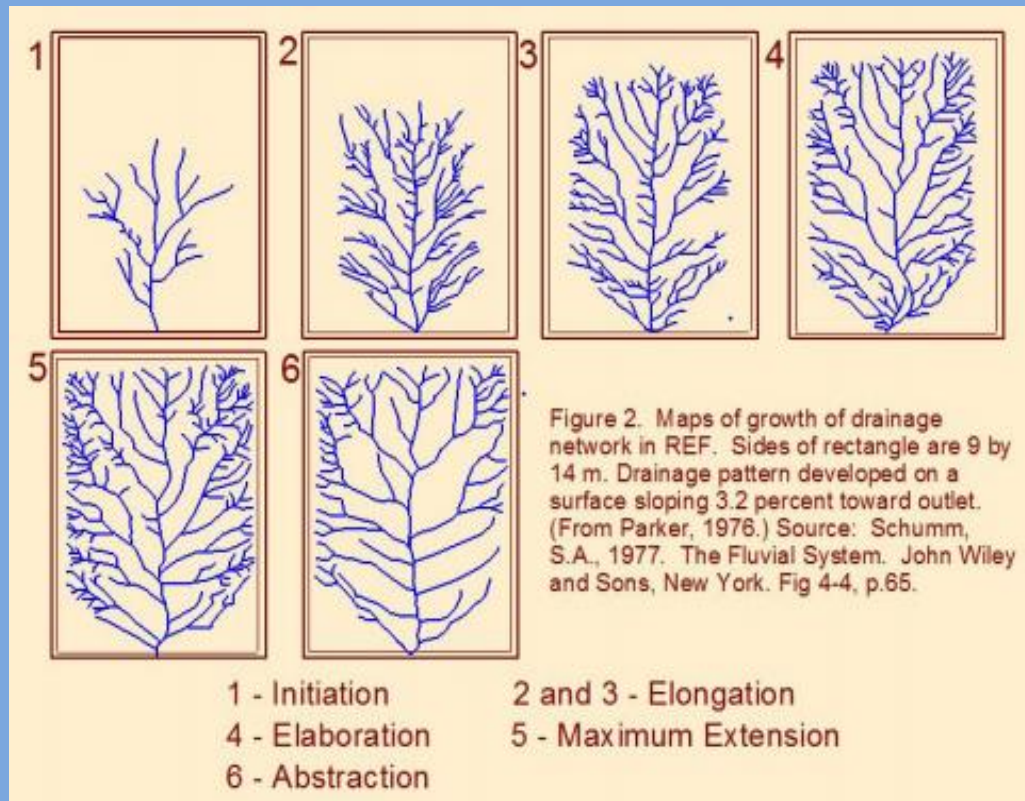


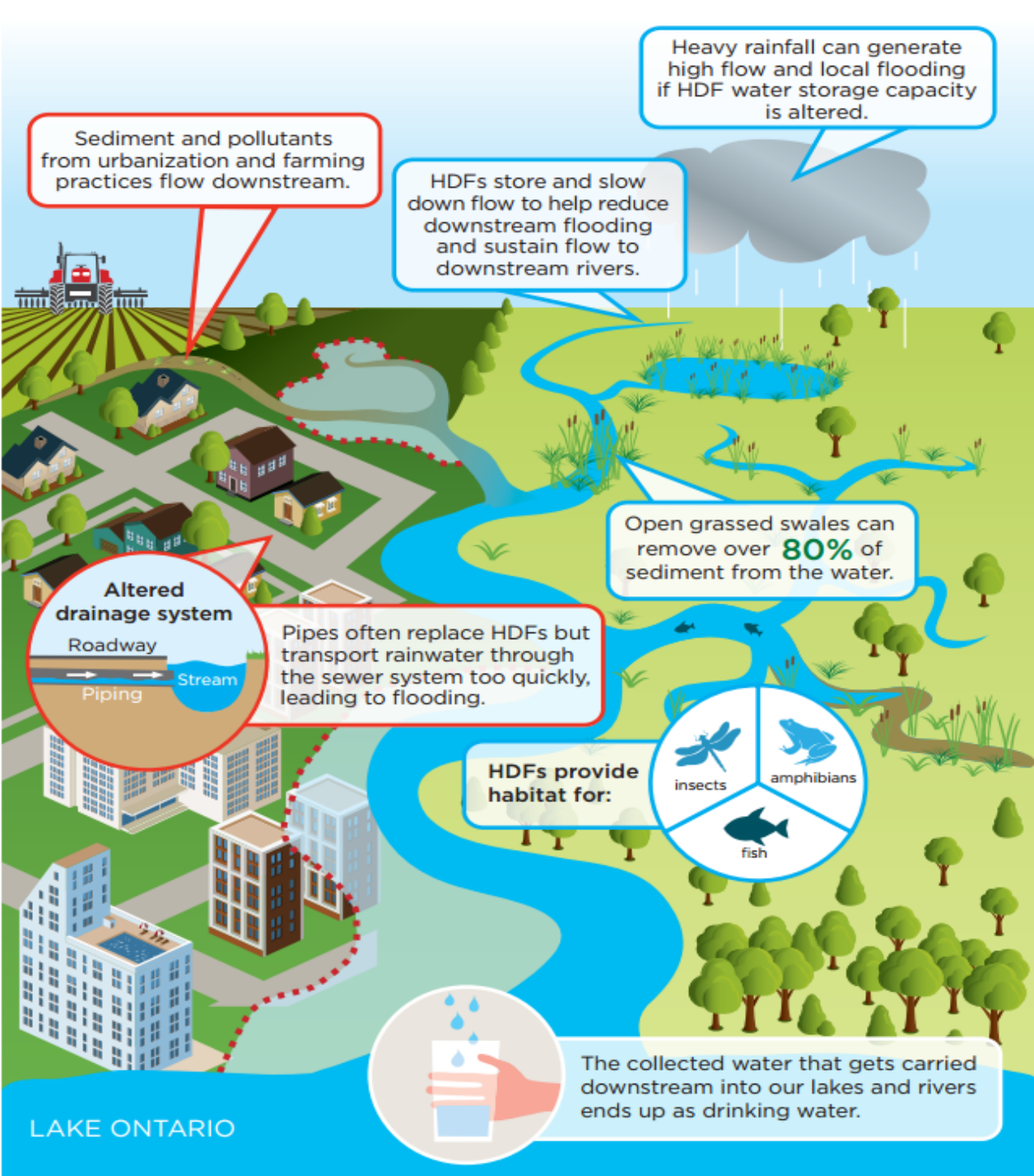
Importance in the Watershed

- Headwaters are where it all begins, the water, the nutrients, the microbes etc.
- Wetlands and headwater streams are key components of our watershed
- They are the beginning and act as buffers and filters for the streams and rivers, where pollution can enter or be removed...wetlands, streambeds etc.



Evolution of a River





What is a Headwater Drainage Feature (HDF)?

HDFs are more important than you think!

HDFs are located across the landscape and are small stream, swale and wetland features that capture water and transport it to larger streams and rivers. They do not necessarily flow all the time but may flow after rainfall or snowmelt.

When left in their natural state, these features have many functions like helping to reduce stream flooding, purifying water, and providing food and habitat for fish and wildlife.

However, they can be altered by people through activities like piping, ditching, and channelizing, which reduce or eliminate these functions. This especially becomes a problem when many HDFs are altered in one watershed.

What can you do?

Leave HDFs in their natural, undisturbed state.
Leave vegetation within and around them, maintain existing drainage flow, and keep livestock away.

Maintain the vegetation surrounding the stream to improve the quality of water and food carried downstream and to remove nutrients and sediment.

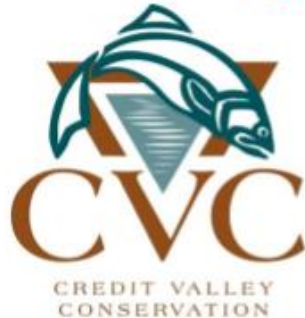
50% - 80%
of the river's length is constituted
by Headwaters streams

 Flood vulnerable area

Assessment of HDFs in Other Jurisdictions



Evaluation, Classification and Management of Headwater Drainage Features Guidelines January 2014



TRCA, CVC Assessment Method classifies HDFs based on four features:

- 1. Hydrology**
- 2. Riparian**
- 3. Fish and Fish Habitat**
- 4. Terrestrial**

Each Feature Evaluated as having:

- Important Function**
- Valued Function**
- Contributing Function**
- Limited Function**

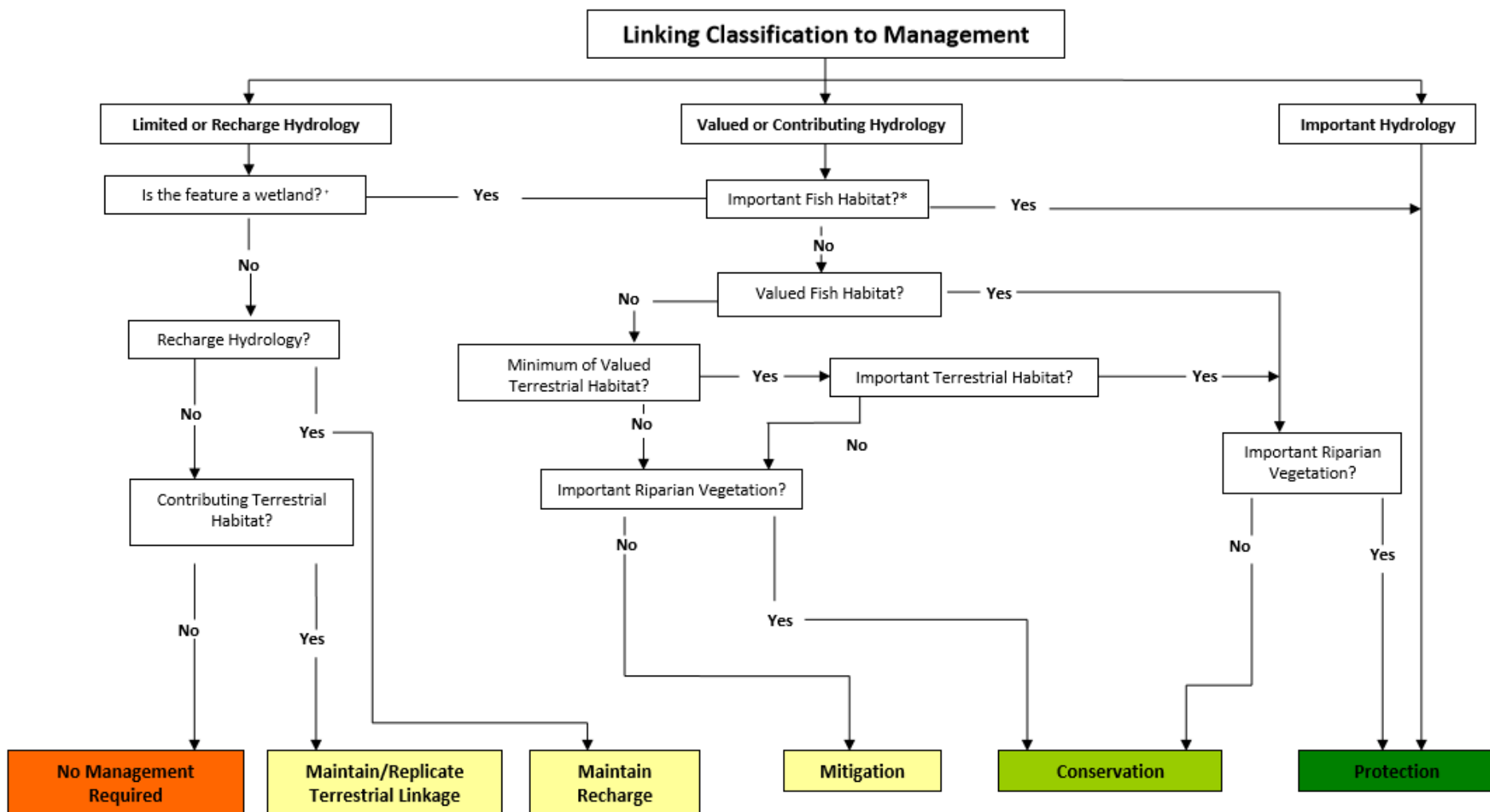
**Based on the assessment,
Management Options Provided**



Headwater Drainage Features (HDFs)

Feature code	Feature Type	Feature Definition
1	Defined natural channel	Channel banks and sorted substrates are visible; there is <u>no</u> evidence that the drainage feature has been historically dredged or straightened.
2	Channelized or Constrained	Channel banks and sorted substrates are visible and there <u>is</u> evidence that the stream has been historically dredged or straightened. In some instances the channel is constrained by filling, such that access to the flood-plain is no longer available.
3	Multi-thread	Multiple channels for one flow source; multi-thread channels are subdivided at low-water stages by multiple midstream bars of sand or gravel. At high water, many or all bars are submerged.
4	No defined feature	A topography with no identifiable depression to convey water and no facultative wetland species are present. Water is transported through overland or sheet flow.
5	Tiled	An outlet from a buried stream or tile drain is visible. There may be a defined channel downstream of the outlet caused by scouring.
6	Wetland	Feature with sustained water storage function. Lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. In either case, the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic plants or water tolerant plants. Obligate wetland species will be dominant (e.g. cattails).
7	Swale	A shallow trough-like depression that carries water flow during rainstorms or snowmelt and has ill-defined banks. Water conveyance is the primary function for the purposes of this definition. Flow not sufficiently sustained to cause substrate sorting or prevent instream vegetation from establishing, and water storage not sustained to promote obligate wetland vegetation (e.g. cattails). Bed may contain facultative wetland plants (e.g. reed canary grass).
8	Roadside ditch	A watercourse that only conveys road runoff. It does not extend upslope of the road that could generate a catchment
9	Pond outlet	Flow is from the outlet of an on or offline, irrigation, storm- water or other pond. Indicate the type of pond present in the comments field.





*Other Conservation Authority policies or other legislation with respect to wetlands, watercourses and/or species at risk need to be assessed in the context of this key.
 +Note that headwater wetlands are considered to be HDFs in the context of this guideline.

Figure 2: Flow chart providing direction on management options



Ontario Stream Assessment Protocol –

Not a requirement in any jurisdiction, but can be applied across Ontario



OSAP

Ontario Stream Assessment Protocol

Version 10 - 2017 - Edited by Les Stanfield

ONTARIO STREAM ASSESSMENT PROTOCOL

SECTION 4: MODULE 10

Constrained Headwater Sampling¹

Contents

1.0 INTRODUCTION	1
1.1 Background on HDFs	2
2.0 PRE-FIELD ACTIVITIES	3
3.0 FIELD PROCEDURES	3
3.1 Timing of field Sampling	4
3.2 Site Descriptors and Site Identifiers	5
3.3 Upstream Section	6
3.3.1 Distance and Bearings	6
3.3.2 Upstream Longitudinal Gradient	7
3.3.3 Feature Type	9
3.3.4 Flow Conditions	9
3.3.5 Sediment Transport to Feature from Adjacent Lands	12
3.3.6 Sediment Transport to Feature from within the Feature	14
3.3.7 Evidence of Sediment Deposition	14
3.3.8 Feature Width	15
3.3.9 Measurement Method:	16
3.3.10 Bankfull Width	17
3.3.11 Bankfull Depth	17
3.3.12 Channel Entrenchment	18
3.3.13 Feature Roughness	18
3.3.14 Riparian and Feature Vegetation	19
3.3.15 Upstream Site Length	21
3.4 Downstream Section	21
3.4.1 Downstream Feature Length	22
3.4.2 Presence of a Barrier to Fish Migration	22
3.5 Full Site Conditions	23
3.5.1 Site Features	23
3.5.2 Channel Connectivity	25
3.6 Tips for Applying this Module	26
4.0 DATA MANAGEMENT	26
5.0 ACKNOWLEDGEMENTS	26
6.0 LITERATURE CITED	27

Appendix 1. Determining Up and Downstream at road crossings.

Appendix 2. Discharge Approximates Baseflow?

Appendix 3. Example Headwater Drainage Feature Field Sheet, Sampling Codes and Definitions and a "Synopsis of rules" sheet.

¹ Authors: L. Stanfield, L. Del Giudice, E. Bearss and D. Morodvanschi



Watershed Dynamics

- A multitude of variables affect the formation and maintenance of a watershed, including: climate, hydrology, geology, soil types, topography, land use, forest cover, wetlands etc.
- Climate (change): droughts (more snow, less rain), temperature extremes, flooding-increased intensity and frequency of precipitation events, changes in water supply due to seasonal changes, water quality changes (warmer air temperatures, reduced stream flows, reduced dilution potential, increased water temperatures-*E.coli*, unionized ammonia)



- IN THE NEWS



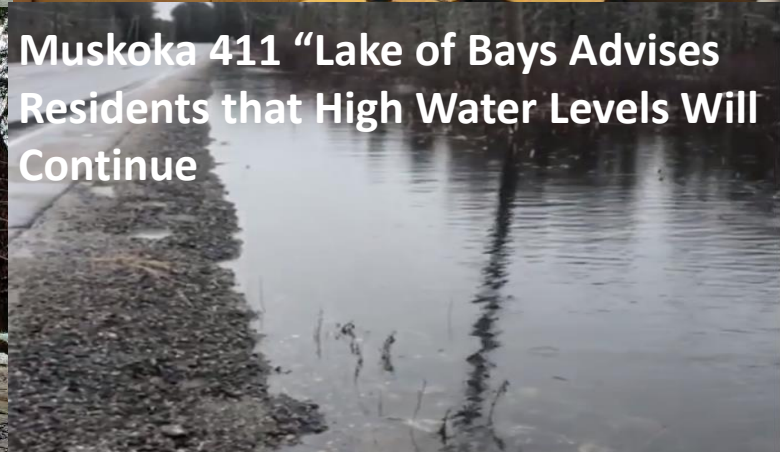
Muskoka 411 “State of Emergency Declared in Bracebridge”



Muskoka 411 “Bracebridge Mayor Smith Details Town Efforts As Flooding Continues”



Muskoka 411 “Road Closures and Repairs Due to Flooding in Huntsville”



Muskoka 411 “Lake of Bays Advises Residents that High Water Levels Will Continue”

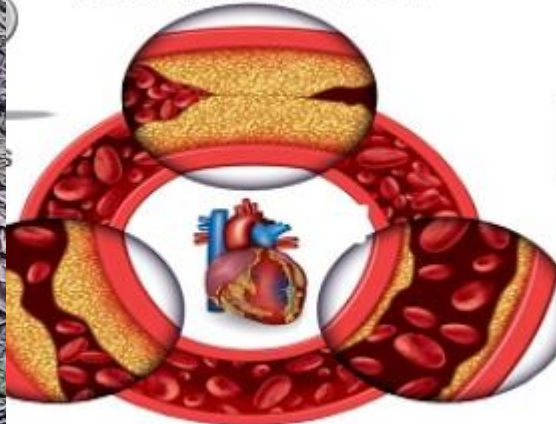


When the system clogs

5 Signs of clogged Arteries

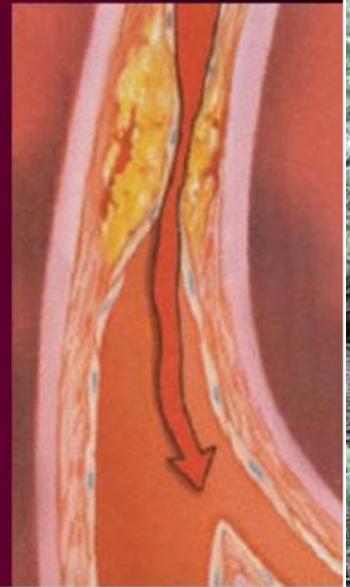
You really need to read this!

YOU NEED TO KNOW



What causes a blocked artery?

- The blockage is usually caused by a build-up of fatty deposits called plaque.
- Plaque is made primarily of cholesterol
- The blood vessel walls thicken and harden
- This can make the passageway for blood too narrow or can completely block it.
- What does blood deliver to cells?
_____ and _____



Northeast of Haliburton



East End of Lake of Bays



Lake of Bays near Baysville



East End of Lake of Bays



Lake of Bays near Baysville



East End of Lake of Bays



Town of Bracebridge



Town of Bracebridge



Rebecca Lake, TLOB



Rebecca Lake, TLOB



Town of Huntsville



North Markham



Near Town of Caledon



North Markham



North Guelph



***North Markham – contributing
habitat for fish***



Lake of Bays



Bloomington



Protecting the land to protect the water

The Oak Ridges Moraine is a ridge of rolling hills running across the GTA about 50 kilometres north of downtown Toronto. As more and more housing development encroaches on the moraine, there is increased concern that the water supply for more than 400,000 people in the GTA will be contaminated.

Where the water goes

①

Rain and melting snow seep through the highly permeable surface of the moraine.

②

Water percolates through the moraine's layers of sand, gravel and clay and collects in a network of underground aquifers.

③

Private and municipal wells draw water from aquifers.

④

Water surfaces as springs, wetlands and streams which provide the headwaters for rivers flowing into Lake Ontario.

How the moraine was formed

1. 13,000 years ago, two glacial ice lobes, Simcoe and Ontario, came close to meeting, pushing up massive deposits of stones, sand and gravel between them.

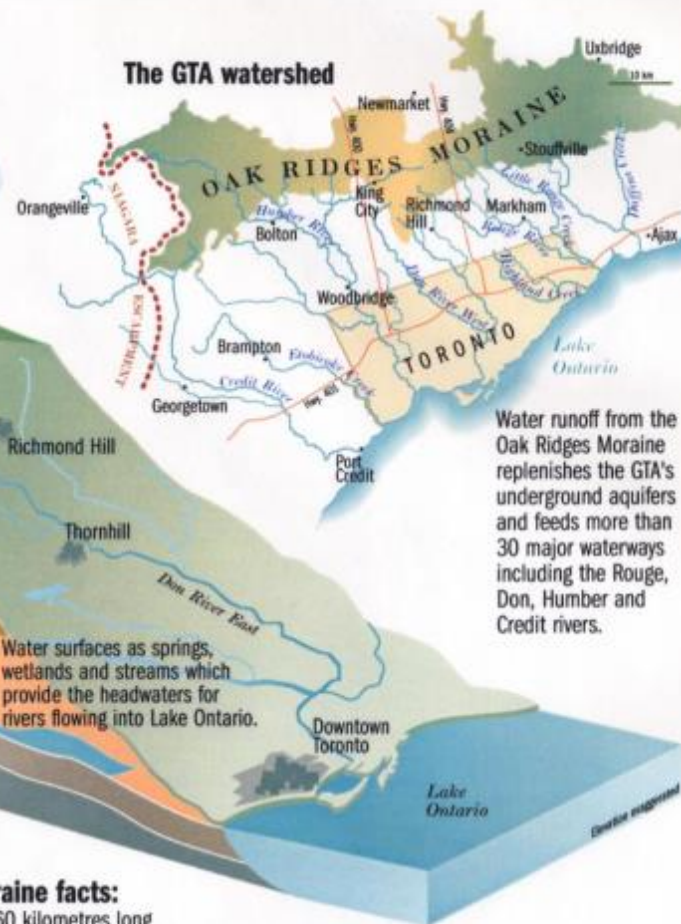


2. When the ice retreated, the glacial deposits remained, forming the Oak Ridges Moraine.

Moraine facts:

- 160 kilometres long
- 3 to 24 kilometres wide
- 70 to 240 metres deep
- Highest point 300 metres above surrounding area

The GTA watershed

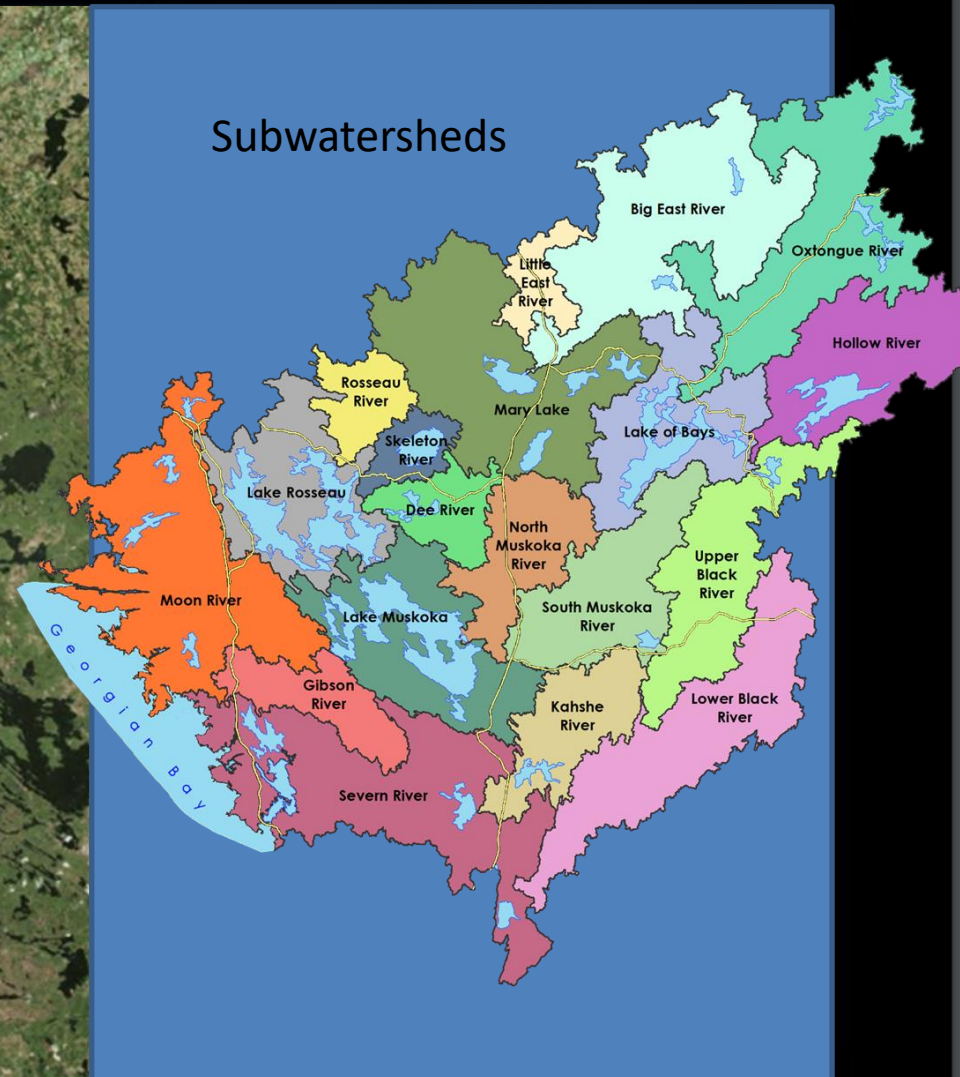
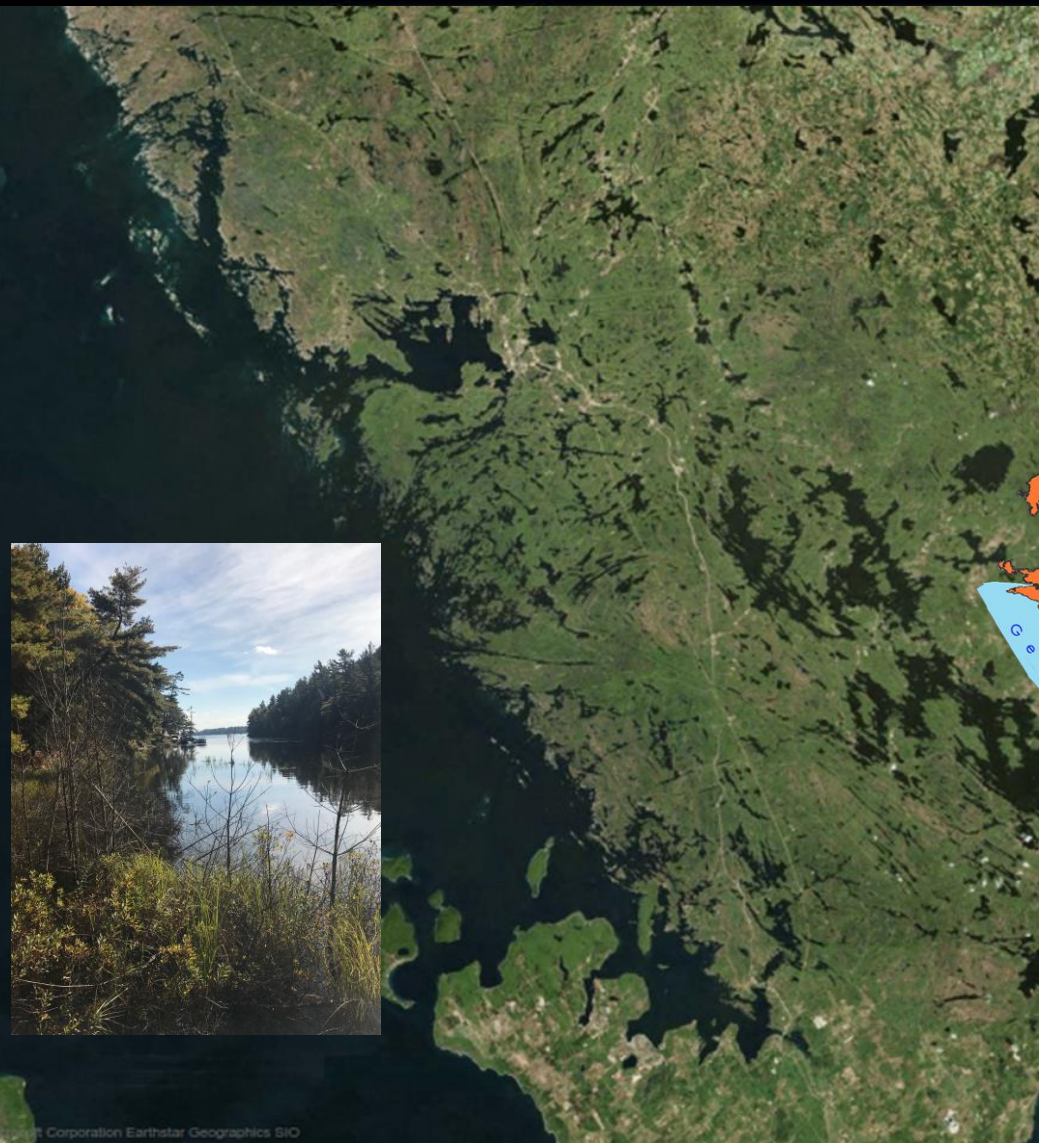


Water runoff from the Oak Ridges Moraine replenishes the GTA's underground aquifers and feeds more than 30 major waterways including the Rouge, Don, Humber and Credit rivers.

SOURCE: Special Places: The Changing Ecosystems of the Toronto Region

GRAPHIC BY CATHERINE FARLEY/TORONTO STAR

Protecting the land to protect the water



Source OGA 2017

Protecting Headwaters

- **Education** – what are they and why are they important?
Actions: headwater indicators in watershed report card, stewardship initiatives
- **Protection** – currently DFO protects seasonal fish habitat.
Policy protects wetlands, buffers, EP zones, etc.
Action: improve policy and implementation, identify and preserve significant headwater areas, **natural heritage system**
- **Implementation** - Low Impact Development, Maintain Open Channels, SWM wetlands, bioswales, daylighting, restoration



A Closer Look - What is Natural Heritage System

- What is the Natural Heritage System... not yet developed in Muskoka.
- Why is it important? Protect the land to protect the water!
- What are our goals? ...the District and Watershed Council?
- How do we get there?...some thoughts



What is a natural heritage system?



Photo: Joe Crowley



Natural Heritage System

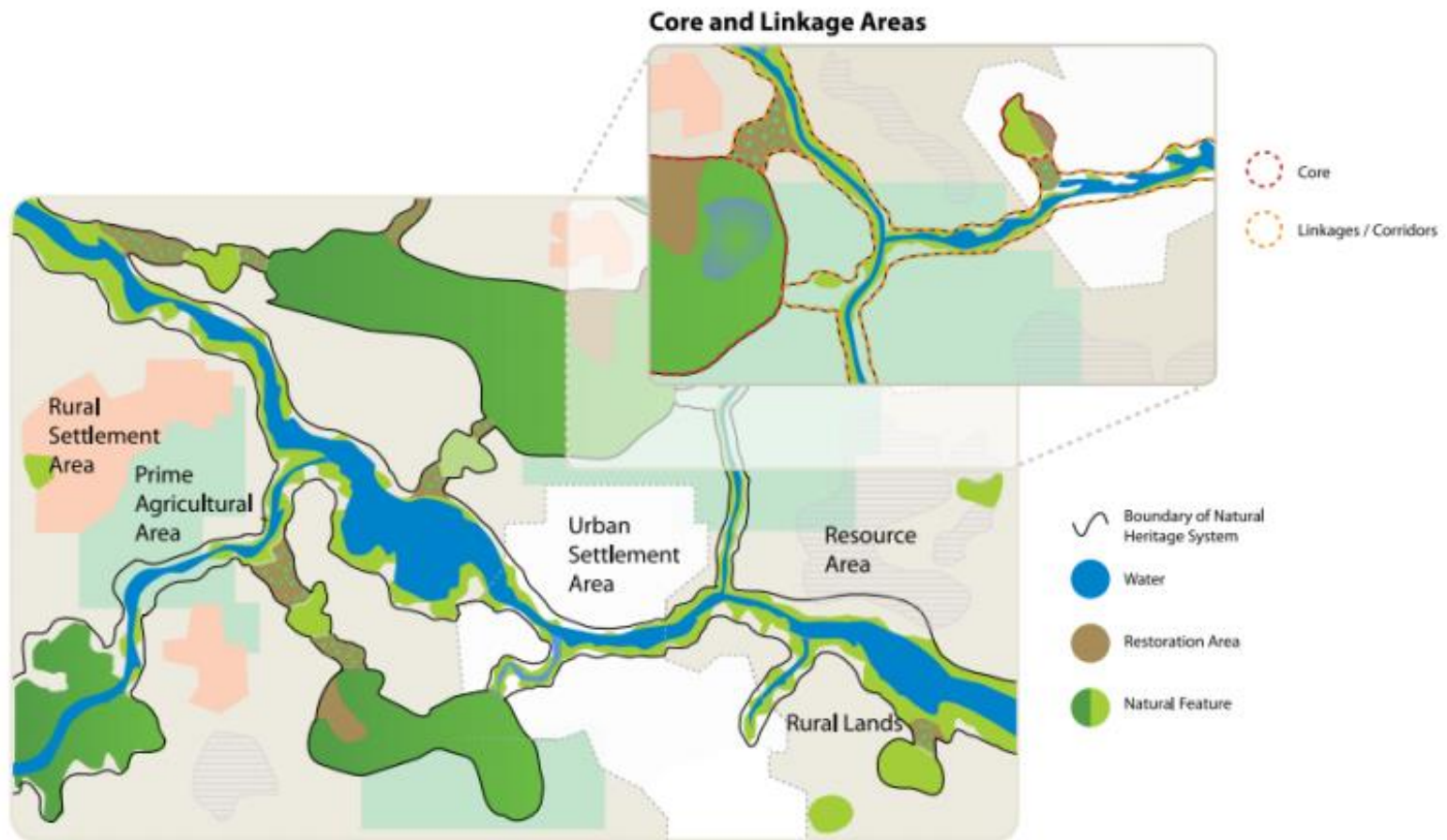
QUESTION - How much needs protecting?

Approach

- Core Areas- select using consistent criteria – (i.e. high ecological integrity, effective size to protect headwaters, may be already protected etc.)
- Linkages – select areas that connect the core areas for example wetlands, riparian areas, river valleys, forests (consider barriers like roads, length, width, connectivity)



Protecting natural heritage ... well

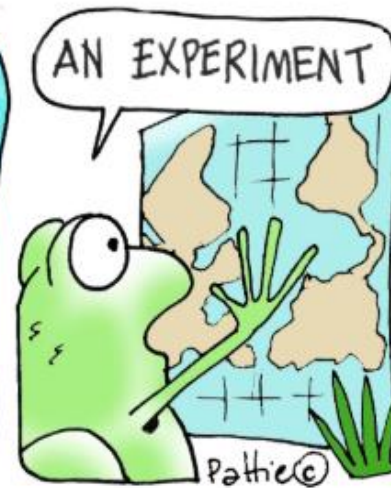


Building Blocks of a Natural Heritage Systems

This diagram shows the components of a natural heritage system running through areas with different land uses.

Brandy Lake





ACKNOWLEDGEMENTS

District of Muskoka and Muskoka Watershed Council:
Christy Doyle, Rebecca Willison

Many of our Clients
– data, photos

RiverStone Staff
– photos, discussions

The work of others who have strived to explain
these complex systems

