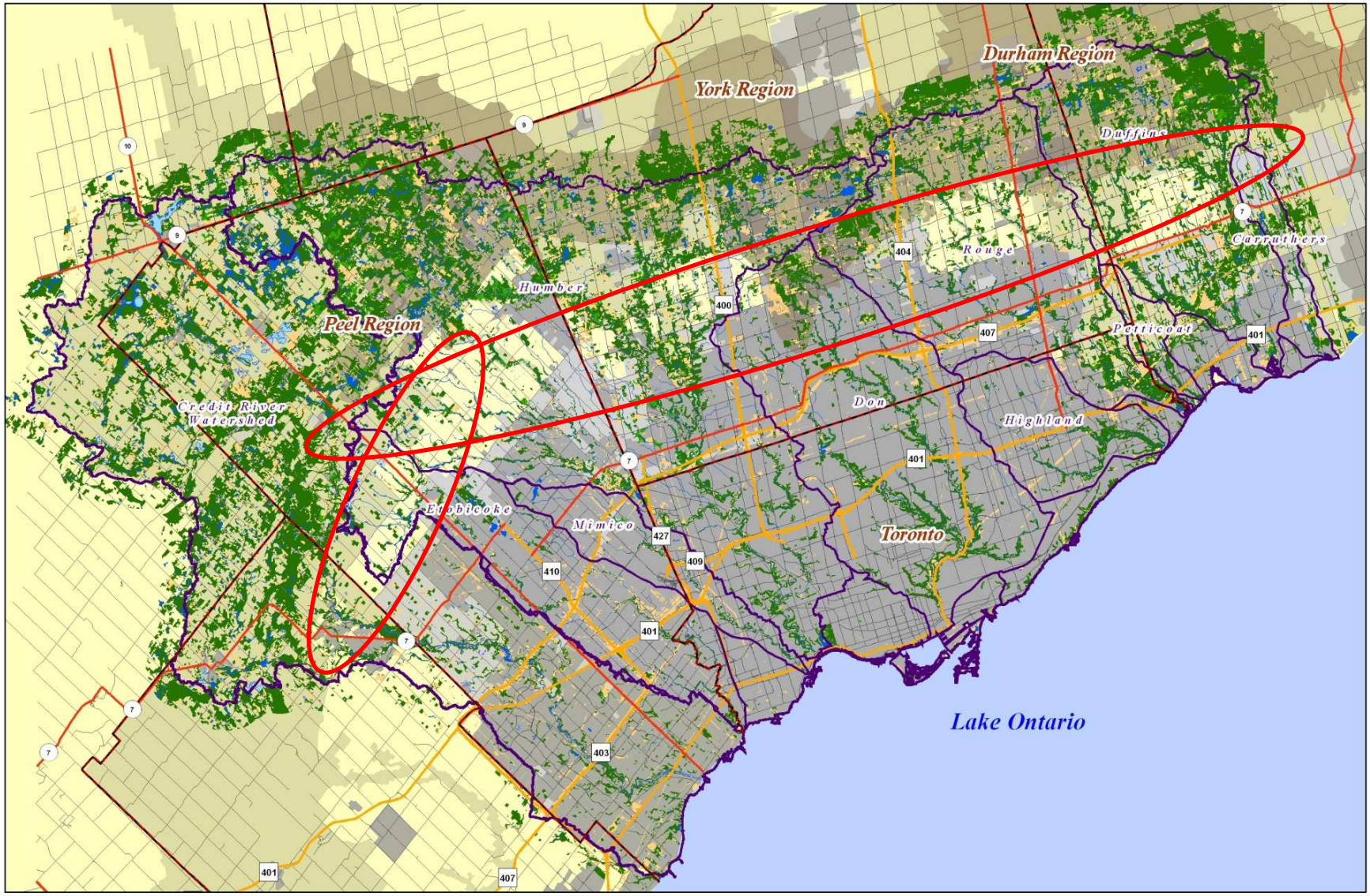
CVC & TRCA
Water Balance Guidelines for the Protection of Natural Features

Scott Sampson, CVC Supervisor Natural Heritage Program
Laura Del Giudice, TRCA Senior Planning Ecologist
April 26, 2012

Conservation Toronto and Region | CVC Credit Valley Conservation

Outline

- Introduction, GTA Context, Features of concern
- The Problem
- The Guideline as a Tool
- Importance of Hydrology to the Ecology of Natural Features
- Examples of Impacts from the GTA
- Overview of Guidelines
- CVC/TRCA Water Balance Study


Durham Region
York Region
Duffins
Carruthers
Rouge
Humber
Peel Region
Petticoat
Credit River Watershed
Don
Highland
Etobicoke
Mimico
Toronto
Lake Ontario
10
9
404
400
407
401
427
409
410
403

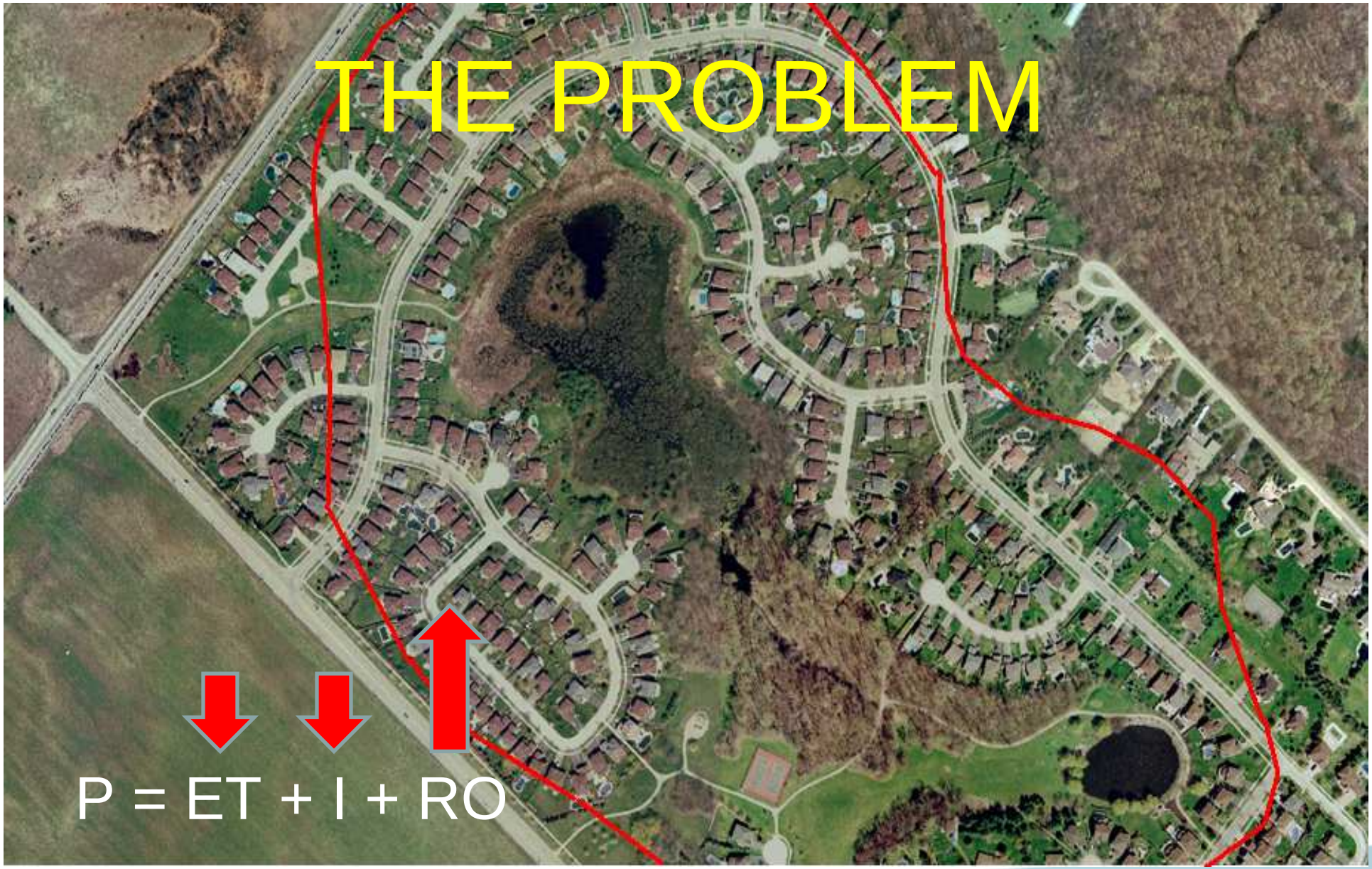
WETLANDS

Photo Credit: The Sernas Group

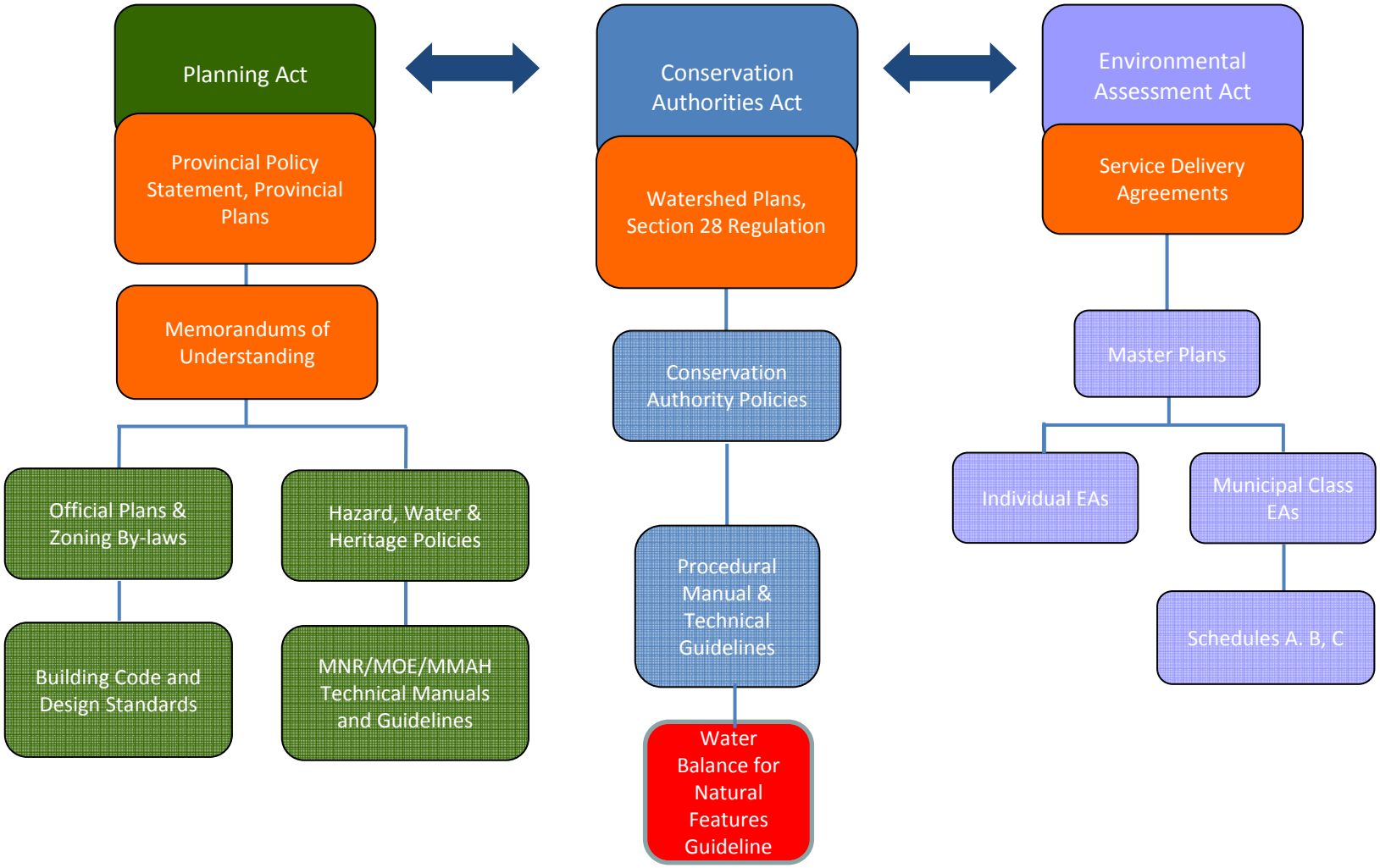
WATERCOURSES

WOODLANDS

THE PROBLEM



The Guideline as a Tool



Hydrology & Ecology

Hydrology is one of the most important factors affecting ecological structure, composition & function of natural areas

Hydrology & Ecological Function

- The source, amount and timing of water is critical to determining:
  - Community extent,
  - Community composition and structure,
  - Species richness,
  - Productivity, and
  - Ecological function

Hydrologic Sensitivity

- All communities will respond to hydrologic changes
- Some are more sensitive than others
- Even with small changes to the hydrology of a wetland, the flora and fauna may respond with significant changes in species composition and biological diversity and in ecosystem productivity.

Effects of Hydrology on Ecological Function

1. Enhances or limits species diversity
2. Productivity enhanced by water flow through & pulsing hydroperiods
3. Accumulations of Organics
4. Nutrient cycling and nutrient availability

Water Balance Guidelines

Conservation Authorities recommend matching pre-development water balance for Natural Heritage Features

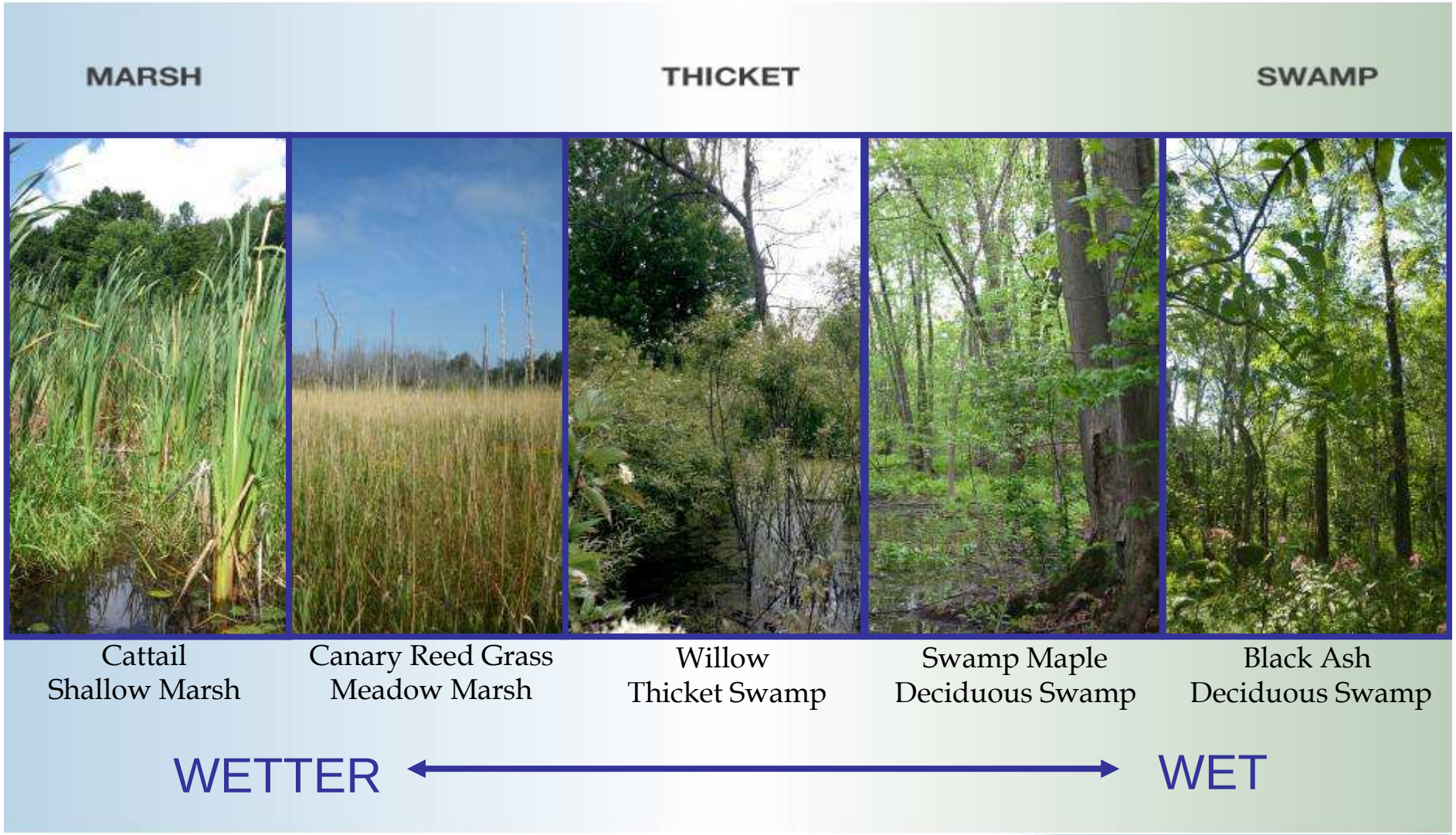
Guiding Principles: Matching Post to Pre-Development

- Maintaining pre-development water balance is critical to preventing negative impacts on the natural features and their ecological function
- Changes are risky and ecological tolerances are not defined
- Prevent cumulative impacts

Forest Hydrological & Ecological Gradients

WET	MOIST	FRESH	DRY
			
Balsam Poplar Green Ash White Cedar	Sugar Maple Balsam Fir White Cedar	Sugar Maple Beech White Ash	Red Oak Bitternut Hickory White Cedar

Wetland Hydrological & Ecological Gradients



Forest Hydrological & Ecological Gradients

WET

Sensitive Fern

MOIST

Ostrich Fern

FRESH

Marginal Wood Fern

DRY

Rattlesnake Fern

Long ← Hydroperiod → Short

American Bullfrog

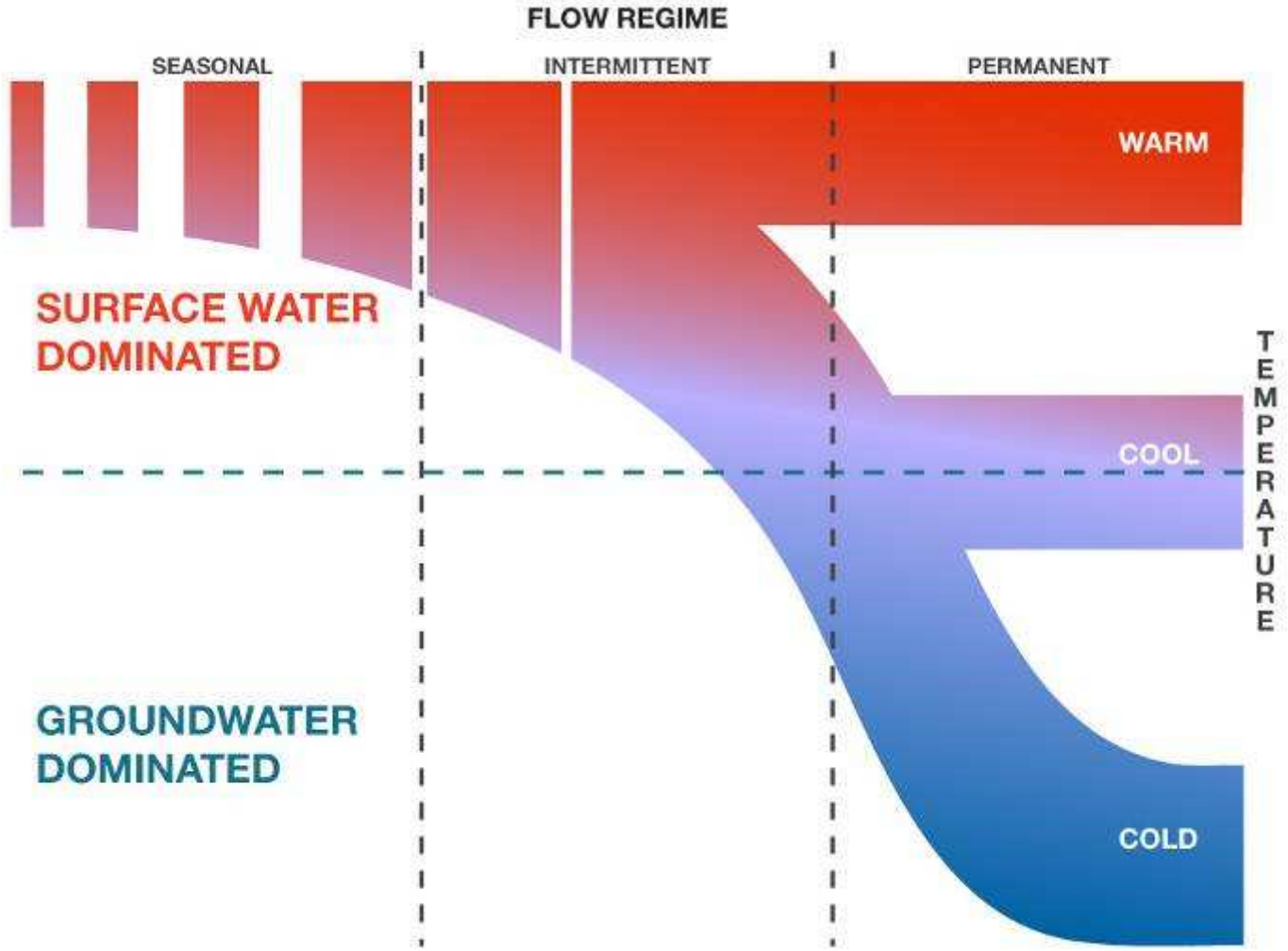
Jefferson Salamander

Wood Frog

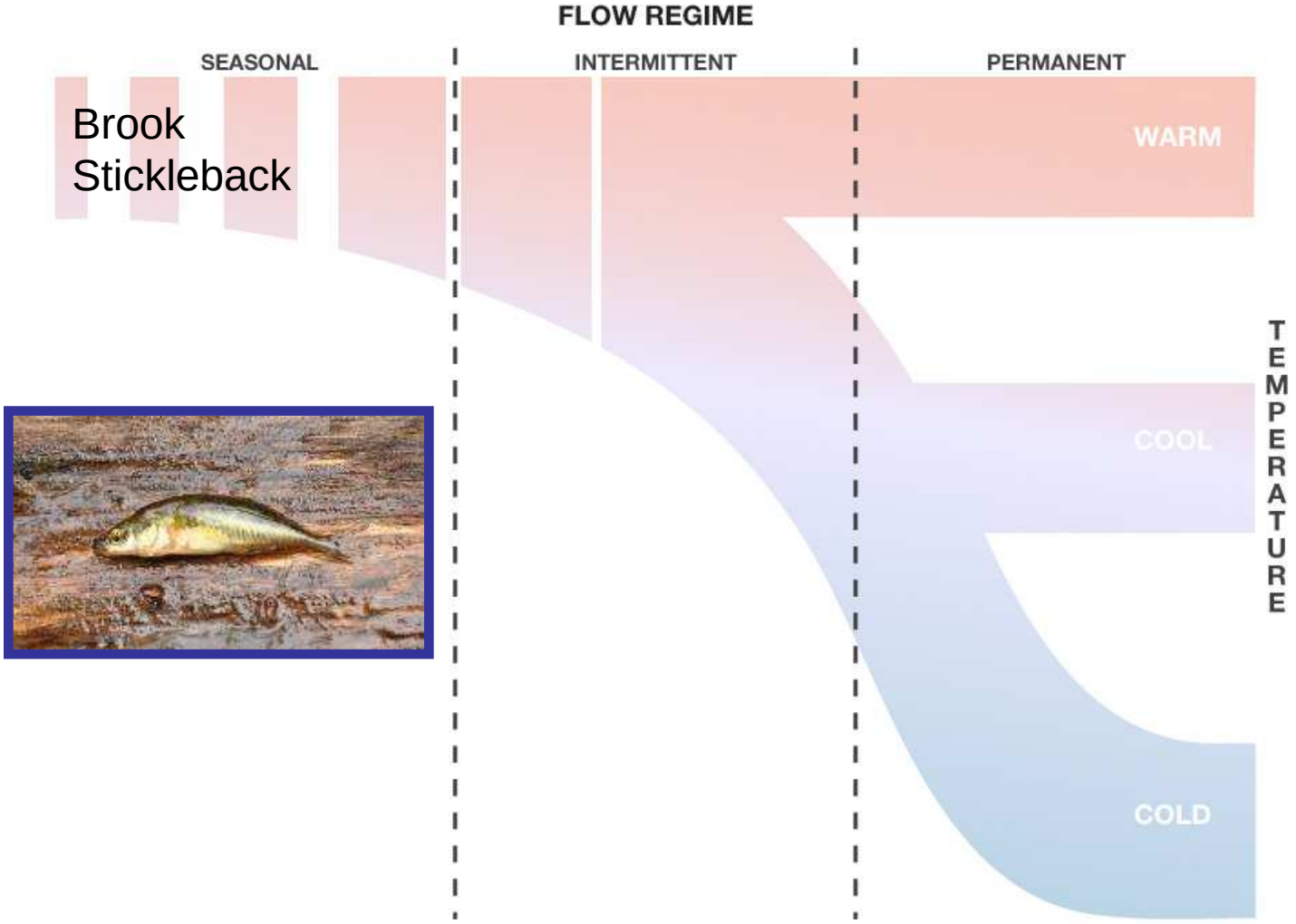
Spring Peeper

American Toad

Fish Community Hydrological & Ecological Gradients

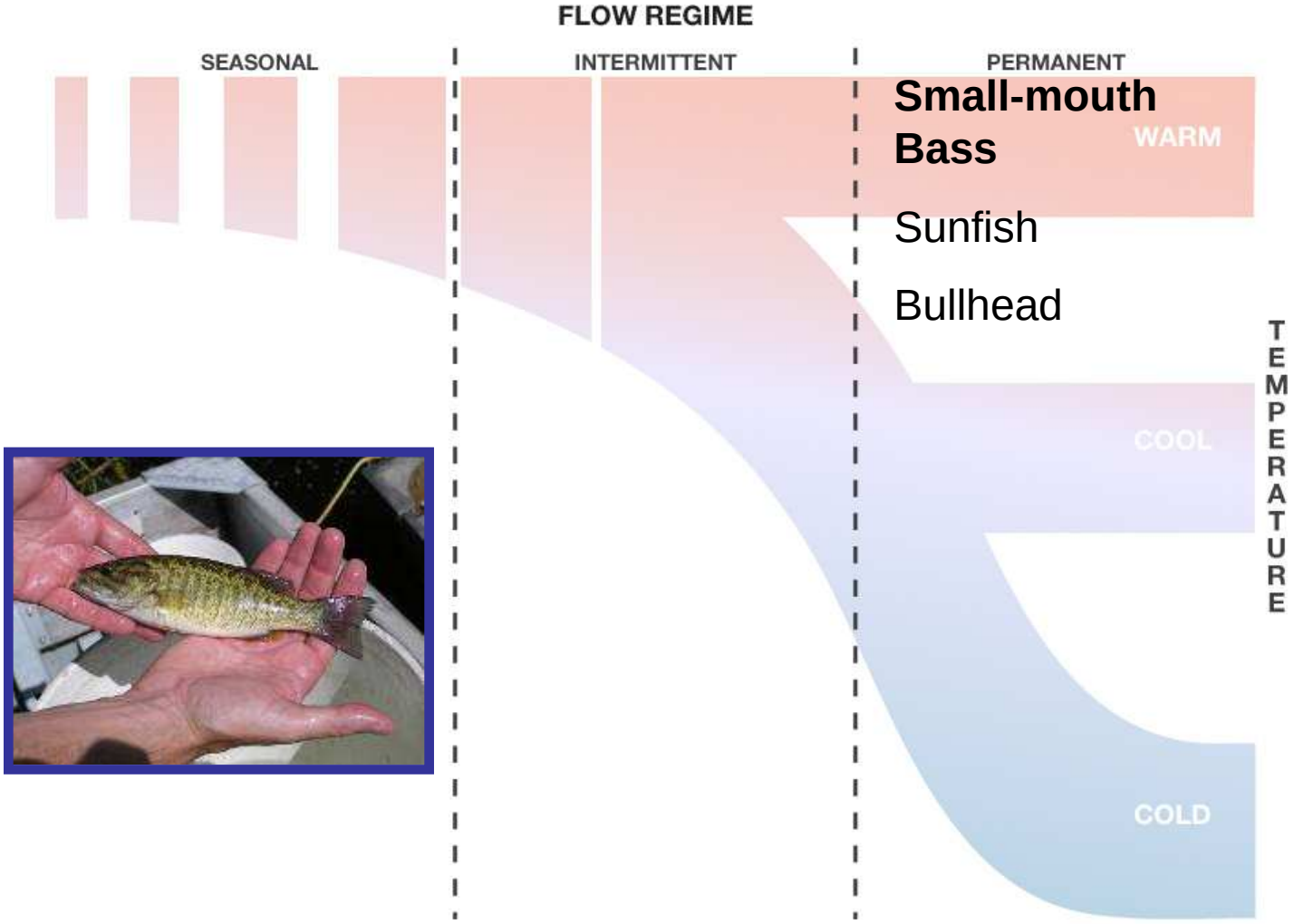


Fish Community Hydrological & Ecological Gradients

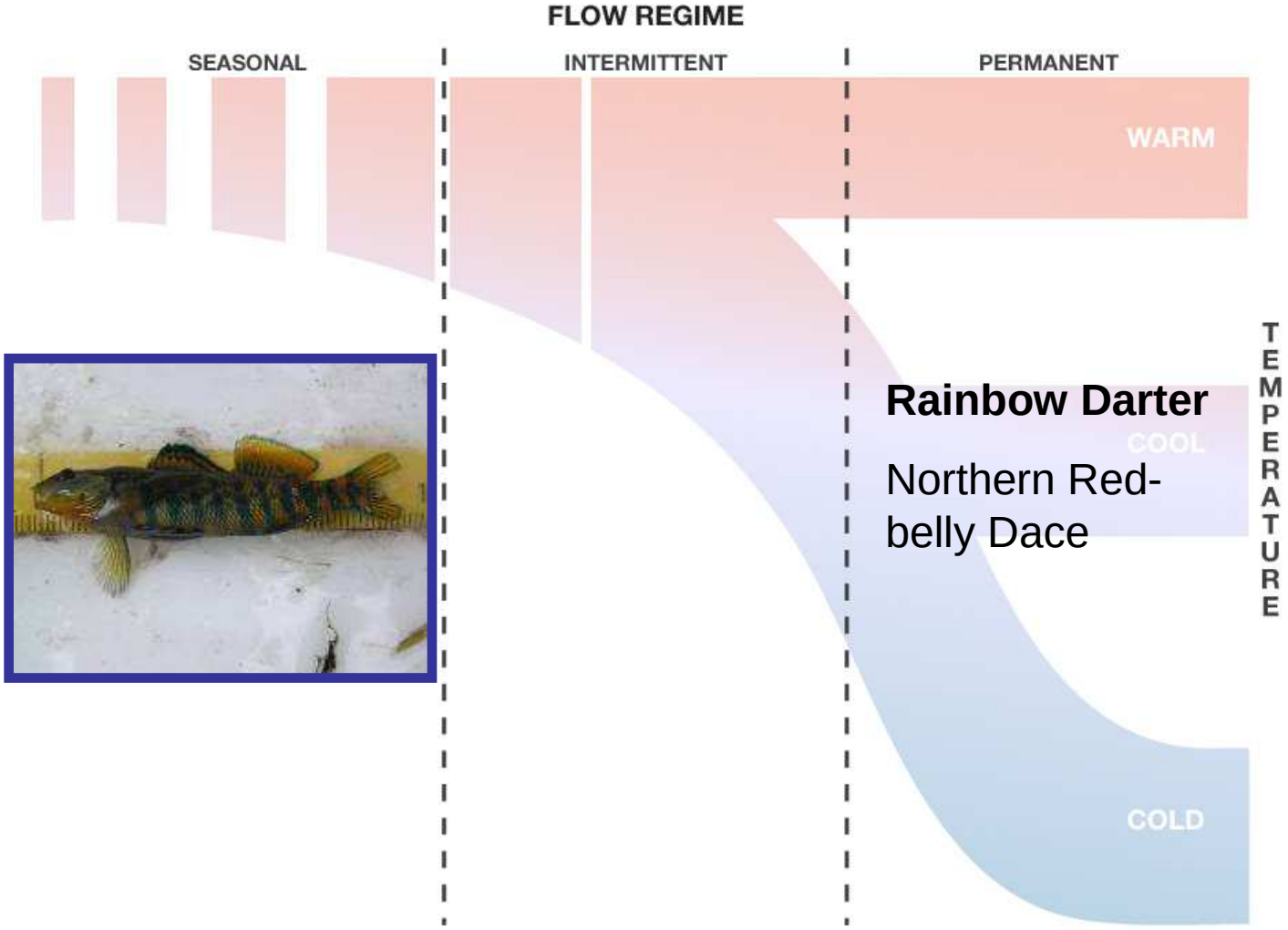


Fish Community Hydrological & Ecological Gradients

Fish Community Hydrological & Ecological Gradients

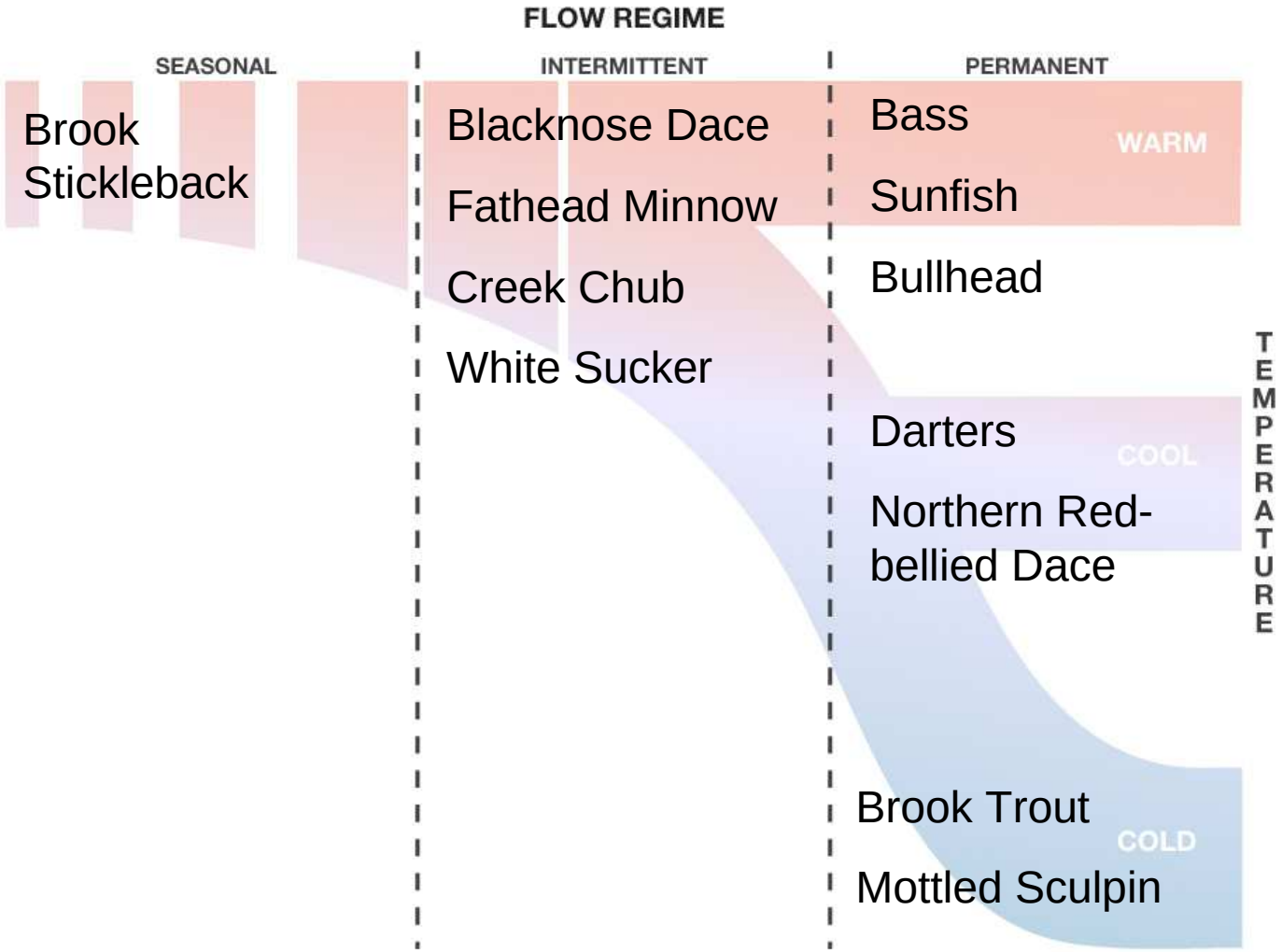


Fish Community Hydrological & Ecological Gradients



Fish Community Hydrological & Ecological Gradients

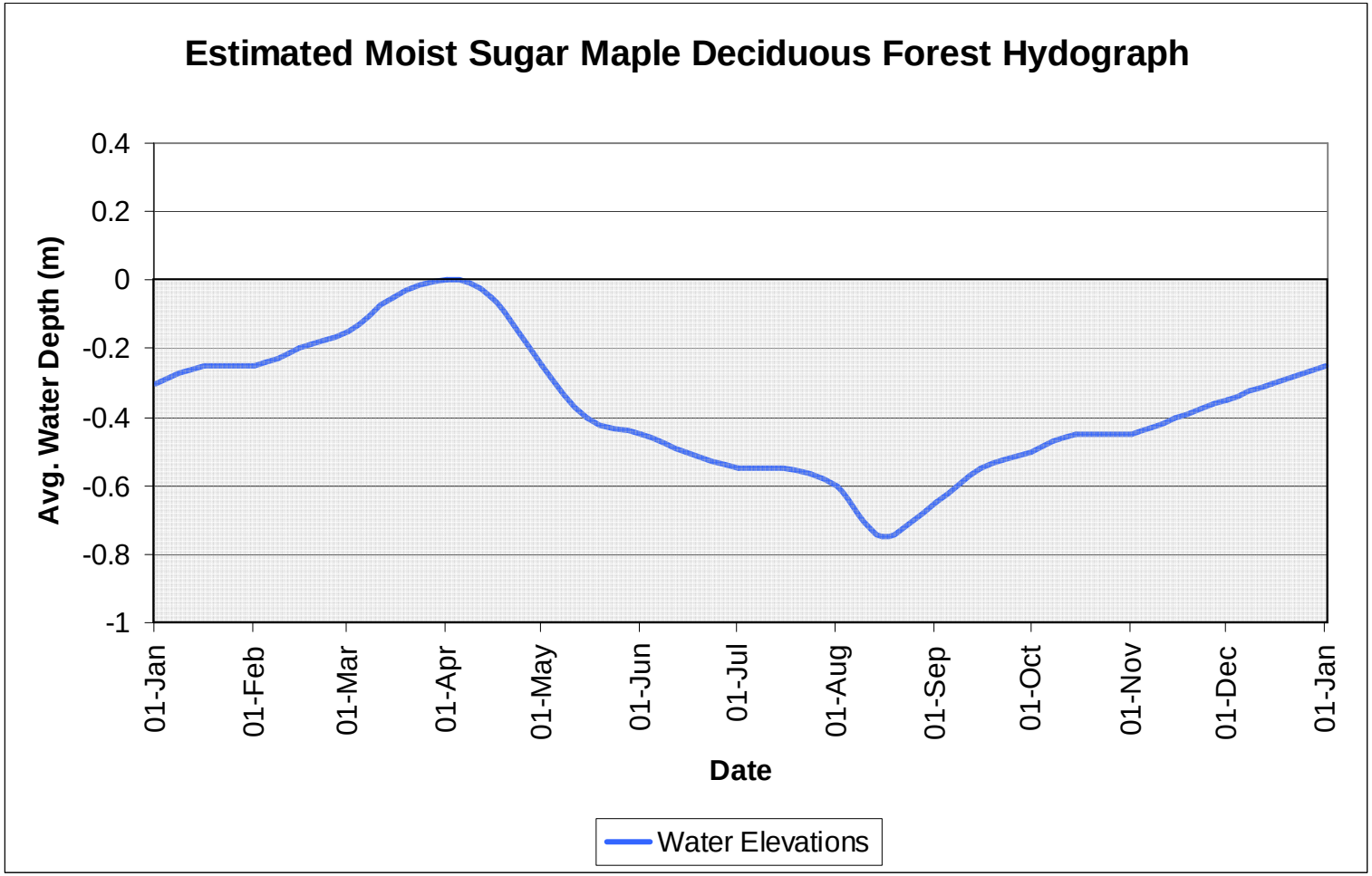
Fish Community Hydrological & Ecological Gradients



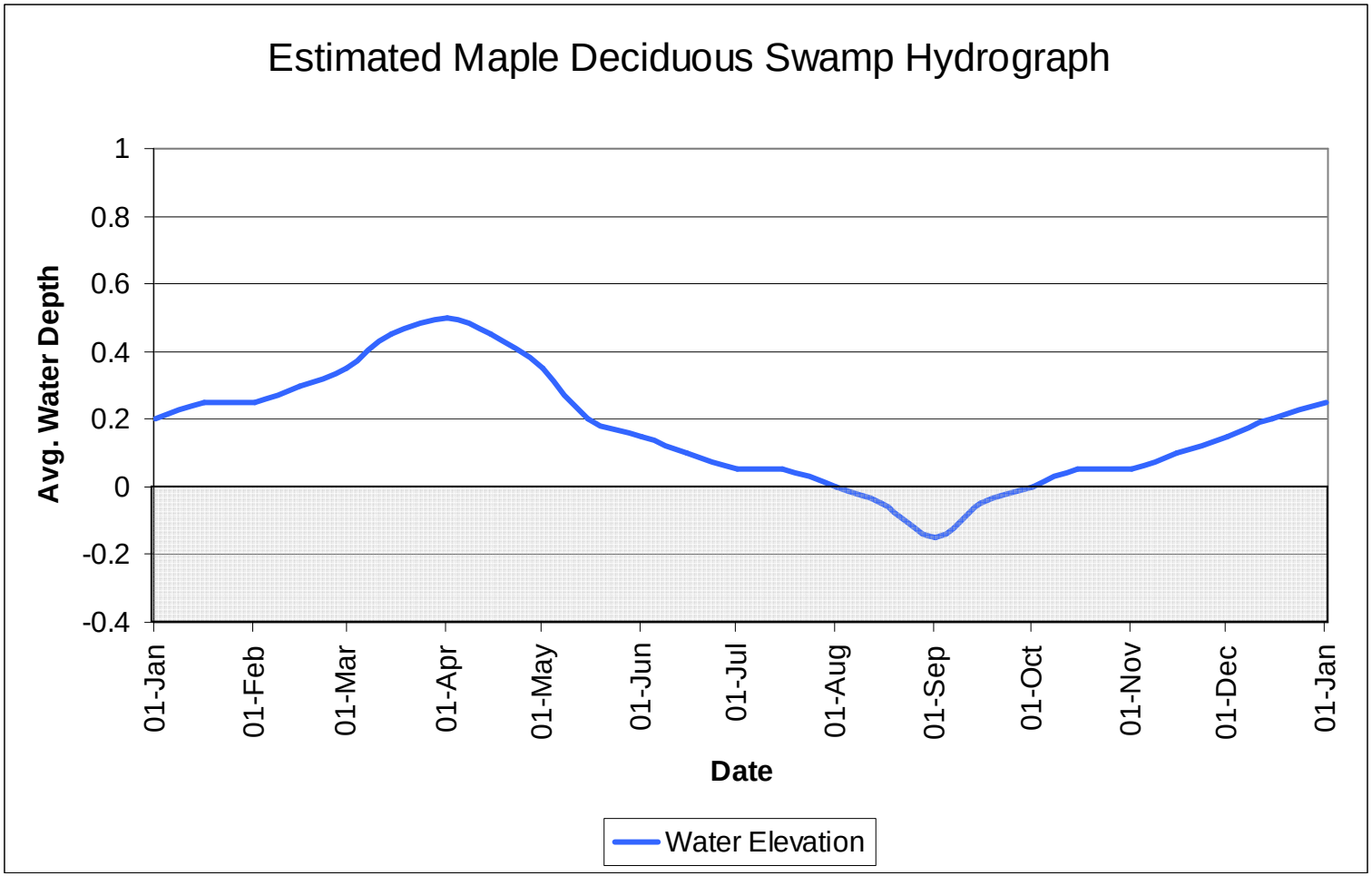
Hydroperiod

- Seasonal pattern of water fluctuation
  - Includes both surface and ground water.
- Hydrologic signature of each wetland
- Four important attributes:
  - Duration;
  - Extent;
  - Depth; and
  - Timing

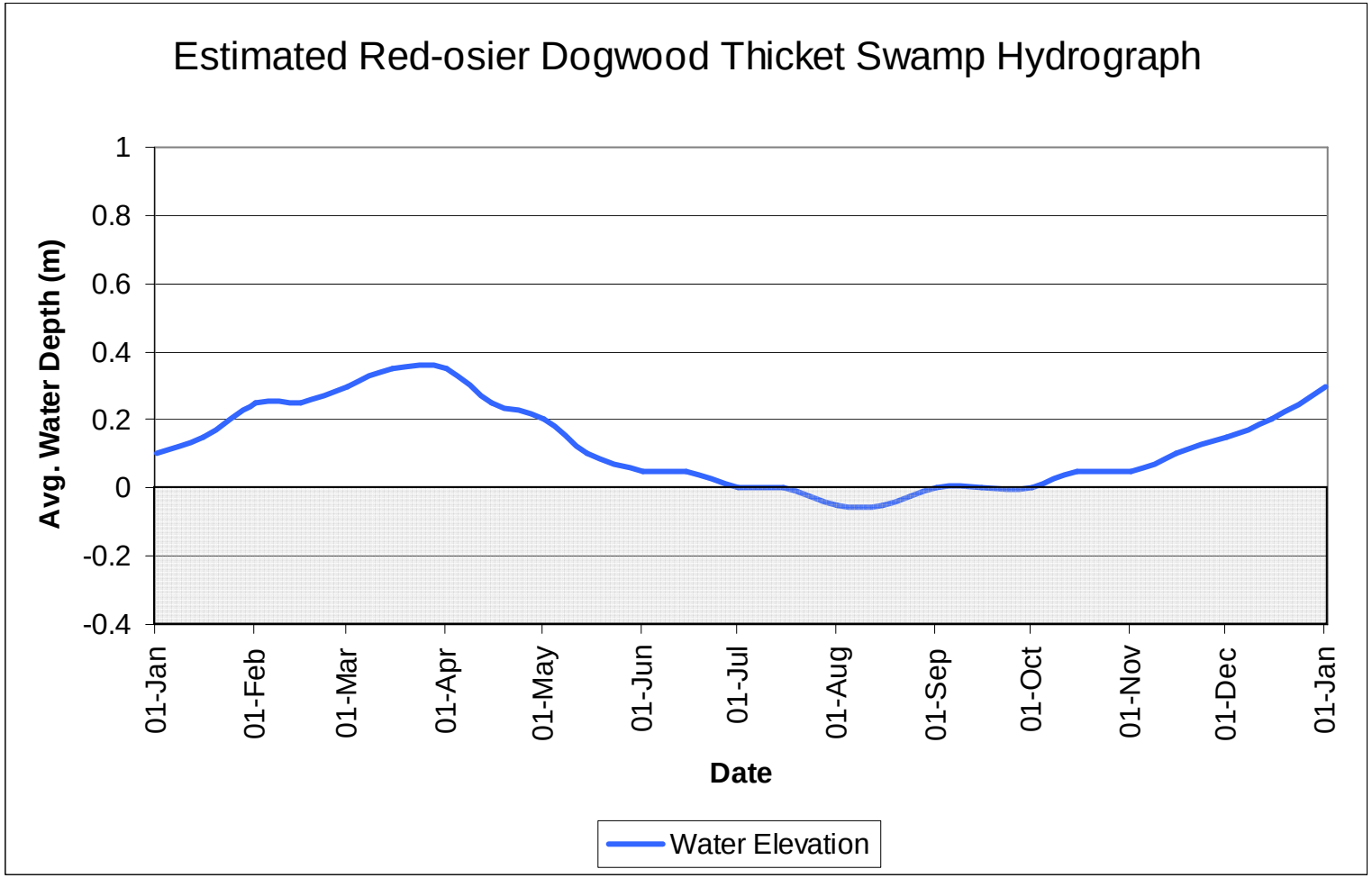
Forest Hydroperiod



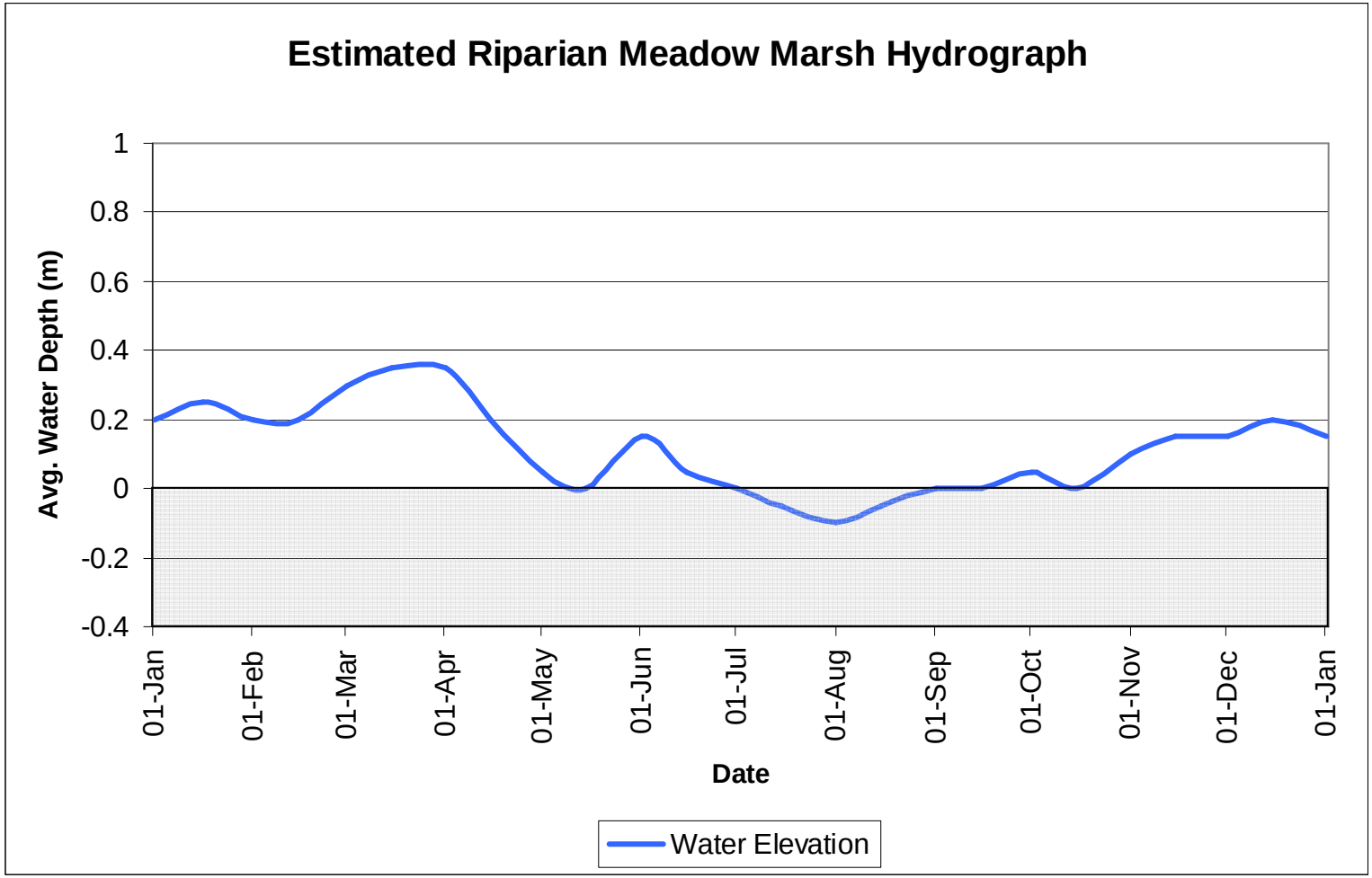
Swamp Hydroperiod



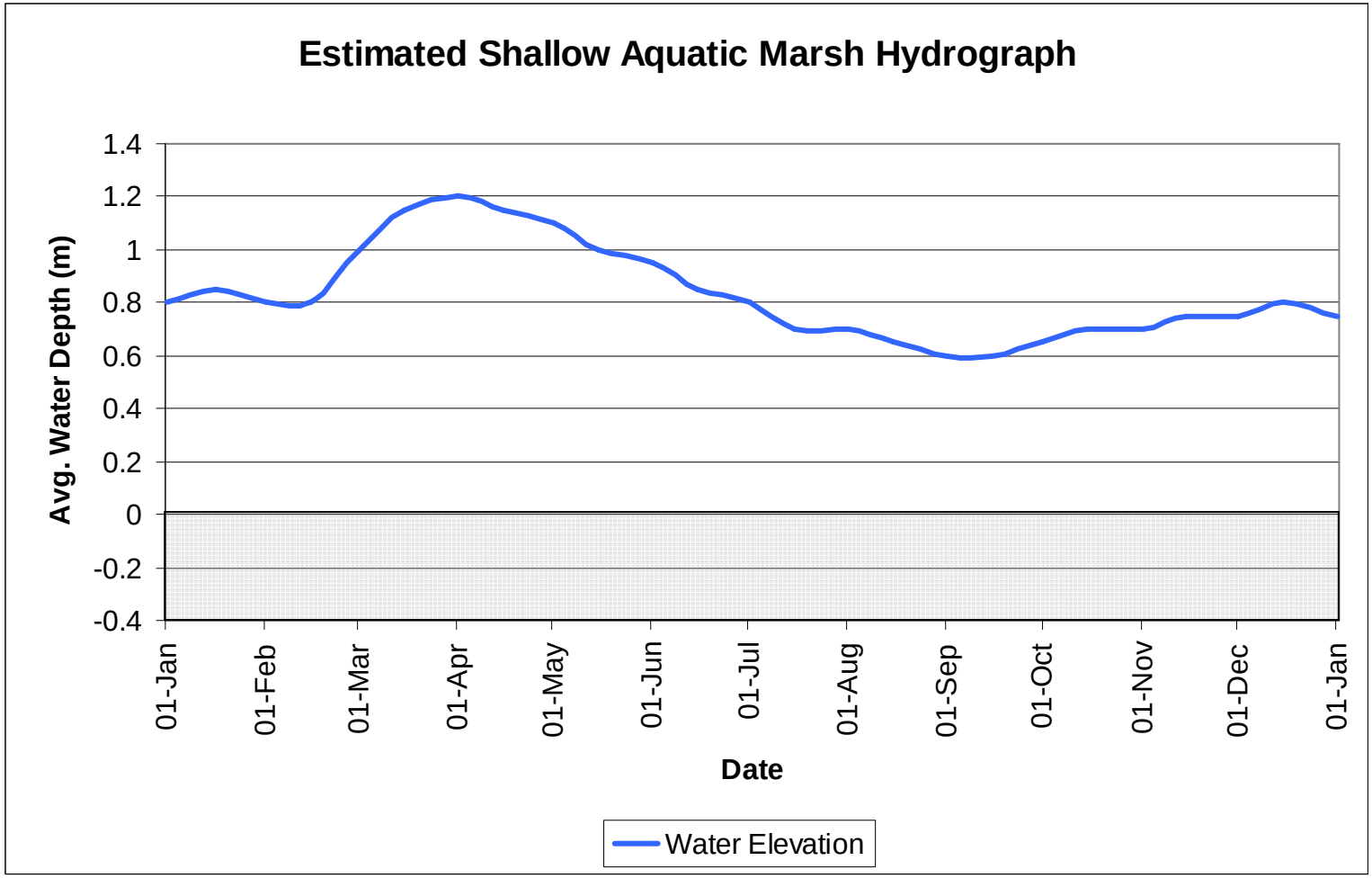
Thicket Swamp Hydroperiod



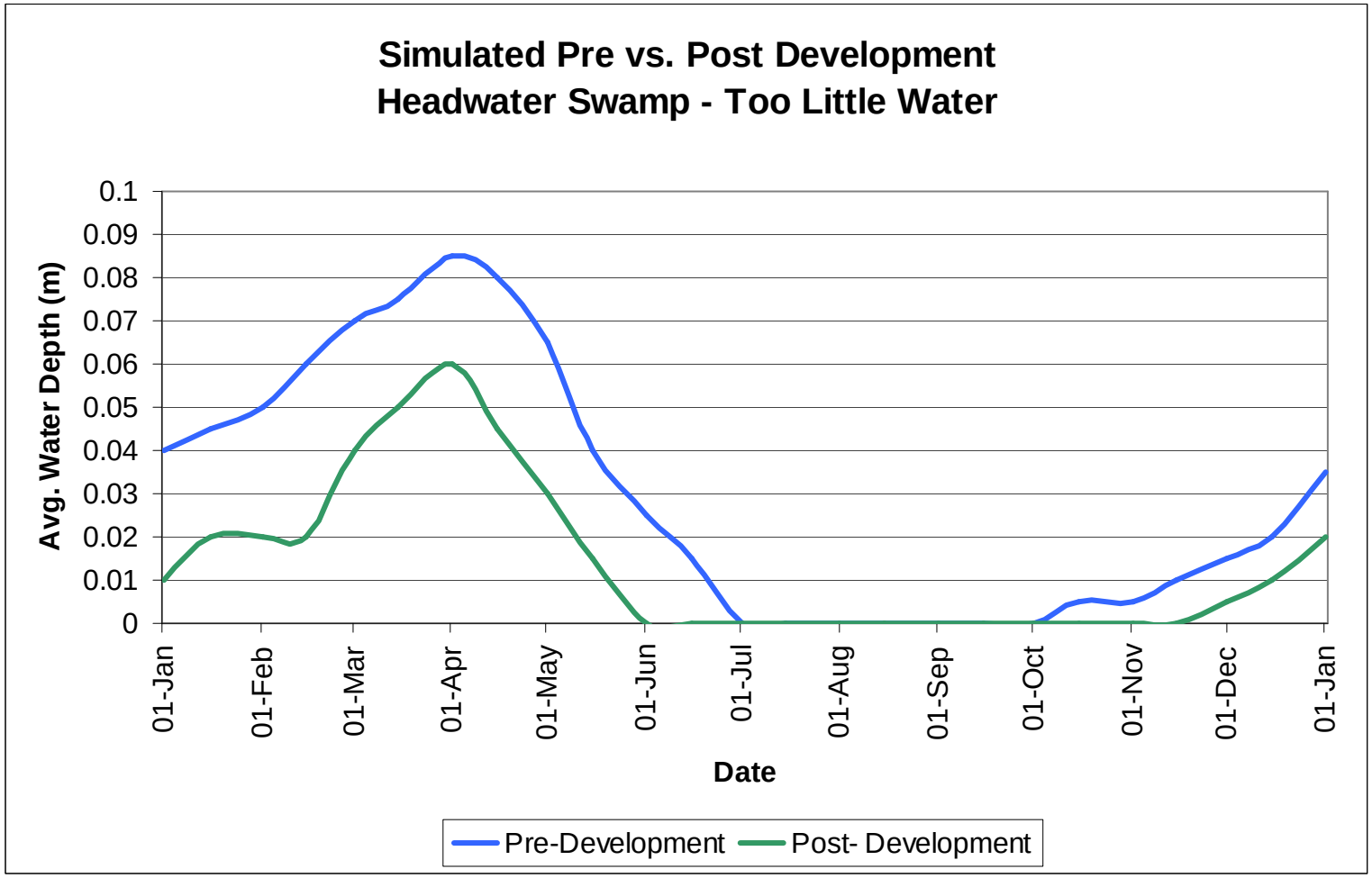
Meadow Marsh Hydroperiod



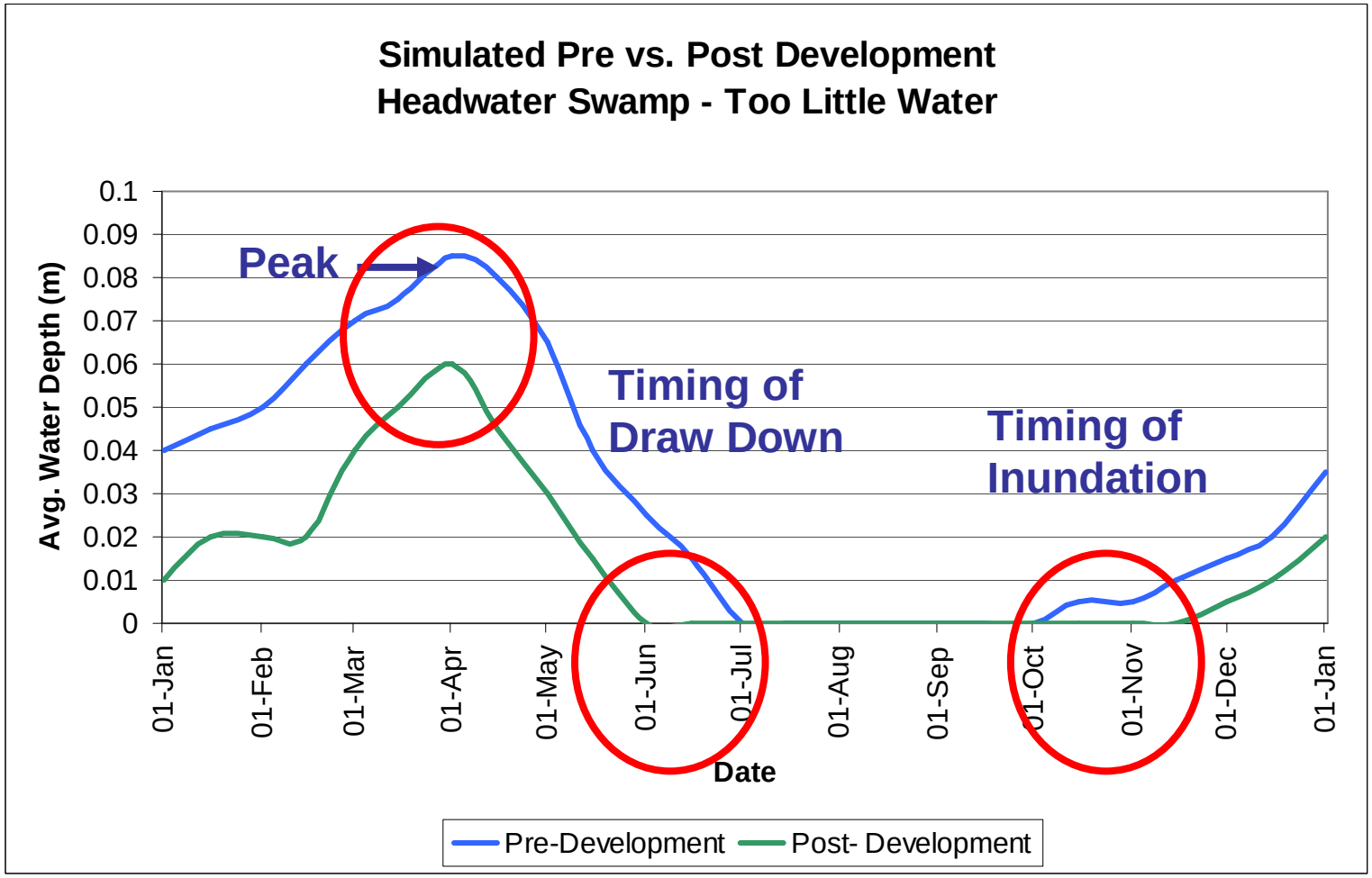
Shallow Aquatic Marsh Hydroperiod



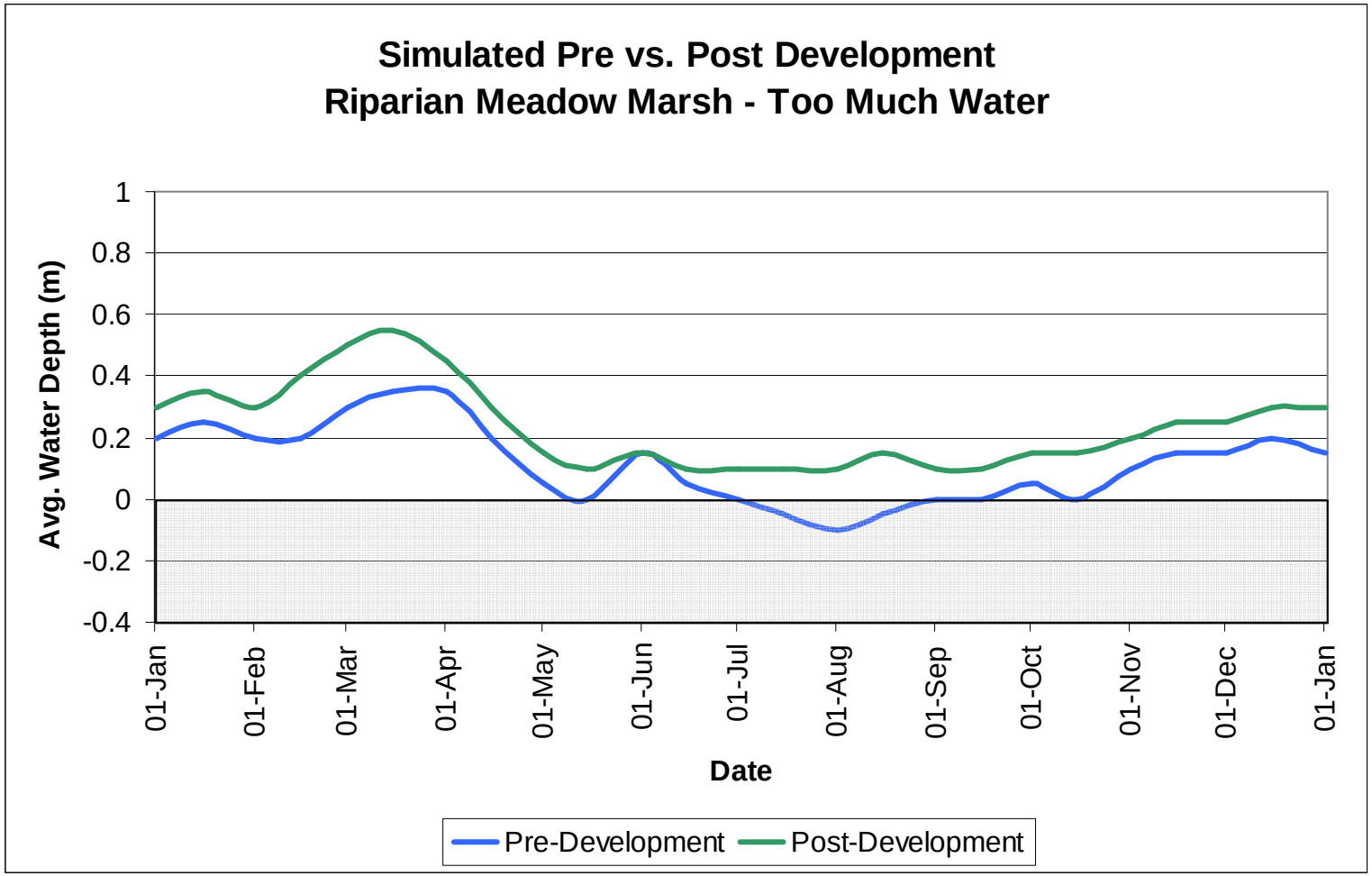
Matching Post – Pre Hydroperiod



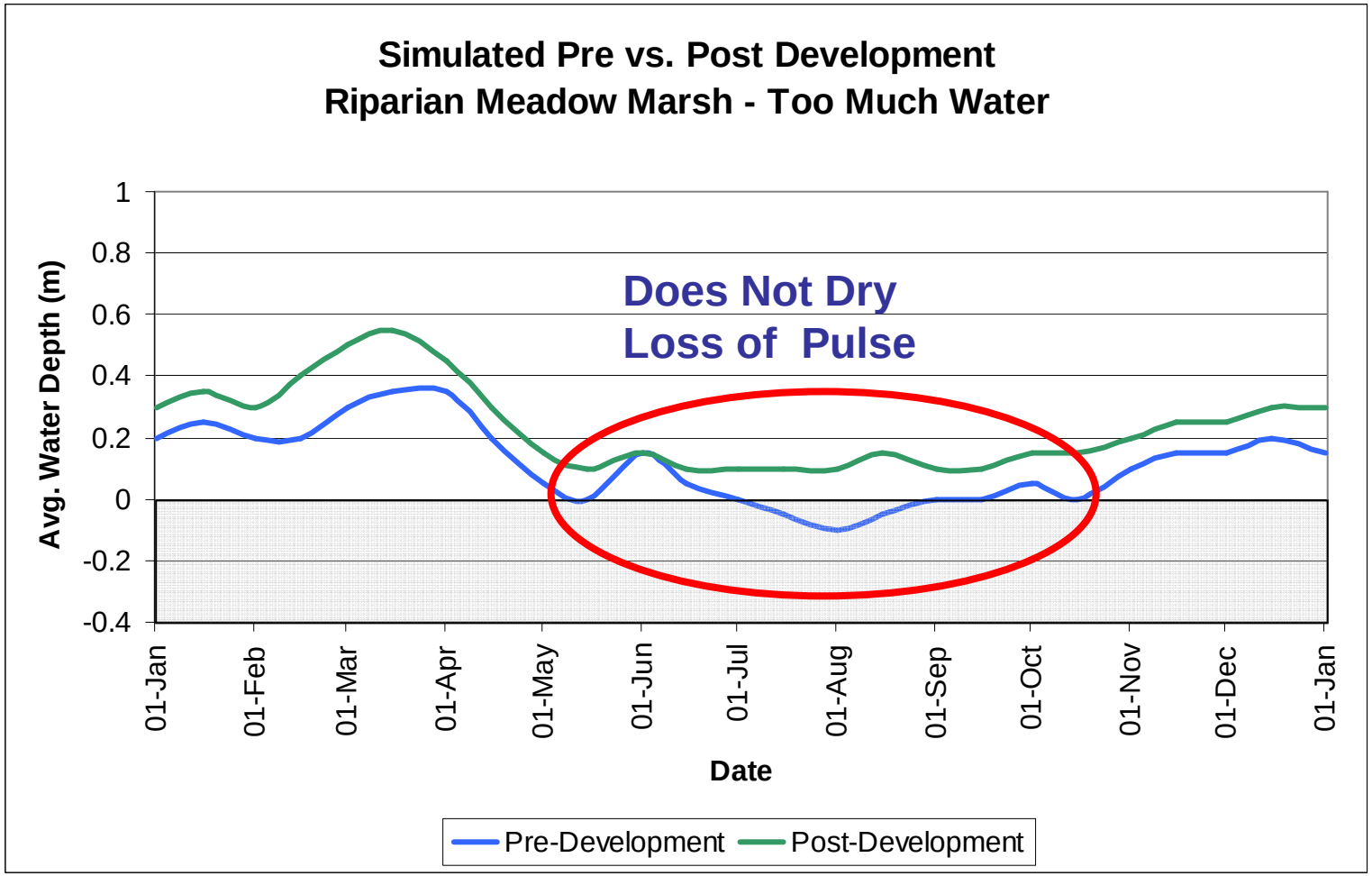
Matching Post – Pre Hydroperiod



Matching Post – Pre Hydroperiod



Matching Post – Pre Hydroperiod



Consequences & Risk

- Uncommon hydrologic events more common
- Natural hydrologic variation lost
- Changes to the physical environment
- Habitat requirement no longer met
- Increased stress, competition, death
- Community shift

RESULT = NEGATIVE IMPACT

Consequences & Risk

Georgetown, ON

- Urban development
- Municipal Well
- Impermeable cover
- Lowering of water table
- Loss of surface inputs

Consequences & Risk

- Decomposition of organic soil
- Stress & death of wetland plants & trees
- Loss of brook trout population
- Loss of cedar swamp

NEGATIVE IMPACT

FLOW DIVERSION

Too little water

Stormwater Inputs

Too much water

Introduction to the Guidelines

- Conservation Authority Water Balance Guidelines for Natural Heritage Features
  - Wetlands
  - Watercourses
  - Woodlands
- Preference is to apply at the MESP/EIR planning stage

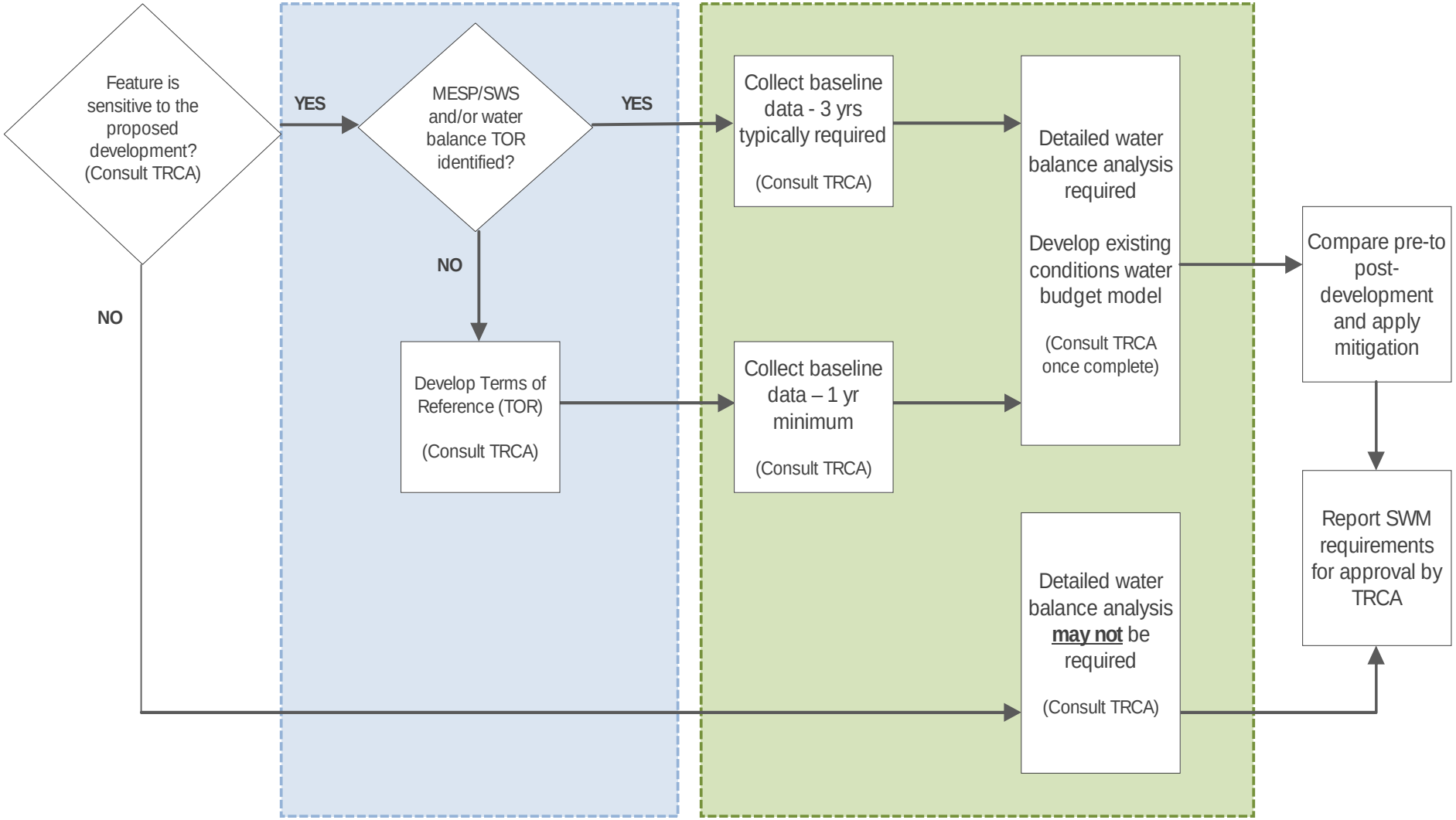
Water Balance Guidelines

OVERALL OBJECTIVE

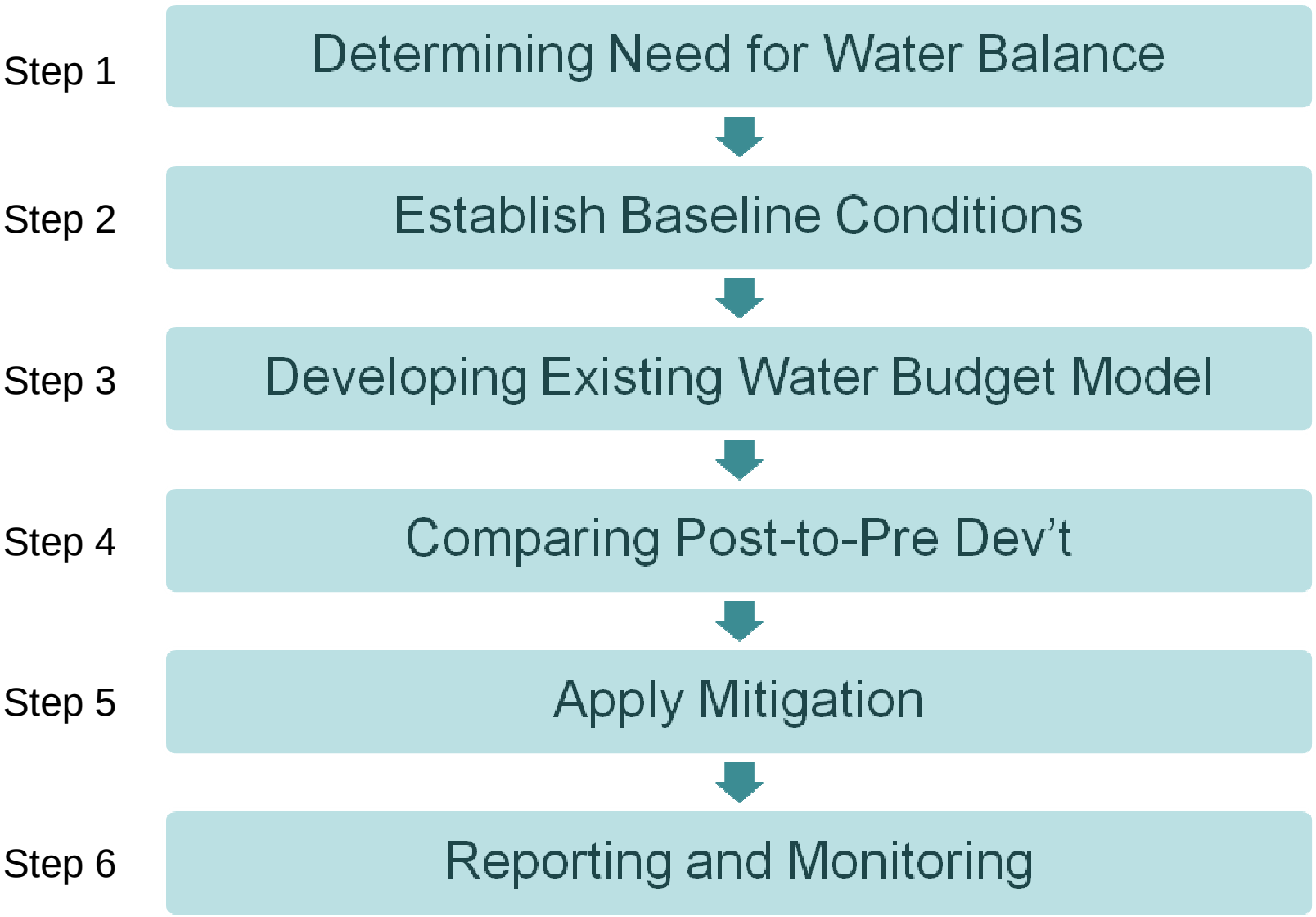
- To prevent negative impacts on long-term hydrological and ecological function of features

Important Considerations

- Apply after decision to protect natural feature has been made
- All stormwater criteria work together to achieve multiple objectives and watershed goals
- Process needs to be multi-disciplinary and integrated



Consult early and consult often


Step 1
Determining Need for Water Balance
Step 2
Establish Baseline Conditions
Step 3
Developing Existing Water Budget Model
Step 4
Comparing Post-to-Pre Dev't
Step 5
Apply Mitigation
Step 6
Reporting and Monitoring

General Guidelines

Step 1 – Determining Need

The Conservation Authority considers:

1. Changes to the catchment size;
2. The form and type of development
3. The sensitivity of the feature

Water Balance not required, if:

1.Not a large change in the catchment area;
2.Form of development not expected to substantially alter hydrology (e.g. open space);
3.Feature is not particularly sensitive

Photo credit: The Sernas Group

Water Balance is required, if:

1.There is a large change in the drainage area;
2.Form of development is expected to substantially alter hydrology (e.g. industrial);
3.Feature is sensitive to hydrological change

Photo credit: The Sernas Group

Step 2 – Establish Baseline Conditions

- Data collection is critical
- Need to instrument EARLY – continuous data for 3 year preferred
- Consult with municipality/CA on the type and configuration of equipment

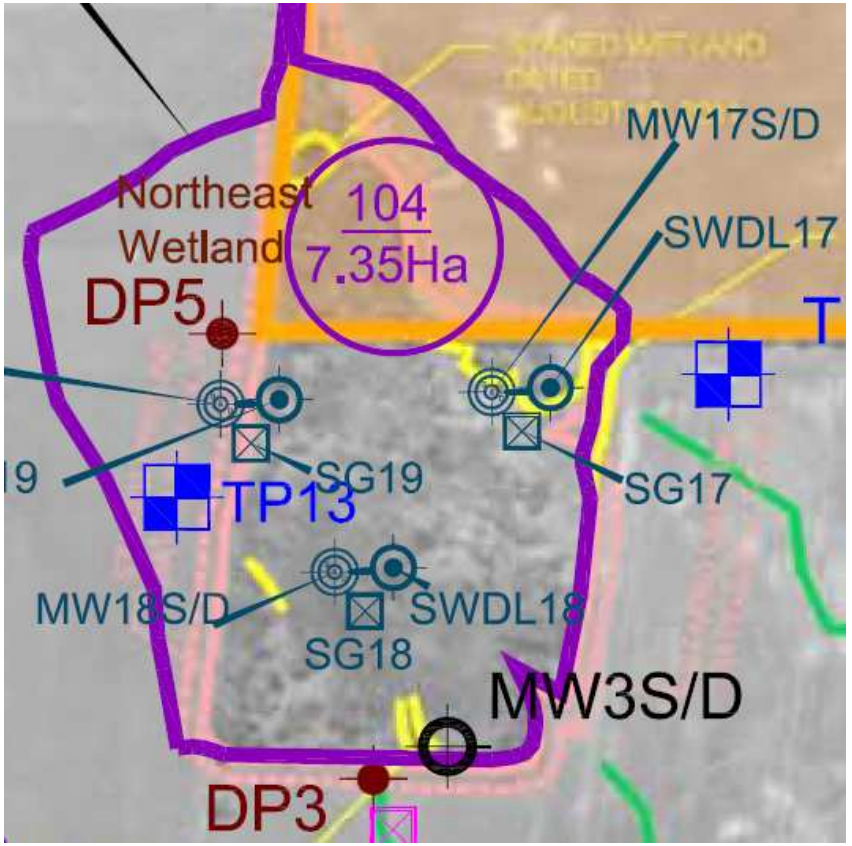


Photo Credit: Terraprobe

Step 3 – Developing Existing Water Budget Model

- Use collected data to develop an water budget model
- Some of the recognized models: PRMS, HSPF, QUALHYMO, or SWMM
- Run long-term analysis using nearest available climate station
- Daily water balance analysis to generate weekly (watercourses and wetlands) or monthly (woodlands) results.

Step 4 – Comparing Pre- and Post-Dev't

- In consultation with CA and municipality, establish goals and targets
- Compare daily pre- and post- to generate weekly or monthly results
- Quantify changes in water budget components – will cause negative impacts?
- Generate maps, tables and graphs

Pre-Development

	Site	Other Areas	Overall
Infiltration	3,583	8,359	11,942
Surface Flow	2,598	6,061	8,659
Total	6,180	14,421	20,601

Post-Development

	Site	Other Areas	Overall
Infiltration	5,939	8,359	14,298
Surface Flow	827	6,061	6,889
Total	6,766	14,421	21,187

Percent Change in Flows to Wetland

	Site Only	Overall
Infiltration	66%	20%
Surface Flow	-68%	-20%
Total Flow	9%	3%

Source: Terraprobe

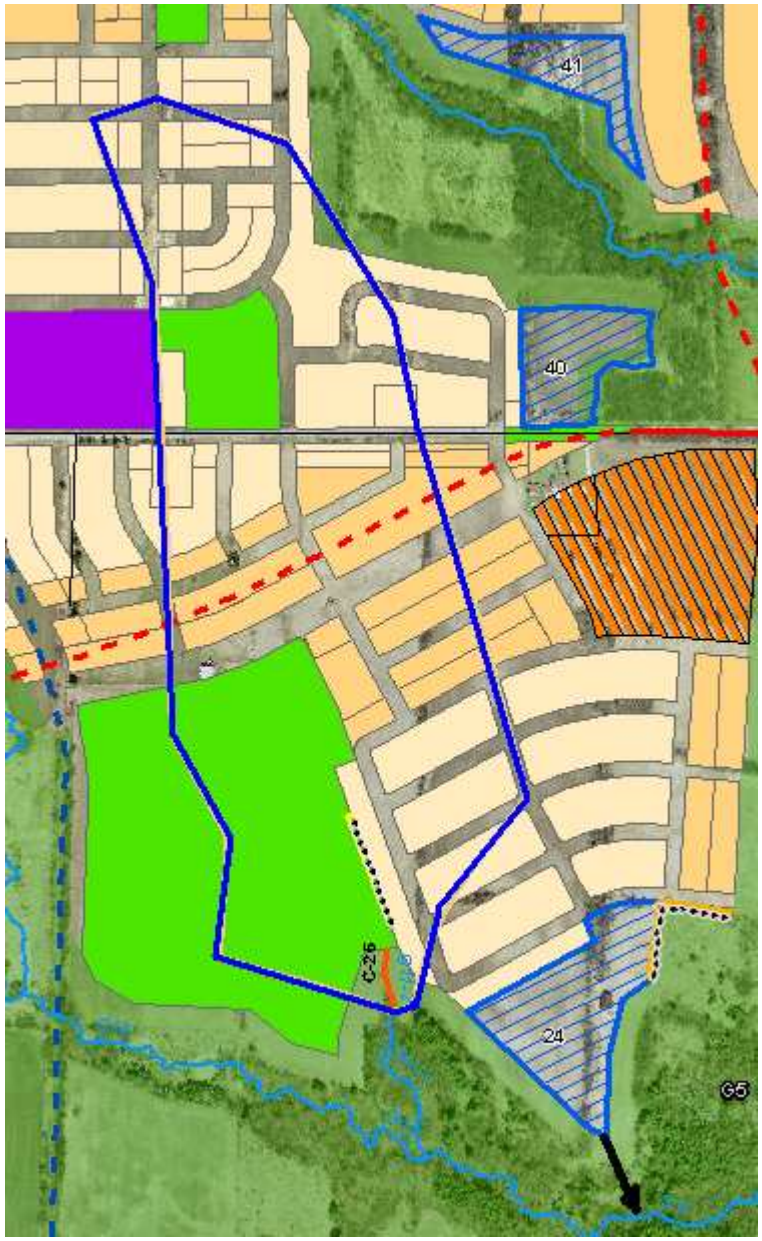


Photo credit: The Sernas Group

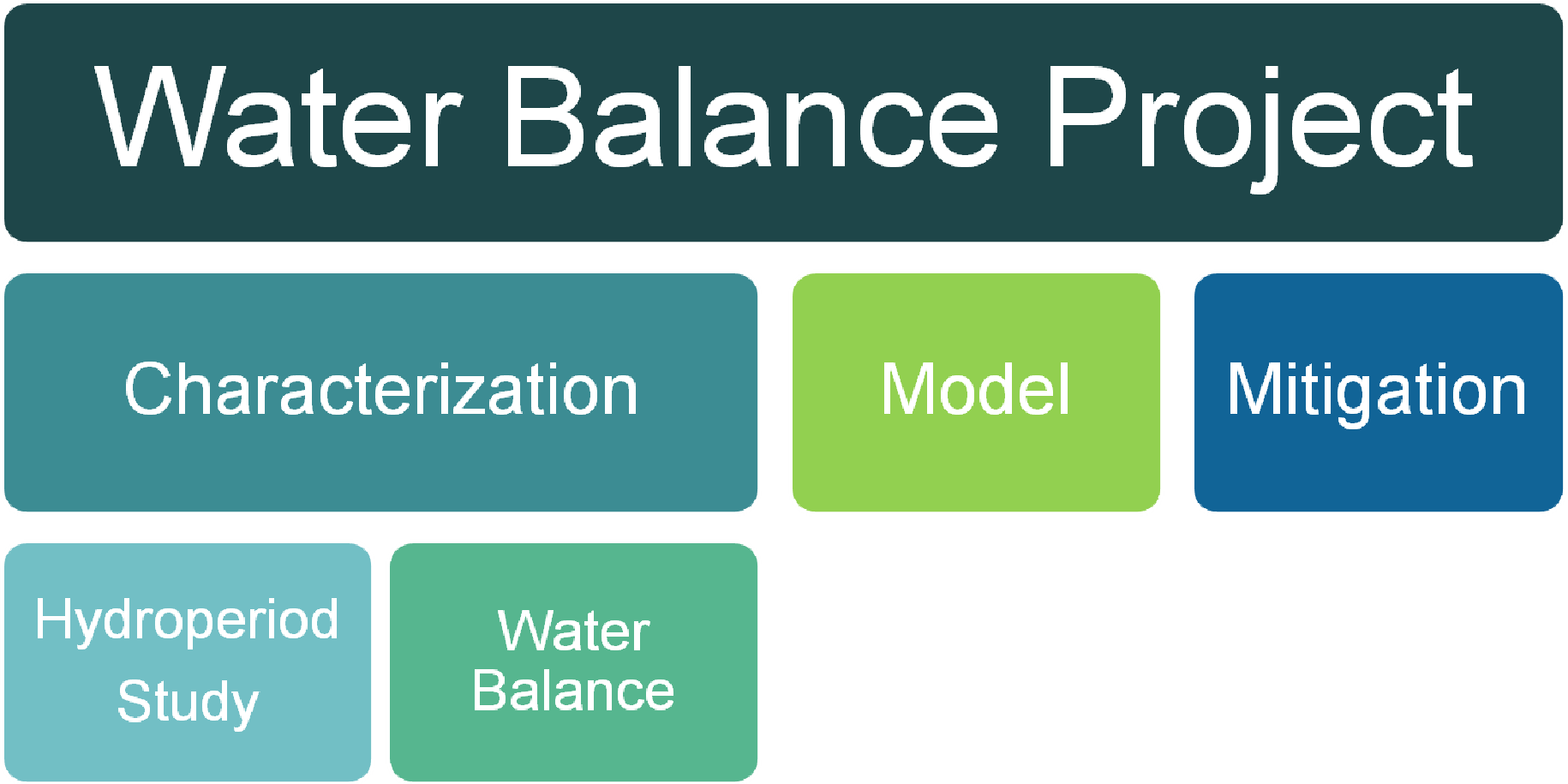
Step 5 – Apply Mitigation

- Apply mitigation to maintain pre-development hydroperiod
- Use clean roof water and direct to bioswales, infiltration galleries, third pipe, etc.
- Connect mitigation measures to natural feature
- Consult municipality and CA

Step 6 – Reporting and Monitoring

- Report pre-, post-, and post-dev't with mitigation conditions
- Consult CA/municipality for monitoring requirements – 3-years
- Design should consider possible remediation if monitoring shows impacts

Water Balance Project Structure



www.sustainabletechnologies.ca

Sustainable Technologies Evaluation Program

Search

Home | Clean Water | Clean Air | Green Building | Links | Search | Contact us

Stormwater Management | Community Wastewater | Stream Restoration | Erosion and Sediment Control | Water Conservation

Clean Water > Stormwater Management > Water Balance Approach > Protection of Natural Features

Water Balance for the Protection of Natural Features

Urbanization can cause detrimental changes to the hydrology of natural features, such as wetlands, woodlands and watercourses because of increases or decreases in water quantity outletting to these features. These changes have been known to cause serious problems such as significant vegetation shifts, altered habitat conditions, and flooding and erosion issues. Toronto and Region Conservation Authority and Credit Valley Conservation have developed guidelines to help mitigate these impacts, and we are initiating a research study to try to better understand the hydrological thresholds that drive these changes in natural systems following development.

Featured Studies:

» The Impacts of Urbanization on the Hydrology of Wetlands: A Literature Review

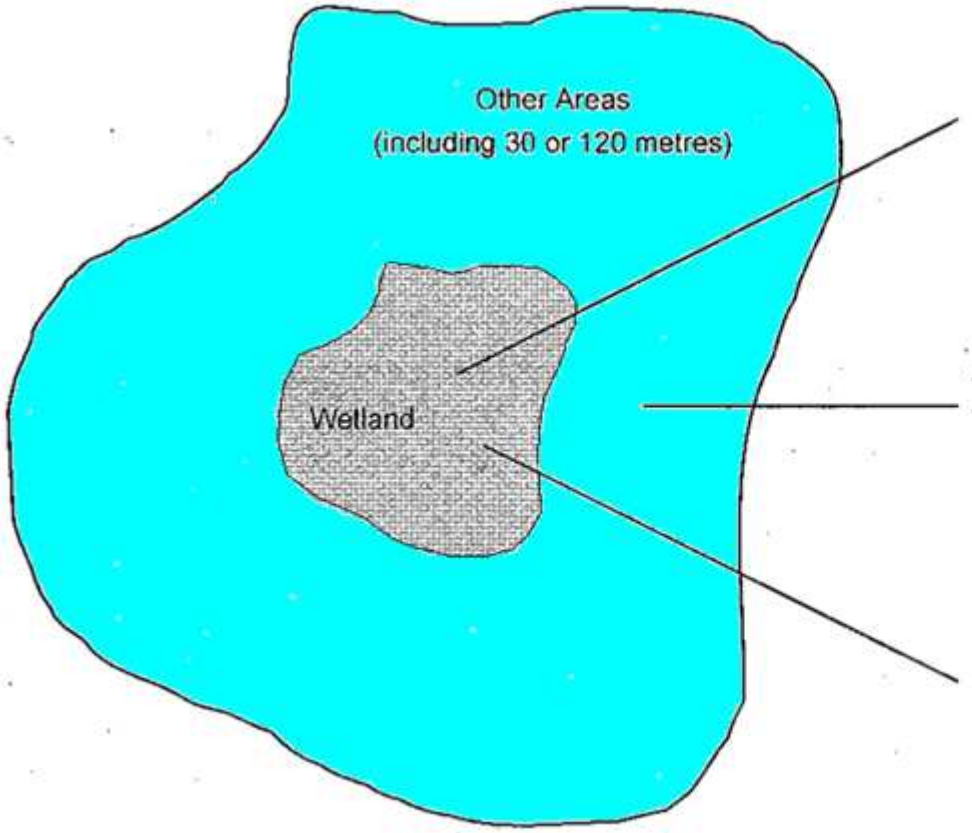
» Water Balance Guidelines for the Protection of Natural Features

» Water Balance for Natural Features Study


QUESTIONS?

Regulatory Responsibilities

Conservation Authorities Act/CA Regulations



Development (as defined in the Act), assessed with respect to the control of flooding, erosion, pollution, dynamic beaches and conservation of land[7].

Development (as defined in the Act), assessed with respect to the hydrologic function of the wetland. If impacts predicted, development is assessed with respect to the control of flooding, erosion, pollution, dynamic beaches and conservation of land.

Interference in any way with the wetland, assessed with respect to the natural features and hydrologic and ecological functions of the wetland.