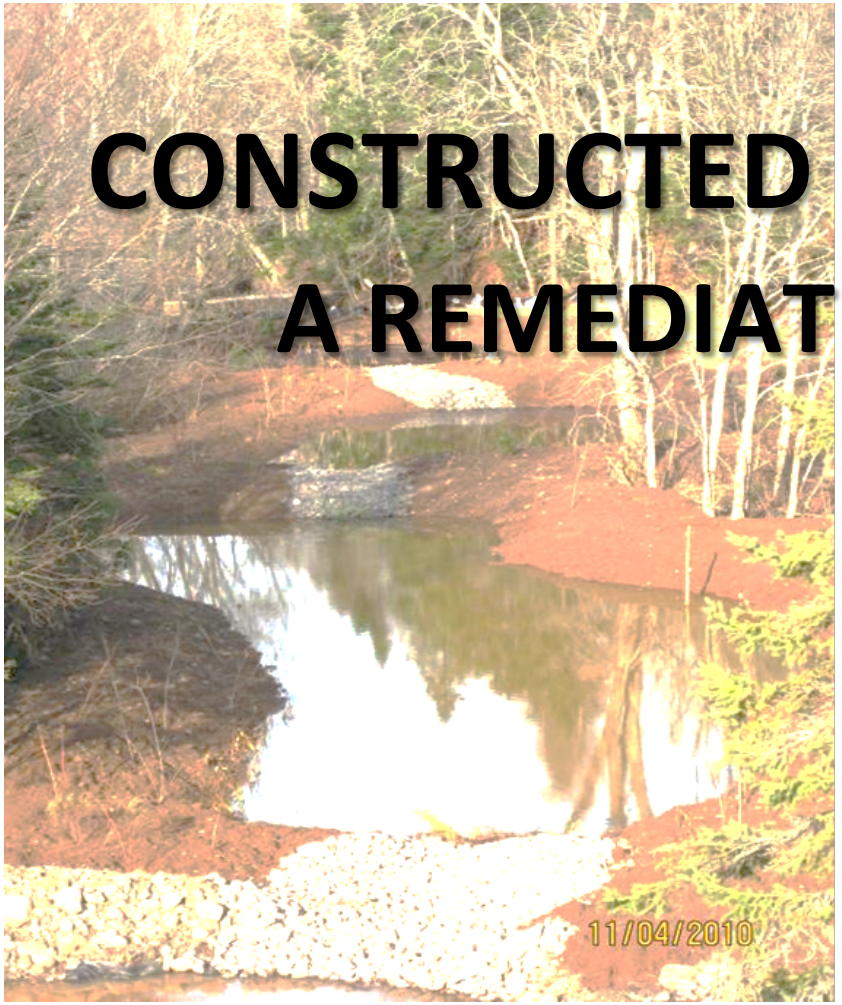
CONSTRUCTED WETLAND DESIGN:
A REMEDIATION CASE STUDY



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Atlantic Reclamation Conference, Wolfville NS, October, 2014

Presentation Overview

- Introduction to Constructed Wetlands
- Case Study Introduction
- Wetland: Why, Objectives & Design
- Wetland Construction & Monitoring Program
- Generalized Results
- Added Benefits & Conclusions

Constructed Wetlands: Intro

- *Artificial wetland created for:*
  - *the treatment of anthropogenic discharge(s),*
  - *land reclamation after industrial use, or*
  - *off-sets for compensation of lost habitat*
- Can be simple or complex
  - Remedial Wetlands should NOT be a simple, rectangular, steep-sided pond / lagoon
- globally popular, but Not well utilized in NS, particularly for remediation

Case Study: Intro

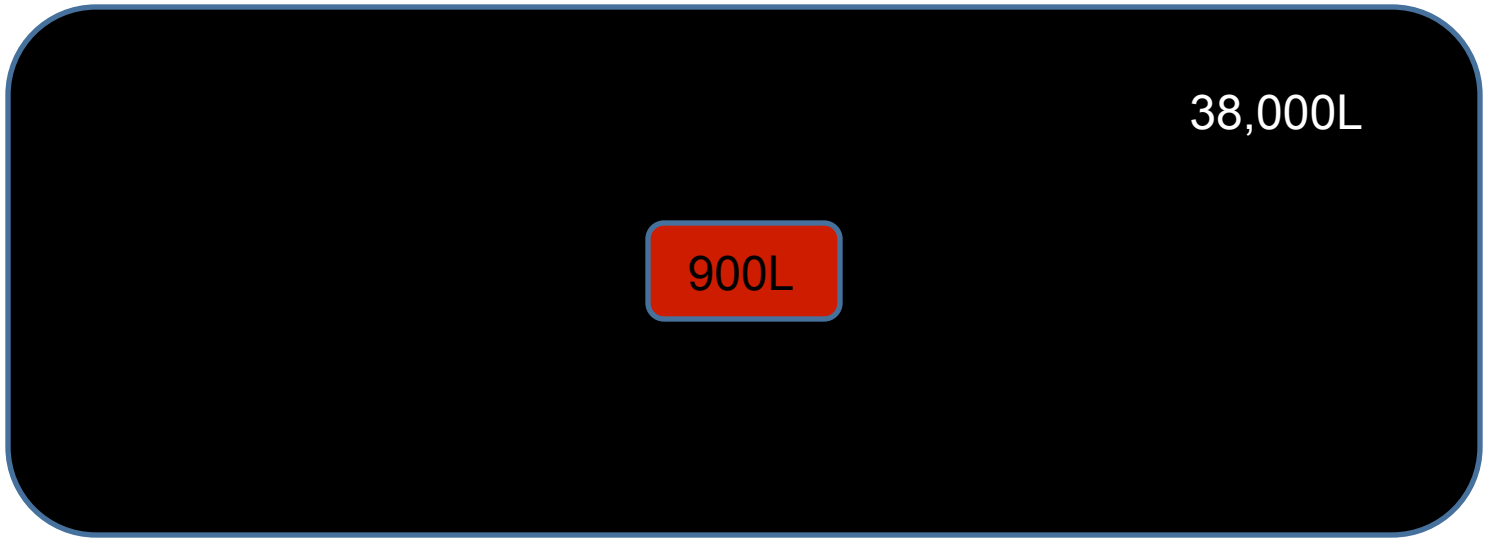
- Large-scale, tanker truck spill remediation project
- Impacts to 3 habitats, over large area = 6 km^2
- Study site = 3,700m^2 including 870m^2 wetland
- Few contaminants of concern (COCs)
- Several site-specific limitations to consider
- Overall complex remedial action plan
- $2.8 M cost of entire project

Case Study: Perspective

Tanker spill: 38,000L

Residential spill: 900L

Residential spill: $250,000



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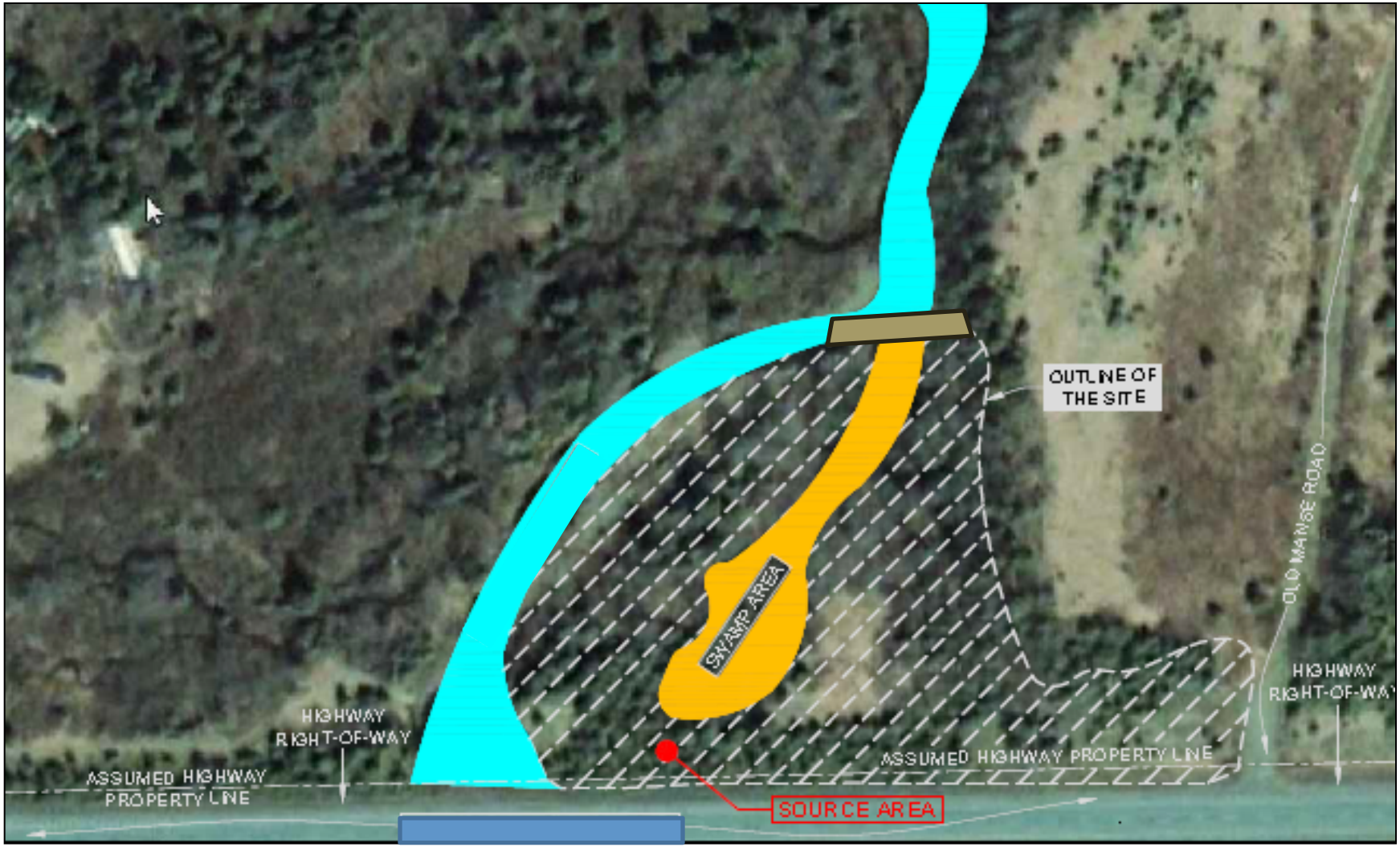
Case Study: Intro



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Case Study: Short-term Remediation

Physical removal of grossly contaminated soil and water

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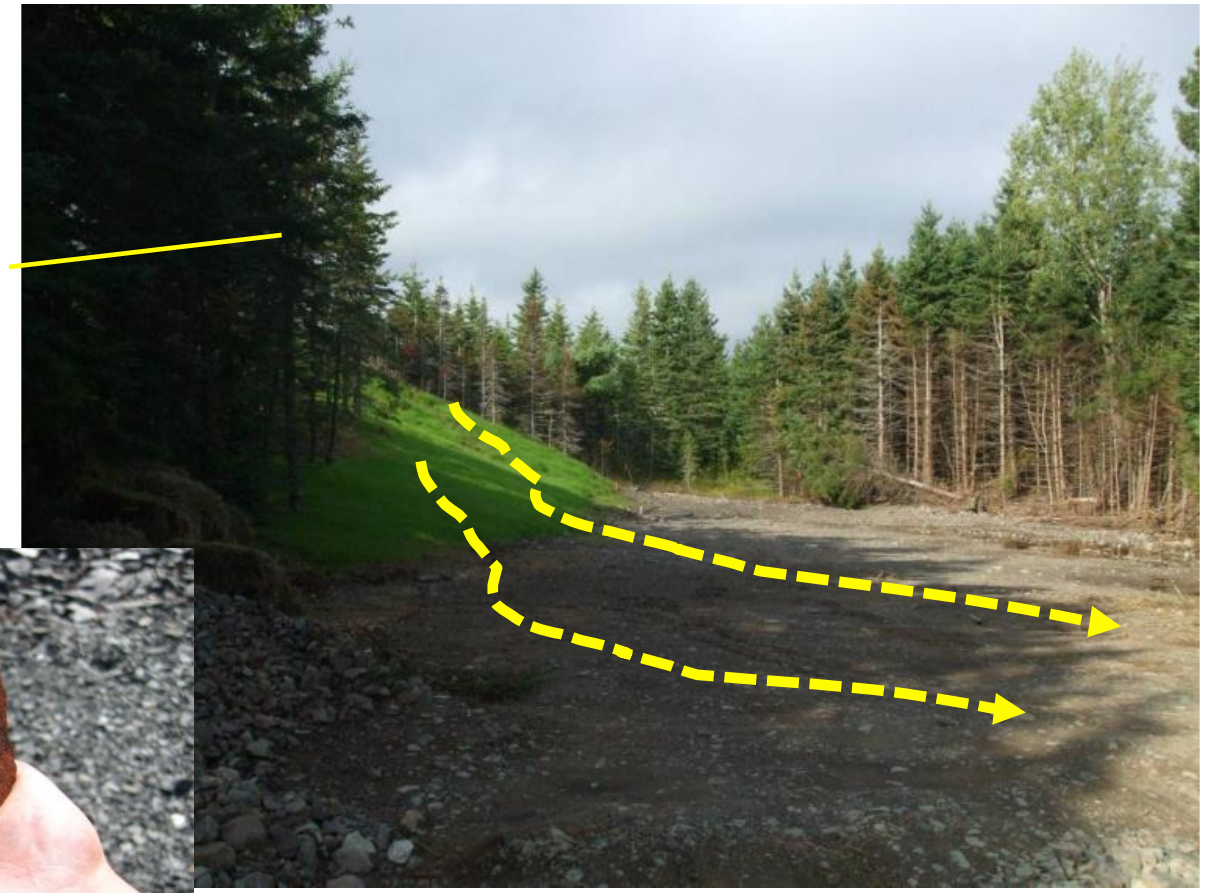
Case Study: Short-term Remediation

Contaminated Soil removal from the swamp, looking south (Aug. 20, 2010).

WHY a Constructed Wetland



elevated metals (waste oil, geology) and migration of residual PHCs

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Constructed Wetland: Goals

1. Residual Petroleum Hydrocarbons
2. Elevated metals (background & waste oil)
3. Off-set loss of floodplain swamp (1.5:1)
4. Improve water quality prior to discharge into River

Constructed Wetland: Design

1. Clean-up objectives,
2. Space restrictions,
3. Topography,
4. Geology,
5. Hydrology
   I. Wetland retention time or flow regime,
6. Local climate,
7. Abundance of native remedial flora, and
8. Open water complex of 3 connected ponds

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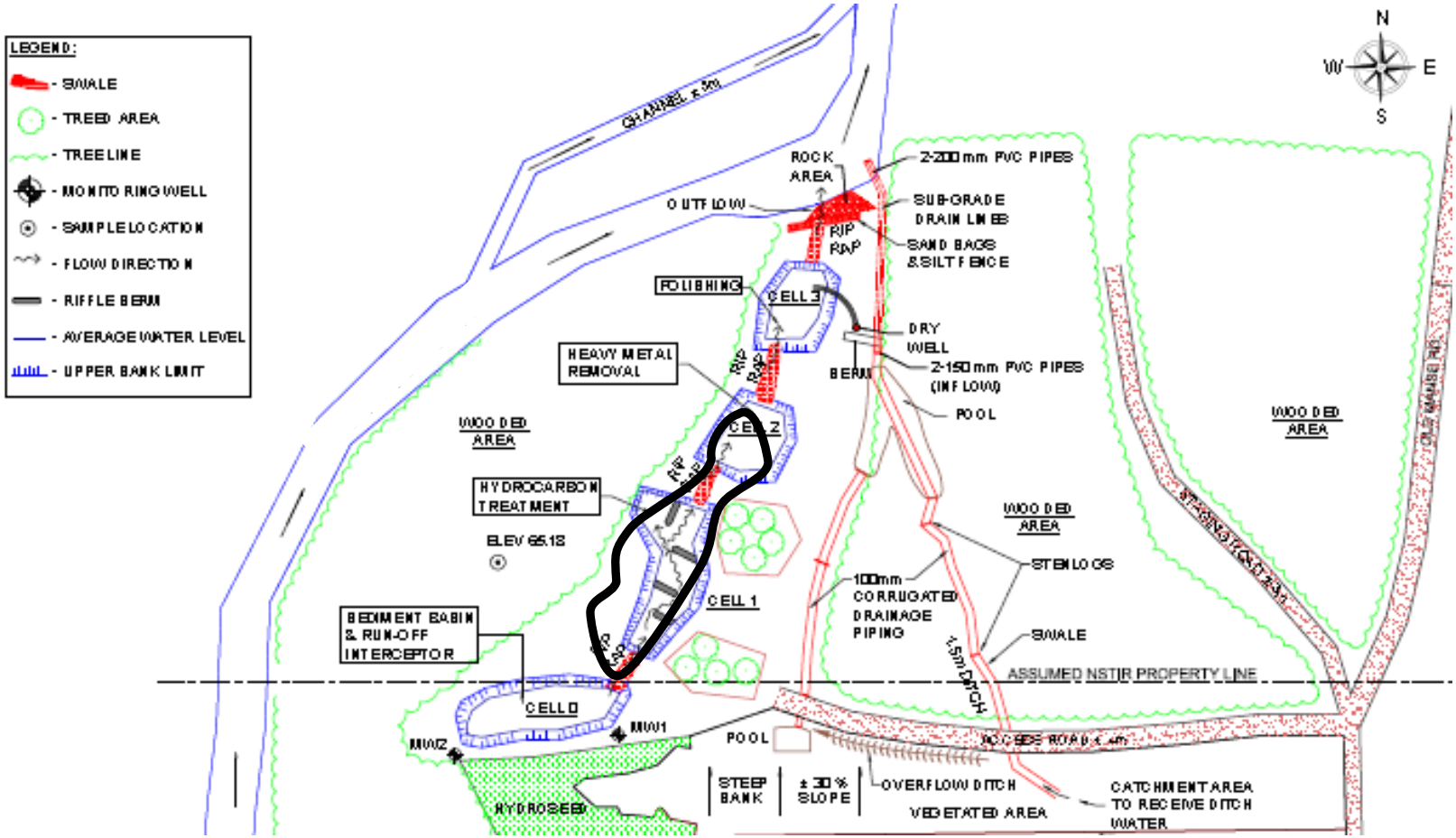
Constructed Wetland: Design



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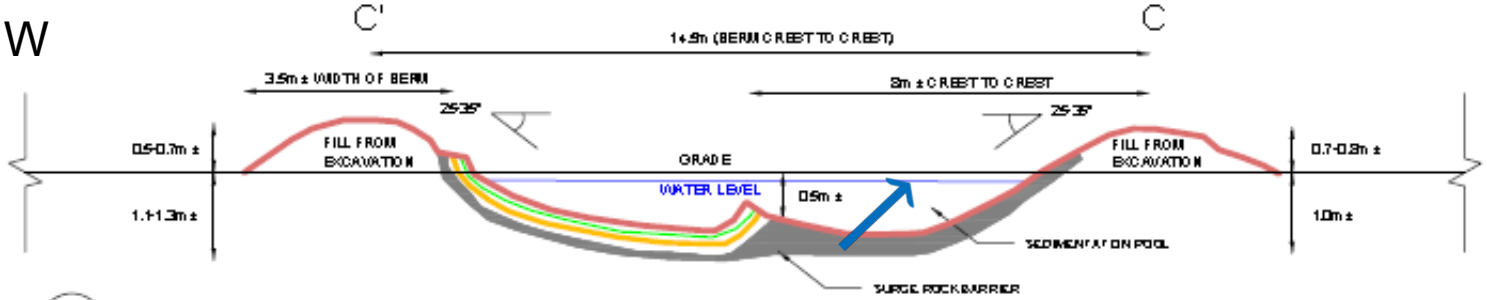
Constructed Wetland: Design

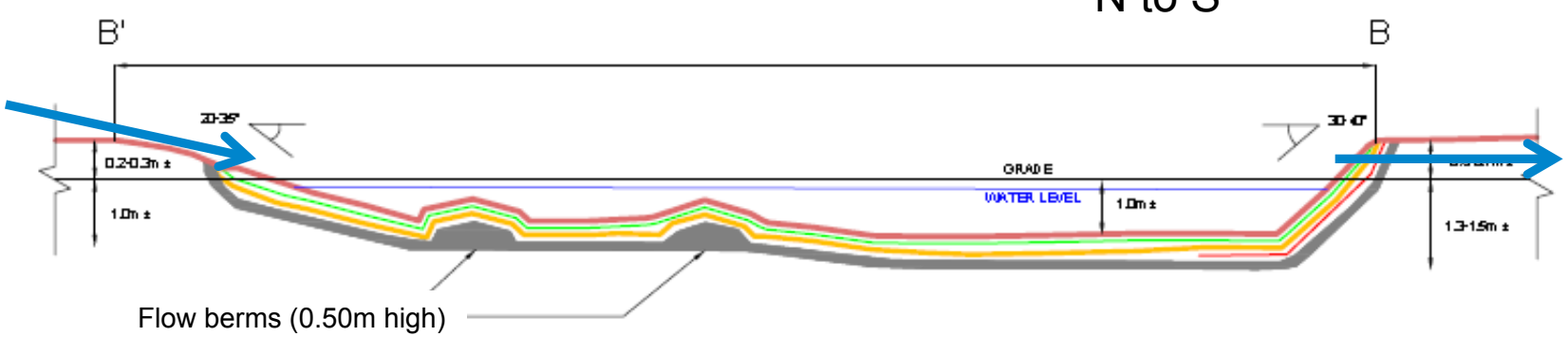
E to W



C / 8 CELL 1 - SECTION C-C'

- Top soil (0.20m thick)
- Coconut fibre
- Peat moss (0.15m thick)
- Geo-textile
- Clean surge rock

N to S



B / 8 CELL 1 - SECTION B-B'

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Case Study: Implementation

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Case Study: Implementation

Open-Water Wetland basal layer – surge rock in Cell 3 (Oct.14, 2010)

Geofabric

Clean surge

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Case Study: Implementation

Straw mat

Peat moss

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Case Study: Implementation

Substrate “planting” layer (topsoil) on base of Cell 1 (Oct. 23, 2010)

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Case Study: Implementation

High-water Gabion Inflow / Outflow

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Case Study: Implementation

Transplanting native, terrestrial, riparian and aquatic species

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Case Study: Implementation

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Construction HAD its Challenges

Proximity to environmental receptors

Weather

Water table

Timing of Planting

Natural Variability

Local Geology

Accessibility

Iron-rich GW seeps

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Case Study: Monitoring

1. Survivability of plants ("performance")

2. Functionality of wetland features

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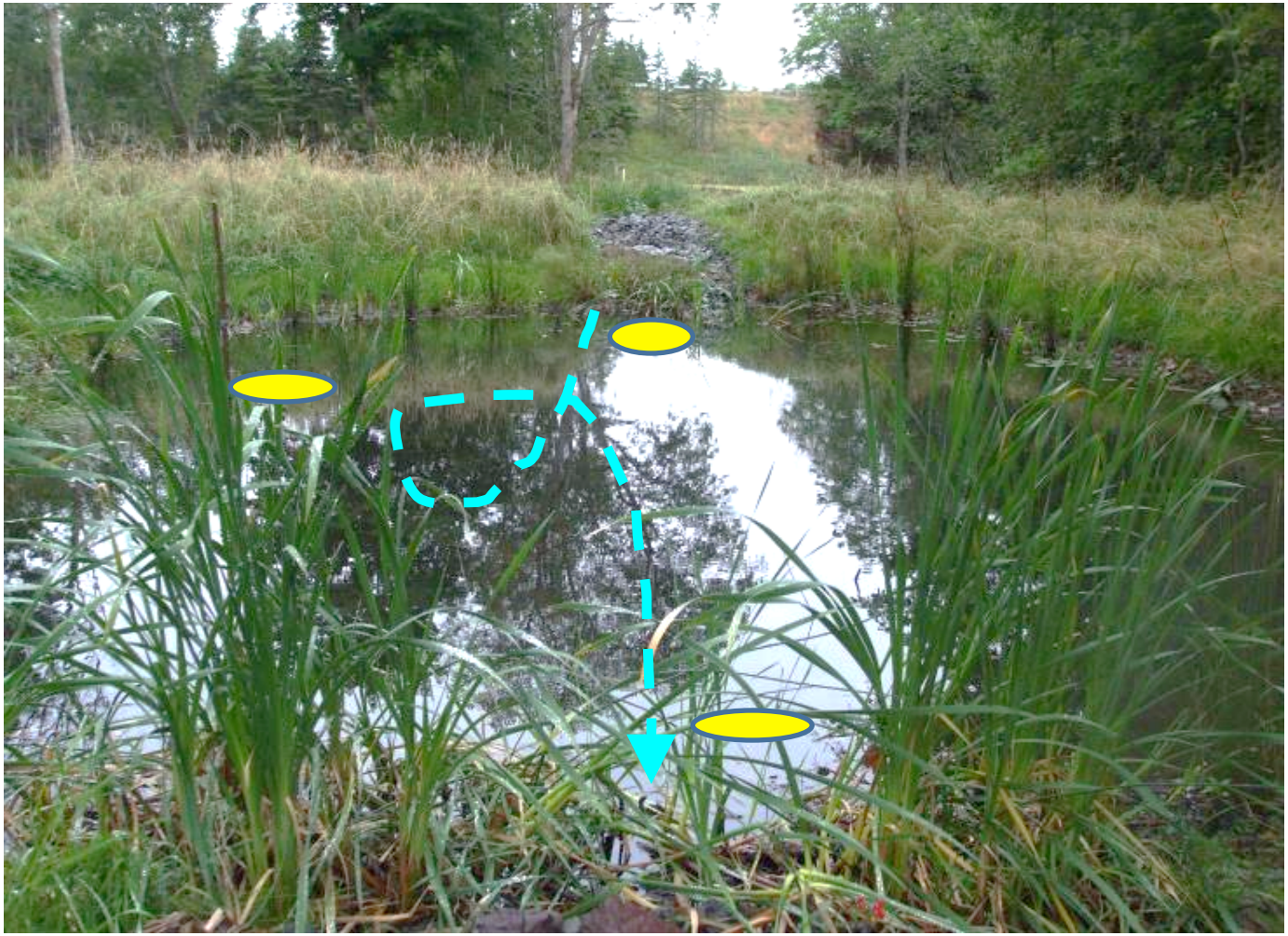
Case Study: Monitoring

3. Remedial Compliance



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Case Study: Results

2-Year Period from Oct. 2010 (baseline) to Oct. 2012

WATER

- Significant (p=0.05) drop in PHCs to below target
- Most metals decreased to below target levels
- Improved water quality

SEDIMENT

- Moderate decrease in PHCs
- Minor decrease in metal levels
  - settling effect

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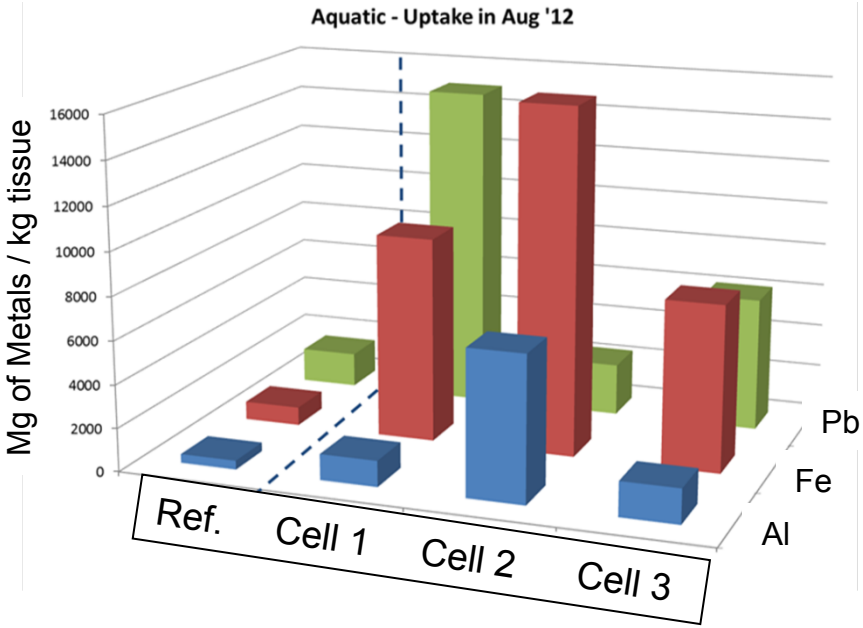
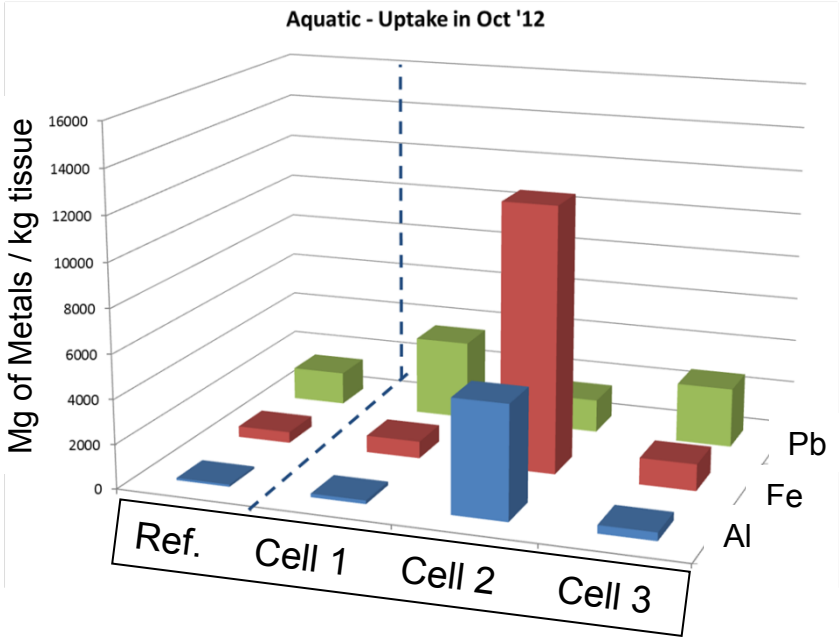
Case Study: Results

Select 'available' metals in cattail (*Typha latiflora*) tissues in August 2012 (left) and October, 2012 (right)





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Constructed Wetland: Added Benefit

Natural colonisation & usability

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Constructed Wetland: Conclusion

- Cost-effective ($0.7M) treatment of COCs ahead of schedule
- Generated habitat (1,350m^2)
  - loss of former swamp (870m^2)
- Diversifying the local ecosystem
- Surface water management
  - Directing and treating road run-off
- Aesthetically pleasing

QUESTIONS??

LINKS

- USEPA Constructed Wetlands
  http://water.epa.gov/type/wetlands/restore/cwetlands.cfm
- PHYTOREM – Environment Canada, 2000; enviroinfo@ec.gc.ca

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