Pave Paradise & Put Up A Borrow Pit

A Case Study on Monitoring Constructed Wetlands

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Outline

• Introduction
• Constructed Wetlands/Borrow Pits
• Borrow Pit Design Standards
• Monitoring Program
• Constructed Wetland Monitoring Framework
• Summary
Introduction

"Suicide 63" - Highway of Death

• What: Highway 63 Twinning Project
• Where: Atmore to Fort McMurray, AB
• When: 2005 - 2016
• Why: Increase safety
Introduction
What is a Borrow Pit?
- “Holes in the ground”
- Material for construction
- Large construction projects
  - >40 built for Hwy 63
- Fill with water

How can they be considered “constructed wetlands”? 
Borrow Pit Design Standards - Then
Borrow Pit Design Standards - Now
Borrow Pit Design Standards - Now
OBJECTIVE
Determine if borrow pits are naturalizing

HOW DO WE MEASURE "NATURALIZATION"?

1. APPROPRIATE PARAMETERS
2. REFERENCE WETLANDS
Monitoring Program - Parameters

- Hydrology
- Water Quality
- Vegetation
- Wildlife
- Aquatic Invertebrates
- Soils
Monitoring Program – Reference Wetlands

SELECTION CRITERIA

1. 1 reference for 3 borrow pits
2. Similar wetland classification
3. Within same watershed
4. Similar size
5. Easy access
6. Minimally disturbed
Monitoring Program – Reference Wetlands

Marsh
Monitoring Program - Summary

3 Year Monitoring Cycle

12 Borrow Pits

2 Sampling Sessions Per Year

5 Reference Wetlands
Monitoring Program Evolution

- **2012**: Monitoring Starts
- **2014**: First Set of Wetlands “Graduate”
- **2015**: NEW Wetland Policy
- **2016**: Constructed Wetland Monitoring Framework
Constructed Wetland Monitoring Framework

- Provincial Applicability
- Simple Ranking System
- Cost Effective
- Easy To Use
Constructed Wetland Monitoring Framework

- Literature Review
- Review Costs
- Review Hwy 63 Monitoring Results
Constructed Wetland Monitoring Framework - Parameters

- Hydrology
  - Expensive
  - Time Consuming

- Water Quality

- Vegetation
  - Expensive analysis
  - Too short of timeline

- Wildlife

- Aquatic Invertebrates

- Soils
Constructed Wetland Monitoring Framework - Parameters

**Water Quality**
- pH, EC, Ammonia, Alkalinity, Total Organic Carbon, Hardness, Orthophosphate and Phosphorous

**Vegetation**
- Floristic Quality Index
- Species Richness

**Wildlife**
- Species Functional Group Presence

**Aquatic Invertebrates**
- Taxon Richness
- ETSD Index
Constructed Wetland Monitoring Framework - Vegetation

\[ FQI = \frac{\text{mean } C_{CN}}{10} \times \frac{\sqrt{N}}{\sqrt{N} + E} \times 100 \]

- Coefficient of Conservatism
- # of Native Species
- # of Exotic Species
Constructed Wetland Monitoring Framework - Wildlife

- **Obligate**
  - In wetlands 99% of time

- **Facultative Wetland**
  - In wetlands 57-99% of time

- **Facultative**
  - In wetlands 34-56% of time

- **No Wildlife**

- **High**
  - Needs Improvement
Constructed Wetland Monitoring Framework – Aquatic Invertebrates

$ETSD = \frac{\sum ETSD}{N}$

ETDS - # of each Taxa
N – Total Taxa Richness in Wetland

Sphaeriidae – Fingernail Clams
Dragonflies
Constructed Wetland Monitoring Framework – Aquatic Invertebrates

Why these groups?
- Indicators of restoration success
- Indicators of elevated nutrients
- Related to human disturbance
- Found in water column

Ephemeroptera
Trichoptera
Sphaeriidae
Dragonflies

Indicators of restoration success
Related to human disturbance
Found in water column
## Constructed Wetland Monitoring Framework – Ranking System

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measures</th>
<th>Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>8 Routine Parameters</td>
<td>0 – 8</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Floristic quality index</td>
<td>0 – 4</td>
</tr>
<tr>
<td></td>
<td>Species richness</td>
<td>0 – 4</td>
</tr>
<tr>
<td>Wildlife</td>
<td>Functional Group Presence</td>
<td>0 – 4</td>
</tr>
<tr>
<td></td>
<td>Aquatic Invertebrates Taxon Richness</td>
<td>0 – 4</td>
</tr>
<tr>
<td></td>
<td>ETSD Index</td>
<td>0 – 4</td>
</tr>
</tbody>
</table>

**Compare borrow pit data to reference data with interdecile system**

Highest Possible Score | 28
## Constructed Wetland Monitoring Framework – Ranking System

<table>
<thead>
<tr>
<th>Total Score</th>
<th>Naturalization Progress Rank</th>
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</tbody>
</table>

No “Graduation” rank has been defined
Constructed Wetland Monitoring Framework – 2017 Results

Naturalization Progress Rank
- High
- Med
- Low
- Needs Improvement

Results were as expected because data was taken 1 year after construction.
Constructed Wetland Monitoring Framework – Moving Forward

2018 Pilot Test

Native Seed

5 Year Term

Graduation Rank
Summary

- Initial Highway 63 wetland monitoring
  - Monitored numerous borrow pits
  - Monitored 6 parameters
  - Most wetland ‘graduated’

- Pilot study for “Constructed Wetland Monitoring Framework”
  - Provincial guideline for monitoring AT wetlands
  - Parameters reduced to 4
  - Natural Progression Ranking Scale
  - Most wetlands ranked “Low”

- Test & refine the Framework for the next ~ 5 years
Thanks to our supporters & partners

Dr. Michael Dadswell

Weta Environmental
Questions?