



**Joint
Consensus | Alberta
Implementation Plan
for Oil Sands Monitoring**

Assessment of Biological Condition: Lower Athabasca River Tributaries and Mainstem

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Key Objectives: Fish & Benthos Programs



Assess efficacy of JOSM (Phase 2) biomonitoring design to address:

Ecosystem Health:

- What is the current status of mainstem fish & benthos?
 - Establish a baseline against which future change can be assessed
 - Assess potential change since historical studies
- Are there reference vs. impact site differences in the biota?

Cumulative Effects:

- Is there evidence of cumulative effects of development on mainstem biota?
- Do predictive relationships exist that link system drivers to biotic responses?

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Overview

- Fish Program
 - Mainstem study design, methods & results
 - Tributary study design, methods & results
- Benthic Program
 - Mainstem study design, methods & results
 - Tributary study design, methods & results
- Deltaic Wetland Program (not covered today)
 - Monitoring program found good ecological condition
 - Focused work on biota → environment driver relationship
- Future Work

Fish Methods

Study Design

- Reference sites outside of the oil sands deposit (where possible)
- Reference sites within the deposit upstream of development
- Exposure sites within the deposit downstream of development

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Environmental Effect Endpoints (EEM)

Effect Indicators	Effect Endpoints
Survival	• age
Growth (energy use)	• size-at-age
Reproduction (energy use)	• gonad/body (mass)
Condition (energy storage)	• body mass to length
	• liver/body (mass)


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Fish Site Locations


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Mainstem Fish Sampling




Small bodied –
trout perch





Large bodied –
white sucker




Contaminants – walleye

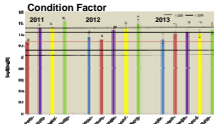
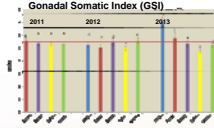
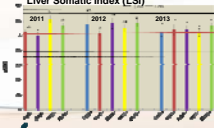




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2011-13 White Sucker



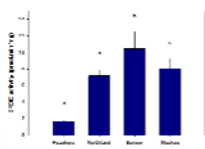
- Increased condition, internal fat accumulation & growth at downstream sites in 2011-12 (2013 similar to reference)
- GSI similar for males at all sites (except 2013) indicating similar energy allocation to reproduction at all sites
- Males downstream of development show inconsistent increase in liver size (2011-12)
- Response patterns in 2011-12 consistent with nutrient enrichment
- Similar pattern in females

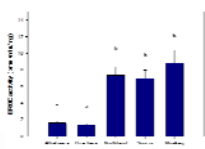
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EROD Across Years

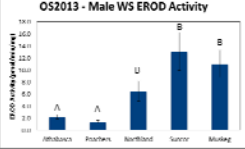
US 2011 - Male WS EROD activity





CS 2012 - Male WS EROD activity




OS2013 - Male WS EROD Activity





Tributary Fish Sampling




Slimy sculpin





Longnose dace

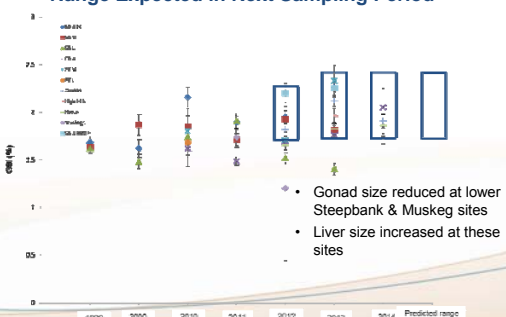


Lake chub





Female Slimy Sculpin Gonad Size Used to Predict Range Expected in Next Sampling Period

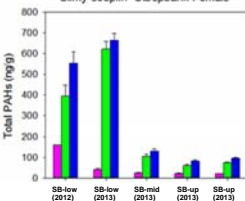


- Gonad size reduced at lower Steepbank & Muskeg sites
- Liver size increased at these sites

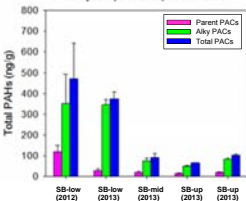



Slimy Sculpin PAC Concentrations (Steepbank)



Slimy sculpin Steepbank Female

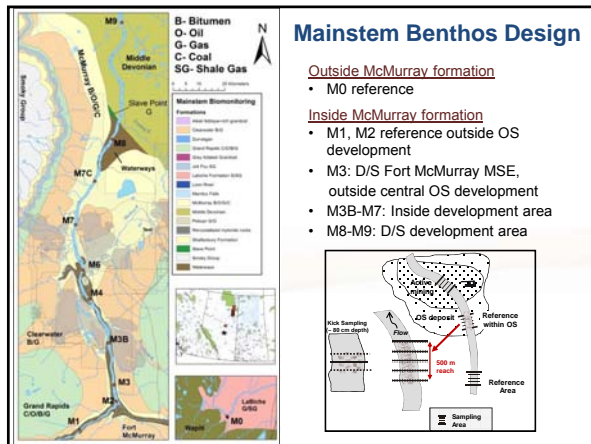


Slimy sculpin Steepbank Males

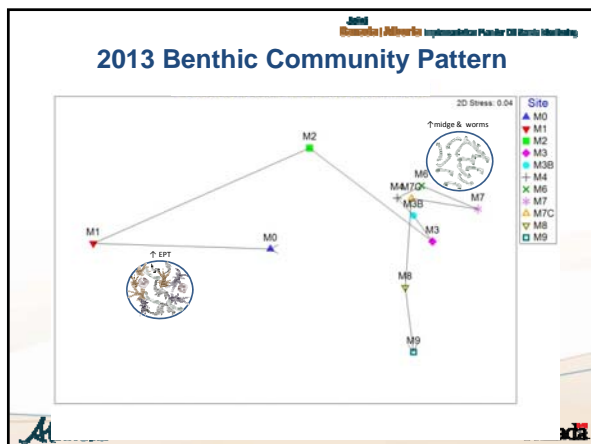


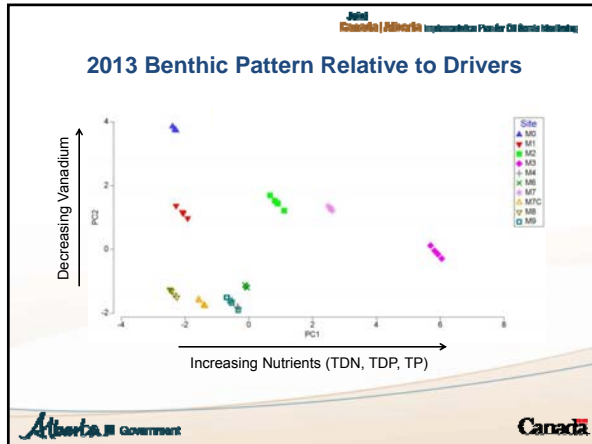
- Corresponding increases in measures of exposure (MFO)

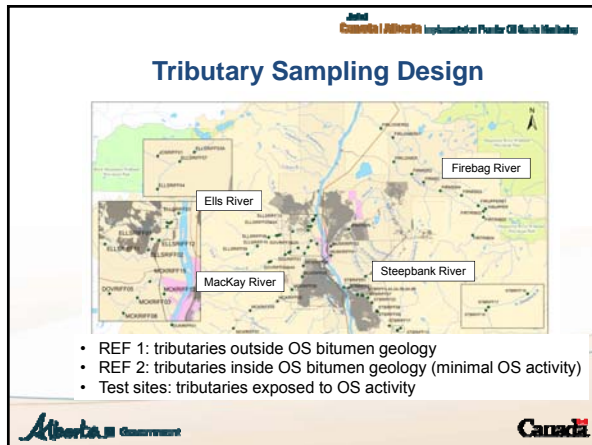



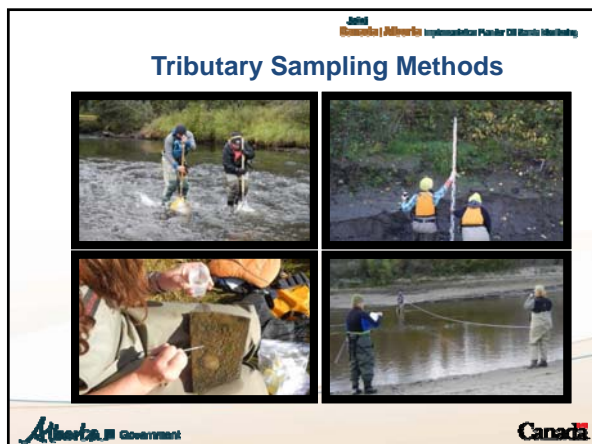


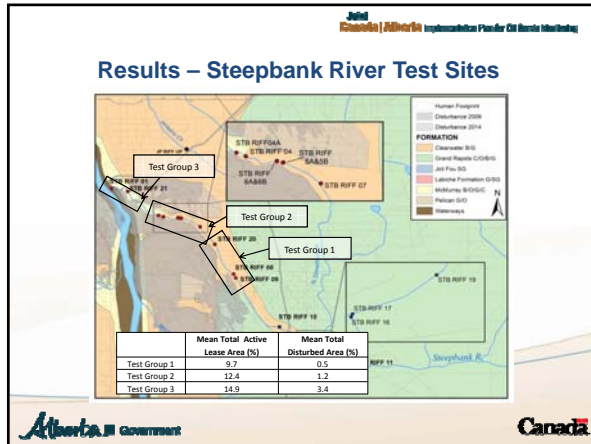


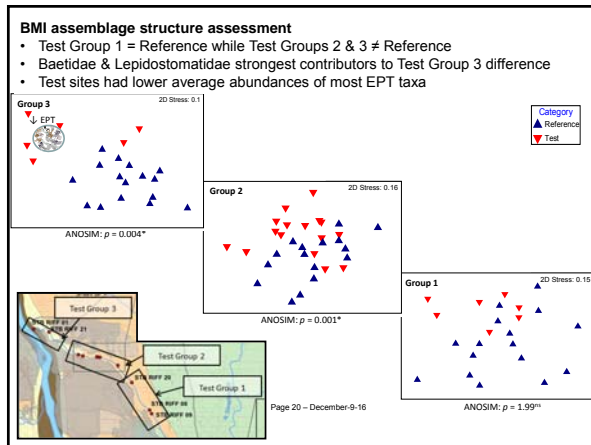












Moving Forward

- Periodic adaptation of long-term monitoring network to incorporate new information
- Develop focused study investigate the association of benthos & fish with nutrient-contaminant signal
- Improve understanding of contaminants source (development or natural)
- Increase sampling of reference area to improve ability to detect impacts
- Improve evaluation of endpoint variability within sites & among years
- Fish strategic plan integrates adaptive, bounded and prescriptive steps (tiers) guided by trigger exceedances
- EEM design can detect changes in fish health within the oil sands area



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