

1-YEAR FEASIBILITY WORK PLAN

Changes to this Work Plan are only accepted via an Approved Addendum.

General Information		
Monitoring Category: <i>(From OSM long-term plan; choose from drop-down menu)</i>	Biotic Response Monitoring	
Strategic Monitoring Objective: <i>(From OSM long-term plan; choose from drop-down menu)</i>	Objective: Detect and report biotic response in relation to Oil Sands Developments	
Work Plan Unique Identifier:	B-RC-9-1718	
Monitoring Activity Title:	Evaluation of study and sampling design for Establishing Reference Condition of Benthic Biodiversity in Peace and Cold Lake Oil Sands Areas	
Geographic Location <i>(choose from drop-down menu, if Project Location is in more than one area choose from second drop-down)</i>	Peace River Oil Sands Region	Cold Lake Oil Sands Deposit
Monitoring Site(s) Coordinates <i>(latitude and longitude)</i>	See Appendix 1B	
Monitoring Organization and Responsible Manager:	Alberta Environment and Parks Environment and Climate Change Canada	Garry Scrimgeour Nancy Glozier
Date Monitoring initiated:	2016	
Specific Monitoring Objective: <i>(State the monitoring objective addressed through this monitoring)</i>	Project Objectives: Through benthic macro-invertebrate monitoring, provide the necessary data and information to address key questions detailed in the Monitoring Plan Summary related to the effects of Oil Sands development on the ecological integrity and condition of the stream and rivers in the Peace River/Cold Lake Oil Sands areas.	
Deliverables (Annual): <i>What Data Reports will be produced and when?</i>	Peace River Oil Sands Region and Cold Lake Oil Sands Deposit: see Section I below.	

Monitoring Plan Summary:

Background

The Joint Oil Sands Monitoring Plan (JOSM) (EC and AESRD 2012) included measurement of aquatic ecosystem health by monitoring benthic macroinvertebrate (BMI) assemblages in the main stem of the Athabasca River and its tributaries. This JOSM program focused on BMI because they are relatively sedentary, can be sensitive to multiple stressors, are critical components of fish habitat, and are the most common aquatic group used for aquatic bioassessments globally. Aquatic biomonitoring of BMI provides a direct measure of change in biotic populations and assemblages in relation to benchmark or reference conditions. The robust monitoring program developed during JOSM is used to measure baseline ecological condition and assess biological change associated with current and future development in aquatic ecosystems of the Lower Athabasca River and its tributaries. This BMI monitoring incorporates recommendations from the JOSM program including those for sampling methods and frequency of sampling. Monitoring is conducted annually at a set of regular sites to assess BMI status and trends. By associating patterns of BMI biodiversity with water and sediment chemistry, physical habitat measurements, and other supporting environmental variables, this program aims to determine whether ecological effects are occurring in response to cumulative stressors associated with human activity in the region.

Objectives

Through BMI monitoring, provide the necessary data and information to address key questions related to the effects of development on the environmental and ecological integrity of streams and rivers in the Peace River Oil Sands Region and Cold Lake Oil Sands Deposit.

The specific bioassessment questions for the BMI component include:

- What is the current status of the BMI assemblage in these ecosystems and are these assemblages changing through time?
- Are there differences in BMI assemblages among reference and potentially impacted sites and are these relationships changing through time?
- What predictive relationships exist that link system environmental drivers (including development stress) to BMI assemblage responses?
- Is there evidence of cumulative effects of development on BMI assemblages in the Peace River or Cold Lake areas?

Assumptions and Constraints

- Nutrient inputs from local communities, forestry activities, Oil Sands and other Oil and Gas Developments may affect biological processes in the rivers and have the potential to confound the effects of Oil Sands stressors including contaminants;
- Contaminant inputs to arise from several possible pathways (including atmospheric transport, tributary inflows, groundwater flux, etc.). These contaminant inputs likely act as stressors that may modify biological composition of benthic food webs;
- Nutrient and contaminant effects on benthic food webs should be detectable through a suite of diagnostic, bioassessment indicators;
- Timely securement of contracts (e.g., external labs) is critical;
- Budget O&M and PY requirements for the Peace Basin and Cold Lake Areas B-RC-9-1718 are linked (logistics, shared sampling crews, equipment, etc.,) to the long term B-LTM-E-5-1718 Tributary study

I. TRIBUTARIES - PEACE RIVER OIL SANDS AREA

I-A. Tributaries Biomonitoring Plan (2017 and proposed 2018-2021): Peace River Oil Sands Region & Deliverables

The biomonitoring plan for tributary sites in the Peace River Oil Sands Area was initiated with the 2016/17 approved work plan (i.e., expansion into the Peace River catchment through reconnaissance and preliminary sampling will be undertaken as this is an area of future development). In the Fall of 2016, reconnaissance in the Wabasca River tributary of the Peace River, led to the establishment of 5 new sites and information on other tributaries for future sampling. The sampling in 2017 will focus on kick sampling and the expanded CABIN protocol in erosional habitats. However, other habitats will be evaluated if they are found to be predominant in the area. A primary objective through the 2017 field sampling as well as GIS land use and mapping is evaluating the feasibility of continued sampling in the Peace River Oil Sands Region in order to establish reference conditions with which to evaluate potentially impacted sites. Appropriate study design will be established along with partner and NGO input and a proposal for sampling over the next 4-year study period will be developed. It is intended that, similar to the Lower Athabasca tributaries and Birch Mountain areas, a set of reference and test sites as outlined below will be established for annual sampling to track temporal changes and develop the ability to access test sites with reference condition or gradient statistical assessment approaches.

The annual sampling design and data collected for 2017-and proposed 2018-2021 is found in Appendices 1A and 1B and Appendix 4:

Peace River Oil Sands Area Fall 2017 – 10-15 sites established; upon review of proposed study design, ongoing sampling 2018-2020 would include 20-25 sites additional per year

The proposed study design, if approved, will target the establishment of 75-100 sampling locations between 2017-2020 in major tributaries to the Peace River such as the Wabasca River and its tributaries, where expansion and current Oil Sands activities are present. The four-year plan will include sample collection at 20-25 sites per year as follows:

- Review available data and reports of previous studies in the area for benthic invertebrates (2017/2018)
- Gathering local knowledge of systems and establishment of type of habitat in major tributaries.
- GIS analysis of development pressures in each tributary area
- Reconnaissance by map, road and helicopter in 2-3 major tributary areas per year
- On an annual basis establishing 10 – 15 new reference sites and 5 test sites.
- Sites will be assessed annually against updated development footprint information to confirm the status as a reference or test site.
- In the final year (2021) no sampling is planned as the focus will be development of assessment approaches/models.

I-B. Completion of Tributary Data Acquisition and Analysis from previous year - Peace River Oil Sands Area

During each year the monitoring work will include the field sampling listed in 1A, 1B and Appendix 4 as well as laboratory processing of samples collected in the previous year. For example, in Fiscal Year 2017-2018 the work

will include processing samples from 2016-2017.

- BMI samples collected in autumn of the previous year will be sorted, identified and enumerated along with QA/QC analysis according to Environment Canada (2012, 2014).
- Water quality samples collected in autumn of the previous year will be analysed, verified and validated.
- Sediment quality samples collected in autumn of the previous year will be analysed, verified and validated.
- Semi-permeable membrane device (SPMD) samples collected in autumn of the previous year will be analysed and QA/QC completed.
- Chlorophyll-*a* (Chl-*a*) samples collected in autumn of the previous year will be analysed and QA/QC completed.
- Analysis of all data collected in the autumn of the previous year will be undertaken and placed into context of the previous sampling years.

II. Cold Lake Oil Sands Area – review of program and recommendations of program design for ongoing years

II-A. Tributaries Biomonitoring Plan (2017 and proposed 2018-2021): Cold Lake Oil Sands Area & Deliverables

Field collections; data compilation, evaluation and reporting, as has been completed previously by AEP/Hatfield. In 2016/2017 ECCC was identified as having the expertise to undertake an evaluation of the previous monitoring design, including evaluation of data, and reports available, site locations, habitat types and sampling methodologies for the sites in the southern operations. Considering the additional work load conducting sampling in 2016 would represent, it was decided for the project leads to first conduct an assessment of the sites, methodologies used, etc., before any further sampling is committed to take on this additional work. This evaluation phase was to include, several days of site/habitat assessment, meetings to review approaches and data. A primary objective through the field investigations as well as GIS land use and mapping is to evaluating the feasibility of continued sampling in the Cold Lake Oil Sands Region in order to establish reference conditions with which to evaluate potentially impacted sites. Appropriate study design will be established along with partner and NGO input and a proposal for sampling over the next 4-year study period will be developed. It is intended that, similar to the Lower Athabasca tributaries and Birch Mountain areas, a set of reference and test sites as outlined below will be established for annual sampling to track temporal changes and develop the ability to access test sites with reference condition or gradient statistical assessment approaches.

The annual sampling design and data collected for 2017 and proposed 2018-2021 is found in Appendix 1C and Appendix 4:

Progress in 2016/2017 included crews conducted an aerial review of the area, reports and sites/ methods have been reviewed. Summary of available data from previous years indicates that a total of 14 sites have had benthic sampling conducted in the Clearwater and Christina rivers, and several smaller water bodies during and prior to the implementation of JOSM. Four sites (2 in each of the Christina and Clearwater rivers) had sampling starting as early as 2002. All sites are depositional in habitat characterization. An additional 8 sites were sampled from 2012-2014; 6 of 8 were depositional. These data and information are available and as with onsite assessments, reviews are currently being reviewed and summarized (draft report Ritcey and Glozier, Appendix 5 attached). A joint meeting (AEP/ECCC) is being planned to review and discuss the objectives and study design

proposed for the area previously referred to as “Southern Operations”, now Cold Lake Oil Sands Area. Pending results of these meetings, ongoing monitoring will be reviewed and confirmed, with the following starting proposal for consideration:

Cold Lake Oil Sands Area Fall 2017 – investigation of sites, no routine sampling planned; upon review of proposed study design, ongoing sampling 2018-2020 would include 15-20 sites additional per year.

The proposed study design, if approved, will target the establishment of 40-50 sampling locations from 2018-2020 in major tributaries to the Christina and Clearwater rivers, and Cold Lake Area where expansion and current Oil Sands activities are present. The four-year plan will include sample collection at 15-30 sites per year as follows:

2017/2018 (no sampling)

- Review available data and reports of previous studies in the area for benthic invertebrates (2017/2018)
- Gathering local knowledge of systems and establishment of type of habitat in major tributaries.
- GIS analysis of development pressures in each tributary area
- Reconnaissance by map, road and helicopter in 2-3 major tributary areas per year

2018-2020 (15-20 per year)

- On an annual basis establishing 10 – 15 new reference sites and 5 test sites.
- Sites will be assessed annually against updated development footprint information to confirm the status as a reference or test site.
- In the final year (2021) no sampling is planned as the focus will be development of assessment approaches/models.

II-B. Completion of Tributary Data Acquisition and Analysis from previous year – *Southern Operation Oil Sands Area Tributaries*

During each year the monitoring work will include the field sampling listed in Appendix 1C and Appendix 4 as well as laboratory processing of samples collected in the previous year. For example, in Fiscal Year 2018-2019 the work will include processing samples from 2017-2018.

- BMI samples collected in autumn of the previous year will be sorted, identified and enumerated along with QA/QC analysis according to Environment Canada (2012, 2014).
- Water quality samples collected in autumn of the previous year will be analysed, verified and validated.
- Sediment quality samples collected in autumn of the previous year will be analysed, verified and validated.
- Semi-permeable membrane device (SPMD) samples collected in autumn of the previous year will be analysed and QA/QC completed.
- Chlorophyll-*a* (Chl-*a*) samples collected in autumn of the previous year will be analysed and QA/QC completed.
- Analysis of all data collected in the autumn of the previous year will be undertaken and placed into context of the previous sampling years.
- BMI samples collected in autumn of the previous year will be sorted, identified and enumerated along

References:

Environment Canada. 2012. Wadeable streams field manual, Canadian Aquatic Biomonitoring Network (CABIN). (http://publications.gc.ca/collections/collection_2012/ec/En84-87-2012-eng.pdf).

Environment Canada. 2014. Laboratory methods for Canadian Aquatic Biomonitoring Network (CABIN): Processing, Taxonomy, and Quality Control of Benthic Macroinvertebrate Samples. (http://publications.gc.ca/collections/collection_2015/ec/En84-86-2014-eng.pdf).

Environment Canada and Alberta Environment and Sustainable Resource Development. 2012. Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring. Government of Canada, Gatineau, QC, Canada, 27 p.

Ritcey, A. and N.E. Glozier 2017 (*draft see Appendix 5*). Expansion of the ECCC CABIN-Based Tributary Biomonitoring Program South of Fort McMurray

Appendix 1A- Annual Monitoring Schedule (Peace River Oil Sands Area)

(Please provide detailed information on the specifics of your monitoring schedule including – **locations, schedule, methods, SOPs, QA/QC data release, references**)

<u>Sampling Locations/Sites</u>	<u>Sampling Schedule (timing/frequency)</u>	<u>Compounds to be Analyzed</u>	<u>SOPs to be Consulted</u> <i>(hyperlinks accepted)</i>	<u>QA/QC Complete & Date Data to be Released</u>
<i>Peace River Oil Sands Area (10-15 in first year, there after 20-25 annually)</i>	Aug – Sept 2017	1) BMI Data – Based on a minimum 6 months to receive data 2) Water Quality, Sediment Quality and Supporting Variable (see Appendix 4)	1) JOSM Benthic Methods Manual (In preparation); includes CABIN 400 µm mesh 3 minute traveling kick sampling approach at 5 locations within each study reach (based on assessment of 2012-2015 FY JOSM data); Supporting habitat measures as per Oil Sands Benthic Methods Manual and field data sheet 2) NLET methods	Jan 2019
<i>Peace River Oil Sands Area (20-25 annually)</i>	Aug – Sept 2018	- As above	- As above	Jan 2020
<i>Peace River Oil Sands Area (20-25 annually)</i>	Aug- Sept 2019	- As above	- As above	Jan 2021
<i>Peace River Oil Sands Area (20-25 annually)</i>	Aug – Sept 2020	- As above	- As above	Jan 2022
<i>No sampling in final year, development of assessment approaches</i>	Aug – Sept 2021			

¹See Appendix 1B-for latitude and longitude for each sample location

Appendix 1B- Site Locations for Annual Monitoring Schedule (Peace River Oil Sands Area)

Latitude and longitude in decimal degree format for each sampling location

Sampling Location	Latitude	Longitude
LGERIFF01	56.84407	-113.81746
LGERIFF02	56.87355	-113.83864
LGERIFF03	56.93326	-113.91513
WABTRIB01	56.923	-114.35859
WABTRIB05	56.89877	-113.6951

Appendix 1C- Annual Monitoring Schedule (*Tributaries: Southern Operators*)

(Please provide detailed information on the specifics of your monitoring schedule including – **locations, schedule, methods, SOPs, QA/QC data release, references**)

<u>Sampling Locations/Sites</u>	<u>Sampling Schedule (timing/frequency)</u>	<u>Compounds to be Analyzed</u>	<u>SOPs to be Consulted</u> <i>(hyperlinks accepted)</i>	<u>QA/QC Complete & Date Data to be Released</u>
<i>No sampling in first year</i>				
<i>Cold Lake Oil Sands Area (15-20 per year)</i>	Aug – Sept 2018	1) BMI Data – Based on a minimum 6 months to receive data 2) Water Quality, Sediment Quality and Supporting Variable (see Appendix 4)	1) JOSM Benthic Methods Manual (In preparation); includes CABIN 400 µm mesh 3 minute traveling kick sampling approach at 5 locations within each study reach (based on assessment of 2012-2015 FY JOSM data); Supporting habitat measures as per Oil Sands Benthic Methods Manual and field data sheet 2) NLET methods	Jan 2020
<i>Cold Lake Oil Sands Area (15-20 per year)</i>	Aug- Sept 2019	- As above	- As above	Jan 2021
<i>Cold Lake Oil Sands (15-20 per year)</i>	Aug – Sept 2020	- As above	- As above	Jan 2022
<i>No sampling in final year - development of assessment approaches</i>	Aug – Sept 2021			

¹Latitude and longitude for each sample location to be determined in 2018 and beyond.

Appendix 2 – Detailed Multi-Year Financial Breakdown: if changes are to be made then an Addendum must be Complete and Approved. – Peace River and Southern Operators

(Complete the following detailed financial breakdown; add or delete categories as required)

Budget requirements	Year 1 (201X- 201Y)		Year 2 (201X- 201Y)		Year 3 (201X- 201Y)		Year 4 (201X- 201Y)		Year 5 (201X- 201Y)	
	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
Salaries and benefits										
a) Appendix 3 - Totals	\$20,047		TBD		TBD		TBD		TBD	
Operations and Maintenance										
a) Vehicles and Transportation	280									
b) Helicopter	30,000									
c) Lab analysis	12,894									
d) Data management	10,000									
e) Field work /students	25000									
1) Consumable Materials and supplies										
a) Waders, sampling equipment, ysi supplies	30,000									
2) Travel										
a) Conferences and meetings (<i>identify conference/meeting</i>)	4,962									



b) Field work - travel	15,000									
c) Project-related travel	10,000									
3) External Contracts										
a) External monitoring contract	35,000									
Grand Total O&M	173,174		TBD		TBD		TBD		TBD	TBD
Grand Total with Overhead	\$214,000		TBD		TBD		TBD		TBD	TBD

Appendix 3 – Staffing Plan (Athabasca Mainstem)

(Complete the following detailed staffing plan; add or delete categories as required)

Responsible Role	Year 1 – Budget Allocation		Year 2 – Budget Allocation		Year 3 – Budget Allocation		Year 4 – Budget Allocation		Year 5 – Budget Allocation	
	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
Science Expertise	\$									
Technical/Field Staff	\$									
Technical/Laboratory Staff	\$20,047									
Administrative and Program Coordination										
Grand Total (inserted into Appendix 2)	\$20,047		TBD		TBD		TBD		TBD	

Appendix 4 – Approvals

Project Submitted by:		
Name:		
Organization: EMSD	Signature:	Date:
Project Approved by:		
Dr. Monique Dubé (AEP)		Dr. Kevin Cash (ECCC)
Signature 		Signature 
Date		Date

Appendix 4 – Summary of the Data Collected, Including Water Quality, Sediment Quality and other Supporting Variables for the Oil Sands BMI Monitoring Program.

Data Collected as part of the Benthic Macro-Invertebrate Monitoring		Specific Parameters	Biomonitoring Program	
			Tributary	Mainstem
a. Benthic Macroinvertebrate Community Sample	Habitat sampled	Cobble	X	X
		Sand	NA	NA
b. Water Quality / YSI grab samples	Nutrients	TP	X	X
		TP Dissolved	X	X
		TN	X	X
		Total Dissolved	X	X
		Nitrate & Nitrite	X	X
		Ammonia	X	X
		Dissolved Organic	X	X
		Particulate Organic	X	X
	Major Ions	Colour	X	X
		Total Suspended Solids	X	X
		Turbidity	X	X
		Cations	X	X
		Anions	X	X
		Alkalinity	X	X
		pH	X	X
	Trace Metals	Conductivity	X	X
		Total Metals	X	X
	PAHs	Dissolved Metals	X	X
		PAHs	X	X
	YSI Handheld Sonde	Alkylated PAHs	X	X
Temperature		X	X	
Specific Conductance		X	X	
pH		X	X	
		Dissolved Oxygen	X	X

		Dissolved Oxygen (%)	X	X
	Flow Measurements	Water Depth (cm)	X	X
		Water Velocity (m/s)	X	X
c. Sediment Quality	Nutrients	Total Organic Carbon &	X	X
	Trace Metals	Total Metals	X	X
	PAHs	PAHs	X	X
		Alkylated PAHs	X	X
d. SPMD	28 day –Time averaged contaminant exposure	PAHs	X	X
		Alkylated PAHs	X	X
e. Other variables	Algal Production – Chlorophyll <i>a</i>	Scrapes (cobble habitat only)	X	X
		Sestonic Algae	NA	X
	Substrate composition	Pebble Count (100 rocks)	X	X
	Hydrologic characteristics	Bankfull width & depth, slope,	X	NA
	Reach characteristics	% and type of riparian vegetation, canopy cover	X	NA

Appendix 5 – Draft Report Ritcey and Glozier 2017 - Expansion of the ECCC CABIN-Based Tributary Biomonitoring Program South of Fort McMurray - *see attachment*