

5 YEAR LONG-TERM MONITORING OR OPERATIONAL ACTIVITY 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-LTM-E-5-1718	
Monitoring Activity Title:	Biodiversity Monitoring of Benthic Macro Invertebrates	
Geographic Location <i>(choose from drop-down menu, if Project Location is in more than one area choose from second drop-down)</i>	Lower Athabasca River	Athabasca River - Tributaries
Monitoring Site(s) Coordinates <i>(latitude and longitude)</i>	See Appendix 1B and Appendix 1D	
Monitoring Organization and Responsible Manager:	Environment and Climate Change Canada	Nancy Glozier Joseph Culp
Date Monitoring Initiated:	2012	
Specific Monitoring Objective: <i>(State the monitoring objective addressed through this monitoring)</i>	Project Objectives: Through benthic macroinvertebrate 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 Lower Athabasca River and its tributaries.	
Deliverables (Annual): <i>What Data Reports will be produced and when?</i>	1) Athabasca River Mainstem Workplan: see Section I below. 2) Tributaries Workplan: Lower Athabasca, and Birch Rivers see Sections II and III below.	

Monitoring Plan Summary:**Background**

The Joint Oil Sands Monitoring Plan (JOSM) (EC and AESRD 2012-15) included measurement of aquatic ecosystem health by monitoring benthic macroinvertebrate (BMI) assemblages in the mainstem 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 Oil Sands development on the environmental and ecological integrity of the Lower Athabasca River and its tributaries.

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 Lower Athabasca River and/or in its tributaries?

Assumptions and Constraints

- Nutrient inputs from Ft. McMurray and Oil Sands Developments may affect biological processes in the river and have the potential to confound the effects of Oil Sands stressors including contaminants;
- Contaminant inputs to the mainstem 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 B-LTM-E-5-1718 are linked (logistics, shared sampling crews, equipment, etc.,) to the Tributary Focused study in the Peace Basin and Southern Operators Areas B-MD-9-1718; and
- Budget O&M and PY requirements for B-LTM-E-5-1718 are linked (logistics, shared sampling crews, equipment etc.,) to the Mainstem Investigation of Cause Study B-IC-1-1718.

I. ATHABASCA RIVER MAINSTEM WORKPLAN

I-A. Athabasca River Mainstem Biomonitoring Plan (2017-2022) and Deliverables

The design identifies 9 cobble locations (M0, M1A, M2 or M2A, M3, M3B, M4, M6, M8 & M9) to be sampled each year with another 3 cobble sites (M1, M7, M7c) to be sampled once every 3 years. (*Sampling of sand reaches has been discontinued as the assessment of 2012-2015 JOSM data indicated these sites have low biodiversity and high variability.*)

The annual sampling design and data collected for 2017-2022 is found in Appendices 1A, 1B and Appendix 4.

Cobble sites: Ten sites (M0, M1A, M2 or M2A, M3, M3B, M4, M6, M8 & M9 plus one of M1, M7, M7c) will be sampled with 5 replicate samples taken per reach.

I-B. Completion of Mainstem Data Acquisition and Analysis From Previous Year

During each year the monitoring work will include the field sampling listed in Appendices 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 Quality Assurance/Quality Control (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. TRIBUTARIES - LOWER ATHABASCA, AND BIRCH RIVERS WORKPLAN

II-A. Tributaries Biomonitoring Plan (2017-2022): Lower Athabasca, and Birch rivers and Deliverables

The biomonitoring plan for tributary sites in the Lower Athabasca River and Birch Mountains area will focus on kick sampling and expanded CABIN protocol in erosional habitats. It is intended that primary sites outlined below will be sampled annually to track temporal changes in reference and test sites. Additional reference and test sites will be sampled on a rotational basis with particular attention to those years when hydrologic conditions are outside of the normal range (extreme high or low flows).

The annual sampling design and data collected for 2017-2022 is found in Appendices 1C, 1D and Appendix 4:

Greater than 100 sampling locations were established between 2011-2016. From these locations a total of 50 erosional sites will be sampled annually from autumn of 2017-2021 in the Lower Athabasca River, Oil Sands Mineable Area and Birch Mountains as described below.

Lower Athabasca River Tributaries (35 – 40 sites annually)

- 15 reference sites (out of 40) in the major tributaries of the Athabasca River (e.g., 3 sites in Steepbank, 3 in MacKay, 2 Dover, 3 in Ells, 3 Firebag and 1 in the Jackpine).
- 10 test sites (out of 38) in catchments with a high proportion of disturbance (e.g., 3 sites in Steepbank, 3 in MacKay, 3 in Ells, 1 in Muskeg).
- 5-10 sites will be sampled on a rotational basis each year, thus achieving at least one site visit to all current sites within the five-year study period.
- Sites will be assessed annually against updated development footprint information to confirm the status as a reference or test site.
- Up to 5 new sites may be established annually to address data gaps identified during the annual site assessment exercise above for reference (e.g., sites with natural exposure to bitumen) and test areas (e.g., additional sites near development boundaries to capture more information about BMI and habitat variability).

Birch Mountains (10-15 sites annually)

- In the Birch Mountains area, currently in a state of minimal disturbance, a set of 10 reference sites (currently out of 26) will be sampled annually.
- 5 new reference sites in the Birch Mountains will be established each year to achieve a total of at least 40 sites in the area which will allow reference conditions to be adequately characterized. As the protocols for determination of these few additional reference sites will follow established approaches developed over the 2011-2016 sampling period, this is considered an adaptive phase of the LTM for biomonitoring in the Birch Mountains.
- Sites will be assessed annually against updated development footprint information to confirm the status as a reference or test site.

II-B. Completion of Tributary Data Acquisition and Analysis from previous year - Lower Athabasca, and Birch rivers

During each year the monitoring work will include the field sampling listed in 1C, 1D 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.
- SPMD samples collected in autumn of the previous year will be analysed and QA/QC completed.
- Chl-*a* samples collected in autumn of the previous year will be analysed and QA/QC completed.
- Data analysis of all data collected in the autumn of the previous year will be undertaken and placed into context of the previous sampling years.

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.

Appendix 1A- Annual Monitoring Schedule (Athabasca Mainstem)

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

<u>Sampling Locations/Sites¹</u>	<u>Sampling Schedule (timing/frequency)</u>	<u>Elements to be Analyzed</u>	<u>SOPs to be Consulted</u> <i>(hyperlinks accepted)</i>	<u>QA/QC Complete & Date Data to be Released</u>
M0, M1A, M2 or M2A, M3, M3B, M4, M6, M8 & M9 plus one of M1, M7, M7c	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) Environment and Climate Change Canada's National Laboratory for Environmental Testing (NLET) methods	Jan 2019
M0, M1A, M2 or M2A, M3, M3B, M4, M6, M8 & M9 plus one of M1, M7, M7c	Aug – Sept 2018	- As above	- As above	Jan 2020
M0, M1A, M2 or M2A, M3, M3B, M4, M6, M8 & M9 plus one of M1, M7, M7c	Aug – Sept 2019	- As above	- As above	Jan 2021
M0, M1A, M2 or M2A, M3, M3B, M4, M6, M8 & M9 plus one of M1, M7, M7c	Aug – Sept 2020	- As above	- As above	Jan 2022
M0, M1A, M2 or M2A, M3, M3B, M4, M6, M8 & M9 plus one of M1, M7, M7c	Aug – Sept 2021	- As above	- As above	Jan 2023

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

Appendix 1B- Site Locations for Annual Monitoring Schedule (Athabasca Mainstem)

Latitude and longitude in decimal degree format for each sampling location along the mainstem Athabasca River.

Sampling Location	Latitude	Longitude
M0	54.7265	-113.3006
M1	56.6416	-111.6191
M1A	56.6219	-111.65542
M2	56.7432	-111.3895
M2A	56.6927	-111.4623
M3	56.7938	-111.4042
M3B	56.9473	-111.4427
M4	57.098	-111.5649
M6	57.202	-111.6104
M7	57.3579	-111.6586
M7C	57.5114	-111.538
M8	57.657	-111.4259
M9	58.0666	-111.3681

Appendix 1C– Annual Monitoring Schedule (*Tributaries: AR-BR-PR*)

(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>Elements 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>Lower Athabasca River Tributaries (35 – 40 sites annually) Birch Mountains (10-15 sites 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>Lower Athabasca River Tributaries (35 – 40 sites annually) Birch Mountains (10-15 sites annually)</i>	Aug – Sept 2018	- As above	- As above	Jan 2020
<i>Lower Athabasca River Tributaries (35 – 40 sites annually) Birch Mountains (10-15 sites annually)</i>	Aug – Sept 2019	- As above	- As above	Jan 2021
<i>Lower Athabasca River Tributaries (35 – 40 sites annually) Birch Mountains (10-15 sites annually)</i>	Aug – Sept 2020	- As above	- As above	Jan 2022
<i>Lower Athabasca River Tributaries (35 – 40 sites annually) Birch Mountains (10-15 sites annually)</i>	Aug – Sept 2021	- As above	- As above	Jan 2023

¹See Appendix 1D for latitude and longitude for each sample location

Appendix 1D- Site Locations for Annual Monitoring Schedule (Athabasca Tributaries)

Latitude and longitude in decimal degree format for each tributary sampling location.

Sampling Location	Latitude	Longitude
BIRTRIB01	58.28430556	-113.199056
BIRTRIB02	58.22232222	-113.178389
BIRTRIB03	58.15297	-113.10387
BIRTRIB04	58.23417	-112.76192
BIRTRIB05	58.1755	-112.21115
BIRTRIB06	58.11858	-113.03207
BIRTRIB07	58.05002	-112.93325
BIRTRIB08	58.10421	-112.94599
BIRTRIB09	57.97546	-112.10649
BIRTRIB10	57.99934	-111.99959
BIRTRIB11	58.02798	-111.96023
BIRTRIB12	58.20528	-112.74071
BIRTRIB13	58.1716	-112.6463
BIRTRIB14	58.178341	-112.71924
BIRTRIB15	57.92786	-112.33569
BIRTRIB16	57.93425	-112.25134
BIRTRIB17	57.95675	-112.16294
BIRTRIB18	57.95641	-112.12891
BIRTRIB19	57.90002	-112.03741
BIRTRIB20	57.98728	-112.03197
BIRTRIB21	57.96626	-112.12144
DOVRIFF01	57.15041667	-111.911139
DOVRIFF02	57.15602778	-111.874917
DOVRIFF02A	57.15472	-111.87424
DOVRIFF04	57.12142	-112.01329
DOVRIFF04A	57.11634	-112.01776
DOVRIFF05	57.17437	-111.80713
DOVRIFF06	57.15908333	-111.864306
DUNRIFF01	56.859611	-112.7115
ELLSRIFF01	57.26466667	-111.733194
ELLSRIFF02	57.24455556	-111.736556
ELLSRIFF03	57.30518611	-110.672917
ELLSRIFF03A	57.2914	-111.69764
ELLSRIFF04	57.2807	-111.70472
ELLSRIFF04A	57.27579	-111.70131
ELLSRIFF05	57.2277	-111.95911
ELLSRIFF05A	57.22782	-111.97022
ELLSRIFF06	57.21833	-112.01964

ELLSRIFF07	57.28983333	-111.709444
ELLSRIFF09	57.15128	-112.1735
ELLSRIFF10	57.18127	-112.11227
ELLSRIFF11	57.23883	-111.8485
ELLSRIFF12	57.26441	-111.71611
ELLSRIFF13	57.22979	-111.9398
ELLSRIFF14	57.2341	-111.77515
FIRLOWER	57.51906	-111.11241
FIRLOWER01	57.6152	-111.11869
FIRLOWER02	57.65123	-111.20847
FIRMID	57.43718	-110.89437
FIRMID02	57.4698	-110.98098
FIRMID03	57.38493	-110.61674
FIRMID04	57.40337	-110.77177
FIRRIFF01	57.33133333	-110.44175
FIRTRIB02	57.32131	-110.45741
FIRTRIB03	57.29755	-110.45716
FIRTRIB04	57.22648	-110.53746
FIRUPPER01	57.34333	-110.49489
HIGHHILLS	56.7516	-110.50624
HNGRIFF01	56.68684	-111.36779
HNGRIFF02	56.64968	-111.35655
HRSRIFF01	56.70302	-111.39361
HRSRIFF02	56.67395	-111.42126
JALRIFF01	57.9973889	-112.913444
JALRIFF02	57.9990833	-112.841583
JALRIFF03	57.98515	-112.78322
JALRIFF04	57.99693	-112.8185
JOSRIFF01	57.28963889	-111.711222
JPRIFFDN	57.25083333	-111.439444
JPRIFFUP	57.07	-111.330556
JPRiff-Up-2	57.06381	-111.31486
MCKRIFF02	56.96138889	-111.951667
MCKRIFF03	57.17767	-111.73501
MCKRIFF04	57.05986	-111.77587
MCKRIFF05	56.92269445	-112.1485
MCKRIFF06	57.10313889	-111.763972
MCKRIFF07	56.84694444	-112.2575
MCKRIFF08	57.15265	-111.76068
MCKRIFF09	57.00797222	-111.848167
MCKRIFF12	57.19111111	-111.670556
MCKRIFF15	57.21261111	-111.710444
MUSRIF1	57.14556	-111.56851

MUSRIF2	57.1825556	-111.5695
STBRIF01	57.02241944	-111.476719
STBRIF02	57.02435	-111.44925
STBRIF04	56.99002778	-111.368889
STBRIF04A	56.99298	-111.3762
STBRIF05A	56.99138889	-111.334167
STBRIF05B	56.99161111	-111.333639
STBRIF06A	56.99136	-111.33884
STBRIF06B	56.99147222	-111.339028
STBRIF07	56.97852778	-111.297333
STBRIF07A	56.97331	-111.28674
STBRIF08	56.92707	-111.23186
STBRIF09	56.92288889	-111.227917
STBRIF10	56.86880556	-111.142472
STBRIF10A	56.86924	-111.14711
STBRIF11	56.82102778	-110.9905
STBRIF13	56.82511111	-111.024111
STBRIF16	56.85055556	-111.084167
STBRIF17	56.85141944	-111.083419
STBRIF19	56.85844444	-111.062806
STBRIF20	56.95936	-111.26883
STBRIF21	57.01719	-111.43898

Appendix 2A – Detailed Multi-Year Financial Breakdown (Athabasca Mainstem): if changes are to be made then an Addendum must be Complete and Approved.

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

Budget requirements	Year 1 (2017-2018)		Year 2 (2018-2019)		Year 3 (2019-2020)		Year 4 (2020-2021)		Year 5 (2021-2022)	
	APPROVED		NOT APPROVED		NOT APPROVED		NOT APPROVED		NOT APPROVED	
	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	\$65,100									
Operations and Maintenance										
a) Vehicles and Transportation	\$1,480									
b) Helicopter	\$51,000									
c) Lab analysis	\$27,132									
d) Students	\$24,000									
e) Field work & training	\$121,053									
Consumable Materials/Supplies										
f) Sample bottles/jars, shipping materials, chemicals	\$55,000									
Travel										
g) Conferences and meetings (<i>identify conference/meeting</i>)										
h) Field work - travel	\$69,250									
i) Project-related travel										

External Contracts										
j) External monitoring contract	\$145,000									
Grand Total * (Before other related costs)	\$612,154									

Appendix 2B – Detailed Multi-Year Financial Breakdown: *(AR Tributaries & Birch Mountains)* if changes are to be made then an Addendum must be Complete and Approved. –

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

Budget requirements	Year 1 (2017- 2018)		Year 2 (2018-2019)		Year 3 (2019-2020)		Year 4 (2020-2021)		Year 5 (2021-2022)	
	APPROVED		NOT APPROVED		NOT APPROVED		NOT APPROVED		NOT APPROVED	
	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
Salaries and Benefits										
b) Appendix 3 - Totals	\$271,600									
Operations and Maintenance										
k) Vehicles and Transportation	\$6,000									
l) Helicopter	\$105,800									
m) Lab analysis	\$89,460									
n) Data management										
o) Field work & training	\$78,540									
Consumable Materials/Supplies										
p) Sample bottles/jars, shipping materials, chemicals	\$3,000									
Travel										
q) Conferences and meetings (<i>identify conference/meeting</i>)										

r) Field work - travel	\$64,000									
s) Project-related travel										
External Contracts										
t) External monitoring contract	\$43,200									
Grand Total *(Before other related costs)	\$661,600									

*The Total Salary (\$271,600) for ECCC in 2017-2018 with other related costs is \$373,504. The Total O&M \$(390,000) for ECCC in 2017-2018 with other related costs is \$441,298. **The Grand Total (\$661,600) for ECCC in 2017-2018 with other related costs is \$814,802.**

Appendix 3A – Staffing Plan (Athabasca Mainstem)

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

Responsible Role	Year 1 – Budget Allocation (APPROVED)		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/Laboratory Staff	\$65,100									
Administrative and Program Coordination										
Grand Total (<i>inserted into Appendix 2A</i>)	\$65,100	\$	\$	\$	\$	\$	\$	\$	\$	\$

Appendix 3B – Staffing Plan (*AR Tributaries & Birch Mountains*)

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



Responsible Role	Year 1 – Budget Allocation APPROVED		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	\$35,750									
Technical/Field Staff	\$235,850									
Administrative and Program Coordination										
Grand Total <i>(inserted into Appendix 2B)</i>	\$271,600	\$	\$	\$	\$	\$	\$	\$	\$	\$

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 BMI Monitoring		Specific Parameters	Biomonitoring Program	
			Tributary	Mainstem
a. BMI 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 Nitrogen	X	X
		Nitrate & Nitrite	X	X
		Ammonia	X	X
		Dissolved Organic N&C	X	X
		Particulate Organic N&C	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
		Conductivity	X	X
	Trace Metals	Total Metals	X	X
		Dissolved Metals	X	X
	PAHs	PAHs	X	X
		Alkylated PAHs	X	X
	YSI Handheld Sonde	Temperature	X	X
		Specific Conductance	X	X
		pH	X	X
		Dissolved Oxygen (mg/L)	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 – Approvals

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