# FOCUSED STUDY ACTIVITY WORK PLAN

## General Information

| Develop Environmental Predictions Framework | | |
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| **Work Plan Unique Identifier:** | *E-5-1718* | |
| **Focused Study Activity Title:** | Develop Environmental Predictions Framework | |
| **Focused Study Category:** | Investigation of Cause or Potential Ecological Impact | |
| **Geographic Location (***choose from drop-down menu. If Project Location is in more than one area choose from second drop-down***)** | Athabasca Oil Sands Region | Lower Athabasca River |
| **Monitoring Site(s) Coordinates** *(latitude and longitude)* | This project does not involve any new environmental monitoring in 2017-18. | |
| **Project Leader:** | Anil Gupta (EMSD/AEP) | |
| **Organization and contact information:** | Environmental Monitoring and Science Division<br>Alberta Environment and Parks<br>Email: anil.gupta@gov.ab.ca<br>Tel: 403 297 3930 | |
| **Date Study initiated:** | April 1st 2017 | |
| **Monitoring Category:**<br>*(From OSM long-term plan; choose from drop-down menu)* | Watershed Monitoring | |
| **Strategic Objective of Focused Study:** *(From OSM long-term plan; choose from drop-down menu)* | Objective W3: Integration and Synthesis | |
| **Hypotheses:**<br>*(Briefly outline the specific hypotheses that your focused study is aiming to address)* | ***Study to Reconstruct a Historical Environmental State and Prediction of Future Environmental Responses***<br>Numerical modelling is the only viable option for reconstruction of a historical environmental state (i.e. baseline conditions) against which any present and future changes could be evaluated or assessed including anthropogenic or natural changes. Once the historical environmental state is reconstructed, these models would be used to predict the future environmental states under various what-if scenarios. | |

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| | ***Investigation of Cause:***<br>Numerical modelling will support the hypothesis testing about cause-and-effect relationships that exist in our complex eco-system. Models are great tools to investigate cause-effect relations (the complex relationship that exist between numerous ecosystem processes) and to simulate what-if scenarios.<br><br>***Monitoring design and method improvement:***<br>Numerical modelling will help in identifying the data gaps and data redundancies, both with respect to monitoring/data types and spatial extent of monitoring. Modelling also compliment monitoring and could assist in designing of an optimal integrated monitoring program for the oil sands region.<br><br>***Reference Level Study:***<br>The historical base line models will provide the reference level (bench mark) again which the present and future changes will be evaluated. For example, impacts of climate change and land use change on water quantity & quality or fisheries habitats. |
| **Deliverables:**<br><br>*What tangible goal (s) and/or product(s) will the monitoring produce and when?* | The focused study will produce following tangible products:<br><br>1. Develop a conceptual predictive modeling framework for lower Athabasca river basin to support cumulative effects assessment and management. The framework will summarize the key questions that could be answered and identify the potential clients for information generated by predictive modeling and why these needs are appropriate for, and relevant to, oil sands monitoring program (OSMP).<br>2. Convene an expert working group on modelling under oil sands monitoring program to ensure linkages between various sub-media specific modelling are identified for comprehensive assessments and prediction of cumulative effects in oil sands area (the focus in 2017-18 will be on water related sub media e.g. surface water, ground water – quantity and quality).<br>3. Maintenance and updating of the numerical models (e.g. regional hydrology, sediment transportation and water quality) previously developed by ECCC and AEP. |

# Detailed Study Plan

(Please provide detailed information on the specifics of your focused study including – (**keywords, hypothesis and the assumptions and constraints behind your hypothesis**)

**Provide a maximum of 10 key words that describe this project. Use commas to separate them:**

Environmental predictions, modeling, modelling framework, hydrologic modeling , sediment transport, water quality, climate change, land use change, Athabasca river, oil sands, numerical modelling.

**Describe how you will test your hypothesis:**

Fundamentally, the reason for modeling is a lack of full access, either in time or space, to the phenomena of interest. Environmental modeling is one of the important tools in the environmental analytics toolbox. Models can be described as mathematical representation of a natural system (often with some degree of simplification), constructed to gain insights into select attributes of a particular physical, biological, economic, or social systems and their complex interactions. Environmental model allows us to integrate system's physical data (i.e. landscape, soil, sub soil, vegetation etc.) with multiple environmental monitoring data (across media) to construct the system in mathematical terms that could be used to for various purposes from reconstructing the historical environmental states (hind-cast) to make long- and short-term forecasts (predictions) to extrapolate from the past and answer "what-if" questions.

Where there is a shortage of data and information, models can be used to provide useful insight. In general, models can help users study the behavior of ecological systems, design field studies, interpret data, and generalize results (EPA, 2009a). Models can also be used to provide concise summaries of data, in both diagnostic and regulatory contexts (NRC, 2007).

This focused study will continue to build upon the significant work completed in past by ECCC and AEP under JOSM program. In past, significant investment has been made in numerical modeling to develop regional hydrological, water quality and sediment transport models. However, a predictive modelling framework is required to guide continuation of modelling work in the future.

Therefore, the focus of this work plan is to develop a conceptual predictive modeling framework for lower Athabasca river basin (LARB) to support cumulative effects assessment and management. The framework report will also identify internal and external clients for predictive modeling, the needs for each client, and why these needs are appropriate for, and relevant to, oil sands monitoring program (OSMP).

**Key Activities and Outcomes:**

1. Organize a modelling workshop with key internal and external stakeholders to achieve following: (i) Develop a good understanding of various modelling initiatives in LARB; (ii) connect with interested key stakeholders and modelling experts; (iii) understand various modelling needs of potential clients/ stakeholders; (iv) identify the gaps to meet the needs i.e. modelling, data etc. and (v) develop a conceptual predictive modelling framework for Lower Athabasca River Basin.

2. Discussion with key AEP internal clients (e.g. Policy and Planning Division, Operations Division, Alberta Climate Change Office) to identify modelling needs in the basin and to develop an appropriate modelling framework that will guide the future modelling work in the basin.
3. Explore the possibility of establishing an expert working group on modelling.
4. Maintenance and updating of the numerical models (e.g. regional hydrology, sediment transportation and water quality) previously developed by ECCC and AEP.

# References:

EPA (US Environmental Protection Agency). 2009a. Guidance Document on the Development, Evaluation and Application of Environmental Models. EPA/100/K-09/003. Washington, DC. Office of the Science Advisor.

EPA (US Environmental Protection Agency). 2009b. Using Probabilistic Methods to Enhance the Role of Risk Analysis in Decision-Making With Case Study Examples EPA/100/R-09/001 Washington, DC. Risk Assessment Forum.

Manno, J., R. Smardon, J. V. DePinto, E. T. Cloyd and S. Del Granado. 2008. The Use of Models In Great Lakes Decision Making: An Interdisciplinary Synthesis Randolph G. Pack Environmental Institute, College of Environmental Science and Forestry. Occasional Paper 16.

McGarity, T. O. and W. E. Wagner 2003. Legal Aspects of the Regulatory Use of Environmental Modeling. Environmental Law Reporter 33(10): 10751-10774.

NRC (National Research Council) 2007. Models in Environmental Regulatory Decision Making. Washington, DC. National Academies Press.

Pascual, P. 2004. Building The Black Box Out Of Plexiglass. Risk Policy Report 11(2): 3.

Van Waveren, R. H., S. Groot, H. Scholten, F. Van Geer, H. Wösten, R. Koeze and J. Noort 2000. Good Modelling Practice Handbook (PDF) (165 pp, 1Mb). Leystad, The Netherlands, STOWA, Utrecht, RWS-RIZA, Dutch Department of Public Works.

# Reporting and Publications

*Provide information on the anticipated reports / publications. (Insert additional rows if needed)*

| Expected Subject/Titles of Publications or Reports | Short Description of Publication or Report | Expected Year of Publication |
|---|---|---|
| Conceptual predictive modeling framework for lower Athabasca River Basin<br><br>(Report) | The report will summarize the key questions that could be answered and identify the potential clients for information generated by predictive modeling and why these needs are appropriate for, and relevant to, oil sands monitoring program (OSMP). | 2018-19 |

# Technical / Professional Roles and Responsibilities

*Identify members of the monitoring team/organization, their roles and responsibilities. Identify monitoring organization leads if different from overall monitoring activity lead. (Insert additional rows if needed)*

| Role | Responsibilities | Resource Name/Organization |
|---|---|---|
| Project Lead (EMSD/AEP) | Project Manager | Anil Gupta |
| Workshop Organizer/coordinator | Responsible for coordinating and arranging the modelling workshop | TBD |
| Workshop Facilitator | To facilitate the modelling workshop | TBD |
| Technical writer | To develop the technical report on workshop recommendations and to draft the conceptual predictive modeling framework for lower Athabasca river basin. | TBD |
| Modeller | Maintenance and updating of the numerical models. | TBD (post Docs) |

# Deliverables (Year 1) If your Focus Study is longer than 1 year then complete **Appendix C** for multi-year deliverables breakdown

Provide a summary of tangible quarterly deliverables. Identify major project areas (deliverables) and results that can be identified as a tangible goal. This could include: field work, lab work/ analysis, evaluation, data, reports, publications, SOPs etc. Do not define process as your Deliverable e.g. 'fly to Ft. McMurray to conduct fieldwork' or 'seek Director approval for report'.

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| **Deliverable(s)** (please provide enough information to support status reporting) |
| **Q1 – April to June** |
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| **Q2 – July to September** |
| Planning of modelling workshop |
| Planning and Scheduling meetings with various internal modelling clients (AEP) |
| Calibration of Regional hydrological model (main tributaries of Athabasca River) |
| Extension of Athabasca River bathymetry between Firebag River and Embarrass Airport and/or Old Fort |
| **Q3 – October to December** |
| Planning of modelling workshop |
| Planning and Scheduling meetings with various internal modelling clients (AEP) |
| Maintenance and updating of the numerical models: Calibration of Regional hydrological model (main tributaries of Athabasca River) |
| Maintenance and updating of the numerical models: Extension of Athabasca River bathymetry between Firebag River and Embarrass Airport and/or Old Fort |
| **Q4 – January to March** |
| Organize a modelling workshop with key stakeholders |
| Develop a report on workshop recommendations |

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| Develop a draft conceptual predictive modeling framework for lower Athabasca river basin |
| Maintenance and updating of the numerical models: Calibration of water quality models (EFDC and Mike11) with new Athabasca River bathymetry |
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# Detailed Financial Breakdown – Year 1 of 3 (2017-2020)

Also complete **Appendix B** for the multi-year financial breakdown

| **Budget requirements – List areas that require budget expenditures: (ADD OR DELETE BUDGET CATEGORIES AS REQUIRED)** | **OS Funding** | **External Funding (*outside JOSM*)** |
|---|---|---|
| **O&M - Operations and Maintenance:** | | |
| Helicopter Costs | **$** | **$** |
| Field Costs | **$** | **$** |
| Data Management | **$** | **$** |
| Internal Lab Analysis | **$** | **$** |
| Consumable Materials & Supplies | **$** | **$** |
| **Sub-Total** | **$** | **$** |
| **O&M - Travel** | | |
| Field Work | **$** | **$** |
| Travel/Conferences (*identify conference*) | **$8,000** | **$** |
| Publications | **$2,000** | **$** |
| **EMSD/ECCC OSM Modelling Conference (Logistics, travel, honorarium, hosting, conference reporting etc.)** | **$25,000** | |
| **Sub-Total** | **$** | **$** |
| **O&M - External Contracts :** | | |
| Goods and Services Contract (*describe contractor*): | **$** | **$** |
| External Lab Analysis | **$** | **$** |
| **Sub-Total** | **$** | **$** |
| **Salaries:** | | |
| Principal Investigator | **$** | **$** |
| Technical / Professional Assistants – One PDF | **$75,000** | **$** |
| Field Staff | **$** | **$** |
| **Sub-Total** | **$** | **$** |
| | | |
| **Total Salaries** | **$** | **$** |
| **Total O&M** | **$** | **$** |
| **2017-2018 GRAND TOTAL*** | **$110,000** | **$** |

# Appendix A – Approvals

| Project Submitted by: | | |
|---|---|---|
| Name: Anil Gupta | | |
| Organization:<br>AEP | Signature: | Date:<br>11 Aug 2017 |

| Project Approved by: | | |
|---|---|---|
| **Dr. Monique Dubé (AEP)** | | **Dr. Kevin Cash (ECCC)** |
| Signature<br>  | | Signature<br>  |
| Date | | Date |

## APPENDIX B – Detailed Multi-year Financial Breakdown (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) | |
|---|---|---|---|---|---|---|
| | Cash | In-kind | Cash | In-kind | Cash | In-kind |
| 1) Salaries and benefits | | | | | | |
| a) Investigators | | | | | | |
| b) Technical/professional assistants- One PDF | $75,000 | | | | | |
| c) Field Staff | | | | | | |
| d) | | | | | | |
| 2) Operations and maintenance | | | | | | |
| a) Facilities | | | | | | |
| b) Equipment | | | | | | |
| c) Lab analysis | | | | | | |
| d) Data management | | | | | | |
| e) Field work | | | | | | |
| 3) Consumable Materials and supplies | | | | | | |
| a) Software/hardware etc. | | | | | | |
| b) | | | | | | |
| 4) Travel | | | | | | |
| a) Conferences and meetings | | | | | | |
| b) Modelling workshop | $25,000 | | | | | |
| c) Project-related travel | $8,000 | | | | | |

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| 5) Dissemination & Engagement | | | | | | |
| a) Publications/Reports | $2,000 | | | | | |
| b) Translation (if required) | | | | | | |
| c) Communications | | | | | | |
| d) Stakeholder Engagement | | | | | | |
| e) Indigenous Peoples Engagement | | | | | | |
| 6) External Contracts | | | | | | |
| a) | | | | | | |
| **Grand Total** | $110,000 | | | | | |