2018-19 Work Plan Template

All fields with an * are mandatory

Project Description Summary

Date *	Project/Work Plan Identifier (if applicable)	Program Type and Strategic Alignment *
6/19/2018	A-PD-4-1819	OSM - Focus Study
Program Category *	**Status ***	**Dept. ID**
Air/Atmosphere/Climate	Existing Project	

Project Leadership / Contact information

Project Title *	Key Words (max 10) *	
Atmospheric Process Research - OS Air pollution emissions, transformation and fate (Year 2 Project Activity)	Airborne measurements, criteria air contaminants, greenhouse gases, emissions, transformation, transport, deposition, fate, oil sands region, air quality prediction model, satellite validation	
Surname *	**Given Name ***	**Title ***
Cober	Stewart	Section Manager
Organization *	**Department**	**Division**
ECCC		
Branch *	**Section/Unit (if applicable)**	**Phone ***
ASTD		(416) 739-4618
Email *	**Mailing Address**	**City**
Stewart.Cober@canada.ca	4905 Dufferin Street	Toronto
Postal Code	**EMSD Executive Owner (If Applicable)**	
M3H 5T4		

Project Information

Project Objective(s) (Bullet Form) *	Broadly stated, the two primary objectives are: 1. Providing emissions rates of criteria air contaminants (CACs) and greenhouse gases (GHGs) for oil sands facilities and refineries in East Edmonton and Fort Saskatchewan, quantifying the rates of change of the primary pollutants and formations of secondary pollutants in the atmosphere, and determining the deposition fluxes of primary and secondary pollutants onto downwind ecosystems using comprehensive aircraft and ground-based measurements as well as remote sensing. 2. Integrating knowledge gained, both from the first phase study and the proposed measurements, into a comprehensive numerical air quality prediction model, to improve the model simulation and prediction capability to assess downwind impacts on ecosystems and human health, with the assumption that the model will be a critical tool for cumulative effects assessment.
Plain Language Overview (100 words) *	This project plan is for the second year of a 5-year focus study (2016-2021) that was proposed in 2016 and approved for 2017-18. The project focuses on understanding and characterizing the emission, transformation, transport and fate of oil sands air pollution. The project includes an aircraft study and some enhanced ground-based measurements including an aircraft study measurement campaign scheduled for the spring and summer of 2018; laboratory investigations of transformation processes; improved satellite data retrieval methodologies; and improvements to and simulations using an advanced air quality numerical prediction model. The aircraft study measurement campaign will be focused on the spring and early summer period of 2018 in order to capture a different season in comparison to the 2013 monitoring intensive. In addition, emission characterization measurements associated with the upgrading and refining activities in Edmonton East/Fort Saskatchewan region are also planned.

Project Duration *	Project Original Start Date *	Estimated Completion Date *
Multi-Year	4/1/2017	3/31/2021

Specify Objectives This Project Will Address in 2018/2019. *	In the fiscal year 2018-2019 (the second year of the project), the aircraft study project activities will continue from those in fiscal year 2017-18 and will consist of the following components: **1.1. Ambient air measurements from an aircraft.** These measurement activities provide data for testing and proving all hypotheses H1 to H8 as listed below. **1.2 Laboratory Studies on Oil Sands Pollutant Transformation.** These studies provide data to test and prove hypotheses H2, H3, and H6. **1.3 Emission data compilation and synthesis**. These activities provide inputs to test and prove hypotheses H1, H2, H4, H5, and H6. **1.4 GEM-MACH Air Quality Model Prediction and Application.** These activities provide outcomes for testing all hypotheses, H1 to H8. **1.5 Remote Sensing of Air Pollutants in the Oil Sands.** These activities provide products to test and prove hypotheses H5. **1.6 Airborne measurements of mercury.** Activities in this component provide data to test and prove hypotheses H7 and H8.
Specify Objectives This Project Will Address Beyond 2018/19 (if multi-year). *	Continuation of above.

Co-Chair Decision

*** Decision Pool A: Workplan approved.**
*** Approved at $4,454,901**
* Coordination between AEP and ECCC must occur in advance and while undertaking flights
* It is a requirement of funding that this project coordinate and discuss with COSIA in advance of flights, while undertaking flights, and following flights.
* When publishing and reporting of results, this team must demonstrate how they have consulted with COSIA and regulators to explore how these and the 2013 results inform regulatory and management decisions
* 2018/19 is the "wrap-up" year of the air craft campaign. Any further focus studies will be informed by or dependent upon the outcomes of this work.
*Funding expectations: as a minimum a final report is required by March 31, 2019. All publications or products resulting from this work requires acknowledgement of funding from the Oil Sands Monitoring Program and are to be provided to the Oil Sands Monitoring Secretariat for tracking and any programmatic communications purposes. Work funded through the Oil Sands Program will be available for public dissemination.

List Key Questions/Hypotheses Related to Each Objective Stated Above. *	**H1)** Characterizing and quantifying air pollutant emissions from in-situ operations, seasonal variabilities in surface mining facilities, and upgrading and refining facilities in east Edmonton/Fort Saskatchewan, using a combination of aircraft observations will address gaps in emissions data estimates **H2)** Using an aircraft-based observational mass balance approach over large geographic regions downwind of the oil sands facilities will allow estimation of dry deposition estimates of sulfur and nitrogen **H3)** Aircraft-based measurements designed to identify the transformed products of oil sands emissions, and laboratory investigations of the chemical nature of the transformation products and their rates of formation will inform gaps in chemical transformation and speciation information **H4)** Using emission observations to improve model emission databases, particularly the under-estimation of emission rates and lack of speciation, integration with Continuous Emissions Monitoring Systems (CEMS) data, and inclusion of small emitters in the oil sands region will inform model emissions data **H5)** Validating new satellite data products from the following existing satellites TROPOspheric Monitoring Instrument (TropOMI), Visible Infrared Imaging Radiometer Suite (VIIRS), Moderate Resolution Imaging Spectroradiometer (MODIS), Greenhouse gases Observing SATellite (GOSAT), Orbiting Carbon Observatory 2 and 3 (OCO2/OCO3) and well as the next generation satellite Tropospheric Emissions: Monitoring of Pollution (TEMPO) using aircraft observations under typical Canadian conditions will enable space-based observations to fill gaps in monitoring **H6)** Impacts estimation and integration of observations, by improving model capabilities, through improved processes representation, and validation and improvement of emissions inputs, will lead to improved confidence in model predictions of pollutant fate and the associated impacts, and will lead to improved methods for assessing cumulative impacts **H7)** The transformation of mercury (Hg) occurs higher in the atmosphere closer to industrial activities and above the forest canopy, and measurements at the current location suggest that the deposition of mercury is being taken up by the overlying forest H8) Re-emission of Hg from forest fires deposition in the region impacts the reported atmospheric mercury deposition and concentration levels in the OS area
Main Assumptions, Constraints, Dependencies. *	Assumptions • It is assumed that the National Research Council aircraft will be available during 2018 (already confirmed) and that requisite funding (from OSM) to support the aircraft study program will be forthcoming in 2017 and 2018 as required. • It is assumed that industries will be operating under normal operating procedures during the period of the intensive measurements proposed in 2018. • The project assumes that knowledge generated from the measurements and the satellite observations will be sufficient to fill the known gaps in emissions data, and reduce uncertainties in the air quality model. • The in situ operations are assumed to be large sources of Criteria Air Contaminants based on estimates of emissions from data on gas use, venting, and flaring. Currently emission reports indicate small emissions but might not include all sources, and may be low due to reporting thresholds. However, an underlying assumption is that individual in-situ facilities create high enough concentrations to be observable by the aircraft. • It is assumed that Hg measurement instruments are suitable for deployment on the aircraft and can measure suitable concentrations for testing Hypotheses H7 and H8. While instruments for gaseous Hg have been deployed from aircraft previously, the speciated Hg instrument needs to examined for suitability for aircraft deployment. • It is assumed that industries will provide data on hourly emissions to the ECCC research team and will identify unusual events that will be used to assist analyses of data from the aircraft campaign. • Air space south of Fort McMurray is assumed to be available for the measurement flights. Constraints Time: Time allocation the aircraft study measurement campaign can pose a challenge. Given the first phase of the measurement campaign is scheduled to start on April 3rd, 2018, various partners involved in the project, and the lead times required for flight planning and logistical coordination, an early approval of the project is essential. An early approval will remove scheduling obstacles arising from field campaign logistical coordination and between ECCC and National Research Council, since the logistics of aircraft deployment schedules have been fit into NRC Convair-580 aircraft schedule, and will enable early coordination between ECCC, AEP (Alberta Environment and Parks), and industry for aircraft flight planning. The aircraft study measurement campaign team has already taken logistical steps assuming that approval will be forthcoming.

Partner Categories (select all that apply) * A partner is an individual, group, agency, community etc. that is an active participant in the project and in achieving the project deliverables.	Knowledge System *	Location (select all that apply) *
☑ Federal Government ☑ Another AEP Division ☐ Another GoA Department ☐ University/Academic Institution ☐ Solely delivered by GoA ☐ Citizen Science ☐ Indigenous Community or Organization ☐ ENGO ☑ Other	Classical Science	☑ Office or Laboratory ☑ Sub-regional ☑ Transboundary (provincial/territorial) ☐ Lower Peace Region ☐ Upper Peace Region ☑ North Saskatchewan Region ☐ Red Deer Region ☑ Lower Athabasca Region ☑ Upper Athabasca Region

AEP ONLY: Strategic Alignment to EMSD Outcomes	
AEP ONLY: Strategic Alignment to EMSD Science Plan, select 1-2 areas that apply (If Applicable)	
Choose one Choose one	

AEP ONLY: Strategic Alignment to AEP Departmental Outcomes		
AEP ONLY: Environmental and Ecosystem Health and Integrity	**AEP ONLY:** Sustainable Economic Diversity	**AEP ONLY:** Social Well-Being
Choose one	Choose one	Choose one
AEP ONLY: Protected Public Health and Safety from Environmental		
Choose one		

AEP ONLY: IMAG/IMSC Information Needs, Please Specify Which Need(s) is Being Addressed. File location M:\EMSD\Common\Portfolio Mgmt System Shared Docs	

AEP ONLY: How This Project Will Address Each Strategic Theme Selected Above.	
Project Methodology	
List the Key Project Phases and Provide Bullets for Each Major Task Under Each Project Phase. *	**Phase 1:** Ambient air measurements from airborne platforms. **Phase 2:** Laboratory Studies on Oil Sands Pollutant Transformation. **Phase 3:** Emission data compilation and synthesis **Phase 4:** GEM-MACH (Global Environmental Multi-scale-Modelling Air Quality and Chemistry) Air Quality Model Prediction and Application **Phase 5:** Remote Sensing of Air Pollutants in the Oil Sands **Phase 6:** Airborne study measurement of Mercury **Phase 7:** Reporting
Describe How Changes in Environmental Condition Will Be Assessed. *	The project focuses on understanding and characterizing the emission, transformation, transport and fate of oil sands air pollution.
Are There Benchmarks (e.g., objectives, tiers, triggers, limits, reference conditions, thresholds, etc.) Being Used to Assess Changes in Environmental Condition? If So, Please Describe, If Not, State "NONE". *	NONE
Provide a Brief Description of the Methods By Project Phase. *	**Phase 1:** The National Research Council of Canada's Convair-580 aircraft will be deployed for the two aircraft study measurement phases separately in April and June, 2018. Specific flights will be designed to address the following topics: Facility integrated emissions using the top -down approach; Source characterization; Transformation and transport; Dry deposition determination; Remote sensing and data product validation **Phase 2**: A series of samples will be collected from the oil sands, including raw oil sand, unprocessed bitumen, processed/extracted bitumen, upgraded synthetic crude oil, tailing ponds water and solvents. The gases evolved from these samples will be analyzed for the volatilities and molecular structure of semivolatile and intermediate volatile organic compounds to determine the key species (or range of species) responsible for secondary organic aerosol (SOA) formation and their SOA potential. The evolved semivolatile and intermediate volatile organic compounds will be further studied in smog chambers and flow -tubes which will simulate processing in the atmosphere. **Phase 3**: Work will include activity data and emission report gathering, compiling, unification, and synthesis with the proposed and past aircraft observations, for the successive years 2016-2018. **Phase 4**: A series of tasks have been identified for the model prediction and applications to the oil sands region: Conduct real-time air-quality forecasts; Evaluate hypotheses explaining the observations; Evaluate the model using existing surface monitoring network data; Estimate deposition for multi -year simulations; Estimate the frequency of Air-Quality Health Index events; Compare with satellite data products, and apply to improve satellite retrieval algorithms; Conduct simulation experiments at very high model resolution; Improve emission inventory **Phase 5**: Assuming that key satellites will be available for the duration of the study period and new satellites will be successfully deployed, this work will include obtaining and validation of data products for aerosols (particulate matter) and for gases (NO_2, SO_2, HCHO, NH_3, CH_4, CO), and possibly airborne measurements for data retrieval validation pending the outcome of a feasibility study. **Phase 6**: Atmospheric mercury (Hg) measurements will be undertaken from the aircraft flights around the OS activities and background regions. Gaseous elemental Hg will be measured using a Tekran 2537 X instrument. Focused study will be conducted on Hg transformation in the atmosphere from a stable chemical to one that easily deposits to the ecosystem possibly enabled by air chemicals released from oil sands industrial activities. **Phase 7:** Analysis of the data will be made available through publications in peer-reviewed literature. 5 Publications have already been accepted in leading journals and another 12 are expected to be published/submitted this fiscal year.
List the Key Indicators Measured. *	Gas pollutants: total hydrocarbon (THC), interdimate volitility compounds (IVOCs), volatile organic compounds (VOCs), organic acids, CO_2, CH_4, NO, NO_2, total oxidized nitrogen compounds (NO_y), SO_2, O_3, HCHO, CO, NH_3 and Hg. Particulates: aerosol optical depth (AOD), particle inorganic composition, particle organic composition, detailed particle chemical speciation, black carbon, particle optical properties, particle number size distributions, total particle number. Meteorology: wind direction, wind speeds, T, P, RH, altitudes, longitudes and latitudes.
Describe Sample Handling Procedures, If Not Applicable, State N/A. *	Sample handling procedures are provided in standard operating procedure documents are currently available internally at ECCC and externally by request. All documents are planned to be posted to public data portal with all measurement data after QA and QC procedures are complete.
List SOPs that Will Be Used, If Not Applicable, State N/A.*	SOPs for aircraft measurement activities from both aircraft study measurement phases developed by April 2018. They are currently available internally at ECCC and externally by request. All documents are planned to be posted to public data portal with all measurement data after QA and QC procedures are complete. Further Standards and Protocols are available on the EMSD website: http://environmentalmonitoring.alberta.ca/resources/standards-and-protocols/

Describe the QA/QC Plan, If Not Applicable, State N/A. *	1) Project quality assurance plan will be prepared for each measurement to be conducted in the project. This will consist of two stages. The first stage will be prior to the actual start of the measurements to document the preparation of the measurements, and the second stage will be after the completion of the measurements to document the actual measurements. 2) Data quality control will consist of two steps. First, detailed field quality control logs will be collected while the measurements are conducted. Second, post study quality control logs will be made. The quality control logs will be kept to document how the data were collected, calibrations made, unusual observations that may affect the collection and data interpretation, unusual environmental conditions for the observations, etc. 3) Standard operating procedures for each instrument and lab analysis will be documented and be part of data submission. 4) Each data point will be flagged appropriately through a series of quality control checks and per quality control logs. Final quality assured and quality controlled data will be formatted as per the Oil Sands Monitoring program requirements using the NATChem data exchange format. Metadata will be part of the data file also as per the data format requirement. 5) Final data will be submitted to the appropriate data portal (primarily the Oil Sands Monitoring Data Portal).
Describe How Indigenous Communities are Involved in the Project Design, Data Collection, and Analysis (Knowledge Co-creation) and How is their Consent Sought. If Not Applicable, State N/A.*	N/A
Components Delivered by Others	
List by Project or Project Phase Each Component That Will Be Delivered by An External Party (including analytical laboratories) and Name the Party. State None if Not Required. *	National Research Council-Institute of Aerospace Research: Provide the NRC Flight Research Laboratory Convair-580 aircraft as the measurement platform
Will These Components be Delivered Under Grant or Contract or Both? Please Describe and Name the Associate Work Plan/Grant/Contract for These Services if Not Included Within This Work Plan. *	A memoradum of agreement (MOA) between ECCC and National Research Council was signed with regard to the use of the Convair-580 research aircraft for the oil sands aircraft measurement program. OSM funding was transferred to NRC as per the MOA to allow the use of the aircraft for the measurement project, and to allow collaborative data analysis and joint publications of results from the measurement program.
Monitoring Site Locations and Coordinates (for all sites, please add them to the Monitoring Site Location tab - a separate excel sheet)	
Attach Map of Locations. Distinguish Indicators by Station if Necessary. Distinguish Sampling Frequency by Station if Necessary.	An interactive map of all sampling locations is available on the ECCC OSM portal at: http://environmental-maps.canada.ca/osm/App/index?GOCTemplateCulture=en-CA
Project Schedule	
FOR OIL SANDS MONITORING PROJECTS ONLY: A coordinated field monitoring schedule for the OSM Program is required. Please complete the attached document named "OSM Program Field Monitoring Schedule" in addition to this work plan. Fill as much as you can recognizing that scheduling changes will occur and the scheduling document will be updated regularly. Please note the scheduling document will be shared with stakeholders.	See Attached
FOR OIL SANDS MONITORING PROJECTS ONLY: Have You Coordinated With Other Project Leads On Field Logistics? If So, Please Specify. *	N/A
Other	

Additional Details.	There are linkages of this project to multiple focused studies being proposed: **First,** there is a direct linkage to the A-MD-2-1718 – Deposition and Effects project. One of the objectives of this proposal is to obtain dry deposition fluxes of criteria air contaminants, in particular acidifying substances (SO2+SO4=), NOX, and organic acids), over large downwind region of the oil sands facilities, directly determined from aircraft measurements using a mass balance approach. Such results will provide comparison with dry deposition determined using inferential models study proposed in the Deposition and Effects project but the aircraft measurement will expand the geographic coverage for dry deposition determination. Airborne Hg measurements are also linked to the Deposition and Effects project, because the latter includes surface measurements of Mercury. **The second** linkage is to the A-MD-5-1718 Enhanced Ground-based Monitoring project to which this project will likely produce source information for the observations made at the Oski-otin site, with consideration of appropriate meteorological conditions. **The third** linkage is to the R-1-1718 Air Evaluation, Integration, Synthesis and Reporting. Airborne studies, modelling studies, and satellite data studies from this project and from the first aircraft focused study in 2013 will provide results on the emissions, transformation, and fates of many criteria air contaminants from the oil sands facilities. These results will be synthesized in a chapter dedicated to the topic of aircraft measurements. Contributions to other chapters in the Synthesis Reports, such as deposition, are envisioned. **The fourth** linkage is to provide modelling analysis of pollutants. The numerical model output will be in support of all air component focused studies and the Synthesis Report. **The fifth** linkage is to A-MD-7-1718 Develop Methods to Measure Tailings Ponds Emissions. This study is investigating the chemical characteristics of pollutants emanating from tailings ponds, quantifying the emission rates using micrometeorological methods, evaluating operational flux chamber methods against the micrometeorological methods, and evaluating the feasibility of various methods for compliance monitoring, and quantify pond-to-pond and seasonal variability of emission rates. The resulting emissions estimates will be compared to GEM-MACH model predictions, with the model being used to determine the emission levels required to reproduce the observed concentrations. The emission results will be incorporated into the emissions data of Component 1.3 of this project. **The sixth** linkage is to the AEP-NOAA aircraft program (Alberta Airborne Methane Emission Measurements) to determine CH4 emissions from oil sands facilities. The AEP-NOAA program started aircraft measurement in September 2017. New measurement campaigns are planned in 2018, with the first deployment planned in April 2018. Coordinated project field campaigns between the present study and the AEP-NOAA program will lead to synergies in terms of spatial coverage, enhanced data coverage, and opportunities to make extended measurement data records for comparison. Gaps in facility coverage and pollution compounds can be addressed with flights of two aircraft. The AEP-NOAA flights can benefit from ECCC's aircraft program by using on ECCC's weather and air quality forecasts.
Will Capacity Building and Training be a Component of the Project and If So, Explain How. If Not, State N/A.*	N/A
Environmental Impact and Considerations.	N/A

Data Management and Digital Assets		
Will Data be Produced as a Result Of This Project? *	Type of Quantitative Data Variables	Frequency Of Collection
Yes	Discrete	Other

Data Collection Period: Start Date - End Date	Timeline For Upload Period: Start Date - End Date
01/06/2018- 06/07/2019	12/31/2019

Is There a Data Sharing Agreement? (Yes or No).	No
Will the Data Include Traditional Knowledge as Defined by and Provided by an Indigenous Representative, Community or Organization (Yes / No).	No
Platform/Location of Data Storage.	Final data will be submitted to the appropriate data portal (primarily the Oil Sands Monitoring Data Portal).

Project Deliverables		
Proposed 2018-19 Deliverable Type (for each deliverable outline document, presentation, meeting, etc.)		
☑ **Peer-reviewed Journal Publication**	☐ **Peer-reviewed Conference Proceeding**	☑ **Non-peer reviewed Conference Proceeding/Technical Reports**
Q1 - Deliverable, Comments	Q1 - Deliverable, Comments	Q1 - Deliverable, Comments
12 publications expected to be published in peer-review journals in 2018		**Internal preliminary reports to ECCC and AEP partners on the laboratory study on the transformation of primary oil sands pollutants.**
Q2 - Deliverable, Comments	Q2 - Deliverable, Comments	Q2 - Deliverable, Comments
Q3 - Deliverable, Comments	Q3 - Deliverable, Comments	Q3 - Deliverable, Comments

Q4 - Deliverable, Comments	Q4 - Deliverable, Comments	Q4 - Deliverable, Comments
☐ **Conference Presentation(s)**	☐ **Stakeholder Presentation**	☐ **Key Engagement/Participation Meeting ***
Q1 - Deliverable, Comments	Q1 - Deliverable, Comments	Q1 - Deliverable, Comments
Choose one	Choose one	Name of Meeting, Year, Location, Dates, Participant Groups and Number of Participants.
Q2 - Deliverable, Comments	Q2 - Deliverable, Comments	Q2 - Deliverable, Comments
Choose one	Choose one	Name of Meeting, Year, Location, Dates, Participant Groups and Number of Participants.
Q3 - Deliverable, Comments	Q3 - Deliverable, Comments	Q3 - Deliverable, Comments
Choose one	Choose one	Name of Meeting, Year, Location, Dates, Participant Groups and Number of Participants.
Q4 - Deliverable, Comments	Q4 - Deliverable, Comments	Q4 - Deliverable, Comments
Choose one	Choose one	Name of Meeting, Year, Location, Dates, Participant Groups and Number of Participants.
Proposed Deliverables After 2018/2019 for the project funds received in 2018/2019		
☑ **Peer-reviewed Journal Publication**	☐ **Peer-reviewed Conference Proceeding**	☐ **Non-peer reviewed Conference Proceeding**
Q1 - Deliverable, Comments	Q1 - Deliverable, Comments	Q1 - Deliverable, Comments
4 publications to be submitted after 2018		
Q2 - Deliverable, Comments	Q2 - Deliverable, Comments	Q2 - Deliverable, Comments
Q3 - Deliverable, Comments	Q3 - Deliverable, Comments	Q3 - Deliverable, Comments
Q4 - Deliverable, Comments	Q4 - Deliverable, Comments	Q4 - Deliverable, Comments
☐ **Conference Presentation(s)**	☐ **Stakeholder Presentation**	☐ **Key Engagement/Participation Meeting ***
Q1 - Deliverable, Comments	Q1 - Deliverable, Comments	Q1 - Deliverable, Comments
Choose one	Choose one	Name of Meeting, Year, Location, Dates, Participant Groups and Number of Participants.

Q2 - Deliverable, Comments	Q2 - Deliverable, Comments	Q2 - Deliverable, Comments
Choose one	Choose one	Name of Meeting, Year, Location, Dates, Participant Groups and Number of Participants.
Q3 - Deliverable, Comments	Q3 - Deliverable, Comments	Q3 - Deliverable, Comments
Choose one	Choose one	Name of Meeting, Year, Location, Dates, Participant Groups and Number of Participants.
Q4 - Deliverable, Comments	Q4 - Deliverable, Comments	Q4 - Deliverable, Comments
Choose one	Choose one	Name of Meeting, Year, Location, Dates, Participant Groups and Number of Participants.

All Completed Products

if a multi-year project, specify all completed products to date (consistent format for the fields below). Add rows as required.

Journal Paper

Required Format: Author (follow APA citation format), Year, Title, Journal, Volume, Page Numbers, Open or Closed and Document Location

Example: Jacoby, W. G. (1994). Public Attitudes Toward Government Spending. American Journal of Political Science, 38(2), 336-361

Fearon, J. D., & Laitin, D. D. (2003). Ethnicity, Insurgency, and Civil War. American Political Science Review, 97(01), 75. doi: 10.1017/S0003055403000534

1) Shao-Meng Li, Amy Leithead, Samar G. Moussa, John Liggio, Michael D. Moran, Daniel Wang, Katherine Hayden, Andrea Darlington, Mark Gordon, Ralf Staebler, Paul A. Makar, Craig A. Stroud, Robert McLaren, Peter S. K. Liu, Jason O'Brien, Richard L. Mittermeier, Junhua Zhang, George Marson, Stewart G. Cober, Mengistu Wolde, and Jeremy J. B. Wentzell. (2017). *Proceedings of the National Academy of Sciences of USA (PNAS)* . DOI: 10.1073/pnas.1617862114

2) John Liggio, Samar Moussa, Jeremy Wentzell, Andrea Darlington, Peter Liu, Amy Leithead, Katherine Hayden, Jason O'Brien, Richard L. Mittermeier, Ralf Staebler, Mengistu Wolde and Shao-Meng Li. (2017). *Atmos. Chem & Phys.* DOI:10.5194/acp-17-8411-2017

3) John Liggio, Craig Stroud, Jeremy J.B. Wentzell, Junhua Zhang, Jacob Sommers, Andrea Darlington, Peter Liu, Samar G. Moussa, Amy Leithead, Katherine Hayden, Richard L. Mittermeier, Ralf Staebler, Mengistu Wolde and Shao-Meng Li. (2017)*Environ. Sci. & Technol.* DOI: 10.1021/acs.est.7b04346

4) Christopher E. Sioris, Ihab Abboud, Vitali E. Fioletov, Chris A. McLinden. (2017)*Atmos. Env.* DOI: 10.1016/j.atmosenv.2017.08.044

5) S. K. Kharol, M. W. Shephard, C. A. McLinden, L. Zhang, C. E. Sioris, J. M. 4 O'Brien, R. Vet, K. E. Cady-Pereira, J. Siemons, and N. A. Krotkov. (2017) *Geophys. Res. Lett.* DOI: 10.1002/2017GL075832

Technical Report

Required Format: Author, Year, Title, Publisher Location, Name of Publisher, Publisher, Document Location

Example: Author, F.M. (Publication Year). Title of Report (Report No. XXX). Publisher City, State: Publisher

1)

2)

3)

4)

5)

Book Chapter

Required Format: Author, Year, Title of Paper, Editors, Title of Book, Page Numbers, Location of Publisher, Name of Publisher, Document Location

Example: Hemingway, E. (1999). The Killers. In J. Updike & K. Kenison (Eds.), The Best American Short Stories of the Century (pp.78-80). Boston, MA: Houghton Mifflin)

1)

2)

3)

4)

5)

Conference Proceeding

Required Format: Author, Year, Title of Paper, Editors, Title of Proceedings, Name of Conference Location of Conference, Publisher Location, Name of

Example: Author of Paper, A., & Author of Paper, B. (Year, Month date). Title of Paper. In A. Editor, B. Editor, & C. Editor. Title of Published Proceedings. Paper Presented at Title of Conference: Subtitle of Conference, Location (inclusive page numbers). Place of Publication: Publisher.)

1)

2)

3)

4)

5)
Public Dissemination Document
Required Format: Author, Year, Title, Journal / Report, Volume, Publisher, Page Number, Number of Pages, Document Location
1)
2)
3)
4)
5)
AEP ONLY: EMSD Strategic and Operational Publication
Required Format: Author, Year, Title, Publisher Location, Name of Publisher, Publisher, Document Location
1)
2)
3)
4)
5)
Other Documents
Detailed Information of Other Documents
1)
2)
3)
4)
5)
Conference Presentation
Required Format: Presenter, Date, Location, Title, Platform or Poster, Conference Name
1) Li S.-M, Nov 21 2017, Carleton University Ottawa, *Methane emissions from oil sands surface mining facilities and the Canadian Bakken shale oil fields* , Platform Presentation at the Methane Symposium
2) Li S.-M, Oct 18 2017, Beijing China, *How fast and how much can secondary organic aerosols be formed in the atmosphere? A case study of the process downwind of the oil sands region in Canada* , Platform Presentation at China Meteorological Administration
3) Li, S.-M, September 28 2017, University of Toronto Toronto, *Determining VOC emissions from oil sands facilities in Canada using aircraft measurements* , Platform Presentation at the Canada-China Forum on Smog and Haze
4) Liggio J, December 2017, New Orleans Louisiana, *Top-down estimates of greenhouse gas intensities and emissions for oil sands facilities in Alberta Canada* , Platform Presentation at the American Geophysical Union Fall Meeting
5) Sommers J, October 2017, Raleigh North Carolina, *Evaluating models of secondary organic aerosols produced from the Athabasca oil sands* , Platform Presentation at the American Association for Aerosol Research
6) Li S.-M. and Liggio J, September 2017, ECCC Ottawa, *Using novel methodologies to quantify air pollutant and greenhouse gas emissions* , Platform Presentation at the Science Café ECCC.
7) Stroud C, June 2017, University of Helsinki Finland, *Effect of inorganic particle acidity on SOA frowth from the photooxidation of a-pinene, results applied to Canada's Athabasca oil sands region* , Platform Presentation at the International Conference on Nucleation and Atmospheric Aerosols
8) Fathi S, June 2017, Toronto Ontario, *Investigating aircraft-based emissions estimates using GEM-MACH with the Top-down Emission Rate Retrieval Algorithm (TERRA)* , Platform Presentation at the CMOS Congress
9) Makar P, April 2017, Vienna Austria, *Acid deposition simulations for Alberta, Saskatchewan, and the Canadian oil sands using the Global Environmental Multiscale-Modelling Air-quality and Chemistry (GEM-MACH) system* , Platform Presentation at the EGU Assembly
10) Gordon M, June 2017, Toronto, Ontario, *A comparison of plume rise algorithms to stack plume measurements in the Athabasca oil sands* , Platform Presentation at the CMOS Congress
Stakeholder Presentation
Required Format: Presenter, Date, Location, Title, Platform or Poster, Name of Meeting
1)
2)
3)
4)
5)
Key Engagement/Participation Meeting
Required Format: Meeting Host, Date, Location
1)
2)
3)
4)
5)

Human Resources / Staffing Plan (roles and responsibilities)

Name & Role	Organization	Responsibilities
Project Lead/Principal Investigator	ECCC	Principal Investigator and project coordination
Project Co-Lead	ECCC	Modeling and forecasting
Principal Investigator	AEP	Sharing of results with partners and Air CAC members
Principal Investigator	ECCC	Communication of results with other components of oil sands monitoring, partners and Air CAC members
Science specialist	ECCC	Airborne measurements of NH3

Science specialist	ECCC	Leading the lab studies, also fast oxygenated volatile organic compounds measurements
Airborne program coordinator/Science specialist	ECCC	Airborne program coordination and aerosol chemical measurements
Project IM/IT coordinator/Science specialist	ECCC	Information Management / Information Technology support
Science specialist	ECCC	Hg measurements
Atmospheric mercury specialist	ECCC	Hg measurements
Science specialist	ECCC	Acids measurements
Science specialist	ECCC	Satellite retrieval products
Science specialist	ECCC	VOC measurements, airborne
Science specialist	ECCC	Aerosol measurements, airborne
Science specialist	ECCC	NOX/SOX/O3 (ozone) measurements, airborne
Science specialist	ECCC	Airborne volatile organic compound/oxygenated volatile organic compound measurements
Science specialist	ECCC	Modeling and forecasting
Science specialist	ECCC	Modelling; emission inventories
Science specialist	ECCC	Modeling; Hg
Science specialist	ECCC	Modeling; cloud impact
Science specialist	ECCC	Modelling: simulation infrastructure and comparisons to observations
Science specialist	ECCC	NH3 bidirectional flux modelling and polyaromatic hydrocarbon modelling
Science specialist	ECCC	Mercury modelling
Science specialist	ECCC	Model forecast infrastructure, model forecasts
Science specialist	ECCC	Emission Inventory Synthesis
Science specialist	ECCC	GHG measurements
National Research Council-Institute of Aerospace Research	National Research Council	Manager of the Convair 580 Research Aircraft, coordinator of National Research Council Institute for Aerospace Research activities
Oil Sands Senior Support (air monitoring component)	ECCC	Provide coordination and liaison within ASTD, and with the Oil Sands Secretariat and OSM partners

AEP ONLY: Additional Human Resources Required from EMSD

Name & Role	Branch - Section	Estimated time (% of annual FTE)	Salary Estimate Range

Financial Details and Budget Request

Source of Funding Requested Year 1 - 2018/19

	AEP ONLY: EMSD	OSM	
Salaries and Benefits		1164558	
Operations and Maintenance		3290343	
Consumable materials and supplies			
Conferences and meetings travel			
Field work travel			
Project-related travel			
Engagement			
Reporting			
External Contracts - Organization/Vendor/Suppliers			
Overhead			
Grants			
Capital			Approved at:
Total budget request for the year	0	4454901	4,454,901
Total budget approved			

Source of Funding Requested Year 2 - 2019/20

	AEP ONLY: EMSD	OSM
Salaries and Benefits		
Operations and Maintenance		
Consumable materials and supplies		
Conferences and meetings travel		
Field work travel		
Project-related travel		
Engagement		
Reporting		
External Contracts - Organization/Vendor/Suppliers		
Overhead		
Grants		
Capital		
Total budget request for the year	0	0
Total budget approved		

Source of Funding Requested Year 3 - 2020/21

	AEP ONLY: EMSD	OSM
Salaries and Benefits		
Operations and Maintenance		
Consumable materials and supplies		
Conferences and meetings travel		
Field work travel		
Project-related travel		
Engagement		
Reporting		
External Contracts - Organization/Vendor/Suppliers		
Overhead		
Grants		
Capital		
Total budget request for the year	0	0
Total budget approved		

Source of Funding Requested Year 4 - 2021/22

	AEP ONLY: EMSD	OSM
Salaries and Benefits		
Operations and Maintenance		
Consumable materials and supplies		
Conferences and meetings travel		
Field work travel		
Project-related travel		
Engagement		
Reporting		
External Contracts - Organization/Vendor/Suppliers		
Overhead		
Grants		
Capital		
Total budget request for the year	0	0
Total budget approved		
Budget Request for the Entire Project	0	4,454,901

Project Approval(s)

Proposal Submitted by

Surname	Given Name	Organization
Cober	Stewart	ECCC
Signature	Date	

Proposal for OSM Reviewed by

EMSD Executive Director	Signature	Date
AEP Administrator/Coordinator - Review	Signature	Date
ECCC Administrator/Coordinator - Review	Signature	Date

OSM Project Approved by

AEP Co-Lead for OSM	Signature	Date
ECCC Co-Lead for OSM	Signature	Date

AEP ONLY: Proposal for EMSD Reviewed by

EMSD Director	Signature	Date

AEP ONLY: EMSD Project Approved by

EMSD Executive Director	Signature	Date
EMSD Chief Scientist	Signature	Date

OSM / EMSD Project Has Not Been Approved

Project Status	Date Notified	Date Required
The project is conditionally approved. The following conditions are required before approval is granted.		
List the Condition(s)		
Condition(s) Addressed / Approval Granted		
Choose one		

OSM / EMSD Approval Post Removal of Condition(s)

Name & Title	Signature	Date