Oil Sands Monitoring Program

Annual Report for 2017-2018

Alberta Government

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Table of Contents

Preface 1
Message from Science Co-Leads 2
Executive Summary 3
1. The Oil Sands Monitoring Program 7
1.1 Oil Sands Monitoring Program Objectives 9
1.2 Governance of the Oil Sands Monitoring Program 10
1.3 Ambient Environmental Monitoring Planning 10
1.4 Adaptive Management 11
1.5 Transparent and Accessible Results 13
2. Indigenous and Stakeholder Participation 15
2.1 Indigenous Engagement – Program Governance 15
2.2 Industry Engagement 16
2.3 Multi-Stakeholder Forums 16
OSM Program 17
3. Program Highlights 17
3.1 The 2017-18 Work Plan 17
3.2 Highlights of Monitoring Results 19
Water 19
Sediment and Deposition 19
Water Quality 19
Water Quantity 20
Groundwater 21
Fish 22
Benthic Invertebrates 22
Biodiversity and Wildlife Health Monitoring 23
Atmospheric Monitoring 24
Predictive Assessments 27
Community Based Monitoring 27
3.3 Program Challenges 27
AEMERA to Government of Alberta Transition 27
Project Level Issues 28
4. Financials 28
5. Summary and Next Steps 30
6. Appendices 31
7. Acronyms 32
8. Technical Annex 37
9. OSM Publications in 2017-18 59

Table of Figures

Figure 1: Map of Current Oil Sands Monitoring Sites 8
Figure 2: 2017-18 Breakdown of Approved OSM Work plans by Theme Area 18

Preface

This report for the Oil Sands Monitoring (OSM) Program was prepared by Alberta Environment and Parks (AEP) and Environment and Climate Change Canada (ECCC). It presents highlights of program accomplishments as well as a technical annex summarising monitoring activities implemented from April 1, 2017 to March 31, 2018.

The OSM Program undertakes ambient environmental monitoring within the oil sands area to enhance understanding of the cumulative effects of oil sands development. The program Co-Chairs are responsible for managing and reporting on the OSM Program, and ensuring the reporting of monitoring results are accurate, balanced, and consistent with the purpose for which data is being collected.

The OSM Program is jointly managed by AEP on behalf of the Government of Alberta and ECCC on behalf of the Government of Canada. Decisions on the 2017-18 Annual Report's content were deliberated and agreed upon by representatives from ECCC and AEP on August 13, 2018 as recommended by the Office of the Auditor General of Alberta.

The final content of the report was reviewed and approved by the Chief Scientist and Assistant Deputy Minister, AEP and the Assistant Deputy Minister, Science and Technology Branch, ECCC.

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Message from Science Co-Leads

It is an honour for us to work as Science Co-Leads for the OSM Program. On behalf of the governments of Canada and Alberta, we are pleased to present the OSM Program Annual Report for 2017-18. In this report we present a summary of our performance in 2017-18 and significant actions taken to implement the program. We are also attentive to the feedback received from the Office of the Auditor General of Alberta on the format of this report as well as feedback from our stakeholders on the OSM Program.

The OSM Program's mandate is to implement an ambient environmental monitoring program for the oil sands that integrates air, water, land and biodiversity. The program strives to improve characterization of the state of the environment and enhance understanding of the cumulative effects of oil sands development in the oil sands area. Scientific and knowledge excellence from western science and Indigenous ways of knowing are fundamental to establishing a credible program and to assessing any impacts of oil sands activities on the environment. This mandate is fundamental to industry competitiveness, accountability, assurance of policy and regulatory protection as well as ensuring the environment in the oil sands region is sustained and protected for Albertans now and into the future.

We are pleased to have worked with Indigenous communities towards the development of the new Operational Framework Agreement and future governance structure following the signing of a renewed Memorandum of Understanding (MOU) between the governments of Alberta and Canada in December 2017. We believe the active participation of Indigenous peoples is vital for relevant and credible oil sands monitoring, and look forward to the continued enhancement of our relationship with Indigenous peoples, industry and other stakeholders in the oil sands region.

OSM projects this year focused on atmospheric, watershed, physical disturbance, wetland ecosystem, biotic response, and community based monitoring programs as well as data management. As we move into the 2018-19 year, the OSM Program remains committed to implementing a robust, and scientifically credible environmental monitoring program with increased focus on integration, reporting and timely access to monitoring data and results.

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Executive Summary

Since February 2012, the governments of Canada and Alberta have worked as partners to implement and jointly manage the Oil Sands Environmental Monitoring (OSM) Program. The program strives to improve characterization of the condition of the environment, and enhance understanding of the cumulative effects related to oil sands development in the oil sands area of Alberta. Building on existing monitoring, where possible, the approach to program implementation is adaptive to ensure the program is responsive to existing knowledge, emerging priorities, and input from Indigenous peoples and key stakeholders.

Canada and Alberta have made progress in strengthening program delivery, and in providing leadership to ensure that necessary monitoring and supporting scientific activities are conducted to meet program commitments and objectives. The annual program budget of $50 million is provided by industry through the Oil Sands Environmental Monitoring Program Regulation (2013) and allocated for the delivery of approved monitoring activities through the governance of the Oil Sands Monitoring Program.

In December 2017, a Memorandum of Understanding (MOU) between Canada and Alberta was signed. The MOU renewed the mutual intentions of both governments to continue to collaborate and be accountable for the design and implementation of an integrated monitoring, evaluation, and reporting system for the oil sands region. It outlined the need for development of a comprehensive Operational Framework Agreement with Indigenous communities in the oil sands region to govern the program now and in future years. The MOU also acknowledged that Treaty and Aboriginal rights of Indigenous peoples is recognized and affirmed under section 35 of the *Constitution Act, 1982* and included the commitment to establish, in cooperation with Indigenous communities in the oil sands region, effective mechanisms for Indigenous participation in the design, implementation, and governance of the program. The Operational Framework Agreement is completed and at the signature stage at the time of writing this annual report.

For 2017-18, science and technical review meetings were held to review work plans. Seventy-two (72) projects were approved for 2017-18. For monitoring and science related activities, at year-end, deliverables were fully met for 39 projects, partially met for 20 projects, and not met for six (6) projects. Further, at year-end, there were four (4) projects deferred or on hold, and three (3) ongoing program administration projects under the program office; these ongoing projects include Indigenous participation, secretariat support and capital purchase.

A sum of $52,000,000 was available in funding for 2017-18. $2,900,000 out of the available $52,000,000 was dedicated for capital expenditures leaving a total of $49,100,000 for project implementation. A total amount of $47,093,947 of the available $49,100,000 (O&M) was spent on project implementation in 2017-18, leaving an unspent balance of $2,006,053.

Products generated through the OSM Program between 2012 and 2018 cumulatively total over 569 including peer-reviewed papers, technical reports, program reports, presentations and workshop material.

Highlights of Monitoring Results to Date

Water

- The water program has identified that while there is exposure to environmental stressors associated with oil sands development, biological responses in the aquatic environment do not indicate population or community level changes.
- There are indications of a changing regional hydro-climatic regime, which should be considered in future adaptive monitoring design and risk assessment.
- In the Athabasca River, changes in environmental condition relative to nutrient and contaminant sources will require ongoing monitoring, including questions related to assessing the confounding effects and risks associated with municipal sewage release and potential seepage from tailings ponds.
- Tributaries, especially the Steepbank and Ells Rivers, need ongoing monitoring of changes in environmental condition over the gradient of exposure.
- Environmental effects-based and chemical water quality changes due to oil sands activities versus natural bitumen deposits cannot be discriminated at this point of time.
- The Peace Athabasca Delta shows some changes in water quality but no associated changes in benthic invertebrate community structure, although attribution for these observed changes requires further focused assessment.
- Some changes in water quality exceeded water quality guidelines in the Athabasca River including more frequently for aluminum, copper, iron and lead. Exceedances in the Peace-Athabasca Delta closely mirror exceedances in the Athabasca with aluminum, copper, lead, and cobalt most frequent. Cobalt was also detected in monitoring under Lower Athabasca Regional Plan.
- Exceedances in water quality guidelines were also reported in the tributaries of the oil sands region including the Ells, Steepbank, Muskeg, MacKay and Firebag Rivers. Exceedances occurred more frequently for aluminum, copper and iron. Selenium, arsenic and vanadium increased downstream in some of these rivers.
- Results have been shared with a series of stakeholders and decision-makers including the Alberta Energy Regulator and the Policy and Planning Division of AEP.

Biodiversity and Wildlife Heath

- The biodiversity and wildlife health program has publicly released field data; updated maps of land cover and human footprint; revised standard operating procedures and provided lists of species of concern to inform decision-making.
- Monitoring of juvenile whooping cranes that were captured in and around Wood Buffalo National Park, with satellite transmitters, allowed near real-time location data to be shared with operators to alert them to whooping crane activity within their leases.
- Monitoring of the relationships between linear disturbances (roads, seismic lines, and pipelines) and duck settling and breeding success, suggest that most duck guilds are

resilient to linear feature development, at least within the range of linear disturbance densities currently on the landscape. These findings can be used to improve both future monitoring and assessment.

- Potential oil sands-related contaminants of concern continue to be measured in selected sentinel wildlife species along with samples of their habitat (e.g. water, sediment, air, plants) for further assessment.

Atmospheric Monitoring

- Air quality is monitored by regional airshed organizations in the Athabasca (Wood Buffalo Environmental Association), Cold Lake (Lakeland Industry and Community Association) and Peace River (Peace River Area Monitoring Program) oil sands regions.
- The long-term air monitoring network is important for:
    - Providing real-time air quality information to the public through the Air Quality Health Index;
    - Assessing air quality against regulatory benchmarks, regional triggers and limits from the Lower Athabasca Regional Plan, and national standards (Canadian Ambient Air Quality Standards); and
    - Determining trends in air quality.
- In 2017-18, concentrations of nitrogen dioxide (NO_2) were lower than the limit defined by the Lower Athabasca Regional Plan (LARP) at all monitoring stations in the Athabasca and Cold Lake oil sands region.
- There were exceedances of Alberta Ambient Air Quality Objectives/Guidelines recorded for hydrogen sulphide (H_2S), fine-particulate matter ($PM_{2.5}$) and ozone. $PM_{2.5}$ exceedances measured at monitoring stations in the Athabasca and Cold Lake airsheds resulted primarily from wildfire smoke. H_2S exceedances that occurred at monitoring stations located close to industrial operations, north of Fort McMurray, were likely caused by adjacent industrial facilities.
- Sulphur dioxide (SO_2) levels higher than a Lower Athabasca Regional Plan trigger were measured at one monitoring station (Lower Camp monitoring station) and is being evaluated.
- The Waskow Ohci Pimatisiwin (Cree for “Air of Life”) emergency response air quality monitoring station was put into operation in Fort McKay in July 2017. This was a significant accomplishment for the OSM Program and demonstrated a direct response of OSM and its partners to concerns of Indigenous communities in the region.
- Provincial scientists in collaboration with the National Oceanic and Atmospheric Administration (NOAA) initiated an aircraft-based greenhouse gas (GHG) emission quantification program to monitor emissions of GHGs from mining and *in-situ* industrial facilities in the Athabasca, Cold Lake, and Peace River oil sands regions.
- An Air Synthesis Review, summarizing the current state of knowledge and publications related to PACs in the oil sands region, was published
- Quantification of PAC deposition and estimations of critical load exceedances of acid deposition in Alberta and Saskatchewan were conducted to examine the potential trans-boundary nature of the impacts of oil sands development.
- The contribution of emissions from tailings ponds to total fugitive emissions to the

atmosphere in the region has not been characterized and quantified.

Predictive Assessments

- Climate and hydrological models were developed for the entire Athabasca River basin to provide projections of flows to the lower Athabasca River and Athabasca River Delta. Application of the models in the future includes assessment of hydrological impacts under changing regional hydro-climatology and development activities. This work will also support on-going hydrological impacts assessments in the region including in Wood Buffalo National Park.

Community-Based Monitoring

- Monitoring led by Indigenous communities in the oil sands region continues. Building on the Fort McKay Berry Project, three new projects focused on expanding the berry project and investigating fish and wetland plant health were initiated. Efforts will continue in future years to build relationships with Indigenous communities, provide training, and work with Elders and Indigenous knowledge holders to obtain a more comprehensive and greater understanding of the issues impacting Indigenous peoples.

Canada and Alberta recognize that monitoring in the oil sands region is a responsibility that has multi-generational implications. Both governments remain committed to working with all partners to implement a robust, scientifically credible environmental monitoring program for the oil sands.

1. The Oil Sands Monitoring Program

The governments of Canada and Alberta recognize the oil sands are a strategic natural resource and a key driver of economic growth. The development of this resource requires greater understanding of associated cumulative environmental impacts to help guide its responsible and effective management.

Environmental monitoring under the Joint Canada-Alberta Oil Sands Monitoring (JOSM) program was a response to stakeholder concerns regarding the environmental impacts of oil sands development in the region. In December 2010, a Federal Oil Sands Advisory Panel presented a report to the federal Environment Minister that reviewed current monitoring activities in the lower Athabasca River system, identified key shortcomings, and provided recommendations on what would constitute a world-class monitoring program for the oil sands region. In response, Environment Canada coordinated federal, provincial, territorial and independent scientists to develop a world class environmental monitoring Plan for the oil sands. The monitoring Plan is a series of technical documents that present what should be monitored, where, when and how (Appendix A). The 2012 Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring (Appendix B) describes how the Governments of Alberta and Canada put in place a monitoring program for the oil sands to provide assurance of environmentally responsible development of the resource.

JOSM operated from 2012-2015 and was replaced by OSM in 2015, although the program continued to be jointly managed between the Governments of Alberta and Canada. From 2012-2014, JOSM was managed by Environment and Sustainable Resource Development (ESRD) Department on behalf of the Government of Alberta and by Environment Canada on behalf of the Government of Canada.

In April 2014, the responsibility for Alberta's contribution to JOSM moved from ESRD to the Alberta Monitoring Evaluation and Reporting Agency (AEMERA). However, with the dissolution of AEMERA in April 2016, this responsibility was subsequently transferred from AEMERA to the newly formed Environmental Monitoring Science Division (EMSD) within AEP in July 2016. The OSM Program lead remains currently with EMSD and is co-managed with Environment and Climate Change Canada.

The OSM Program strives to monitor, evaluate, and report on the environmental impacts of oil sands development in northern Alberta, assess the risks of any impacts, and improve the characterization of the state of the environment in an open and transparent manner. The current extent of the monitoring program is illustrated in Figure 1. The program is led by two OSM Program Co-Chairs (AEP and ECCC), two Science Co-Leads (AEP and ECCC) and a governance structure supported by a Program Secretariat.

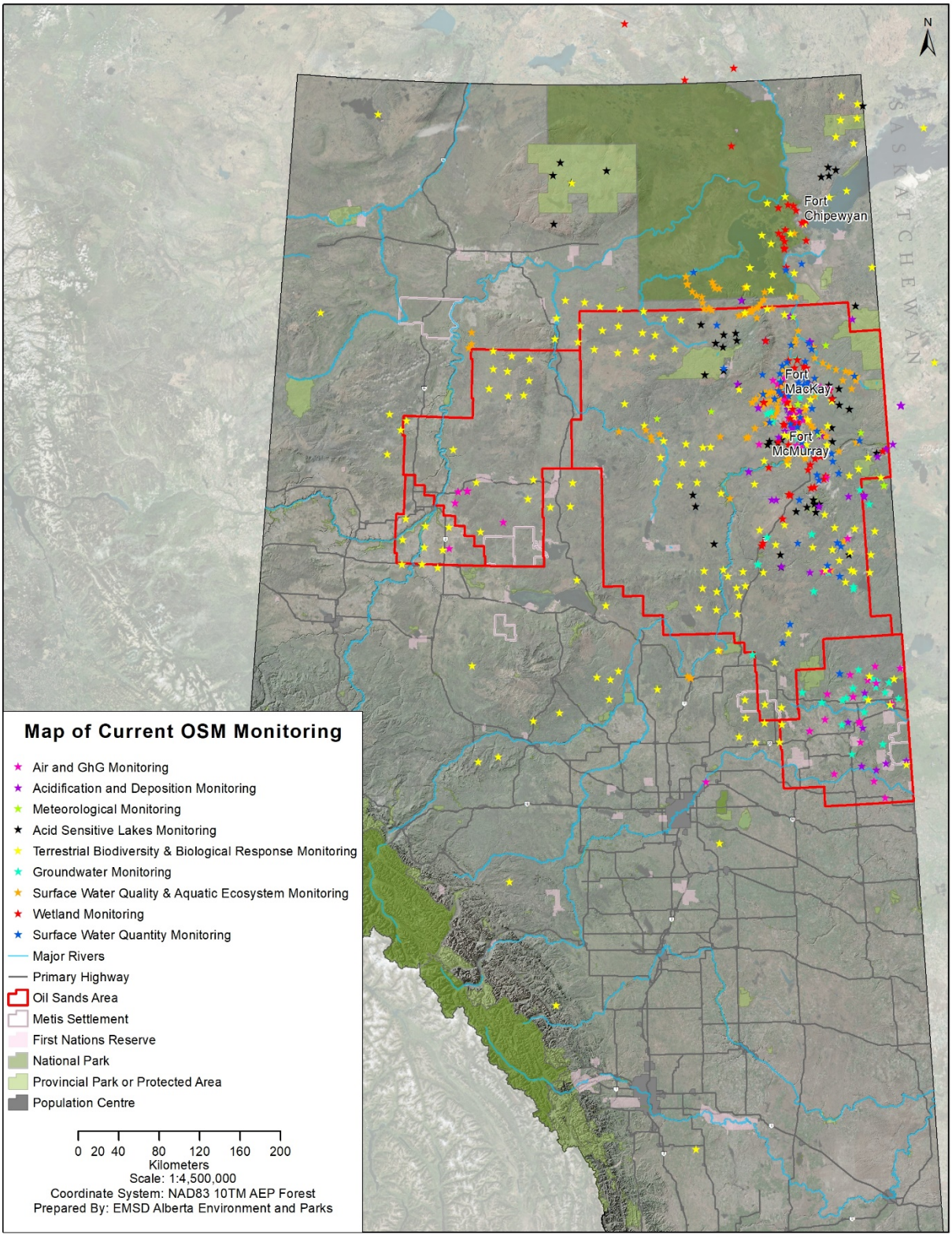

Figure 1: Map of Current Oil Sands Monitoring Sites

1.1 Oil Sands Monitoring Program Objectives

The objectives of the JOSM Program were outlined in the 2011 Integrated Oil Sands Environment Monitoring Plan (Appendix A) and the 2012 Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring (Appendix B). Together, these foundational documents guided the development and path forward for the JOSM Program and remain key aspects of the OSM Program.

The commitments made under the two foundational documents of the JOSM Program were renewed with the signing of a Memorandum of Understanding (MOU), by the respective Ministers representing the governments of Canada and Alberta, in December 2017. The objectives outlined in the MOU present a path forward consistent with those of the previous JOSM Program.

The current objectives of the OSM Program, listed in the MOU (Appendix C), are to:

- obtain data on baseline conditions, identify and track the environmental impacts from oil sands development, including timely assessment of cumulative environmental effects, that remain after application of existing legislative and regulatory controls and including the identification and tracking of monitoring indicators of relevance to Indigenous communities;
- ensure monitoring is and remains comprehensive, by seeking and integrating a multiple evidence based approach, inclusive to Indigenous knowledge, to inform monitoring program decisions;
- ensure monitoring is and remains relevant by seeking information on environmental impacts of oil sands development from relevant Indigenous communities, stakeholders, established advisory panels, and appropriate scientific experts, regardless of their affiliations to the Parties;
- implement scientifically rigorous, comprehensive, integrated and transparent environmental monitoring of oil sands development that meets the highest standards of scientific integrity;
- make use of the best cost-effective technical resources available for environmental monitoring of the impacts of oil sands development;
- be of sufficient scope to consider the trans-boundary nature of the issue and, where appropriate, to collaborate with other territorial and provincial governments;
- ensure quality monitoring data and information exists as a tool to inform provincial and federal decision-making and policy development pertaining to individual and cumulative effects; and
- ensure transparency and timely public reporting through accessible, comparable and quality-assured data and information, reports, and publications evaluating, interpreting and synthesizing the monitoring results of the system.

1.2 Governance of the Oil Sands Monitoring Program

The MOU signed by both governments in December 2017, renewed the mutual intentions of both governments to share accountability and collaborate on the design and implementation of an integrated monitoring, evaluation, and reporting system. It also confirmed the joint commitment to revise and establish effective mechanisms for Indigenous participation in the design, implementation, and governance of the monitoring system in cooperation with Indigenous communities in the oil sands region.

An Operational Framework Agreement (OFA) that supports the MOU is being developed in collaboration with 17 Indigenous communities in the oil sands region and is at the final review and signature stage at the time this annual report was written. During the 2017-18 program year, several key and foundation meetings with Indigenous communities, industry and governments occurred and continued into the 2018-19 program year. The OFA defines the governance and implementation model that will guide the decision-making structure and processes, roles and responsibilities, monitoring mandate, and detailed objectives of the OSM Program going forward. The OFA is a living document that accommodates any future revisions that may be required to ensure the OSM Program's desired objectives are met. A corresponding Letter of Agreement (LOA) is also being developed to complement the OFA and serve as the means for the governments of Canada and Alberta and Indigenous communities in the oil sands region to endorse the Operational Framework Agreement. All Indigenous communities are free to sign and remove their names from the Letter of Agreement as their situation or relationship with the OSM Program changes.

In future years, the responsibility for implementing the actions outlined under the Operational Framework Agreement will be supported by a dedicated OSM Program Office and Secretariat.

1.3 Ambient Environmental Monitoring Planning

Integration of the monitoring arrangements of various independent organizations, into a single program under the joint management of the two governments are continuing. The decision to return the core function of environmental monitoring, and consequently the OSM program, to government in Alberta meant that the implementation of the new model for the planning and implementation of oil sands monitoring (presented at the February 2016 multi-stakeholder forum) did not proceed as intended. Consequently, for 2017-18 work planning meetings with multi-stakeholder groups and technical discussions were held to review and recommend projects to the OSM program Co-Chairs for approval. To ensure ambient monitoring activities planned for delivery in

2017-18 supported OSM program objectives, the majority of approved OSM work plans were for long term and core monitoring activities. These multi-stakeholder reviews and technical discussions also helped to identify existing information gaps.

Discussions between the governments, Indigenous leaders, industry, and other stakeholders have charted a new path forward regarding program governance and planning under the guidance of the MOU. The Operational Framework Agreement, endorsed through a Letter of Agreement, will be implemented for work planning in the 2019-20 planning cycle.

1.4 Adaptive Management

In 2012, both governments committed to managing environmental monitoring in the oil sands region in an adaptive manner. To this end, the governments of Canada and Alberta agreed to an external expert peer review of the monitoring system after year three (2015) of implementation, with further reviews every five-years to ensure scientific integrity of the program is maintained.

The 2015 panel review concluded that the program had substantially improved environmental monitoring in the region, but also highlighted areas for additional improvement. Canada and Alberta have since taken steps to implement the panel's recommendations. Key actions underway to address the panel's recommendations are highlighted in the table below.

	Recommendation	Actions Underway to Address Recommendation
1	Better define and document specific policy and scientific goals of the governments of Canada and Alberta for the monitoring of the oil sands.	Over the past year, ECCC and AEP have worked on developing a long-term agreement that will include longer-term planning with enhanced clarity for the program's governance and scientific objectives. In December 2017, the governments of Canada and Alberta signed the MOU renewing their commitment to monitoring the environmental impacts of oil sands development activities. In the MOU, both governments committed to the engagement of Indigenous communities in the oil sands region in the integrated monitoring, evaluation and reporting of the environmental impacts of oil sands development, including the appropriate use of the best available Indigenous knowledge. The MOU also acknowledges the treaty and aboriginal rights of Indigenous peoples as recognized and affirmed in section 35 of the *Constitution Act, 1982*. The MOU sets the course for the future of the OSM Program, which includes an Operational Framework Agreement that defines the monitoring objectives of the

	Recommendation	Actions Underway to Address Recommendation
		OSM Program as well as the governance model to guide decision-making, program processes, structure, roles and responsibilities. Development of the Operational Framework Agreement that will support the MOU began in early 2018 with completion expected in Fall 2018.
2	Conduct more comprehensive data analysis and interpretation.	Integrated analysis of results requires several years of data collection; the OSM Program is now at a stage where integrated analysis of results can occur. To that end, a comprehensive analysis of the water monitoring program has been completed resulting in 9 reports under the Oil Sands Monitoring Technical Report Series. Several other integrated analysis are pending and will be released over the next year, and then on a recurrent basis.
3	Take the necessary steps to enhance the integration of the monitoring within and across the four components.	Based on the recommendations of the Interim Science Review Committee during the 2018-19 annual work planning process in February 2018, a series of program wide scientific integration workshops are planned. The integration workshops will involve science and Indigenous knowledge experts, and provide critical review of seven (7) program theme areas including key learnings from the program since 2012. This will help identify key patterns in monitoring results, alignment or concurrence of results across theme areas (e.g., water and air), monitoring gaps, redundancies, and opportunities for adaptive management of the OSM Program. The integration workshops will develop recommendations to inform monitoring design and work planning for the 2019-20 planning cycle. The workshops will begin in late 2018 and cover thematic areas including Terrestrial Biological Monitoring, Atmospheric Deposition, Surface Water, Mercury, Groundwater, Geospatial Science, and Predictive Modelling.
4	Develop and document a uniform Quality Assurance (QA) approach that is implemented and tracked across all	Since 2015-16, there has been increased focus on establishing a uniform and consistent QA/QC approach across OSM. In 2017-18, work in this area focused on identifying priorities for consolidation of Standard

	Recommendation	Actions Underway to Address Recommendation
	monitoring activities.	Operating Procedures (SOPs). A draft Quality Management report was developed and is in review. Future work in 2018-19 will focus on the critical review of existing SOPs to identify those that may be adopted program-wide.
5	Make monitoring data and information more readily available and accessible to stakeholders.	Data and information management of the OSM Program has been influenced by the co-management construct of the OSM Program between two governments as well as the three transitions of the program in and out of government over the past six years. That said, in 2017-18, the program focused on developing a data management framework for migration and consolidation of historical data sets (e.g., RAMP) and various data portals, websites and product repositories. An integrated OSM website is under development including a consolidated repository of hundreds of OSM products consisting of journal articles and technical reports created under the OSM Program since 2012. In addition, an integrated data portal is being produced with the first release of data planned for fall of 2018. Eventually, the data portal operated by Government of Canada will merge with this integrated OSM data portal.

The annual planning process will support the OSM Program's abilities to address existing and emerging monitoring priorities. The OSM Program will consider Indigenous communities and stakeholder priorities in annual planning to ensure approved projects align with the OSM Program's objectives while remaining adaptable and relevant to the needs of stakeholders. The steps taken by Alberta and Canada to implement the Science Integrity Review Panel's recommendations contribute to the objective of a scientifically rigorous, comprehensive, integrated and transparent environmental monitoring of oil sands development that meets the highest standards of scientific integrity.

The next expert panel, external program-wide science integrity review is planned for 2020.

1.5 Transparent and Accessible Results

A key focus of the OSM Program is to ensure open and transparent access to quality assured monitoring data where information is uploaded, organized, and made publicly available in a timely, standardized, and coordinated manner.

Transitions of the OSM program have influenced timely access to data and information, however, significant efforts were made in 2017-18 to ensure that data collected under the program is publicly accessible through the Canada-Alberta Oil Sands Environmental Monitoring Information Portal and Alberta's Environmental Monitoring and Science Division.

Consolidation of historical data portals, websites and publication repositories occurred during 2017-18. A new website and searchable product repository consisting of hundreds of papers and technical reports produced since 2012 is also under development (http://oilsandsmonitoringprogram.com). Since 2012, the OSM Program has produced over 500 products including peer-reviewed papers, technical reports, program reports, presentations and workshop material reports and papers.

An OSM Technical Report Series was developed in 2017-18 with the first release of integrated analysis from the water program released to stakeholders in the fall of 2018.

In addition, an integrated data management framework is under development to provide access to credible OSM environmental monitoring data with the first release from this integrated portal available in fall of 2018.

Current and past annual monitoring plans and associated work plans for OSM projects are now available online and provide detailed information about ongoing work.

In the future, an emphasis will be placed on non-technical communication and formats more suitable for Indigenous communities and the general public. This is based on feedback from stakeholders to help the OSM Program improve communication materials and access to them.

In addition to the above, significant improvements have been made in the area of program management. Open and transparent program management is necessary to ensure work plans are visible, deliverables are understood, and budget expenditures are on track with approved budgets. The program has adopted a standardized work plan template for collecting project information for review and approval as part of the planning process. Key project information collected includes project deliverables, timelines, budget, and participants' roles and responsibilities. Projects activities and deliverables are tracked quarterly, with each delivery organization providing an update on the status of delivery and expenditure. A new project management tool "Innotas" is being implemented to support program-wide efforts aimed at better project oversight and financial accountability. Work plan information including approved budget and deliverables will be entered into Innotas with project status as well as expenditure relative to approved budget tracked on a quarterly basis. The Innotas tool is hosted and managed by AEP with full system access for ECCC. The intent is for quarterly reports and annual reports to be posted publically.

This work serves to ensure transparency and timely public reporting through accessible, comparable, and quality-assured data and information, reports, and publications evaluating, interpreting and synthesizing the monitoring results of the system. It also supports efforts to ensure quality monitoring data and information exists as a tool to inform provincial and federal

decision-making, and to provide timely, accurate and transparent reporting of environmental impacts to the public.

In addition to the sources above, OSM Program monitoring data and information can be found at the following sources:

- Air Data Warehouse - http://airdata.alberta.ca
- Wood Buffalo Environmental Association - www.wbea.org
- Lakeland and Industry Community Association - www.lica.ca
- Alberta Biodiversity Monitoring Institute - www.abmi.ca

2. Indigenous and Stakeholder Participation

Given the invaluable contributions of stakeholders and Indigenous communities to the OSM Program, it is important to acknowledge their role in building a strong foundation for environmental monitoring, evaluation, and reporting in the oil sands region.

2.1 Indigenous Engagement – Program Governance

One of the key messages of the MOU was for increased collaboration with representatives from local Indigenous communities to pave the way for greater Indigenous involvement in setting monitoring priorities, and making decisions related to ambient environmental monitoring in the oil sands region.

Indigenous communities in the oil sands region were invited to join a Task Team to be responsible for the development of the Operational Framework Agreement. In response to the invitation, interested communities nominated representatives to work collaboratively with officials from AEP and ECCC on the Operational Framework Agreement Task Team. Seventeen (17) Indigenous communities participated in development of the Operational Framework Agreement. The first of seven working sessions on drafting the new Operational Framework Agreement took place on March 21, 2018. At the time of writing this annual report, the Operational Framework Agreement has been completed and is currently in the signature stage.

The OSM program currently includes several community based monitoring projects and work plans led by Indigenous communities in the oil sands region. In addition, several of the western science monitoring work plans collaborate and partner with Indigenous communities in the implementation of those work plans.

The new governance structure of the OSM program will further improve Indigenous participation and collaboration.

Both governments remain committed, as identified in the MOU, to seeking opportunities for capacity building within Indigenous communities and to working with Indigenous peoples to

foster openness, transparency and the inclusion of Indigenous knowledge into environmental monitoring of the oil sands region. In addition to the items above, the MOU also identifies a commitment by the Government of Canada of up to $2 million annually for development of capacity for Indigenous designed and led community based monitoring in the oil sands region. This annual contribution is in addition to capacity funding through the Operational Framework Agreement (governance process), as well as any funding provided through the OSM work plans themselves.

These efforts will move the OSM program significantly forward towards improved Indigenous engagement and participation. Outcomes realized will ensure the perspectives and concerns of Indigenous communities are heard and prioritized through environmental monitoring in the oil sands, including through funding recommendations to the OSM program as part of the annual work planning process.

2.2 Industry Engagement

Engagement with industry continued through 2017-18. This engagement was through interactions with individual mining and in situ oil sands operators as well as industry associations including CAPP (Canadian Association of Petroleum Producers) and COSIA (Canada's Oil Sands Innovation Alliance).

CAPP interacts with OSM executives primarily on matters related to governance. CAPP provided comments on the Operational Framework Agreement at the request of the Task Team and industry will be active participants in the governance process of the OSM Program to ensure true intent towards consensus on matters related to oil sands monitoring. Discussions also continue with CAPP on alignment of ambient regional monitoring with regulatory requirements as specified under regulatory approvals issued to industry by the Alberta Energy Regulator and as per the Oil Sands Environmental Monitoring Program Regulation.

Technical discussions on OSM monitoring occur between the OSM Program and COSIA.

Regular meetings have been held on areas of common interest including access to industry sites as well as ensuring ambient monitoring and facility performance monitoring are complementary.

2.3 Multi-Stakeholder Forums

The multi-stakeholder forums are one of the mechanisms through which the governments of Canada and Alberta share information, and seek feedback from the broader stakeholder community on oil sands monitoring. These forums bring together representatives from the governments, First Nations and Métis communities and organizations, oil sands industry, non-governmental organizations, and academia to share information and discuss progress made on oil sands monitoring activities.

The transfer of responsibility for Alberta's contribution to managing the OSM program from AEMERA to AEP resulted in logistical challenges and changes in processes and consequently no formal multi-stakeholder forums were held in 2017-18. However, it is expected that multi-stakeholder forums will be held in the 2018-19 as part of the continued commitment to ongoing stakeholder engagement and outreach.

OSM Program

As part of the 2018-19 OSM work planning in February 2018, the multi-stakeholder Interim Science Review Committee recommended that the program be scientifically assessed across several theme areas to provide a better understanding of the OSM Program's current status, lessons learned and path forward.

Responding to this direction, OSM Program executives made the decision to develop and implement a series of theme-based Integration Workshops to generate the strategic and integrated recommendations required to inform the program and its work planning process in 2019-20 and beyond. Workshops are scheduled to commence in October 2018 and continue through to the end of February 2019. Themes to be addressed include the following: Terrestrial Biological Monitoring, Atmospheric Deposition, Surface Water, Mercury, Groundwater, Geospatial Science, and Predictive Modelling.

3. Program Highlights

The work completed since the oil sands monitoring program was announced in 2012 has built a strong foundation for environmental monitoring, evaluation, and reporting on oil sands development activities in the region.

3.1 The 2017-18 Work Plan

The 2017-18 Ambient Environment Monitoring Plan for Oil Sands Development (Appendix D) provides information on the activities undertaken for the 2017-18 fiscal year. A total of 72 projects (see Appendix D) were approved for implementation in 2017-18 fiscal year as shown below:

- Atmospheric Monitoring: 15 projects
- Watershed Monitoring: 9 projects
- Biotic Response Monitoring: 17 projects
- Indigenous Monitoring Program: 6 projects
- Wetland Ecosystem Monitoring: 5 projects
- Standards, Quality Assurance/Quality Control, Data Management: 13 projects
- Program Administration: 5 projects

- Two new areas funded in 2017-18 included Indigenous Participation and OSM Capital Purchase

Approved OSM projects, were classified as follows:

- Long-term Monitoring: refers to the routine monitoring of status and trends of physical, chemical or biological parameters related to oil sands development activities to detect and evaluate changes in the environment over a period of time, typically >5 years. Although these are long term projects, deliverables are subject to annual reviews for scientific soundness and cost effectiveness. A total of 18 Long-term Monitoring projects were approved for implementation in 2017-18.

- Focused Study: refers to a class of purposeful projects with definite start and end dates (typically 3 years). Focused Study projects are implemented as required for any of the following purposes:
    - To develop or validate a current monitoring design and/or protocols
    - To confirm or quantify an initial observation of significant effect
    - To investigate the potential cause of an observed adverse effect
    - To characterize a disturbed environmental state resulting from human activity as distinct from a disturbed state resulting from a natural environmental stressor

In 2017-18, 34 Focused Studies were approved for implementation.

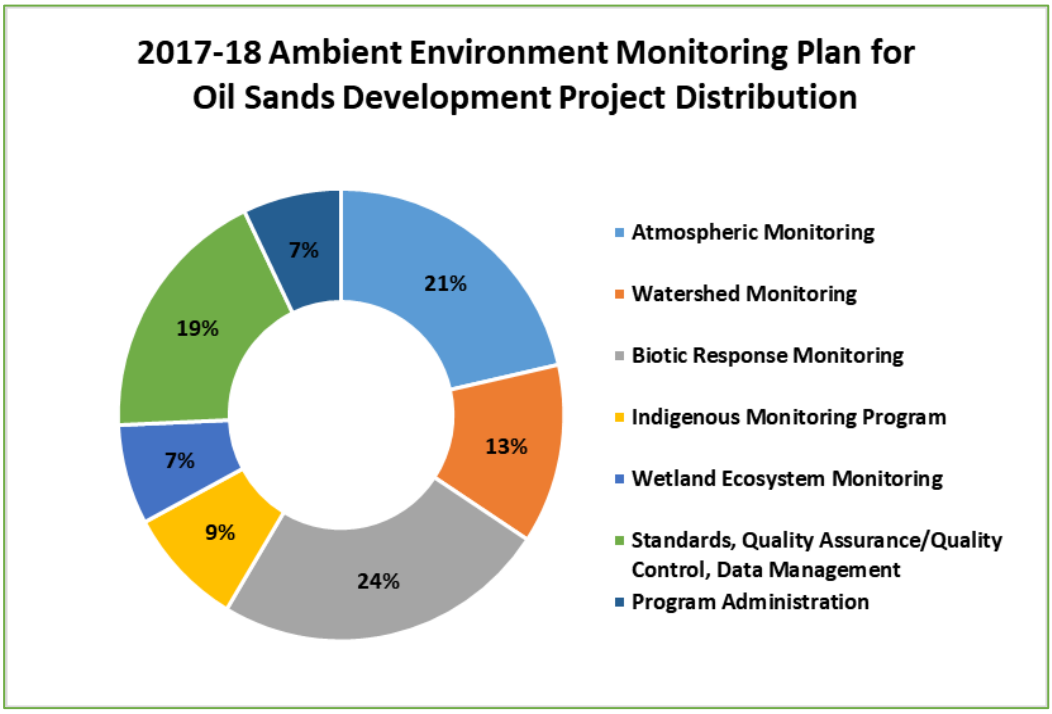

Figure 2: 2017-18 Breakdown of Approved OSM Work plans by Theme Area

3.2 Highlights of Monitoring Results

Since the initiation of the OSM Program in 2012 over 500 products have been produced including technical reports, peer-reviewed journal articles, standard operating procedures, and program reports. The OSM Program is now at a stage to synthesize and integrate this information to assess 1) if patterns of change in environmental condition are occurring 2) if any changes are due to oil sands development and 3) key gaps. This assessment must include consideration of Indigenous knowledge and expertise as well as western science.

Ongoing integrated assessments will be a focus of effort in 2018 and beyond. This will include review of the published work produced under the OSM Program, review of the published work under OSM in the context of other relevant monitoring and research in the region, discussions with Indigenous and western science experts through Integration Workshops and integrated analysis of data within theme areas and across themes in the interest of cumulative effects assessment.

Key patterns of results to date and including 2017-18 are summarized by theme in the following sections.

Water

Eight synthesis reports were developed under the OSM Technical Report Series in 2017-18 and are scheduled for release in September of 2018 highlighting a significant contribution to integration of results across the water monitoring program in the oil sands region. These will be available through the OSM Program website. Results from these reports are summarized below.

Sediment and Deposition

A focus of OSM sediment monitoring has been on paleolimnological assessments to determine the spatial extent and background levels of key stressors. Oil sands activity increases some parameters (polycyclic aromatic compounds, or PACs, and metals) in the Athabasca River and tributaries, which is measurable for 50-75 km downstream of activities.

Shifts in temperature related to changes in regional hydro-climatology may be affecting biological productivity in lakes over the past century based on analysis of fossils in lake sediments in the region.

Depositional studies have shown increasing signals of oil sands related contaminants attributed to bitumen in fugitive dust and petcoke particulates; monitoring has been recommended to quantify magnitude and environmental fate of the emissions from these sources.

Water Quality

The water quality program increased sample collection frequency at key locations, installed water quality data sondes (continuous monitoring instruments), and implemented other changes

recommended in a workshop held to rationalize and optimize the water quality monitoring network. The report from this workshop will be released in the fall of 2018 as a component of the OSM Technical Report Series.

A total of 1300 water quality samples from 21 locations in the first three years of monitoring of the Athabasca River showed no discernible association with oil sands activity with the exception of selenium which increased downstream of MacKay River. The reason for the observed increase in selenium is unknown at this time (i.e. is it derived from natural geological sources or related to oil sands operations) and will continue to be evaluated.

The largest increase between locations upstream and downstream of the Fort McMurray wastewater treatment plant was observed for phosphorus and will continue to be monitored.

Trends in Athabasca River water quality were not directly related to upstream oil sands activities but largely related to changes in flow. Further monitoring is required. Changes in aluminum, copper, iron and lead levels exceeded water quality guidelines in the Athabasca River. .

Exceedances in the Peace-Athabasca Delta (PAD) closely mirror exceedances in the Athabasca with aluminum, copper, lead, and cobalt most frequent. Cobalt was also detected in monitoring under Lower Athabasca Regional Plan.

Some changes in water quality exceeding water quality guidelines were reported in tributaries including the Ells, Steepbank, Muskeg, MacKay and Firebag Rivers. Exceedances occurred more frequently for aluminum, copper and iron. Selenium, arsenic and vanadium increased downstream in some of these rivers.

A focused study on the Muskeg River showed that arsenic, selenium and vanadium increased during early phases of oil sands mine development including land clearing activities.

Some parameters such as PACs increased during the spring, which may be due to snow melting. It was not possible to determine if the increases were due to oil sands activity or erosion of natural bitumen deposits. Further focused research is being conducted to assess the relative contributions of these possible sources and their ecological significance.

Water Quantity

Recent water quantity monitoring has centered on upgrading hydrometric (water level and flow) equipment to Water Survey of Canada standards. As part of the water quantity program, 31

stations have undergone infrastructure upgrades (or are in the process of being upgraded) to comply with current Water Survey standards. As part of the station upgrades, all were equipped with satellite telemetry to support data transmission and near real-time data accessibility. Data from these upgraded stations contribute to a better understanding of regional water mass balance, and also provide critical information for the water quality program.

Water quantity analysis on the mainstem Athabasca River and the tributaries is underway including extensive modelling efforts to predict flows during current and projected regional climatic extremes and under different development scenarios.

Groundwater

In 2015-16 a data discovery effort led to a compilation of over 100,000 groundwater records. In 2017-18, a groundwater monitoring workshop was conducted to share updates, outline data needs, and identify existing barriers to data sharing between industry, provincial regulators, and provincial and federal governments. As a result of this effort, several areas of future integration between groundwater and wetland monitoring components were identified and are informing future wetland monitoring design.

Regional groundwater monitoring was conducted in 2017 to further inform characterization of baseline conditions, changes and cumulative effects. Monitoring was conducted at wells classified as strategic, surveillance, and investigative; however, several wells were inaccessible due to poor road conditions or other logistical issues. Groundwater level data was collected both manually and from *in situ* instruments, and groundwater samples collected were analyzed for chemical and isotopic composition. Monitoring confirmed two previously identified geochemical anomalies where there may be aquifer connectivity, including a potential connection between the Surficial Sands and McMurray Formation, as well as between the McMurray Formation and saline Devonian formations along the salt scarp in areas north of Fort McMurray. The ecological implications of these findings are being assessed.

Progress through Collaboration:
2017-18 saw the groundwater monitoring program put significant effort into compiling datasets from different levels of government, industry, and academia to improve accessibility, comparability, and transparency.

From this work, a number of recommendations for groundwater monitoring improvements have been suggested, including future investigation into groundwater-surface water interactions.

Monitoring has focused on groundwater and surface water interactions and the importance of groundwater to flow regimes in some rivers in the region. Overall, groundwater chemistry in the regional network is spatially diverse, both within and between formations. Focus in future years will be on consolidation and rationalization of the design of the groundwater monitoring program.

Monitoring of process water seepage from tailings ponds into the Athabasca River is ongoing with a focus on determining the occurrence outside of containment in groundwater and surface water and also on the development of techniques to better characterize the chemical signatures of process waters from natural waters containing bitumen.

Fish

Fish monitoring focused on toxicity, and fish population and health status in the Athabasca River and its tributaries. In the initial years of monitoring (2011-2012) white sucker monitored in the Athabasca River showed evidence of nutrient enrichment, however this trend was not evident in later years.

In the Steepbank River, within the oil sands deposit from 2010 through 2013, slimy sculpin, showed exposure to PAC-related compounds and altered organ size (liver and gonads). The ecological implications of these changes are being assessed. Continued monitoring is currently underway to provide a better understanding of the implication of the observed changes.

Exposures of fish in the lab to river sediments from the Steepbank and Ells Rivers decreased embryo-larval fish survival and exposures to melted snow from sites near mining activity also indicated decreased larval fish survival. However, spring melt water collected from these sites did not have the same effect, suggesting that dilution of contaminants in snow during spring melt is likely reducing exposure effects.

Tissues of white sucker and walleye showed increasing concentration in some tissues of PACs; however, no discernable trends were found for male walleye or trout-perch. Determining the source of exposure is confounded by the current inability to differentiate point and non-point source contaminants from oil sands operation activity and natural bitumen inputs (e.g., erosion) within the tributaries.

Benthic Invertebrates

Aquatic benthic invertebrates were monitored in the tributaries, Peace Athabasca Delta, and the Athabasca River. The Lower Athabasca River has good ecological condition with intolerant taxa, such as Ephemeroptera, Plecoptera and Trichoptera, found in large abundances at all sampling sites. The middle reaches show signs of mild environmental stress that should be examined more closely to tease apart the combined effects of nutrient and possible-contaminant related stressors.

Tributaries also showed good ecological condition in benthic community structure (i.e., dominated by intolerant taxa), although communities in areas with increased human disturbance showed trends towards mild environmental stress. Benthic

communities in the Steepbank and Ells rivers changed with gradients in catchment disturbance and PAC concentration.

Benthic communities in the PAD showed high biodiversity and no evidence of effects arising specifically from oil sands activities.

Biodiversity and Wildlife Health Monitoring

Biodiversity and wildlife health monitoring has released field data publicly, maps of land cover and human footprint have been updated, standard operating procedures revised, and lists of species of concern provided to inform decision-making.

A report summarizing rare plant distribution and abundance was released through collaboration with scientists from the University of Alberta.

Monitoring of focal wildlife populations included the fitting of 10 juvenile whooping cranes, captured in and around Wood Buffalo National Park, with satellite transmitters. Location data collected from these birds builds on over 260 unique migrations tracked via satellite telemetry since 2010. Near real-time location data are shared with operators to alert them to whooping crane activity within their leases

Aerial surveys of moose and deer in two Wildlife Management Units were conducted, and summary reports from the prior year's surveys were completed.

A focal study of the relationships between linear disturbances (roads, seismic lines, and pipelines) and duck settling and breeding success suggest that most duck guilds are resilient to linear feature development, at least within the range of linear disturbance densities currently on the landscape.

During 2017-18, the Wildlife Health Monitoring Program (the former JOSM Wildlife Contaminants and Toxicology Program) continues to monitor the cumulative effects of oil sands related contaminants of concern on sentinel wildlife species. Wildlife and habitat samples were collected and submitted for analysis in collaboration with numerous Indigenous partners, with communities, and with Community Based Monitoring Programs. Potential oil sands-related contaminants of concern were measured in chosen sentinel wildlife species along with samples of their habitat (e.g. water, sediment, air, plants) for assessment. The program focused on measuring contaminant exposure and possible effects in 1) gull and tern eggs 2) in mammals, mainly semi-aquatic furbearers, and, 3) in wood frogs. Wildlife samples continue to be collected and analyzed.

The synthesis and assessment of the existing wildlife contaminants and toxicology information from the region continues with partners, an activity that provides the Wildlife Health and Biodiversity Monitoring programs, as well as the wetlands program with information on temporal changes and the spatial distribution of contaminant burdens in wildlife across the region. A synthesis report of the program is slated for completion in 2019/20.

Atmospheric Monitoring

Air quality is monitored by regional airshed organizations in the Athabasca (Wood Buffalo Environmental Association), Cold Lake (Lakeland Industry and Community Association) and Peace River (Peace River Area Monitoring Program) oil sands regions. The long-term air monitoring network is important for:

- providing real-time air quality information to the public through the Air Quality Health Index;
- assessing air quality against regulatory benchmarks, regional triggers and limits from the Lower Athabasca Regional Plan, and national standards (Canadian Ambient Air Quality Standards); and
- determining spatial and temporal trends in air quality.

For the 10-year period from 2008 to 2017 the following trends were observed:

- decreasing NO_2 concentrations at the Anzac, Fort McMurray-Athabasca Valley, and Fort McMurray-Patricia McInnes stations, likely due to lower emissions from urban sources such as automobiles;
- decreasing SO_2 concentrations at the Buffalo Viewpoint, Fort Chipewyan, Fort McKay South, and Fort McMurray-Patricia McInnes stations, likely due to lower emissions from industrial sources;
- decreasing H_2S concentrations at the Buffalo Viewpoint, Lower Camp, Mannix, and Mildred Lake stations, likely due to lower emissions from industrial sources;
- decreasing total reduced sulphur (TRS) concentrations at Barge Landing, Fort McKay-Bertha Ganter, Fort McKay South, Fort McMurray-Athabasca Valley, and Horizon, likely due to lower emissions from industrial sources; and
- increasing TRS concentrations at the Cold Lake South station, but concentrations remain low compared to other monitoring stations in the oil sands region.

In 2017-18, concentrations of nitrogen dioxide (NO_2) were lower than the limit defined by the Lower Athabasca Regional Plan (LARP) at all monitoring stations in the Athabasca and Cold Lake oil sands regions.

There were exceedances of Alberta Ambient Air Quality Objectives/Guidelines recorded for hydrogen sulphide (H_2S), fine-particulate matter ($PM_{2.5}$) and Ozone. $PM_{2.5}$ exceedances measured at monitoring stations in the Athabasca and Cold Lake airsheds resulted primarily from wildfire smoke. Adjacent industrial facilities were likely the cause of H_2S exceedances that occurred at monitoring stations located close to industrial operations north of Fort McMurray.

All exceedances of regulatory benchmarks were reported to regulators.

Sulphur dioxide (SO_2) levels that were higher than a Lower Athabasca Regional Plan trigger were measured at one monitoring station (Lower Camp monitoring station). AEP is working with industry and other stakeholders to determine the cause(s) of the elevated SO_2 levels at this station.

To address air quality concerns, the Waskow Ohci Pimatisiwin (Cree for “Air of Life”) emergency response air quality monitoring station was put into operation in Fort McKay in July 2017. This was a significant accomplishment for the OSM Program and demonstrated a direct response of OSM and its partners to the concerns of Indigenous communities in the region. This community is in a unique circumstance largely surrounded by oil sands development with a single road to access the community. Data collected every five-minutes at this station is compared against emergency response thresholds for H_2S and SO_2 agreed to by Alberta Health and the Fort McKay Air Quality and Odour Advisory Committee. If these thresholds are exceeded, local and provincial authorities are notified through an automated system. In the 2017-18 fiscal year, there were no exceedances of emergency response thresholds at the Waskow Ohci Pimatisiwin station.

The Community Odour Monitoring Program (COMP) was implemented in 2017-18 and includes a mobile application that is intended to be used by the public to provide information on odours events. Information can be submitted on the time, location, strength and description of the odour. This information is compiled annually and used to better understand odour issues in the oil sands region.

Provincial scientists in collaboration with the National Oceanic and Atmospheric Administration (NOAA) initiated an aircraft based greenhouse gas (GHG) emission quantification program in 2017 funded by the OSM Program. The emission quantification project included monitoring

emissions of GHGs from mining and *in-situ* industrial facilities in the Athabasca, Cold Lake, and Peace River oil sands regions. The objectives of aircraft measurements were to: (1) quantify GHG emissions and compare these emissions to the Alberta GHG emissions inventory; (2) broaden the understanding on GHG emissions from *in-situ* and mining operations; and (3) improve the estimation of yearly emissions.

Methane (CH_4), carbon dioxide (CO_2), ethane (C_2H_6) and ozone (O_3) were measured with on-board analyzers. This work makes use of the best cost-effective technical resources available to assess the environmental impacts of emission sources from oil sands operations. Flask samples of air were collected for lab analysis of up to 50 species of hydrocarbons, halocarbons and isotopes of carbon. A total of 56 hours of monitoring data was collected during flights in August and October 2017. Flight plans were coordinated with industry through Canada's Oil Sands Innovation Alliance (COSIA) and preliminary results have been shared.

A fourth consecutive year of monitoring of air quality and greenhouse gases was successfully completed in partnership with the Fort McKay First Nation and Fort McKay Métis at the Oski-Otin site. The focus of the measurements was on characterizing the chemical composition of pollutants and their concentration levels, complemented by meteorological measurements. The measurements improve understanding of what is being emitted from the surrounding oil sands activities and the atmospheric processes influencing air pollutant concentrations.

Continuous monitoring activities, short term samples and data collection, laboratory and modeling experiments were focused on understanding the emissions, transport, transformation and fate of atmospheric pollutant emissions. The results will ultimately contribute to our knowledge of the cumulative effects from oil sands operations.

An Air Synthesis Review summarized the current state of knowledge and publications related to PACs in the oil sands region. A group of 29 experts from government, environmental associations, and academia contributed to this deliverable

Quantification of PAC deposition and estimations of critical load exceedances of acid deposition in Alberta and Saskatchewan were conducted to examine the potential trans-boundary nature of the impacts of oil sands development. Model analysis suggest that the acid deposition may be insufficiently neutralized to prevent ecosystem damage beyond a perimeter of few kilometers around the facilities and that a large geographic region could be in exceedance of critical loads for aquatic ecosystems. Further monitoring and analysis is required in this area. This research supports the objective of considering the trans-boundary nature of the impacts of oil sands development activities and, where appropriate, collaborating with other territorial and provincial governments.

The contribution of emissions from tailings ponds to total fugitive emissions to the atmosphere in the region has not been characterized and quantified. A one month long comprehensive tailings ponds study was conducted in the summer of 2017 quantifying emission fluxes from the pond surface to the atmosphere. Results are pending and will be communicated with stakeholders and more broadly.

Predictive Assessments

Hydro-climatological models were developed for the entire Athabasca River basin to provide projections of flows to the lower Athabasca River and Athabasca River Delta. Predictive modeling teams continued to refine the Variable Infiltration Capacity (VIC) hydrological model for the Athabasca River Basin, improving the spatial resolution of the model. The model was recalibrated and validated at 19 hydrometric stations and 21 snow-course survey locations to enhance the ability of reproducing flows in the basin. Future application of the modeling framework is to assess hydrological impacts under changing development activities and climatic conditions. Building the model is part of the program's commitment to using the best, cost effective technical resources available for ambient environmental monitoring to assess baseline conditions, detect change in environmental conditions and predict future environmental conditions under various development scenarios.

Why does it matter?
The updated VIC model is capable of generating stream flows from 1961 to 2015 at any location in the Athabasca River Basin. This has the potential to be used for generating stream flows at ungauged locations or filling data gaps at gauged locations in the basin. Future applications of the model could include assessments of hydrological impacts under changing climate and anthropogenic activities in the basin.

Community Based Monitoring

Building on past work, the OSM Program funded three projects focusing on berry health, investigating fish, and culturally important wetland plants. Efforts will continue in future years to build relationships with Indigenous communities, provide training, and work with Elders and Indigenous knowledge holders to obtain a more comprehensive and greater understanding of the issues impacting Indigenous peoples.

3.3 Program Challenges

While the 2017-18 year saw significant progress, there were some challenges that hindered progress of the program towards its key objectives. In the interest of openness and transparency, those challenges are identified below.

AEMERA to Government of Alberta Transition

On the Alberta side of the OSM Program, AEMERA dissolved in April 2016 and responsibilities transitioned to a new division in AEP called EMSD in July 2016. While the transition was positive in a number of ways, data management, project management and public reporting over

the 2016-17 (the first 8 months of the transition year) and 2017-18 were affected due to logistical challenges and changes in processes between an independent arms-length agency and government. This transition resulted in decreased project delivery as staff and resources were being transferred from the external agency to the internal government ministry.

Significant work occurred in 2017-18 to "re-set" and "refresh" program processes including:

- refreshing administration and communication processes, including consolidation of publication repositories and development of a publically accessible searchable database
- consolidation of webpages and development of new OSM webpage
- development of publication and communications processes for OSM
- development and release of an OSM Technical Report Series,
- streamlining the grant process; contract and financial coding practices; asset management and capital purchases and
- development of consistent work planning templates and electronic project reporting and program management

Acquisition of a data management system occurred along with migration of historical databases and content (e.g., RAMP) and development of new integrated data portal. The development of an OSM Program Office is also underway and will provide joint oversight of the program in future years including project planning, implementation, and tracking; coordinating quarterly and annual reporting as well as managing stakeholder engagements by providing the program with the full-time dedicated support it requires.

Project Level Issues

Specific project level issues varied by project and included challenges in acquiring required approvals (e.g., land dispositions for installation of monitoring equipment), managing workforce capacity, accessing private property or operator leases, and delays due to weather conditions in the field. Several projects were also placed on hold or were significantly underspent as a result of lower than planned levels of stakeholder engagement or the reasons listed above. A complete list of project issues and their connection to project specific budget variances is available in the 2017-18 Year-End Financial Report (Appendix E).

4. Financials

This section reports on the financial results of the OSM Program for the 2017-18 fiscal year and includes details on funding allocation between organizations, end of year totals, capital purchases and rationale for significant project level variances.

Funding for the OSM Program is made possible through the Oil Sands Environmental Monitoring Program Regulation, which directs industry to fund the program according to a funding formula developed collaboratively by Canadian Association of Petroleum Producers (CAPP), and the Alberta government to allocate monitoring costs to oil sands operators.

For 2017-18, $53,207,757 was the total approved for 72 projects submitted under the OSM Program. The total funds available were $52,000,000 comprised of industry billing in the amount of $50,000,000 collected under the Oil Sands Environmental Monitoring Program Regulation and an additional $2,000,000 was from the OSM Reserve Fund (approved deferred revenue).

The difference between the approved budget and available funding in the sum of $1,207,757 was risk managed base upon a history of underspend in previous years and the need to ensure adequate funding levels for transitional program elements.

Of the available $52,000,000, a sum of $2,900,000 was dedicated to capital purchase leaving a total of $49,100,000 for project implementation.

Approved funds were distributed as per approved work plans to ECCC ($17,015,235), AEP ($16,707,734) and external monitoring organizations including, but not limited to, Alberta Biological Monitoring Institute (ABMI), Lakeland Industry and Community Association (LICA) and Wood Buffalo Environmental Association (WBEA) ($19,484,788).

A total amount of $47,093,947 of the available $49,100,000 (Operations and Maintenance or O&M) was spent on project implementation in 2017-18, leaving an unspent balance of $2,006,053.

A total of $2,900,000 was converted from O&M to capital funds in 2017-2018 to support equipment purchases by AEP for monitoring infrastructure and upgrades. This was the first year of the program that provided the opportunity for conversion of funds into a Capital designation.

In 2017-18, $1,174,315 of the $2,900,000 Capital funding was spent on equipment purchases leaving an unspent balance of $1,725,685 for capital purchases in 2018-19. Capital funds are eligible for accrual across fiscal years. Conversion of O&M to capital from the OSM Program did not occur in 2018-19 given the accrual.

For further details on specific projects and Capital purchases by project, please see the 2017-18 Year-End Financial Report (Appendix E)

Variances in program budget for 2017-18 are largely due to factors such as delays in initiating monitoring activities resulting from inability to obtain required permits and approvals in a timely manner, staff transitions and delays in implementing hiring processes, challenges with estimating actual project costs as part of the planning process resulting in over-budgeting, as well as issues with financial tracking associated with the alignment of the two distinct financial systems with the transition from AEMERA back into the Government of Alberta.

The surplus of $2,006,053 O&M and $1,725,685 of Capital will be held as deferred revenue and added to the current surplus detailed in the Five Year Spending Plan (Appendix F).

5. Summary and Next Steps

The governments of Canada and Alberta recognize that monitoring in the oil sands region is a responsibility that has multi-generational implications for the province as well as the nation. Both governments remain committed to working to ensure the environmentally sustainable development of the oil sands.

The 2017-18 fiscal year saw many new developments aimed at setting the stage for future success and enhancing collaborative efforts between the OSM Program and relevant stakeholders.

A focal point of work over the year included the creation of the MOU that renewed the mutual intentions of both governments to collaborate and be accountable for the design and implementation of an integrated monitoring, evaluation, and reporting system. It also outlined the development of a comprehensive Operational Framework Agreement that will define the governance and implementation model for the OSM Program in future years.

The formal collaboration between governments, Indigenous peoples, and key stakeholders to jointly govern the OSM Program will ensure alignment with the program's objective of a monitoring system that is comprehensive, relevant, inclusive to Indigenous knowledge through seeking and integrating a multiple evidence based approach to inform monitoring program decisions.

Both Canada and Alberta remain committed to an independent, expert peer review of the monitoring system for scientific integrity. The next independent review is expected in 2020 and will further inform future directions for the program.

Data and information collected and created under the OSM Program will continue to support provincial and federal discussions pertaining to cumulative effects by providing a better understanding of the potential and complex effects of oil sands development in the region.

6. Appendices

A. An Integrated Oil Sands Environment Monitoring Plan

B. Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring

C. Memorandum of Understanding Respecting Oil Sands Monitoring

D. 2017-18 Ambient Environmental Monitoring Plan For Oil Sands Development

E. 2017-18 Year-End Financial Report

F. Five Year Spending Plan

G. Technical Annex

7. Acronyms

AAAQOs	Alberta's Ambient Air Quality Objectives: Alberta's ambient air quality objectives and guidelines are developed under the Alberta Environmental Protection and Enhancement Act (EPEA). Objectives are developed to protect Alberta's air quality.
ABMI	Alberta Biological Monitoring Institute: an agency that monitors and reports on status of biodiversity throughout the province of Alberta.
ADPC	Acoustic Doppler Current Profiles: a hydroacoustic current meter similar to a sonar used to measure water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column.
AEMERA	Alberta Environmental Monitoring Evaluation and Reporting Agency: the provincial organization established to monitor, evaluate and report on key air, water, land and biodiversity indicators to better inform decision-making by policy makers, regulators, planners, researchers, communities, industries and the public; AEMERA was rolled back into back into the government in June 2016.
AEMERIS	Alberta Environmental Monitoring, Evaluation & Reporting Information Service: a data library under AEMERA that provided searchable data from a variety of sources either regionally or by category.
AEP	Alberta Environment and Parks: the provincial ministry with the mandate to protect the province's air, land, water and biodiversity.
AMS	Air Monitoring Stations: these are stations set up to measure ambient air quality across Alberta.
AQHI	Air Quality Health Index: a tool that relates the outdoor air quality to health. The index uses a scale of 1 to 10, and the lower the number, the lower the health risks.
CAPP	Canadian Association of Petroleum Producers: a group that represents the upstream Canadian oil and natural gas industry.
CEW	Canadian Eco-toxicology Workshop: this is Canada's predominant annual meeting in the field of ecological toxicology and related disciplines. It was formerly known as Aquatic Toxicity Workshop.
COMP	Community Odour Monitoring Program: a voluntary program set up by Wood Buffalo Environmental Association to better understand ambient air quality in the region.
COSIA	Canada's Oil Sands Innovation Alliance: an alliance of oil sands producers focused on accelerating the pace of improvement in environmental performance in Canada's oil sands through collaborative action and innovation.
CO_2	Carbon Dioxide: a chemical compound that exists as a gas at room temperature, and is made of on carbon and two oxygen atoms. It is a greenhouse gas.
DNA	Deoxyribonucleic Acid: a molecule that contains the genetic code of organisms.
ECCC	Environment and Climate Change Canada: the department of the Government of Canada with responsibility for coordinating environmental policies and programs as well as preserving and enhancing Canada's natural environment and renewable resources.
EFDC	Environmental Fluid Dynamics Code: a multifunctional surface water modeling system, which includes hydrodynamic, sediment-contaminant, and eutrophication

components.

ELT	Extract, Transform and Load: database functions used as a tool to pull data out of one database and place it into another.
EMSD	Environmental Monitoring and Science Division: a division of Alberta's ministry of environment responsible for monitoring, evaluating and reporting on key air, water, land and biodiversity indicators. The division's mandate is to provide open and transparent access to scientific data and information on the condition of Alberta's environment.
EPEA	Environmental Protection and Enhancement Act: the primary Act in Alberta through which regulatory requirements related to air quality is managed. The purpose of EPEA is to support and promote the protection, enhancement and wise use of the environment.
FHM	Forest Health Management: a practice of managing the forests in a way that balances the goal of environmental protection, social good and economic development
FME	Feature Manipulation Engine: a platform that streamlines the translation of spatial data between geometric and digital formats. It is intended especially for use with geographic information system (GIS), computer-aided design (CAD) and raster graphics software.
FWMIS	Fisheries and Wildlife Management Information System: the Government of Alberta's Fisheries and Wildlife database. FWMIS provides a central repository for which government, industry, and the public can store and access extensive and reliable fish and wildlife inventory data.
GEM-MACH	Global Environmental Multi-scale - Modelling Air quality and Chemistry: an in-line chemical transport air quality forecast model. This model is a comprehensive air quality model containing a full description of atmospheric chemistry and meteorological processes. The model uses the emissions inventory to assess the source of tropospheric ozone precursors.
GHG	Greenhouse Gas: greenhouse gases, such as carbon dioxide, methane, nitrous oxide, chlorofluorocarbon and ozone, reflect radiation that the Earth emits, and stop it from being lost into space. This causes the Earth's temperature to be higher than it would be without greenhouse gases
GIS	Geographic Information System: is a framework for gathering, managing, and analyzing data. Rooted in the science of geography, GIS integrates many types of data, analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. With this unique capability, GIS reveals deeper insights into data, such as patterns, relationships, and situations–helping users make smarter decisions.
Hg	Mercury: a chemical element that is liquid at standard conditions for temperature and pressure.
H2S	Hydrogen Sulfide: a colorless, toxic, flammable gas that smells like rotten eggs. It is heavier than air it tends to accumulate at the bottom of poorly ventilated spaces.
HYDAT	Hydrometric Data: this is data pertaining to the measurement of hydraulic parameters of water bodies flowing above or below ground, or quasistatic in lakes, reservoirs and underground formations.

ISO	International Organization for Standardization: an independent, non-governmental international organization with a membership of 161 national standards bodies that develops and publishes International Standards. ISO has published 22263 International Standards and related documents, covering almost every industry, from technology, to food safety, to agriculture and healthcare.
ISO 17025	ISO's standard describing General Requirements for the Competence of Testing and Calibration Laboratories. It enables laboratories to demonstrate that they operate competently and generate valid results, thereby promoting confidence in their work.
LC/GC-QToF	Liquid and Gas Chromatography time-of-flight mass spectrometry: a chromatographic technique that allow quantification and profiling of products being examined. This technique improves analysis through high resolution, accurate mass information for speciation and increased linear dynamic range compared to traditional fixed-wavelength UV detection.
LICA	Lakeland Industry and Community Association: a community-based not-for-profit association registered under the Alberta Societies Act with a focus on environmental monitoring, environmental management, and community education and outreach. LICA also works with the OSM Program on the delivery of air monitoring projects.
LiDAR	Light Detection and Ranging: a surveying method that measures distance to a target by illuminating the target with pulsed laser light and measuring the reflected pulses with a sensor. These light pulses—combined with other data recorded by the airborne system— generate precise, three-dimensional information about the shape of the Earth and its surface characteristics.
MySQL	Structures Query Language ('My' is the name of co-founder Michael Widenius's daughter): It is an open source relational database management system.
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NOX	Oxides of Nitrogen: a mixture of gases that are composed of nitrogen and oxygen. Two of the most toxicologically significant compounds are nitric oxide (NO) and nitrogen dioxide (NO_2). Other gases belonging to this group are nitrogen monoxide (or nitrous oxide, N_2O), and nitrogen pentoxide (NO_5).
NMHC	Non-methane Hydrocarbon: these are organic molecules consisting of just carbon and hydrogen; often loosely applied also to derivatives of hydrocarbons containing oxygen, halogens, etc. The atmospheric burden of hydrocarbons is provided from both natural and anthropogenic emissions.
NPRI	National Pollutant Release Inventory: Canada's legislated, publicly accessible inventory of pollutant releases (to air, water and land), disposals and transfers for recycling
O3	Ozone: a gas present in very low concentrations throughout the Earth's atmosphere but highest concentration in the ozone layer of the stratosphere, which absorbs most of Sun's ultraviolet radiation. Ozone acts as a greenhouse gas, absorbing some of the infrared energy emitted by the earth.
OGC	Open Geospatial Consortium: an international voluntary industry consortium of over 519 companies, government agencies and universities participating in a consensus process to develop publicly available interface standards for geospatial content and services, sensor web and Internet of Things, GIS data processing and data sharing.

OS	Oil Sands: a natural mixture of sand, water and bitumen (oil that is too heavy or thick to flow on its own).
OSPW	Oil Sands Process Water: this is spent water generated during bitumen extraction and may be toxic to aquatic life due to the presence of naphthenic acids.
PAC	Poly Aromatic Compounds: these are organic compounds containing only carbon and hydrogen in multiple aromatic rings. They are present in coal, tar and oil deposits and may also be produced by the incomplete combustion of organic matter.
PADEMP	Peace-Athabasca Delta Ecological Monitoring Program: a program that will measure, evaluate and communicate the state of the Peace Athabasca Delta ecosystem, including any changes to this ecosystem that result from cumulative regional development and climate change.
PAD	Peace-Athabasca Delta: the largest freshwater inland river delta in North America. It is located in northeast Alberta, partially within Wood Buffalo National Park and also spreads into the Regional Municipality of Wood Buffalo, west and south of the historical community of Fort Chipewyan.
$PM_{2.5}$	Particulate Matter: aerosol particles with diameter less than 2.5 micrometers. Exposure to these particles may have negative health impacts.
PRAMP	Peace River Area Monitoring Program: monitors odours, emissions and air quality to ensure a healthy environment in the Peace River area including Three Creeks, Reno, Seal and Walrus regions.
PYLET	Pacific Yukon Lab for Environmental Testing: is a centre for the study of marine, estuarine and freshwater toxicology and chemistry, with specialization in salmonid toxicogenomics, bacterial source tracking, and marine water quality monitoring. The facility is located on Burrard Inlet in North Vancouver.
QA/QC	Quality Assurance and Quality Control: QA/QC is the combination of quality assurance (process or set of processes used to measure and assure the quality of a product), and quality control (process of ensuring products and services meet consumer expectations).
RMWB	Regional Municipality of Wood Buffalo: a municipality region in northeastern Alberta.
RSC	Reduced Sulphur Compounds: describes a total of six reduced sulphur compounds including Hydrogen sulphide (H_2S), Carbon disulphide (CS_2), Carbonyl sulphide (COS); Dimethyl sulphide (C_2H_6S), Methyl mercaptan (CH_4S) and Dimethyl disulphide ($C_2H_6S_2$). These compounds are not normally considered a health hazard. They are, however, a primary cause of odours.
SAGD	Steam Assisted Gravity Drainage: an enhanced oil recovery technology for producing heavy crude oil and bitumen.
SensorML	Sensor Model Language: an approved Open Geospatial Consortium standard. SensorML provides standard models and an XML encoding for describing sensors and measurement processes. SensorML can be used to describe a wide range of sensors, including both dynamic and stationary platforms and both in-situ and remote sensors
SETAC	Society of Environmental Toxicology and Chemistry : a not-for-profit, worldwide professional organization composed of more than 5,100 individuals and institutions in over 80 countries dedicated to the study, analysis and solution of environmental

problems, the management and regulation of natural resources, research and development and environmental education.

SFC-Orbitrap Supercritical Fluid Chromatography: a form of normal phase chromatography that uses a supercritical fluid such as carbon dioxide as the mobile phase. SFC is used for the analysis and purification of low to moderate molecular weight, thermally labile molecules and can also be used for the separation of chiral compounds.

SPMD Semi Permeable Membrane Devices: are passive sampling devices used to monitor trace levels of organic compounds. SPMDs are an effective way of monitoring the concentrations of chemicals from anthropogenic runoff and pollution in the marine environment because of their ability to detect minuscule levels of chemicals.

SO_2 Sulphur Dioxide: a colorless gas that is readily transformed to sulphuric acid mist in the presence of water vapor. Health effects caused by exposure to high levels of SO_2 include breathing problems, respiratory illness, changes in the lung's defences, and worsening respiratory and cardiovascular disease.

STOTEN Science of the Total Environment: an international multi-disciplinary journal for publication of original research on the total environment, which includes the atmosphere, hydrosphere, biosphere, lithosphere, and anthroposphere.

TEEM Terrestrial Environmental Effects Monitoring: a program designed to detect, characterize, quantify, and report on emission-related effects to terrestrial ecosystems and traditional land resources in the Wood Buffalo region. Monitoring results inform stakeholders' decisions.

TEK Traditional Ecological Knowledge: TEK describes aboriginal, indigenous, or other forms of traditional knowledge's regarding sustainability of local resources. TEK refers to "a cumulative body of knowledge, belief, and practice, evolving by accumulation of TEK and handed down through generations through traditional songs, stories and beliefs.

VIC Variable Infiltration Capacity: a large-scale, semi-distributed hydrologic model.

VOC Volatile organic compound: compounds that easily become vapors or gases at room temperature. VOCs are released from burning fuel such as gasoline, wood, coal, or natural gas but also from many consumer products.

WBEA Wood Buffalo Environmental Association: a non-profit organization that monitors the environment of the Regional Municipality of Wood Buffalo in north-eastern Alberta.

WBNP Wood Buffalo National Park: Canada's largest national park established in 1922 to protect the last remaining herds of bison in northern Canada. It is located in northeastern Alberta and the southern Northwest Territories.

WMU Wildlife Management Unit: the Province of Alberta is divided into a series of Wildlife Management Units (WMU). Wildlife within the boundaries of each WMU is managed by the Ministry of Environment and Parks (AEP) according to the regulations established in Alberta's Wildlife Act.

XML Extensible Markup Language: describes a flexible way to create information formats and electronically share structured data via the public Internet, as well as via corporate networks.

8. Technical Annex

This section presents a summary of funded work plans, key deliverables as communicated in the work plans, and the status of the deliverables resulting from monitoring activities implemented in 2017-18. This summary of project status is collated under the following categories: Atmospheric Monitoring, Watershed Monitoring, Biotic Response Monitoring, Wetland Ecosystem Monitoring, Community Monitoring Program, Quality Assurance/Quality Control, and Data Management.

The information presented in this section of the report was provided and reviewed for completeness and accuracy by the project leads representing the respective OSM project delivery organizations.

Long-Term Monitoring – Surveillance		
Oil Sands Monitoring Activities	Key Targets (specific commitments for 2017-18)	Status (states whether deliverables were met fully, partially or not at all) Deliverables (demonstrates what was delivered relative to commitment)
Atmospheric Pollutant Active Monitoring Network	– Operate and maintain continuous monitoring stations and integrated samplers – Produce quality assured near real - time data from continuous monitoring, available online – Produce regular data reports from the previous year's data collection	– Deliverables partially met – One industry operated station is awaiting transfer to PRAMP; otherwise stations operated with an uptime greater than 90% on a monthly basis. – Hourly data is available for all operating ambient monitoring stations online via Airshed websites (WBEA, LICA and PRAMP) with all quality assured data submitted to the Alberta Air Data Warehouse. – Monthly reports have been submitted to AEP are also available on Airshed websites.
Atmospheric Pollutant Passive Monitoring Network	– Operate and maintain passive monitoring stations in Cold Lake region and Peace River complex. – Provide validated data to AEP in electronic format	– Deliverables partially met – Data has been received from all stations, however not in electronic form to AEP as PRAMP has not yet taken over passive monitoring for the Peace River complex. – Data from Cold Lake and Peace River passive monitoring programs has been provided to AEP.
Atmospheric Pollutant Deposition Monitoring Network – to Forest	– Conduct air and deposition monitoring on a regular schedule	– Deliverables met – Air and deposition monitoring occurred as planned

Ecosystems	– Maintain and calibrate sampling equipment and site infrastructure – Analysis of samples for a range of pollutants – Provide access to data via WBEA website. – Validate technology and sampling procedures for remote sample collection/deployment	– Calibration of sampling equipment and maintenance of site infrastructure completed – Samples analysis completed – Data available and accessible via WBEA website. – Technology and sampling procedures for remote sample collection/deployment validated – Completed reports are available online via WBEA website – Metadata maintained by data management system
Meteorological Network	– Operate and maintain meteorological monitoring stations and infrastructure – Provide and maintain meteorological data and meta-data via the WBEA website	– Deliverables met – Infrastructure is well maintained – Quality control of data routinely conducted – Real time meteorological data accessible via WBEA website
Atmospheric Pollutant Deposition Monitoring - Lakes and Snowpack	– Laboratory analysis of snow and lake sediments – Data analysis, evaluation/interpretation – Publication on “Spatial and temporal patterns in trace element deposition in the Athabasca oil sands region (Alberta, Canada)” – Publication on “Sources of methylmercury to snowpack of the Alberta Oil Sands Region: A study of in situ methylation and particulates”	– Deliverables met – Analysis of snowmelt samples and lake sediment cores were completed with data comparison ongoing – Publications completed and published in Environmental Research Letters and Environment Science and Technology
Surface Water Quantity Monitoring - Water Levels and Flows	– Operation and maintenance of Water Survey Canada hydrometric stations – Initiate planning, design, and construction of hydrometric infrastructure to support monitoring activities	– Deliverables met – 31 stations have undergone infrastructure upgrades to comply with Water Survey of Canada standards – Operation of Maintenance and Hydrometric stations completed and data available via Water Office and Water Survey of Canada’s Data Mart
Surface Water Quality Monitoring (AEP)	– Water sample collection, submission, and analysis from mainstream	– Deliverables met – All long term mainstream and tributary river water quality stations sampled

	Athabasca River stations and tributary river stations – Review data for quality	– Field results have undergone quality control and are saved
Groundwater Monitoring	– Field sampling and lab analysis of groundwater samples – Archive results in AEP database system	– Deliverables partially met – Groundwater stations monitored for water levels and water quality – Field sampling delayed due to delays from 2016/17 sampling, limited staff capacity and site access – Data upload pending validation
Regional Terrestrial/Aquatic Monitoring - Status and Trends	– Submit lists of invasive species, weeds, and species at risk indicating the number of sites they were observed in – Update SOPs for processing bryophytes, vascular plants, and mites and springtails – Submit scientific publications to journals	– Deliverables partially met – Lists in Excel files submitted – Five SOP were updated (processing Lichens, processing Bryophytes, processing Vascular Plants, processing Aquatic Inverts, Camera Trap Processing Protocol 2016-06-02). – Publications produced. Azeria, et al. Plant functional traits as indicators of recovery of certified well sites. March 31, 2018. (Presented at the North American Congress for Conservation Biology). Van Wilgenburg et al., 2017. Paired sampling standardizes point count data from humans and acoustic recorders. Published in Avian Conservation and Ecology, 12(1):13.
Regional Habitat Disruption Monitoring - Status and Trends of Footprint	– Public release of acquired geospatial human footprint and landcover data – Reports on activities in the oil sands region for human footprint and land cover for 2016	– Deliverables partially met – Reports for 2016 still in progress – Public release of 2016 human footprint and land cover at 3x7 km plots and provincial extent available online. – Sample-based (3x7 km) HF for 2016 - available online. – Reports on wall-to-wall human footprint – available online – Seismic line recovery – available internally. – Mapping of a sample-based very detailed photo-plot landcover dataset updated in 2016-2017.
Focal Plants Monitoring	– Complete surveys on persistence of historic plant populations – Complete assessment on the mitigation effectiveness of plant	– Deliverables met – Surveyed 20 historic rare plant populations in 2017, focusing on more heavily disturbed sites on oil and gas lease areas to better assess the relationship between high footprint and population persistence. Of these 20,

	translocation and rare plant detectability – Synthesize existing information on rare plants into an online plant atlas	only two sites had reported absences of the target species. – Mitigative translocations visited for a final monitoring year in 2017. Results were similar to previous years, i.e. high survivorship. Sarracenia purpurea survival is approximately 90% and approximately 80% for Carex oligosperma. The first detectability project, "Investigating detection success: lessons from trials using decoy rare plants", was submitted to Plant Ecology in October, 2017 and is in review. The second detectability project, using Carex as a model group for investigating imperfect detection in graminoids, is expected to be submitted for publication." – Digital data collated and organized to populate content of atlas or atlas products. Online plant atlas available at http://www.ace-lab.org/atlas.php

Long-Term Monitoring – Effects		
Oil Sands Monitoring Activities	Key Targets (specific commitments for 2017-18)	Status (states whether deliverables were met fully, partially or not at all) Deliverables (demonstrates what was delivered relative to commitment)
Quantifying Risk from Oil Sands Mining to Endangered Whooping Cranes	– Number and location of crane nests, crane young at and near WBNP determined via aerial surveys – Juvenile cranes marked with satellite transmitters and GPS locations of marked individuals collected during breeding and fall migration. – Re-sight marked cranes in SK through ground-based surveys – Draft annual operational report	– Deliverables met – Aerial surveys determined location of 98 nests (May) and 63 hatched young (July). – Captured, branded and deployed transmitters on 10 juvenile cranes. – Monitored banded cranes via satellite telemetry during breeding (N=7; banded prior to 2017) and fall migration (N=11; 6 banded in 2017, 5 banded previously). – Ground-based surveys in SK re-sighted 23 cranes with transmitters (6 banded in 2017, 17 banded previously). – Draft annual operational report, including cumulative results, completed and available upon request
Biotic Response to Habitat Disturbance of	– Design and implement field data collection for 2017-18 status and trend	– Deliverables met

Focal Wildlife	monitoring of old forest land birds; wetland-associated birds and other vocalizing species, and cause-effect monitoring program. – Complete field data collection for bird status and trends, and cause-effect monitoring. – Integrate bird data collected by automatic recording units and human observers – Analysis of cause-effect monitoring, and status and trend data – Finalize and publish reports – Assess methodological improvements	– Study designs reviewed and field sites selected with sampling in Lower Athabasca, Peace River and Cold Lakes. – All surveys completed, and processing of waterfowl Automatic Recording Unit (ARU) data to integrate with aerial surveys completed. – Advancements made to integrate ARU and human point count data. – Regional status of four species at risk assessed; empirical trend estimates for land bird species determined and released. – Nineteen manuscripts from this project have been prepared and submitted. – Methodological improvements published in numerous publications in 2017-18.
Biodiversity Monitoring of Benthic Macro Invertebrates	– Prepare/organise all field logistics, equipment maintenance, contract preparation, training etc. – Analyse, verify and validate previous years' data – Projected to collect up to 15 sites from tributaries in the Birch Mountains, up to 40 sites from major tributaries in the OS mineable area, and up to 12 sites from the Athabasca River Mainstream – Process and prepare samples for analysis	– Deliverables met – All contracts and logistics planned in place for fall sampling, training session provided in Alberta in July 2017 to over 10 students. – Benthic samples from previous year analyzed and validated; master files created and compilation of all supporting data underway. – A total of 47 tributary sites were sampled in and around the OS mineable area in Sept 2017 – A total of 8 tributary reference sites were sampled in the Birch Mountains area – A total of 11 from the Athabasca River Mainstream were sampled – Samples were processed and prepared, and analysis completed.
Biotic Response of Ungulates to Oil Sands Activity	– Submit data and reports to FWMIS – Identify priority Wildlife Management Unit (WMU) and draft work plan for program delivery. – Conduct WMU surveys	– Deliverables partially met – Project staff reassigned in Q1, will complete data and report submission in 2018-19 Q2. – Weather and snow conditions were not favourable to complete all WMU surveys.

	– Data entry and processing	– WMU 256, and 501 deferred to 2018-19 – All other deliverables completed
Fish Health Monitoring	– Prepare/organize all field and lab logistics, training and planning – Temperature recorder deployment and fish sampling in Peace River area – Assessment of fish tissue contaminant levels and presenting histological assessment at Fort Chipewyan – Presentation and publication of live tumor assessment as part of PADEMP meeting	– Deliverables met – Temperature recorders were deployed at all sites where fishing sampling was conducted. – All fish samples collected on schedule and all sample analyses completed. – Data on liver tumor work is being prepared for publication. – Large bodied fish results submitted for a conference presentation. – Presentation of live tumor assessment was prepared for presentation at PADEMP meeting; meeting was delayed by meeting organizers.
Monitoring Targeted Biodiversity	– Acquire and process field data (off-grid) for new field (species and habitat) data as per the 2017-18 Monitoring Plan, following Standard Operating Procedures.	– Deliverables partially met – Data collection included 12 off-grid terrestrial sites and 12 off-grid wetland sites – Field data: Publicly released via abmi.ca of field data from all sites acquired and processed in 2016-17. Data delays include the delivery of the 2016 Lichen and Moss data which will be available in 2018. Remote camera data is available by request. – Field data: Acquired and processed (on-grid/off-grid) – The project received conditional approval from OSM co-chairs via letter on April 21, 2017. – The Grant Agreement between AEP and ABMI for this project was executed on December 20, 2017. – Publication: Hird J.N., DeLancey E.R., McDermid G.J., Kariyeva J. (2017) “Google Earth Engine, Open-Access Satellite Data, and Machine Learning in Support of Large-Area Probabilistic Wetland Mapping.” Remote Sensing, 9(12): 1315
Acid Sensitive Lakes Monitoring	– Prepare sampling plan and schedule – Sampling and biogeochemical analysis of 50 acid sensitive lakes	– Deliverables met – Water samples collected at all lakes and sent to analytical labs for measurement.

	– Review and compare field data and lab results to previous years to check for significant changes in lake water chemistry – Complete draft technical report	– Review and comparison of field data and lab results to previous years for significant changes in lake water chemistry was completed; findings discussed in technical report. – Draft technical report summarizing limnology of the 50 lakes has been completed and circulated to scientists within EMSD and ECCC for review and input.

Community Monitoring Program		
Oil Sands Monitoring Activities	Key Targets	Status (states whether deliverables were met fully, partially or not at all) Deliverables (demonstrates what was delivered relative to commitment)
Strengthen Community Reporting of Odours - Ambient Air Odour Study	– Participate in AER/AEP/ECCC Fort McKay Community Odour Recommendations meetings – Design and implement Community Odour Monitoring Program (COMP) for communities in Regional Municipality of Wood Buffalo (RMWB) – Develop and implement a Reduced Sulphur Compounds (RSC) monitoring program at selected Air Monitoring Stations (AMS) sites – Maintain collection, processing, validation and reporting of COMP and RSC sample data and meta-data into Wood Buffalo Environmental Association (WBEA) data management system – Integrate COMP and RSC data with available ambient air monitoring data	– Deliverables met – Participated in monthly Fort McKay Air Quality and Odour Advisory Committee meetings. – The Community Odour Monitoring Program was designed and implemented in the Regional Municipality of Wood Buffalo by WBEA. The results of this program are at http://wbea.org/wp-content/uploads/2018/05/comp_app_report_february_12_2018.pdf. – Sampling using absorbent tubes for RSCs took place at Bertha Ganter – Fort McKay and Mannix Air Monitoring Stations. Data from this monitoring is maintained by the WBEA data management system.
Acute Odour Monitoring Network Pilot Study	– Modify WBEA notification system to allow reporting against defined alert levels	– Deliverables met – The monitoring equipment was installed in the portable station and the notification system modified to provide alerts

	– Install portable station at Oski-ôtin location. – Operate and calibrate emergency response stations and provide 5-minute and 1-hour data on WBEA website – Report and track ground level ambient air concentration exceedances of the AAAQOs in real time – Maintain collection, processing, validation and reporting of all air quality data and associated meta-data – Develop methods and technology for odour identification and quantification	– The WBEA portable station (Waskow Ohci Pimatisiwin station) was installed in early July in Fort McKay – The station was operated by WBEA and 5-minute and 1-hour data is available on WBEA's website – Exceedances of AAAQOs are provided to AEP and other stakeholders immediate after being measured at the monitoring station. – The data is collected and reviewed by WBEA and maintained in WBEA's data management system. –
Community-Based Fish Monitoring Pilot Project	– Establish working groups and work plans in the 3 regions – Athabasca, Cold Lake and Peace River regions – Field sample collection and data analysis – Development of analytical model that combines qualitative and quantitative results that "bridges" Indigenous and western knowledge systems – Video documentation and reporting back	– Deliverables partially met – Working group established for Cold Lake project including staff from EMSD, researchers from University of Saskatchewan, and staff from Cold Lake First Nation. – Being year one of a three-year project, efforts in 2017/18 focused on relationship building through training and western science data collection. It will take time to get to a stage where Indigenous and scientific knowledge can be "bridged" using analytical models – Video documentation not completed due to limited staff capacity
Community Led Berry Contamination Study	– Site identification and community interest confirmation in Fort McKay, Moose Lake – Expansion of project to other Indigenous communities/organizations in the area – Lab analysis of samples and community meetings with Elders – 5 year study review and community open house to present 5 year study result	– Deliverables partially met – Fort McKay First Nation completed annual berry collection routine with new equipment installed at 1 existing site and confirmation of interest in Fort McKay and Moose Lake sites – 3 new communities/organizations participated and collected berry samples for analysis – Community open house held in March 2018 – Health promoting compounds and trace elements analysis on berries completed for 4 communities. NO_2,

	– Draft data, community report for publication, peer review	O_3, SO_2, and VOC passive monitoring completed for Fort McKay sites. – Interviews with elders conducted – Draft report delayed due to substantial effort in data collation; Expected by end of July 2018.
Environmental Monitoring Technician Training Program Pilot	– Confirm program schedule and logistics – Deliver five modules – Conduct student and instructor survey – Pilot report	– Deliverables not met – Due to unexpected staff departure pilot training program could not be implemented
Culturally Important Wetland Plants	– Community workshop and interviews with community members on wetland plant importance – Site tour to potential wetland study sites across the Athabasca and Peace regions – On-site safety and protocol training of select individuals from each community – Potential sampling at sample sites, analysis and reporting – Produce project report and host 4 community open houses	– Deliverables partially met – 2 Indigenous communities/organizations participated in this project in the Athabasca region, 3 began work in the Peace – All 5 communities participated in workshops and interviews on wetland plant importance – Site tours were conducted and Indigenous Knowledge was shared and documented. Participating groups did not identify requirement to collect samples at this point and therefore safety training was not required. – A shared community open house was hosted by Fort McMurray First Nation on March 28, 2018 – Community and project reports are expected to be released in September of 2018

Focused Study: Program Design including Method Development		
Oil Sands Monitoring Activities	Key Targets	Status (states whether deliverables were met fully, partially or not at all) Deliverables (demonstrates what was delivered relative to commitment)

Method Comparison of Wet Precipitation (Comparison of NADP vs WBEA sampling protocols)	– Collect weekly precipitation samples at Bertha Ganter – Fort McKay AMS – Receive and maintain records of weekly ion concentration – Maintain collection, processing, validation and reporting of sample data and meta data into WEBA data management systems	– Deliverables met – Precipitation samples collected weekly and NADP sample analysis results are received by WBEA – A preliminary evaluation of the data comparing the two laboratories and methods has been completed. Based on this analysis, it was determined that the monitoring protocol needs to be adjusted and additional data needs to be collected to complete the comparison study.
Atmospheric Process Study - Deposition and Effects	– An interim report will document project progress including implementation of activities, sample collection, sample and data analysis, publications, presentations, and submissions to the data portal.	– Deliverables met – Interim reports submitted; papers on the work published or in advanced preparation.
Ambient Air Monitoring Network Optimization	– First draft of technical report on network assessment of current monitoring data using clustering analysis – First draft of removal bias analysis report – Draft of overarching monitoring questions – Stakeholder meeting summarizing results of previous network analysis.	– Deliverables met – Report was prepared "Draft Methods and Techniques for Ambient Air Monitoring Network Optimization in the Oil Sands Region of Alberta" – Initial monitoring questions / objectives were prepared for the oil sands ambient air monitoring network – Technical stakeholder meeting held in February 2018
Atmospheric Process Study - OS Air Pollution, Emissions, Transformation and Fate	– Science plan for airborne measurements, laboratory studies on oil sands pollutant transformation – Emission data compilation and synthesis – Remote sensing of air pollutants and air quality model prediction and application – Laboratory studies on oil sands pollutant transformation	– Deliverables met – The science plan and flight plans were published and distributed – Aircraft was fully instrumented and test flights completed prior to April 1, 2018 – While data analyses from 2013 field campaign still continue, 15 scientific papers using data from that campaign have been published, submitted for publication or in advance preparation through the fiscal year – Interim progress reports available

Atmospheric Process Study - Enhanced Ground-Based Monitoring - Oski-ôtin Monitoring site	– Deliver specific instrument weekly and final updates, LIDAR ozone profiles and LIDAR aerosol daily curtain images to the data portal – Data collection for column NO_2, SO_2 and Aerosol Optical Depth – Greenhouse gas data delivered to data portal – Interim reports prepared	– Deliverables met – LIDAR Ozone and LIDAR aerosol profile postponed (ozone data analysis software is still being written and evaluated) to Q1 of next year. – Validated total NO_2 column data between August 2016 and December 2017 is available. SO_2 total column data are not available due to ongoing work on algorithm improvement – Final 2016 measurements of CO_2 and CH_4 collected at Oski-ôtin have been posted to the Canada-Alberta Oil Sands Environmental Monitoring Information Portal.
Integrated Deposition Monitoring Design	– Plan and organize webinar series – Plan and organize workshop – Post and update deposition study SOPs – Workshop report; literature review report	– Deliverables met – Webinars held on May 25 and June 6, 2017 – Workshop held in Toronto on September 27 and 28, 2017; Draft workshop report prepared – List of relevant SOPs updated, additional deposition SOPs received – Literature review paper prepared and reviewed internally
Develop Methods to Measure Tailings Ponds Emissions	– Study design and safety training and obtain permits to conduct field measurements. – Site preparation for instrumentation and field work at Suncor tailings pond site – Continued data analysis and reporting of field data	– Deliverables met – Data sharing agreement signed June 22. – ECCC field measurements were conducted and site was maintained by ECCC with support from Suncor, AECOM and AEP – Data analyzed, uploaded to common website for partners to access
Boreal Caribou Census Through DNA Estimates	– Organize laboratory analysis and ship caribou DNA samples to Trent University – Prepare summary report of caribou range surveyed – Draft Request For Quotes to select air charter companies for surveys – Caribou fecal DNA surveys (weather permitting)	– Deliverables met – Laboratory analysis of Caribou DNA samples completed – Summary report of caribou range surveyed prepared – Quotes obtained from select air charter companies for surveys – Caribou fecal DNA surveys completed Data entry and processing completed

	– Data entry and processing	
Biotic Health and Biodiversity Monitoring (method development to establish a long-term monitoring design)	– Recruit scientist – Prepare an annual report	– Deliverables not met – EMSD was unable to recruit one or more qualified scientist to complete the project
Forest Health Monitoring Program Design Review	– Complete annual Forest Condition Assessments at Forest Health Monitoring (FHM) sites. – Catalogue existing FHM datasets into WEBA data management systems – Maintain program management and produce draft technical report – Public access to FHM data via WEBA website	– Deliverables met – Digitization of Forest Health datasets completed – Technical reports completed and reviewed – Project proposal for the integration of the FHM database with the WBEA website has been initiated with a project kick-off scheduled for early April – Second manuscript, "Source Apportionment of an Epiphytic Lichen Biomonitor to Elucidate the Sources and Spatial Distribution of Polycyclic Aromatic Hydrocarbons in the Athabasca Oil Sands Region, Alberta, Canada," submitted to *Science of the Total Environment*.
Develop an Accredited Standard Method for Quantitative Analysis of Naphthenic Acids Concentrations	– OSPW sample collection and characterization – Oversight of collection and sub-sampling of required source waters being collected by COSIA for the development of CRMs – Continue characterizations of bitumen-influenced samples collected in 2017/18 – Complete sub-sampling of required source waters for the development of CRMs	– Deliverables met – OSPW reference material is being analyzed and characterized by internal ECCC laboratory – Laboratory in Burlington is set up and being used for extraction of OSPW CRMs. – Collection of required OSPW source waters complete (10 ponds). – OSPW reference material analysed/characterised for use in early summer 2018. – NPRI consultation document is out for review and discussion. ECCC scientists and SRAD staff to hold technical meeting with Canadian Association of Petroleum Producers and Mining Association of Canada to discussion current progress of analytical methodology for NAs in early April 2018.

Develop Quantitative Methods to Monitor Tailing Pond Seepage	– OSPW sample collection and characterization – Toxicological characterization – Drafts of publication(s) related to 1st tier fractionation and associated characterization of bitumen-influenced waters collected – Oversee collection and sub-sampling of required source waters collected by COSIA for the development of CRMs – Characterization of bitumen-influenced samples collected for CRMs – Prepare publications	– Deliverables met – Sample collection of OSPW completed, characterisation of bitumen-influenced samples ongoing. – Two publications on OSPW seepage methodology have been drafted and co-author input is being integrated. – Drafts of publication(s) related to 1st and 2nd Tier fractionation and associated characterization of bitumen-influenced waters completed (4) and others ongoing.
Representative Sub-Basin Studies - Ells and Steepbank Rivers (REPs)	– Process periphyton samples and send for isotope analysis – Process stone samples – Process nutrient diffusing substrate samples for chlorophyll and ash-free dry mass – Process scour pad and depositional sediment – Process bulk kicknet samples for invertebrates	– Deliverables not met – Funding was not received – Deliverables deferred for 2018-19
Assessment of GW Monitoring - Towards a Comprehensive GW Monitoring Strategy/Design	– Literature review and data compilation – Define methodology for assessment/analysis and data gap assessment – Analysis & draft report preparation – Report completion – Presentation of results at meeting	– Deliverables partially met – Accessible data acquired has been compiled, georeferenced and stored in GIS framework – Delays due to staffing position delays – Report in preparation with expected release after fiscal year end – Participation in the Wetland Monitoring Integration Workshop
Design of Deltaic Wetland Ecosystem Health Monitoring Program	– Completion of GPS and bathymetric surveys of wetland monitoring sites – Field work and biomonitoring at 10 PAD sites	– Deliverables met – Surveys and sampling completed on schedule. – Processing of data and analysis of PAD macro benthos and DNA data.

	– Process hydrological and geophysical data to support biomonitoring components of the study – Preparation of manuscript on probabilistic ERA. – Review of seasonal/interannual variability in PAD macro benthos and diatom communities	– A manuscript on the preliminary diatom monitoring work was completed and published in the open access journal PeerJ. – Analysis of PAD macro benthos and DNA data is ongoing, and a draft report was prepared for year-end.
Remote sensing wetland ecosystem change detection method development	– Planning of field campaigns at Technical workshop in Edmonton. – Field data collection – LiDAR classification, data processing and data validation – Writing journal article and annual report	– Deliverables not met – Initial delay in work plan approval and granting delays due to internal processing issues.
Wetland Ecosystem Monitoring	– Site selection and reconnaissance of new and existing monitoring sites – Conduct field monitoring of the effects of hydrologic alteration to fen ecosystems, bog ecosystems – Conduct field monitoring and develop indicators for wetland monitoring – Workshop and OSM LTM annual report	– Deliverables partially met – Grants not executed due to internal processing delays. – Partial site-selection was conducted for new and existing sites for AEP-led wetland monitoring.

Focused Study: Investigation of Cause		
Oil Sands Monitoring Activities	Key Targets	Status (states whether deliverables were met fully, partially or not at all) Deliverables (demonstrates what was delivered relative to commitment)
Ambient Air Quality Surveillance: Beaver River Valley	– Collect meteorological data using existing calibrated instruments – Produce monthly data summaries – Report on frequency and meteorology associated with valley flow drainage	– Deliverables not met – Meteorological stations have not been set up by LICA as per project plan and no data has been produced – Plans have been made for the acquisition and deployment of meteorological equipment during the summer of 2018.

Atmospheric Deposition - Identification of Sources of Contaminants in Snowpack and Lake Sediments	– Lab analyses of source materials and existing and new sample extracts for PACs in OS snow and sediment cores – Publication reporting on determination of novel PACs in environmental media previously analyzed for conventional PACs – Presentations at SETAC North America – Analysis of dated sediment cores of paleo-limnological data, chlorophyll *a*, PACs and mercury	– Deliverables met – All lab analyses completed and verified data submitted to the Canada-Alberta Oil Sands Environmental Monitoring Information Portal. – Presentation done on November 2017 – Manuscript preparation underway to report on spatial trends of novel PACs in snow.
Monitoring Benthic-Macro Invertebrates: Investigation of Cause of Nutrients Signatures in the Athabasca River	– Prepare/organise all field logistics, equipment maintenance, contract preparation, etc. – Water, SPMD and sediment chemistry analysis, metabolomics and stable isotope analysis, benthic processing – Preparation of progress reports	– Deliverables met – All sampling on schedule with Benthic-Macro Invertebrates sampled at 6 sites. – Samples analyzed for end of fiscal delivery. – Progress reports prepared and metabolomics data will be part of a conference presentation at the annual meeting of the Metabolomics Society in June 2018.
Colonial Water birds Monitoring: Temporal and Spatial Patterns in Mercury Levels in Gull and Tern Eggs and Possible Underlying Factors	– Prepare/organize all field and lab logistics. – Sample collection, processing and analysis, data acquisition, planning – Prepare progress reports – Prepare manuscript on spatial trends	– Deliverables met – All egg samples were processed and prepared for chemical analysis – Data analysis and interpretation continue with a focus on explaining temporal trends in egg mercury (Hg) levels. Utility of Hg isotopes in understanding Hg dynamics is being investigated. Permit reporting completed. – Manuscript published in Environmental Toxicology and Chemistry
Wildlife Contaminants and Toxicology: Investigation of Pathophysiological Effects	– Equipment maintenance, contract preparation, planning, etc. – Sample preparation and analysis, data acquisition and data reporting – Progress reporting	– Deliverables met – All sample analysis on schedule with data generated for PACs and metals (including Hg) – Summary reports were provided to collaborating Indigenous communities and other stakeholder groups.

		– Five OSM related papers published; three more OSM related papers in preparation
Amphibian and Wetland Health: Investigation of Wetland Ecosystem Health	– Field work in northern Alberta and the Peace-Athabasca Delta – Preparation of samples for analysis: water, tissues, SPMD and sediments – Analysis of sampled for toxicity endpoints and biomarkers of exposure. – Progress reporting	– Deliverables met – All field work and preparation of samples for analysis conducted; further, there was analysis of samples for toxicity endpoints and biomarkers of exposure. – Progress reporting is complete; manuscripts are in review with co-authors or in the peer-review process in various scientific journals. An additional manuscript outlining the findings associated with SPMD extract laboratory exposure studies is drafted from data generated in 2017/18.
Correlation of Anthropogenic Stressors with Changes in Water Quality (Tributary Systems)	– Calculate loads for key parameters during rain events. – Undertake statistical analysis to compare loads of key parameters – Load calculations for total nutrients and total metals and analyze variability in contaminant concentrations – Draft manuscript on contribution of seasonal events to annual contaminant loads – Complete assembly of integrated data sets containing all water quality constituents (nutrients, metals, ions, PACs)	– Deliverables met – Analyses of differences in chemical loads between reference and impacts sites are complete. Results are being examined and organized for presentation in a scientific paper – Data set containing most water quality constituents has been posted on Canada-Alberta oil sands environmental monitoring portal
Waterfowl Effects-based Assessment	– Conduct analysis, hierarchical modeling, grid and wetland level – Final report preparation	– Deliverables met – Grant executed in Q2 – Hierarchical modeling, wetland level, and hierarchical modeling, grid level, started in Q2 due to delayed Grant Agreement – Final report completed - Assessment of Correlations between Duck Pair Abundance and Breeding Success and Increasing Intensity of Oil Sands Related Habitat Change

Focused Study: Establishing Reference Conditions		
Oil Sands Monitoring Activities	Key Targets	Status (states whether deliverables were met fully, partially or not at all) Deliverables (demonstrates what was delivered relative to commitment)
Airborne GHG Emission Measurements (NASA-NOAA)	– Complete field work during scheduled flight windows in May, June, August, September and November with preparation of data sheets of measured emission rates – Analyze flask air samples – Final project report and data sheet	– Deliverables partially met – Flights were postponed due to delayed preparation of agreements and safety concerns, and no data was collected in May-July. Flights were undertaken in August and October – Data sheets showing methane and CO_2 emission rates for completed flights were provided to AEP to stakeholders – Analysis of flask samples is complete and data is available to stakeholders
Development of Study and Sampling Design for Establishing Reference Condition of Benthic Biodiversity in Peace and Cold Lake Oil Sands Areas	– Evaluation and reconnaissance of streams and habitat types in the area and initial field sampling in sub basins identified the Peace River and Cold Lake Oil Sands Area – GIS contract deliverables review – Processing and preparation of samples for analysis	– Deliverables met – Project approved in Q2 and initial planning conducted in Q2. – Reconnaissance of streams and habitat types was conducted by map and onsite visits for over 25 sites in Peace River and 20 sites in Cold Lake Oil Sands Area – GIS contract analyses were delivered. – Samples collected at 3 tributary sites in the Peace River oil sands area – Samples currently being analysed and on target for end of fiscal delivery.
Monitoring Fish Communities	– Establish fish trap/fence at Muskeg River for fish study (fish species, length, weight) and fish tagging following spawning – Data QA/QC and initial comparison with data from previous years. – Hiring fish biologist to support fish biodiversity monitoring program and fish health program	– Deliverables not met – Project was not initiated - no funds expended

	– Work planning for core fish biodiversity monitoring for 2018-19	

Data Management, Evaluation and Reporting		
Oil Sands Monitoring Activities	Key Targets	Status (states whether deliverables were met fully, partially or not at all) Deliverables (demonstrates what was delivered relative to commitment)
Standard Operating Procedures for Monitoring - Collating and Auditing	– Publication of ISO 17025 summary requirements for analytical labs – Consolidated air SOPs and selected scientific publications on standards and quality – Selected scientific publications on standards and quality –	– Deliverables partially met – ISO 17025 summary prepared, reviewed, finalized and posted in July 2017. – Overlapping air SOPs identified and held discussions with relevant airsheds regarding SOP consolidation. This component has been incorporated into the 2018-2019 work plan as part of multi-year effort as directed by the OSM co-leads. – The following Standards and Quality related reports posted: – 2015-2016 Certified Reference Material Inter-Laboratory Study report posted in August 2017. – CALA-SCC Scope of Accreditation for Analytical Labs posted in July 2017. – Drafted trend analysis report for ambient air quality prepared and circulated for internal review. – Draft Ozone data quality investigation report prepared.
AEP Data Management System & Portal	– Data importing capabilities, standardization of data importing process – Metadata descriptive structure – QA/QC standards and validation protocols	– Deliverables partially met – Segregating medias and has been met for the OSM Water Quality but is ongoing for the other medias within this project – Metadata standards have been agreed upon; parameters need to be vetted

	– Delineation of roles and responsibilities – Water quality SOPs – design and implementation of education/training – User acceptance testing	– Working through validation of QA/QC protocols – Delineation of roles and responsibilities has been outlined and agreed upon for the OSM Water Quality media but is ongoing for other medias within this project – Water quality SOPs – design and implementation of education/training has been allocated to the Standards and Protocols group – Implementation (including user acceptance testing) on new system deferred to Q2 18/19 due to system and services contract negotiation with the vendor
AEP Asset Management System	– Assess and conduct inventory – Plan, build, asset management execution, configuration, administration and security workshop, executive reports and dashboards workshops – End user training, implementation, adoption and post implementation review.	– Deliverables partially met – Asset inventory completed – Plan, build, configure and hold workshop has been completed. Executive reports and dashboards workshops are yet to be completed due to the delay in the acquisition of licenses and delaying system implementation – End user training, implementation, adoption and post implementation review has been deferred due to the delay in the acquisition of licenses and delaying system implementation
AEP Data Management Program	– Water quality specific process and data maps throughout the OSM data process life-cycle, across all data management stages – Standardize data format for water quality to be adopted by providers – Create AEP/EMSD OSM water quality data catalog and data inventory – Implement procedures, processes, SOP's, research for data visualization and public data availability	– Deliverables partially met – Processes have been mapped and governance completed – Development of mature standard template deferred to standards and protocols monitoring group – Research for data visualization is deferred and will be addressed in the 2018-19 road map; Public data availability is deferred to 2018-19
ECCC Data Publishing and Improvements to Standardization, Storage and Master	– Ensure ECCC OSM portal remains operational; implement processes to Extract, Transform and Load (ETL)	– Deliverables met – Continued, monthly releases of ECCC OSM data – Working with AEP, completion, update and migration of ECCC Monitoring Site metadata into an OGC

Data Management	data into Open Geospatial Consortium (OGC) standards – Upgrade data access tools and interface to improve sharing and usability to newly standardized ECCC OSM data products – Work with Alberta Environment and Parks (AEP), provide access to ECCC OSM metadata from ECCC's data catalogue in ISO/OGC standardized formats and enable linking to partner federated data from ECCC managed portal	SensorML/TimeseriesML profile, including development of automated ETL workflows was – Completed an initial assessment, modeling and data quality criteria of source Water Quality Data Warehouse against the OGC TimeseriesML standard. – Completed a version 1.0 data previewer/downloader for Open Geospatial Consortium (OGC) XML format data, and began definition of requirements for future versions – Testing on access to AEP collaborative working environment completed and reported to Secretariat and Work Planning for 2018-19 conducted with AEP, including harmonizing deliverables toward a shared data platform.
Import RAMP Data to AEP Data System	– All RAMP monitoring data are repatriated to AEP's data system – AEP maintain the RAMP public web site until AEP/EMSD develops an alternative public web site for providing public access of all OSM monitoring data. – Develop recommendations on how the migrated data could be fully discoverable and searchable by utilizing appropriate metadata	– Deliverables met – 14 documents were created to summarize all of the programs/data collected under the historical RAMP monitoring. – Hatfield provided the metadata document that outlined all of the RAMP monitoring – RAMP public website was migrated over to EMSD/AEP and is now maintained by EMSD – The historical RAMP data was provided to EMSD via MySQL database, which also serves as the data sources for the RAMP public website
AEP Portfolio/Project Management System	– Implement project management system as detailed in work plan	– Deliverables partially met – System under redesign
OS External Collaboration System	– Plan, configure, setup, test and deploy a secure centralized collaborative shared repository	– Deliverables met – Secure centralized collaborative shared repository was deployed as planned
Develop Environmental Predictions Framework	– Calibration of hydrological models in Athabasca River region – Plan and organize modelling workshop – Extension of Lower Athabasca River bathymetry between Firebag River and Old Fort	– Deliverables partially met – Comprehensive documents on Integrated Environmental Modeling for Cumulative Effects Assessment has been drafted along with a predictive modelling framework for Lower Athabasca river basin

		– The VIC hydrological model has been re-configured with a finer grid, 2~3 km resolution for the modelling domain and additional snow related parameters were added for model calibration and validation. Model was also updated with additional available data. The updated model was re-calibration and validation at 19 flow monitoring locations (main stem and tributaries). – Athabasca River bathymetry is extended between Firebag River and Old Fort and the extended bathymetry between Firebag and Old Fort was merged with the previous bathymetry between Fort McMurray and Firebag to create one signal DEM for the Lower Athabasca River. – The planned modelling workshop under this project was deferred to next year. OSM Program is organizing several integration workshops in 2018-19 across several thematic areas. One of the thematic area is "predictive modelling".
Big Data Environmental Analytics - Integrated Geospatial Environmental Analytics of OSM Data	– Geospatial analysis of environmental data to identify trends, patterns and "hot spots" and analyses of variation patterns	– Deliverables met – Water quality data collected under former Regional Aquatic Monitoring Program (now amalgamated to OSM) has been analyzed to detect the trends in certain water quality parameters. The detected trends are being used to understand the spatial patterns and identify the hot spots of trends in the oil sands area. An "R" program has been developed and tested to conduct the trend analysis. – Two manuscripts in process for publication
Reporting Ambient Monitoring Results - Air Evaluation Integration Synthesis and Reporting - Technical Audience	– Inception workshop (or series of webinars) to set strategy, structure, content and timeline for the report. – Drafting of report sections by experts. – First draft of the report available to group for review.	– Deliverables met – The report was submitted to the Oil Sands Secretariat – A second work shop was deemed not necessary as ongoing work on the report and communications were able to proceed effectively remotely by email and teleconferences. – Final manuscript "Air Synthesis Review: Polycyclic Aromatic Compounds in the Oil Sands Region"

	– Second workshop to finalize the report content and key messages; Revision and finalization of report.	submitted to the journal *Environmental Reviews* by the financial end.
Reporting Ambient Monitoring Results - Watershed Evaluation and Integration	– Complete and finalize technical reports and synthesis reports for external review – Submit externally reviewed technical and synthesis reports for publication on government websites.	– Deliverables met – Proofs of the technical reports reviewed by the authors. All reports with the exception of the water quality mainstream completed and submitted to AEP and ECCC management. – Water quality mainstream report was prepared and submitted in June 2018
Reporting Ambient Monitoring Results - Ecosystem Health Integration	– Recruit scientist to undertake ecosystem health integration and reporting – Preparation of synthesis report	– Deliverables partially met – Due to inability to recruit required staff in a timely manner, deliverables were partially met. – A Synthesis Report: Effects of Land Disturbance Associated with Oil Sands Development on Biodiversity in Northern Alberta: A Technical Synthesis was completed using funds from previous years held in collaboration with Scientist from the University of Alberta.

9. OSM Publications in 2017-18

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