2023-2024 OSM WORK PLAN APPLICATION

This form will be used to assess the merits of the proposed work plan and its fit with the Oil Sands Monitoring (OSM) Program mandate and strategic priorities. Applicants must complete the form in its entirety. Applicants that fail to use this form and complete all sections in the timeframe will not be considered.

OSM Work Plan Submission Deadline: The deadline for submission of proposed work plans is ***October 31, 2022 at 4:30 PM Mountain Standard time.*** *Late submissions will not be accepted.*	***October 31, 2022*** *4:30 PM MST*
Decision Notification	*Mid to Late March 2023*

Work Plan Completion

Please ***Enable Macros*** *on the form when prompted.*

The applicant is required to provide information in sufficient detail to allow the evaluation team to assess the work plan. Please follow the requirements/instructions carefully while at the same time being concise in substantiating the project's merits. *The OSM Program is not responsible for the costs incurred by the applicant in the preparation and submission of any proposed work plan.*

Privacy: *The OSM Program is governed by the Freedom of Information and Protection of Privacy Act (FOIP) and may be required to disclose information received under this Application, or other information delivered to the OSM Program in relation to a Project, when an access request is made by anyone in the public. Applicants are encouraged to familiarize themselves with FOIP. All work plans are public documents.*

Technical Requirements: When working on this form, please maintain Macros compatibility by always saving your draft and your final submission as a **Microsoft Word Macro-Enabled Document**, failure to do so will result in loss of form functionality**.** This form was created using Microsoft word 2016 on a PC and may not have functionality on other versions of Microsoft on PC or MACS.

Government Lead/Coordinator: All work plans under the OSM Program require either a government lead or a government coordinator. This will ensure that the financial tables (for Alberta Environment and Parks & Environment and Climate Change Canada) are completed accurately for work plan consideration. ***However,*** *if an* ***Indigenous community, environmental nongovernmental organization*** *or any other* ***external partner*** *is completing a work plan proposal, they would* ***only*** *complete the* ***grant or contract budget component*** *of the* ***Human Resources & Financials Section*** *for their project. The government coordinator within Alberta Environment & Parks would be responsible for completing the remaining components of the Human Resources and Financial Section of this Work Plan Application, as they are responsible for contract and grant facilitation of successful submissions. All other sections outside of* ***Human Resources & Financials Section*** *of this work plan proposal are to be completed in full by all applicants.*

Supplemental Materials: *The OSM Program recognizes that majority of work planning submissions are a result of joint effort and monitoring expertise. Should the applicant wish to submit supplemental materials in addition to their application additional resources are available in the Work Planning Package accessible here:* **2023-24 Work Planning Package (Ctrl+CLICK)**

Should you have any ***questions*** *about completing this work planning form or uploading your final submission documents, please send all inquiries by email to:* **OSM.Info@gov.ab.ca**.

Work Plan Submission

*Upon completion of this application, please submit the appropriately named work plan (**Microsoft Word Macro-Enabled Document**) and all supporting documents to the link provided below. Failure to follow the naming convention provided may result in oversight of your application.*

*Please upload (by drag and dropping) the **WORK PLAN SUBMISSION & ALL SUPPORTING DOCUMENTS** here:*

WORK PLAN SUBMISSION LINK (CTRL+CLICK HERE)

Please use the following file naming convention when submitting your WORK PLAN:

202324_wkpln_WorkPlanTitle_ ProjectLeadLastNameFirstName

Example:

202324_wkpln_OilSandsResiduesinFishTissue_SmithJoe

If applicable, **please use the following file naming convention when submitting your supplementary or supporting files.** Please number them according to the guidance and examples provided:

202324_sup##_WorkPlanTitle_ ProjectLeadLastNameFirstName

Examples:

202324_sup01_OilSandsResiduesinFishTissue_SmithJoe

202324_sup02_OilSandsResiduesinFishTissue_SmithJoe

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202324_sup10_OilSandsResiduesinFishTissue_SmithJoe

Do not resave your work plan or documents under any other naming conventions. *If you need to make revisions and resubmit before the work planning deadline of October 31, 2022, **DO NOT** rename your submission. When resubmitting, simply resubmit with the exact naming convention so that it replaces the original submission. **DO NOT** add any additional components such as versioning or dates to the file naming convention. Please direct any questions regarding the submission or naming of submissions to **OSM.Info@gov.ab.ca**.*

WORK PLAN APPLICATION

PROJECT INFORMATION	
Project Title:	Integrated Geospatial Program
Lead Applicant, Organization, or Community:	Government of Alberta, Ministry of Environment and Protected Areas
Work Plan Identifier Number: *If this is an on-going project please fill the identifier number for 22/23 fiscal by adjusting the last four digits:* ***Example:*** *D-1-2223 would become D-1-****2324***	CC-2-2324
Project Region(s):	Oil Sands Region
Project Start Year: *First year funding under the OSM program was received for this project (if applicable)*	2023
Project End Year: *Last year funding under the OSM program is requested* ***Example: 2024***	2024
Total 2023/24 Project Budget: *For the 2023/24 fiscal year*	$1,499,600.00
Requested OSM Program Funding: *For the 2023/24 fiscal year*	$1,499,600.00
Project Type:	Longterm Monitoring
Project Theme:	Cross-Cutting
Anticipated Total Duration of Projects (Core and Focused Study (3 years))	Year 1
Current Year	**Focused Study:** Choose an item.
	Core Monitoring: Choose an item.

CONTACT INFORMATION	
Lead Applicant/ Principal Investigator: Every work plan application requires one lead applicant. This lead is accountable for the entire work plan and all deliverables.	Mina Nasr
Job Title:	Senior Geospatial Scientist
Organization:	Government of Alberta, Ministry of Environment and Protected Areas
Address:	3535 Research Road NW, Calgary, AB T2L 2K8
Phone:	403 351-0639
Email:	mina.nasr@gov.ab.ca

PROJECT SUMMARY

Should your application be successful, The OSM Program reserves the right to publish this work plan application. Please check the box below to acknowledge you have read and understand:

☒ *I acknowledge and understand*

In the space below please provide a summary (300 words max) of the proposed project that includes a brief overview of the project drivers and objectives, the proposed approach/methodology, project deliverables, and how the project will deliver to the OSM Program objectives. The summary should be written in plain language.

The purpose of this work plan is to provide geospatial science support required to achieve the vision of the Data and Integrated Analytics Technical Advisory Committee (TAC) for an adaptive and integrated monitoring, evaluation, and reporting system outlined in the TAC's Scope of Work document, submitted to the OSM Program and reviewed by SIKIC. The main goal of this work plan is to ensure the geospatial needs of OSM's various TACs are met with reference to OSM conceptual models.

As per SIKIC's advice, the geospatial needs identified and included in this work plan are based on an OSM Geospatial Needs workshop held on September 15th, 2021 (Nasr and Monk 2022; Sup01) followed by one-on-one and group discussions with OSM scientists and TAC leads/acting leads and completion of OSM geospatial needs templates by OSM programs (Sup02). These geospatial science activities mainly support core/surveillance monitoring in the Oil Sands Region, all reviewed, supported, and generated collaboratively by media-specific TACs.

The OSM Program's five-year Geospatial Development Program (hereafter Integrated Geospatial Program) was announced in 2019 (Sup03). This work plan is consistent with Phase One of the implementation of the Program's Integrated Geospatial Program (Sup03). This work plan presents the objectives, tasks, and deliverables of OSM's Integrated Geospatial Program in 2023-2024 (Sup04-revised) approved by Oversight Committee (OC), which aims to systematically identify oil-sands areas of concern and to support spatial assessment and spatio-temporal assessments, and theme-area site selection and reporting activities within an adaptive monitoring framework.

The work plan development approach was based on identifying geospatial science needs by conducting a gap analysis for essential geospatial data and products with reference to the OSM programmatic conceptual model (Sup05-revised), critical analysis for identifying essential geospatial analysis and tool development to support monitoring site selection and adaptive monitoring, and pressure/stressor-based mapping (Sup06) for locating sampling sites along the stressor gradients. This effort assures the lack of redundancy (or duplication) of effort in the OSM Program. Generally, these deliverables answer OSM key questions (e.g. wetlands products).

This work plan will deliver based on the following objectives (Sup01): geospatial data development needs are facilitated for the various OSM monitoring programs (Objective 1), an integrated geospatial science plan is formed to support cross-media analyses of geospatial data and OSM mapping products (e.g. State of Environment Reporting maps), all required to deliver the OSM Program (Objective 2). OSM online mapping services, publicly accessible geospatial data management and publication using OSM geospatial data tree (Sup08), and relevant goepstial tool developments to enable users to develop their own mapping products (Objective 3) are not included in 2023-2024 deliverables as per OC specified approval conditions for 2023-2024.

The Integrated Geospatial Program acts as the central repository and framework for OSM geospatial sciences products and services. The 2023-2024 deliverables will focus on developing high priority geospatial data (e.g. Human Footprint), acquisition of remote sensing data (satellite imagery, LiDAR), and geospatial tool/model (e.g. stressor mapping). Additionally, the Integrated Geosptial Program will provide geospatial science support for assessments of the potential causes of environmental changes by theme area programs.

This work plan is an updated (revised) version of the original work plan proposal based on the approval requirements for 2023-2024 specified by OC.

Nasr, M., and Monk, W. 2022. Geospatial Science Support and Activities for Environmental Monitoring, Evaluation and Reporting in the Oil Sands Area: Summary of User Needs. Government of Alberta, Ministry of Environment and Protected Areas. ISBN 978-1-4601-5574-5. https://open.alberta.ca/publications/geospatial-science-support-activities-for-environmental-monitoring-evaluation-reporting-oilsands.

1.0 Merits of the Work Plan

All work plans under the OSM Program must serve the mandate of the program by determining (1) if changes in indicators are occurring in the oil sands region and (2) if the changes are caused by oil sands development activities and (3) the contribution in the context of cumulative effects. In the space below please provide information on the following:

- *Describe the key drivers for the project identifying linkages to Adaptive Monitoring framework particularly as it relates to surveillance, confirmation and limits of change (as per OC approved Key Questions).*
- *Explain the knowledge gap as it relates to the Adaptive Monitoring that is being addressed along with the context and scope of the problem as well as the Source – pathway – Receptor Conceptual Models .*
- *Describe how the project meets the mandate of the OSM Program or areas of limited knowledge is the work being designed to answer with consideration for the TAC specific Scope of Work Document (attached) and the Key Questions (attached)?*
- *Discuss results of previous monitoring/studies/development and* what has been achieved to date. Please identify potential linkages to relevant sections of the State of Environment Report.

Geospatial data combines location information (usually geographic coordinates), attribute information (the characteristics of the object, event, or phenomena concerned), and temporal information (the time or life span at which the location and attributes exist) (Stock et al. 2016). Monitoring conducted by OSM Program theme areas (wetlands, terrestrial biological, surface water and aquatic biological, groundwater, air and atmospheric deposition) is explicitly spatial and requires coordinated data collection and analysis (Nasr and Monk 2022; Swanson 2019a,b).

The assessment of the aggregate response of ecosystem attributes (e.g. area and extent of wetlands, vegetation greenness, biomass and height, and open water fluctuations), to oil sands development activities is an on-going effort with the OSM Program. Field-based surveillance monitoring (e.g. vegetation height and Leaf Area Index; estimates of vegetation productivity; vegetation health and status; wetland class and area) of many sites across the Oil Sands Region and across time is cost prohibitive and often cannot be generalized across spatial domains. Geographic Information System (GIS) and remotely sensed technologies provide cost-effective and consistent measurements of some environmental attributes over large geographies, through time (Chasmer et al. 2020a,b) that can facilitate better understanding of impacts caused by oil sands activities at broader spatial scales.
The OSM source-pathway-effect based approach for the assessment of oil sands development effects on various ecosystems (i.e., air; terrestrial; wetlands; water) informs the identification of geospatial data for sources, pathways and ecosystem responses, and appropriate geospatial analyses and modelling to assess these relationships. The three key oil sands source groups including Hydrologic Alteration (e.g. groundwater and surface water withdrawals/diversion), Land Disturbance (human footprint inventory), and Contaminants (e.g. annual atmospheric deposition) are common environmental pressure groups identified by OSM conceptual models (Ficken et al. 2021), and a basis for OSM stressor mapping (Nasr 2021).

The OSM geospatial stressor-based approach for the assessment of cumulative effects (Sup06) supports problem formulation by identifying geospatial data for pressure/stressors and appropriate geospatial analysis and modelling to assess pathways and cause-effect relationships. This approach identifies pressure/stressor groups related to Hydrologic Alteration, Land Disturbance, Contaminants (e.g. air emissions/depositions and leaks/spills on land), and Human Pressure (e.g. population; light at night; noise). Using geospatial data, characterization of stressors and geospatial analyses conducted at a local scale are generalized across the entire Oil Sands Region. This stressor mapping is further used to inform study design and site selection criteria, identifying areas that are high risk and low risk to oil sands development impacts. This information informs site selection and field monitoring design, and provides a means to update and optimize study designs within the scope of OSM Program.
Topography in the oil sands region is often subtle. It is also a primary driver of water movement, which defines catchment areas and hydrologic gradients. Additionally, incipient ecological change associated with stressors such as hydrologic change is likely to be detected at the boundaries of habitat units, at a relatively fine scale. It is important to increase the spatial and temporal resolution of geospatial

products and deliverables (including improved monitoring designs) for the Oil Sands Region. This can be achieved by using high-resolution LiDAR-derived landscape data as well as high-resolution temporal satellite images (e.g. LANDSAT, SENTINEL, RADARSAT) and other aerial data for assessing change (e.g. wetland area and vegetation cover changes; water flow/level change) over time and space. Watershed-level assessments using nested hierarchical watersheds are comparable with local projects (i.e., on-lease sites). However, existing topographic models, delineated watersheds/wetlands, and hydro features are not yet broadly available at suitable spatial resolution for regional and local assessments of environmental conditions in the Oil Sands Region.

Using OSM programmatic conceptual model, an additional effort could be made to finalize OSM Geospatial Stressor-based Approach for the Assessment of Cumulative Effects and integrate it with the assessment of spatial variabilities and changes of climate, unexpected events (e.g. wildfire), hydrological variabilities, and inherent characteristics of natural environment (i.e., landscape features and topography) as part of a watershed integrity approach to assess the Valued Component of ecosystem structure and function in OSM programmatic conceptual model (Flotemersch et al. 2015; Sup07). The latter is a novel approach by which stressors-response (indicators) relationships and pathways can be assessed by OSM theme-area projects for the entire Oil Sands Region and for local projects. This also allows careful collection, acquisition, and evaluation of OSM geospatial data in a form of an inventory that can be available through OSM Geospatial Portal for data sharing, visualization, mapping, and cross-cutting geospatial tools and analysis/modelling.

References:

Chasmer, L., Cobbaert, D., Mahoney, C., Millard, K., Peters, D., Devito, K .2020a. Remote sensing of boreal wetlands 1: data use for policy and management. Remote Sensing. 12 (8), 1320.

Chasmer, L., Mahoney, C., Millard, K., Nelson, K., Peters, D., Merchan, M., Cobbaert, D., et al. 2020b. Remote sensing of boreal wetlands 2: methods for evaluating boreal wetland ecosystem state and drivers of change. Remote Sensing. 12 (8), 1321.

Ficken, C.D., Connor, S.J., Rooney, R. et al. 2021. Drivers, pressures, and state responses to inform long-term oil sands wetland monitoring program objectives. Wetlands Ecological Management. https://doi.org/10.1007/s11273-021-09828-2.

Flotemersch J.E., Leibowitz S.G., Hill R.A., Stoddard M.C., Thoms J.L., Tharme R.E. 2015. A Watershed Integrity Definition and Assessment Approach to Support Strategic Management of Watersheds. https://doi.org/10.1002/rra.2978.

Nasr M. OSM State of Environment Reporting: Chapter 2: Introduction to the Oil Sands Monitoring (OSM) Integrated Geospatial Framework: Mapping Human Activities. Submitted in 2021. Not published yet.

Nasr, M., and Monk, W. 2022. Geospatial Science Support and Activities for Environmental Monitoring, Evaluation and Reporting in the Oil Sands Area: Summary of User Needs. Government of Alberta, Ministry of Environment and Protected Areas. ISBN 978-1-4601-5574-5. https://open.alberta.ca/publications/geospatial-science-support-activities-for-environmental-monitoring-evaluation-reporting-oilsands.

Stock, K. and Guesgen, H., 2016. Geospatial reasoning with open data. In Automating Open Source Intelligence (pp. 171-204). Syngress.

Swanson, S. 2019a. Oil Sands Monitoring Program: Integration Workshop Reports (Part 1 of 2). OSM Technical Report Series No. 7.1. https://open.alberta.ca/publications/9781460144947.

Swanson, S. 2019b. Oil Sands Monitoring Program: Recommendation Report (Part 2 of 2). OSM Technical Report Series No. 7.2. https://open.alberta.ca/publications/9781460144954.

2.0 Objectives of the Work Plan

List in point form the Objectives of the 2023/24 work plan below

Objective 1. Acquire, process, and release geospatial data required to characterize oil sands sources/stressors, habitat (ecosystem) responses/effects, and source-effect pathways in the Oil Sands Region.
• In accordance with the OSM theme-specific conceptual models, Objective 1 aligns with compiled OSM geospatial requirements for geospatial data development/acquisition in 2023-2024 (Sup02).

Objective 2. Provide OSM Program participants with geospatial science and analytical products and services required to deliver the OSM Program.
• Geospatial data analysis and modelling are undertaken with Objective 2 through a series of projects identified by theme area programs (Sup02) to support an integrated geospatial science plan in the OSM Program.

Objective 3. OSM Geospatial Portal development and implementation.
• OSM data management and mapping services are supported by Objective 3 to facilitate publicly accessible geospatial data publication and OSM mapping products (maps; geospatial tools; interactive mapping) for OSM data users. This Objective will NOT be delivered in 2023-24 and it is being retained in recognition of its importance as a key pillar of OSM Integrated Geospatial Program.

3.0 Scope

Evaluation of Scope Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would:

- be in scope of the OSM Program (e.g., regional boundaries, specific to oil sands development, within boundaries of the Oil Sands Environmental Monitoring Program Regulation)
- consider the TAC-specific Scope of Work document and the key questions
- integrate western science with Indigenous Community-Based Monitoring)
- address the Adaptive Monitoring particularly as it relates to surveillance, confirmation and limits of change as per approved Key Questions.
- have an experimental design that addresses the Pressure/Stressor, Pathway/Exposure, Response continuum
- produce data/knowledge aligned with OSM Program requirements and is working with Service Alberta
- uses Standard Operating Procedures/ Best Management Practices/ Standard Methods including for Indigenous Community-Based Monitoring

3.1 Sub Theme

Please select from the dropdown menu below the theme(s) your monitoring work plan relates to:

Cross Cutting

3.2 Core Monitoring or Focused study

Please select from the dropdown menu below if the monitoring in the work plan is "core monitoring" and/or a "focused study". Core monitoring are long term monitoring programs that have been in operation for at least 3 years, have been previously designated by the OSM program as core, and will continue to operate into the future. Focused studies are short term projects 1-2 years that address a specific emerging issue. For the purposes of 2023/24 work planning all Community Based Monitoring Projects are Focused Studies.

Core Monitoring

3.3 Sub Theme Key Questions

Please select from the dropdown menus below the sub-theme(s) your monitoring work plan relates to and address the Key Questions:

3.3.1 Surface Water Theme

3.3.1.1. Sub Themes:

Choose an item.

3.4.1.2 Surface Water Key Questions

Explain how your surface water monitoring program addresses the key questions below.

1. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in water quality, biological health (e.g., benthos, fish) and/or water quantity/flows relative to baseline? If yes, is there evidence that the observed change is attributable to oil sands development? (Describe source-pathway-receptor and/or conceptual models and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies?

Click or tap here to enter text.

4. Are changes in water quality and/or water quantity and/or biological health informing Indigenous key questions and concerns?

Click or tap here to enter text.

5. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

6. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

7. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

Click or tap here to enter text.

3.3.2 Groundwater Theme

3.3.2.1 Sub Themes:

Choose an item.

3.3.2.2 Groundwater Key Questions

Explain how your groundwater monitoring program addresses the key questions below.

1. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in groundwater quality and/or quantity relative to baseline? If yes, is there evidence that the observed change is attributable to oil sands development? *(Describe source-pathway-receptor and/or conceptual models)* and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies?

Click or tap here to enter text.

4. Are changes in groundwater quality and/or quantity informing Indigenous key questions and concerns Indigenous concerns and health?

Click or tap here to enter text.

5. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

6. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

7. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

Click or tap here to enter text.

3.3.3 Wetlands Theme

3.3.3.1 Sub Themes:

Choose an item.

3.3.3.2 Wetlands - Key Questions

Explain how your wetlands monitoring program addresses the key questions below.

1. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in wetlands due to contaminants and hydrological processes? If yes, is there evidence that the observed change is attributable to oil sands development? (Describe source-pathway-receptor and/or conceptual models) and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies?

Click or tap here to enter text.

4. Are changes in wetlands informing Indigenous key questions and concerns?

Click or tap here to enter text.

5. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

6. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

7. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

Click or tap here to enter text.

3.3.4 Air Theme

3.3.4.1 Sub Themes:

Choose an item.

3.3.4.2 Air & Deposition - Key Questions

Explain how your air & deposition monitoring program addresses the key questions below.

1. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in air quality? If yes, is there evidence that the observed change is attributable to oil sands development? (Describe source-pathway-receptor and/or conceptual models) and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies

Click or tap here to enter text.

4. Are changes in air quality informing Indigenous key questions and concerns?

Click or tap here to enter text.

5. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

6. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

7. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

Click or tap here to enter text.

3.3.5 Terrestrial Biology Theme

3.3.5.1 Sub Themes:

Choose an item.

3.3.5.2 Terrestrial Biology - Key Questions

Explain how your terrestrial biological monitoring program addresses the key questions below.

1. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in terrestrial ecosystems due to contaminants and landscape alteration? If yes, is there evidence that the observed change is attributable to oil sands development? (Describe source-pathway-receptor and/or conceptual models) and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies?

Click or tap here to enter text.

4. Are changes in terrestrial ecosystems informing Indigenous key questions and concerns?

Click or tap here to enter text.

5. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

6. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

7. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

Click or tap here to enter text.

3.3.6 Cross-Cutting Across Theme Areas

3.3.6.1 Sub Themes:

Geospatial/ Remote Sensing

If "Other" was selected from the drop down list above please describe below:

Click or tap here to enter text.

3.3.6.2 Cross-Cutting - Key Questions

Explain how your cross-cutting monitoring program addresses the key questions below.

1. Is data produced following OSM Program requirements and provided into the OSM Program data management system?

All geospatial data produced will be subject to audit to ensure that data is fit for purpose and meets the data quality requirements of the OSM Program. All geospatial data produced will be provided to the OSM Program Data Services team for ingestion with proper metadata aligned with OSM data management system. Geospatial data quality and resolution uncertainty information for various parameters (e.g. physical distance; stressor/natural indicator) will be documented to inform proper use and sound interpretation.

2. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

SOPs specific to geospatial sciences will be developed with an alignment with broader OSM Program's quality assurance standards that is aligned with GOA guidelines and procedures. This includes an internal geospatial SOP for OSM geospatial data management. Existing geospatial standards developed by ECCC and/or Government of Alberta will be considered.

3. How does the monitoring identify integration amongst projects, themes or with communities?

The OSM Integrated Geospatial Program work plan is a cross-cutting project that takes a programmatic view of the OSM Program and inherently integrates among all OSM teams in three main ways: • This work plan quantifies the magnitude and distribution of oil sands pressure/stressors within the three Oil Sands Designated Areas of Athabasca Oil Sands, Cold Lake Oil Sands, and Peace River Oil Sands, and develops geospatial tool that can be used for(geo)statistical exploration of relationships between regional landscape stressors and monitoring receptor (or response) data. Such information and tools can be used by all theme areas to stratify and evaluate monitoring designs in an adaptive way. • The work under this work plan is producing a curated, high quality package of OSM specific data that, in collaboration with Service Alberta will be made available to all OSM theme areas and CBM projects in addition to the public. This will ensure that all OSM teams are using a standardized high quality data to undertake analysis, allowing for direct comparison and integration of data between theme areas. • This geospatial work plan aims to identify and develop (internally or externally) high priority data critical to the OSM Program. As such, this work plan will ensure programmatic co-ordination and generation of high priority data and incorporation of advanced geospatial science in analysis, evaluation/assessment, and reporting activities. This will ensure that any data produced can be leveraged by all OSM teams, ensuring a coordinated and integrated approach to the development and updates of key geospatial data and tools.

4. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

This work plan was developed based on a systematic process (holding a geospatial needs workshop and close consultation with OSM TAC leads and scientists) to identify various TACs' needs for geospatial science support. As each TAC identifies its geospatial priorities based on a theme-specific conceptual model, this work plan will co-ordinate the development of geospatial data that may include pressure/stressor (e.g., human footprint). This data is a common need among various theme areas' conceptual models. Although not included in this year's activities and deliverables, future development of integrative/central geospatial tools through the Integrated Geosptial Program will provide a consistent central resource for both regional and local projects (e.g. on-lease sites), which is expected to aim evaluating and assessing relationships/correlations among various parts of the theme area central models.

This work plan largely will aim to quantify the magnitude and distribution of pressures and stressors within the Oil Sands Region, and as such largely falls on the left hand side of the conceptual model. Starting in 2020-21, the development of additional geospatial data of natural landscape (e.g. vegetation health parameters) as well as collecting other available landscape and pressure/stressor data (e.g. updated wetland inventory, industrial water usage) enables us to assess pathways and receptors (the middle part of the conceptual model). As per Oversight Committee (OC) direction, vegetation health parameters, updated wetland inventory, and industrial water usage geospatial data will not be delivered in 2023-2024 through this work plan, but such geospatial needs will be further discussed in collaboration with OSM TACs for provision in 2024-2025. The aim is to specifically identify priority (or essential) geospatial data that can be utilized to assess theme-area receptor or response indicators as a result of oil sands-related pressure/stressor indicators. As an example, the assessment of pressures, stressors and water quality (receptor) relationship (pathway) was completed in 2021-22 (Choung et al. 2022 – under review).

Reference:
Choung C.B., Bush A., Monk W., Nasr M., Baird D. The challenge of spatialising point-source water quality monitoring data for multi-substance risk assessment in the Canadian Oil Sands Region. Science of the Total Environment, November 2022 (expected journal submission date).

5. How will this work advance understanding transition towards adaptive monitoring?

This work plan will aim to conduct geospatial science activities that are supported and identified as priority needs by various TACs. These activities align with the TACs' goal for an adaptive approach for cumulative assessments and surveillance monitoring design updates, assessment, and reporting. The development of high resolution geospatial data through this project will aim to the development of stressor-based monitoring designs for all theme areas (Sup06), as it will continue to quantify the magnitude and distribution of stressors within the Oil Sands Region spatiotemporally. The geospatial science activities and outcomes of this work plan will be communicated with OSM teams through OSM Program's TACs.

6. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

The OSM Integrated Gospatial Program has collaborated with OSM State of Environment (SoE) Reporting's technical team and project's PIs since 2020-21, producing over 50 SoE maps. This task is still in progress as PIs require new maps and updates to existing maps.

Additionally, a SoE chapter on OSM geospatial science projects (Chapter 2) including cumulative effects analysis of multiple stressors in the Oil Sands Region, a regional time-series analysis of Human Footprint data (2010-2018), and ranking results for regional stream connectivity. In future SoE reports, updated analysis results will be prepared using new data (e.g. trend analysis results for human footprints for 2021 and beyond) as well as new geospatial science products (e.g. water quality risk mapping, vegetation health monitoring by remote sensing).

The OSM Integrated Gospatial Program will continue supporting future SoE reporting by providing cartography and analysis support, web (online) mapping, and updates on SoE's geospatial chapter.

4.0 Mitigation

Evaluation of Mitigation Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially inform:

- efficacy of an existing regulation or policy
- an EPEA approval condition
- a regional framework (i.e., LARP)
- an emerging issue

Explain how your monitoring program informs management, policy and regulatory compliance. As relevant consider adaptive monitoring and the approved Key Questions in your response.

The geospatial data, tool and reporting products delivered by this work plan are multi-purpose by design.

The outlined geospatial data and products advance the OSM Program's vision, they are aligned with multiple objectives listed in the Operational Framework Agreement (Oil Sands Monitoring Program, 2018), and they are essential to addressing several of the Oil Sands Monitoring Key Questions (DRAFT) released by the OSM Program office on November 23, 2020. Examples include data products that characterize regional variability and temporal change in vegetation removal and alteration, vegetation recovery, habitat mapping, watershed boundaries, indicators of groundwater dependent ecosystem, Human Footprint Inventory, and other data, evaluation and reporting products.

By characterizing the current state of multiple stressors, receptors, and stressor-response pathways identified in conceptual models published by the OSM Program (Swanson 2019a,b), these geospatial data and science products are essential to providing assurance that existing regulatory and non-regulatory mechanisms are effective in protecting the health of people and the environment in the region. Ongoing advancement of geospatially characterized stressor-response pathways specific to OSM identified needs and foci will be enhanced based on an existing tool that characterizes relative environmental pressure at multiple scales. This tool was developed under a provincial platform commitment and is in the process of being refined and tested but aspects of the approach are directly relevant to the OSM Program.

These same data and science products also support the development and calculation of several indicators within the draft Biodiversity Management Framework (BMF) for the Lower Athabasca Region. OSM geospatial data and products are used to augment and refine existing BMF indicators (e.g., species indicators) and are widely used to support development of the Biodiversity Management Framework within and beyond the Lower Athabasca Region (Indicator Reporting Protocols, Science Support Documentation, Supporting Focal Studies developed by the BMF Science-Technical Committee and sponsored by the BMF Core Team).

Geospatial data and science products that characterize the structure, composition and function at the regional, subregional and local scales, are also essential to investigations of potential exceedances of indicators within the Surface Water Quality Management Framework for the Lower Athabasca Region. These same data and science products are also appropriate for use in investigations of cause of changes in surface water quality, aquatic biological, and other indicators monitored within the OSM Program.

References:
Oil Sands Monitoring Program. 2018. Letter of Agreement and Operational Framework. 53 pp. ISBN: 978-1-4601-4236-3. https://open.alberta.ca/publications/9781460142363.

Swanson S. 2019a. Oil Sands Monitoring Program: Integration Workshop Reports (Part 1 of 2). (OSM Technical Report Series No. 7.1). Retrieved from: https://open.alberta.ca/publications/9781460144947.

Swanson S. 2019b. Oil Sands Monitoring Program: Recommendation Report (Part 2 of 2). (OSM Technical Report Series No. 7.2). Retrieved from: https://open.alberta.ca/publications/9781460144954.

5.0 Indigenous Issues

Evaluation of Indigenous Issues Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially:

- Investigate Indigenous communities key questions and concerns
- Includes culturally relevant receptor(s) and indicator(s)
- Include or be driven by Indigenous communities (participatory or collaborative)
- Develop capacity in Indigenous communities
- Include a Council Resolution or Letter of Support from one or more Indigenous communities
- Describe how ethics protocols and best practices regarding involvement of Indigenous peoples will be adhered to
- Provide information on how Indigenous Knowledge will be collected, interpreted, validated, and used in a way that meets community Indigenous Knowledge protocols

Explain how your monitoring activities are inclusive and respond to Indigenous key questions and concerns and inform the ability to understand impacts on concerns and inform Section 35 Rights

It is important that Indigenous communities are involved in both the identification of indicators and key geospatial products and/or services important to Indigenous communities.
This work plan is closely communicated through the Data and Integrated Analytics Technical Advisory Committee (TAC), which includes Indigenous representatives, in order to ensure that communities are engaged in a meaningful and productive way. Additionally, this work plan will host a geospatial workshop (or meetings) including TAC members including Indigenous representatives for integration and addressing community concerns.

As this work plan is under the Data and Integrated Analytics TAC, co-development of indicators and metrics with Indigenous communities will be an important focus of future TAC workshops. Such an engagement will be informed by the process that is currently being developed with the theme area programs, and by the Indigenous Community Based Monitoring (CBM) Advisory Committee.
The work outline in this project has also been reviewed and supported by various TACs, including Indigenous representatives.

Does this project include an Integrated Community Based Monitoring Component?

No

If YES, please complete the ICBM Work Plan Forms and submit using the link below

Please note that completion of the ICBM template is mandatory if yes is indicated above and must be submitted along with each work plan that includes an integrated CBM component

ICBM WORK PLAN SUBMISSION LINK (CTRL+CLICK HERE)

5.1 Alignment with Interim Ethical Guidelines for ICBM in the OSM Program

1. Are there any community specific protocols that will be followed?

Click or tap here to enter text.

2. Does the work plan involve methods for Indigenous participants to share information or knowledge (e.g. interview, focus group, survey/structured interview), or any other Indigenous participation? If yes, describe how risks and harms will be assessed, and the consent process that will be used.

Click or tap here to enter text.

3. Do the activities include any other collecting/sharing, interpreting, or applying Indigenous knowledge? Please describe how these activities will be conducted in alignment with the Interim Ethical Guidelines, and any community-based protocols and/or guidelines that may also apply.

Click or tap here to enter text.

4. Indicate how Indigenous communities / Indigenous knowledge holders will be involved to ensure appropriate analysis, interpretation and application of data and knowledge.

Click or tap here to enter text.

5. How are Indigenous communities involved in identifying or confirming the appropriateness of approach, methods, and/or indicators?

Click or tap here to enter text.

6. How does this work plan directly benefit your community? How does it support capacity building in your community?

Click or tap here to enter text.

7. How is the information from this work plan going to be reported back to your community in a way that is accessible, transparent and easy to understand?

Click or tap here to enter text.

6.0 Measuring Change

Evaluation of Measuring Change Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially:

- assess changes in environmental conditions compared to baseline (e.g., validation of EIA predictions)
- report uncertainty in estimates and monitoring is of sufficient power to detect change due to oil sands development on reasonable temporal or spatial scales
- include indicators along the spectrum of response (e.g., individual, population, community)
- focus on areas of highest risk (where change is detected, where change is greater than expected, where development is expected to expand (collection of baseline)
- measure change along a stressor gradient or a stressor/reference comparison

Explain how your monitoring identifies environmental changes and how can be assessed against a baseline condition. As relevant, consider adaptive monitoring, the TAC specific Scope of Work document and the Key Questions in your response.

This work plan is designed to measure change in both space and time, and to provide this information to all theme areas to support field-based monitoring, site selection, assessment, and evaluation activities. In particular, this work plan will (Sup02):

• Increase the attribution of human footprint data to include dates on certain features will allow us to calculate the rate of human footprint change over time, and establish the baseline human footprint conditions that existed within the three Oil Sands Designated Areas of Athabasca Oil Sands, Cold Lake Oil Sands, Peace River Oil Sands as far back as spatial data is available (1950s; 1980s). The human footprint data are high priority products that provide detailed information on landscape disturbance stressors required by all theme areas. Additionally, a detailed high resolution human footprint data development for small areas (e.g. microbasins) will support theme specific projects such as benthic monitoring in the Oil Sands Region.

• Identify and quantify oil sands pressure/stressors from available high quality geospatial data using OSM conceptual models. This information has and will be provided to all theme area leads, which can be used to ensure that monitoring is undertaken along known stressor gradients that are assessed and quantified programmatically.

• Characterize pressure/stressors over the entire Oil Sands Region will allow us to measure change relative to a spatial baseline by using analogous reference conditions. Furthermore, this effort supports statistically evaluation of all current and historic monitoring undertaken by the OSM Program against calculated stressor gradients in the region.

• Map habitat recovery as a result of temporal forest regeneration using high resolution satellite and aerial imagery, coupled with human footprint of seismic lines, well pads, and other disturbances associated with oil sands exploration and production will aim measuring the effectiveness of existing regulations related to oil sands exploration and production activities in the Oil Sands Region. According to the TBM TAC, this mapping effort is a high priority due to observed shifts in wildlife communities in the Oil Sands Region.

• Map groundwater dependent ecosystem to support core/surveillance groundwater monitoring design and updates related to both the quality and quantity of groundwater discharge. The groundwater TAC has identified a knowledge gap as a priority for identifying groundwater-dependent ecosystems that

may be adversely affected by a variety of factors, including landscape disturbance, oil sands groundwater withdrawals, and seepage from tailings ponds.

• Evaluate and keep record of data quality, methodology, and uncertainty. This is a very important and critical task in long-term assessment of change using geospatial data.

7.0 Accounting for Scale

Evaluation of Accounting for Scale Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially be:

- appropriate to the key question and indicator of interest
- relevant to sub-regional and regional questions
- relevant to organism, population and/or community levels of biological organization
- where modelled results are validated with monitored data
- where monitoring informs on environmental processes that occur at a regional scale. e.g. Characterizing individual sources to gain a regional estimate of acid deposition and understand signal from individual contributing sources.

Explain how your monitoring tracks regional and sub-regional state of the environment, including cumulative effects. As relevant, consider adaptive monitoring, the TAC specific Scope of Work document and the Key Questions in your response.

This work plan has started a stressor-based approach to map cumulative effects from oil sands development and operations, and as such directly quantifies the regional and subregional state of the environment and cumulative effects. The development of a geospatial stressor-based cumulative effects model is by characterizing stressors derived from local developments (e.g. lease mining sites), individual contributing sources of atmospheric emissions (e.g., emission stacks) and operational leak/spill or accidents and tailing seepage, local watercourse road crossings, and others (e.g. roads; pipelines; seismic lines). Using this approach, stressors will be individually and cumulatively quantified at multiple spatial scales, using nested hierarchy watersheds. This will allow us to assess the environmental conditions in the Oil Sands Region for microbasins (small watersheds for local assessments) to larger watersheds of Hydrologic Unit Code of 10 or 8 for larger sub-regional and regional assessments.

8.0 Transparency

Evaluation of Transparency Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially include:

- a plan for dissemination of monitoring data, including appropriate timing, format, and aligns with OSM program data management plan
- demonstrated transparency in past performance
- identified an annual progress report as a deliverable
- reporting of monitoring results occurs at timing and format that is appropriate for recipient audience.

Explain how your monitoring generates data and reporting that is accessible, credible and useful. As relevant, consider adaptive monitoring, the TAC specific Scope of Work document and the Key Questions in your response.

The Integrated Geosptial Program has started working in collaboration with Service Alberta to develop a high quality curated geospatial data package that will be open and publicly available and accessible. Once programmatic scope and implementation plan are developed, this work will be included in the 2024-25 work plan in collaboration with the Data Services work plan. As a result, it is envisioned that any geospatial data products directly developed under the Integrated Geosptial Program will be included within this data package, including the enhanced Human Footprint Inventory which will be delivered annually by the end of each fiscal year, high resolution imageries, and other data products included in 2023-2024 deliverables.

It is expected that in collaboration with Service Alberta, OSM geospatial data package will be hosted publicly for the OSM program through OSM Data Portal/Catalogue (under construction by Service Alberta) and will include geospatial data that are systematically arranged in a folder structure (air, water resources, biomes & micro-Biomes, soil, sub-surface and landform, land cover, access and development, human social, and exceptional events). The OSM geospatial folder includes data developed through the OSM Program as well as data collected/acquired from other sources. In addition, to assure quality-driven products and deliveries in OSM Program, this work plan will make an effort for proper documentation of data quality, methods and uncertainty.

It is provioned that through future (2024-2025 and beyond) collaboration with Data Services work plan, the development of an online web mapping, data visualization tool, and web geospatial analysis services will be implemented to effectively communicate the results of the geospatial stressor-based cumulative effects model to the public at large while the OSM teams and collaborators could access geospatial data, geospatial tools, and OSM mapping templates.

In addition to the development and delivery of publications as outlined in this project, there are several technical documents and peer-reviewed scientific manuscripts for publication that will be produced in support of the OSM geospatial science delivery, OSM annual progress report, and State of Environment (SoE) reporting.

9.0 Efficiency

Evaluation of Efficiency Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would include:

- appropriately addressed a risk-informed allocation of resources
- identified the role and justification for each staff member on the proposed work plan
- identified in-kind and leveraged resources (e.g., resources and approaches are appropriately shared with other OSM projects where possible)
- established partnerships (value-added) and demonstrated examples of coordinated efficiencies (e.g., field, analytical)
- identified co-location of monitoring effort
- demonstrated monitoring activities and information collected are not duplicative
- considered sampling/measurement/methods compatibility to other data sources (e.g., AER)

Explain how your monitoring is integrated with other OSM projects and incorporates community-based participation and/or engagement in proposed monitoring activities. As relevant, consider adaptive monitoring, the TAC specific Scope of Work document and the Key Questions in your response.

This work plan will aim to support geospatial data development/collection/acquisition and assessment of stressors affects. The goal is to support all theme areas programs and to ensure the spatial data products used by the OSM Program are consistent among OSM teams. Specifically, through this project, we will develop geospatial data of oil sands pressure/stressors that will support all theme areas of the OSM program. In 2019-20, we developed a conceptual framework for the analysis of geospatial stressors, and quantified stressors across the Oil Sands Region to support site selection by the terrestrial biological, wetland, and groundwater theme areas. Since then, the model has been refined by identifying and prioritizing key pressure/stressors selected (or identified) by the OSM theme areas (this work is included in 2020-2021 Sate of Environment (SoE) reporting; Nasr 2021).

Moving forward with the new Program's direction to an adaptive approach for environmental monitoring and assessment, the pressure/stressor mapping will be further updated to characterize landscape disturbances (Nasr and Orwin 2022). Our approach is to make sure the geospatial data products and model outcomes are useful to all theme areas especially in developing and optimizing monitoring designs in the Oil Sands Region.

The OSM Integrated Geospatial Program have supported and will continue to support advancing GIS/remote sensing methodological approaches and developing mapping templates for the OSM Program. This is specifically useful to all core, focus and community-based Monitoring projects, and SoE data analysis and mapping.

Reference:

Nasr M. OSM State of Environment Reporting: Chapter 2: Introduction to the Oil Sands Monitoring (OSM) Integrated Geospatial Framework: Mapping Human Activities. Submitted in 2021. Not published yet.

Nasr M., Orwin J.F In Prep (2022). A Geospatial Approach to Identifying and Mapping Areas of Relative Environmental Pressure on Ecosystem Integrity.

10.0 Work Plan Approach/Methods

10.1 List the Key Project Phases and Provide Bullets for Each Major Task under Each Project Phase *

Objective 1. Acquire, process, and release geospatial data required to characterize oil sands sources/stressors, habitat (ecosystem) responses/effects, and source-effect pathways in the Oil Sands Region.

Task 1.1 ESSENTIAL geospatial data development.
• Task 1.1a Historical and enhanced human footprint inventory.

The details of the geospatial data development process will be outlined in four phases as part of the above Sub-Task (Task 1.1a):
Phase 1 – 2023-2024: compilation and evaluation of primary datasets/information;
Phase 2 – 2023-2024: development of geospatial data including data attributes and metadata;
Phase 3 – 2023-2024: geospatial data submission and technical reporting;
Phase 4 – 2024-2025: publication of the geospatial data through OSM Geospatial Data Portal.

Task 1.2 ESSENTIAL geospatial data acquisition.

Three phases will be followed for the acquisition of satellite and LiDAR data products:
Phase 1 – 2023-2024: identifying a vendor (for LiDAR), preferably a well-recognized vendor with previous experience in capturing and processing aerial and satellite images in Alberta;
Phase 2 – 2023-2024: contracts developments;
Phase 3 – 2023-2024: geospatial data products submission and technical reporting.

Objective 2. Provide OSM Program participants with geospatial science and analytical products and services required to deliver the OSM Program.

• Task 2.1 Geospatial mapping for the assessment of cumulative effects of pressure/stressors.
Phase 1 – 2023-2024: compilation and evaluation of new data developed or accessed in 2022-2023;
Phase 2 – 2023-2024: refinement of OSM stressor mapping approach (Sup06) and calculations of new data metrics in GIS and produce updated stressor maps;
Phase 3 – 2024-2025: web mapping and services for OSM stressor mapping through OSM Geosptial Portal;
Phase 4: Reporting.

• Task 2.2 Habitat mapping of forest regeneration.
Phase 1 – 2023-2024: compilation of existing data products including LiDAR, high resolution temporal remote sensing data product;
Phase 2 – 2023-2024: collection of new data and field validation of the data.
Phase 3 – 2023-2024: data management, calibration and verification.
Phase 4 – 2023-2024: geospatial processing and analysis, and mapping;
Phase 5 – 2023-2024: technical reporting.

• Task 2.3 Groundwater dependent ecosystem (GDE) mapping.
Phase 1 – 2023-2024: literature review (approaches and indicators (groundwater and biological));
Phase 2 – 2023-2024: data review and collation;
Phase 3 – 2023-2024: initial watershed mapping;
Phase 4 – 2023-2024: technical reporting;
Phase 5 – 2024-2025: publication of the geospatial data through OSM Geosptial Portal.

Task 2.4. Microbasin human footprint mapping to support OSM Benthic Invertebrate Biomonitoring.
Phase 1 – 2023-2024: compilation and evaluation of primary data/information;
Phase 2 – 2023-2024: geospatial analysis to develop microbasin boundary data and extract data for selected microbasins;
Phase 3 – 2023-2024: Geospatial data/product submission and technical reporting.

This task will provide updates to Groundwater TAC, Data and Integration Analytics TAC, and SIKIC regarding performance of each phase of this task as they are completed.

• Task 2.5 Snowpack/wintertime contaminant deposition mapping.
Phase 1 – 2023-2024: data collection through the Air TAC;
Phase 2 – 2023-2024: geospatial analysis;
Phase 3 – 2023-2024: peer-reviewed manuscript for publication.

• Task 2.6 Support State of Environment (SoE) reporting.
Phase 1 – 2023-2024: compiling geospatial needs for analysis and mapping;
Phase 2 – 2023-2024: development of static mapping;
Phase 3 – 2023-2024: maps publication;
Phase 3 – 2023-2024: identifying future needs for SoE and other OSM analysis and mapping projects.
Phase 4 – 2024-2025: Development of online mapping through OSM Geosptial Portal.

• Task 2.7. Identify, assess, and strategize geospatial needs required to deliver the OSM Program.
Phase 1 – 2023-2024: compilation of geospatial science needs in the OSM Program;
Phase 2 – 2023-2024: presentation and materials preparation (related to OSM geospatial needs and activities) for OSM TACs' workshops;
Phase 3 – 2023-2024: participatation in one-one and group discussions with OSM scientists and PIs for future work planning.
Phase 4 – host a geospatial workshop to present OSM geospatial program's framework and discuss geospatial products.

Objective 3 (Task 3). Awaiting programmatic scope and implementation plan development in collaboration with the Data Services work plan. This task will not be delivered in 2023-2024.

10.2 Describe how changes in environmental Condition will be assessed *

The development and implementation of geospatial standards is one mechanism to assist with the detection of change in environmental conditions that can be assessed. Data standards will be developed to consider the level of accuracy (as well as spatial/temporal resolution and attribute/thematic depth) required to detect meaningful change in environmental conditions in the oil sands area arising from oil sands activities.

The development of geospatial tools and automation of such tools in OSM Geospatial Data Portal will support a program-wide consistent and reliable process for assessing change in the oil sands area. Changes in environmental condition will be assessed by quantifying the cumulative effects associated with multiple pressure/stressors for each unit of analysis (i.e., HUC10 watershed) within the Athabasca Oil Sands, Cold Lake Oil Sands, and Peace River Oil Sands Areas. This will support ecosystem-level risk assessment in a cost effective, repeatable, and scientifically rigorous manner.

In the assessment of cumulative effects, we will use a watershed integrity approach by which human activities and ecosystem-related factors are used to assess watershed condition, health, resiliency and sustainability (Flotemersch et al. 2015). At the national level, USEPA has already adapted this process. Within the scope of this work plan, we will aim to develop a watershed integrity framework for the oil sands region of Alberta. Based on the review of the literature, we developed a preliminary watershed integrity model that identifies five four key Value Components each presenting stressor criteria and their relevant stressors indicators. Within the scope of OSM programmatic conceptual model, we will first examine (add/remove) stressors criteria, and indicators within each Value Component group using multi-criteria decision-making methods in GIS. Then all the Value Components will be integrated at a watershed level (e.g., HUC10 units) to assess the stressors-receptor (response) relationships.

Reference:
Flotemersch J.E., Leibowitz S.G., Hill R.A., Stoddard M.C., Thoms J.L., Tharme R.E. 2015. A Watershed Integrity Definition and Assessment Approach to Support Strategic Management of Watersheds. 2015 https://doi.org/10.1002/rra.2978.

10.3 Are There Benchmarks Being Used to Assess Changes in Environmental Condition? If So, Please Describe, If Not, State "NONE" *****

Benchmarks are being developed as a part of this project. Additional benchmarks as developed by other theme areas, or identified through literature review will be assessed and incorporated into the geospatial stressor-based and geospatial models as appropriate.

(e.g., objectives, tiers, triggers, limits, reference conditions, thresholds, etc.)

10.4 Provide a Brief Description of the Western Science or Community-Based Monitoring Indigenous Community-Based Monitoring Methods by Project Phase *

This section provides detailed descriptions of tasks associated with each objective of this work plan. The tasks' interdependencies and priority levels were identified based on the information provided by the theme area TAC leads (Sup02) and aligned with each TAC's Scope of Work (SoW) and associated work plan proposals. The tasks and deliverables included in this section are reviewed and approved by OC.

Objective 1. Acquire, process, and release geospatial data required to characterize oil sands sources/stressors, habitat (ecosystem) responses/effects, and source-effect pathways in the Oil Sands Region.

Task 1.1 ESSENTIAL geospatial data development.

• Task 1.1a Historical and enhanced human footprint inventory. Develop an updated inventory of human footprint (HF; land disturbances) for 1950s, 1980s and 2021 conditions in the Oil Sands Region. This is a core dataset for the oil sands pressure of land disturbance that is updated annually, including enhancements for oil sands specific attribution. HF data are needed to establish reference conditions for land disturbance and conditions during key development periods to assess changes in land disturbances over time attributable to oil sands development.

Note on Interdependencies: Delivered by ABMI; collaboration with the Government of Alberta's Ministry of Environment and Protected Areas (EPA)- the Alberta Human Footprint Monitoring Program (AHFMP) and OSM Integrated Geospatial Program. Informs Task 2.2 - Habitat Monitoring of Forest Regeneration.

Status: Continuing from 2019-2020; identified as "High Priority" by OSM TACs (Sup02); completed during 2023-2024 and beyond.

The TBM TAC 2023-2024 SoW identified "human footprint monitoring and mapping" as the first element of the core/surveillance monitoring associated with the land disturbance stressor. In the monitoring approach for the 2023-2024 TBM core program, one of the required components is to integrate geospatial HF monitoring into TBM activities and expand the program to include qualitative assessments of oil sands HF, and targeted footprint attribution. The Wetlands TAC 2023-2024 SoW identified HF monitoring and mapping as high priority for wetland site network expansion (land disturbance is a key variable of the site selection criteria), and is a priority dataset for assessing and reporting change in wetland area and extent through state of the environment reports. Additionally, the Surface Water TAC identified this project as high priority and with a particular connection to the Benthic Invertebrate Biomonitoring Program for extracting data for selected microbasin areas (Task 2.4). Aligned with the Data and Integrated Analytics TAC SoW, the updated and new historical HF will be used to update the SoE geospatial chapter (Chapter 2: stressor mapping, human footprint mapping; Task 2.1), and will be included in OSM Geospatial Portal for access by OSM data users (Task 3).

Description: The development and analysis of HF is a critical component to an effective adaptive monitoring program, and has been consistently recommended for inclusion for OSM (Roberts et al. 2022). These data provide enormous value because they provide information and details on the amount and extent of oil sands disturbance on the land surface, and how it has changed over time, and how it is affecting ecological endpoints. Human footprint (landscape disturbance) are an essential part of all OSM Program theme area conceptual models (Swanson 2019ab). The 2023-2024 SoW for the TBM, Data and Integration Analytics, and Wetlands TACs also specifically describe the need for HF data. Information and results generated through HF monitoring provide critical information to support definition of reference conditions, monitoring site selection across stressor gradients, interpretation of biological change, assessment of cumulative effects and are used in the OSM State of Environment report (e.g., Chapter 2 Stressor Analysis Framework). HF data updates and maps underpin the quantification of environmental pressures due to oil sands activities and creation of oil sands stressor maps.

The OSM Program HF monitoring effort benefits from the availability of the provincially funded high-resolution Alberta-wide SPOT6 satellite imagery mosaic, and 1950s and 1980s orthophotomosaics, which represents in-kind contributions from EPA. As such, OSM funds leverage this imagery to specifically map and monitor land transformation in the Oil Sands Region, and yield detailed stressor information for ambient monitoring specific to oil sands industrial activities. Creating HF data involves visualization, manual interpretation, and heads-up digitization of all the HF features detected in the 2021 SOPT6, 1950s and 1980s orthophotos using specifically designed SOPs and HF delineation protocols. For historical HF, ABMI will use the same process for standard HFI updates for a given year but will use the 1950s or 1980s historical aerial imagery orthophotos (with 1.65m and 1.25 m spatial resolution, respectively) instead of contemporary satellite imagery (e.g. SPOT6 imagery with 1.5 m spatial resolution). The HF includes 115 feature types classified into 20 sublayers such as well sites, mines, roads, seismic lines and pipelines, etc. Indirect pressures of noise and light, identified as concern by Indigenous communities and part of the TBM Conceptual Model, are also included.

This project will develop a report on historical HFI and new enhancements for HFI in the Oil Sands Region, including attribution updates for 2021 conditions. This reporting includes updated categories that differentiate the HF expansion due to oil sands activities. Enhanced attribution updates for HFI data include continuing to add (a) "Year of Origin" attribute to all HF features in the Oil Sands Region; age attribution will support time-series analysis, including trend and change detection, (b) "Sector" attribute to all HF features in the Oil Sands Region, e.g., to differentiate roads used by forestry from roads used by the oil sands industry, (c) "Light" value for 2021; support time-series analysis, including trend and change detection, (d) "Noise" value for 2021; support change detection analysis between 2019 and 2021 conditions, (e) "NDVI" (Normalized Difference Vegetation Index) value for 2021; support time-series analysis, including trend and change detection, (f) "Exploration vs Production" – this work was initiated in 2022 to accurately assess environmental impacts of regional oil and gas activities, we will assemble, develop, analyze, and report on oil and gas exploration and production variables with the objective of separating exploration disturbance from production disturbance for conventional oil and gas, surface mining and, if possible, in-situ production. These two development types (exploration vs. production) operate under different regulatory frameworks and have differing approaches to long term mitigation. This project will also scope and develop a roadmap for additional attribution and information needs on oil sands stressors with the TBM TAC, e.g., oil sands production timelines, disturbance status, spatial resolution, and temporal information needs.

References:

Roberts, D.R., Bayne, E.M., Beausoleil, D.L., Dennett, J.M., Fisher, J.T.,Hazewinkel, R.R.O., Sayanda, D., Wyatt, F., & Dubé, M.G. 2022. A synthetic review of terrestrial biological research from the Alberta oil sands region: ten years of published literature. Integrated Environmental Assessment and Management. 18(2): 388-406.

Swanson, S. 2019a. Oil Sands Monitoring Program: Integration Workshop Reports (Part 1 of 2). OSM Technical Report Series No. 7.1. https://open.alberta.ca/publications/9781460144947.

Swanson, S. 2019b. Oil Sands Monitoring Program: Recommendation Report (Part 2 of 2). OSM Technical

Report Series No. 7.2. https://open.alberta.ca/publications/9781460144954.

Task 1.2 ESSENTIAL geospatial data acquisition. Acquire high-resolution aerial or satellite imagery in the Oil Sands Region by close consultation with OSM project leads for identifying ESSENTIAL data products and areas of interest.

Note on Interdependencies: Delivered by OSM integrated geospatial program; collaboration with ABMI on data collection and OSM TBM and Wetlands TACs as data users.

Status: Proposed 2023-2024 work plan; identified as "Hight Priority" by OSM TACs (Sup02); completed during 2023-2024 and beyond.

The Data and Integrated Analytics TAC SoW for 2023-2024 priority geospatial data products include "LiDAR and high-resolution temporal remote sensing data", which are required to enable watershed-scale and site-specific assessments."

Description: High-resolution aerial and satellite imagery is a critical and foundational data need across multiple theme areas of OSM to support characterization of stressors and changes in environmental endpoints. Complete coverage of high-resolution imagery in areas of oil sands disturbances is essential for understanding the dynamics occurring along the stressor-response pathway. Two information needs for high-resolution data have been identified:

• LiDAR data prodcut- LiDAR data is being collected across much of the Oil Sands Region by multiple groups including forestry, oil sands sector, and government. These efforts are anticipated to provide broad spatial coverage, but some gaps in high priority monitoring locations, in particular adjacent to the mineable region, are expected. Complete data coverage in this area is required to support multiple initiatives (Task 2.2 Habitat Mapping of Forest Regeneration). LiDAR data will be collected by wide angle mapping on fixed wing aircraft at approximately 10-18 pts/m2. Collection of these data will enable the production of higher resolution digital elevation models, canopy height models, etc.

• RADARSAT-2 data product - Polarimetric Synthetic Aperture Radar (SAR) data is needed for a targeted area of the Lower Athabasca as it has been demonstrated to be the most effective data for understanding shallow water dynamics, which are a major component of changes in sensitive biological indicators associated with rare boreal ecosystems (Delancey et al. 2021). SAR can penetrate to the vegetation/water surface, unlike optical data, and polarimetric SAR can detect important vegetation flooding and hydrology. Quad-Polairzation images with approximately 8 m resolution are available between 2014-2020 in 50 km X 50 km tiles for the areas of interest, which includes McLelland Lake and the Anzac area. These data will be used by the core TBM program to identify prime habitat characteristics and areas of key indicators (Landbirds sub work plan under TBM TAC).

References:

Delancey E.R, Brisco B., McLeod L.J.T., Hedley R., Bayne E.M., Murnaghan K., Gregory F., Kariyeva J. 2021. Modelling, Characterizing, and Monitoring Boreal Forest Wetland Bird Habitat with RADARSAT-2 and Landsat-8 Data. Water, 13, 2327.

Objective 2. Provide OSM Program participants with geospatial science products and services required to deliver the OSM Program.

Task 2.1 Geospatial mapping for the assessment of cumulative effects of pressure/stressors. Report on OSM stressors mapping (analysis) based on updated geospatial data and further geospatial analysis for characterizing oil sands specific pressure/stressors for supporting theme area site selection/monitoring design, evaluation, and reporting in the Oil Sands Region.

Note on Interdependencies: delivered by OSM Integrated Geospatial Program; collaboration with the theme area TACs.

Status: Continuing from 2019-2020; identified as "High Priority" by OSM TACs (Sup02); completed during

2023-2024 and beyond.

The Data and Integration Analytics TAC SoW for 2023-2024 identified stressor mapping as one of the key programmatic geospatial science activities required by all theme area programs for supporting monitoring design, evaluation, and reporting.

The stressor map updates are directory tied to deliverables under Task 1.1a (HFI) and Task 1.1c (industrial oil sands water use inventory) of this work plan, and atmospheric deposition data produced under Data and Deposition TAC (e.g. Task 2.5 of this work plan).

Description: In 2023-2024, this work plan will continue refining and updating OSM geospatial stressor-based approach (Sup06) for the assessment of cumulative effects based on updated geospatial data for pressure/stressors. The updates will leverage a similar relative environmental pressure tool and approach developed under the Provincial Geospatial Science Framework: Quality-Driven Data Development, Geospatial Modelling, Evaluation and Assessment in response to Platform Commitment2.15.7 to improve data collection on environmental outcomes for parks and public lands across the Province. A manuscript based on this provincial project is currently being prepared (Nasr and Orwin 2022). This approach identifies and uses relative pressure data related to hydrologic alteration, land disturbances, contaminants (e.g., air emissions/depositions and leaks/spills on land), and human pressure (e.g. population, light at night, noise), of which many align with the OSM programmatic conceptual model (Sup05-revised).

Since this proposed OSM project is at a regional-scale approach, a collection of information will be done to identify historically identified areas of concern, baseline conditions, and limit of change in the Oil Sands Region based on theme area programs' input. This way, the geospatial analysis of cumulative effects assessment will be further refined by including additional data metrics calculations to capture oil sands specific stressors/pressure (e.g. industrial oil sands surface water and groundwater withdrawal/diversion) and to incorporate appropriate weighting factors in distinguishing oil sands development and activity effects in the region. The geospatial analysis is based on a programming multicriteria analysis in Geographic Information System (GIS) (Eastman 1999) which develops scalable stressor maps showing spatial characterization of hierarchy watersheds in the region (SoE Chapter 2 Mapping Human Activities). The stressed areas (or areas of concern) will be identified based on a stress rank grouping of watersheds.

In collaboration with Service Alberta in 2024-2025, a plan will be developed to implement OSM stressor mapping as a geospatial tool in OSM Geospatial Portal for sharing with OSM theme area programs. In the following year (2024-25), the tool will be published and fully operational for OSM projects.

References:

Eastman R. 1999. Multi-criteria evaluation and GIS. Chap. 35. Longley P.A., Goodchild M.F, aguire D.J., Rhind D.W. (eds). Geographical information systems. Wiley, New York. pp. 493-502.

Nasr M., Orwin J.F In Prep (2022). A Geospatial Approach to Identifying and Mapping Areas of Relative Environmental Pressure on Ecosystem Integrity.

Task 2.2 Habitat mapping of forest regeneration. Quantify spatial and temporal trends of forest regeneration on oil sands footprint that support the assessment of ecological response to changing habitat units.

Note on Interdependencies: Delivered by ABMI; collaboration with OSM Integrated Geospatial Program and TBM TAC. This work informs Task 1.1a Human Footprint Monitoring.

Status: Continuing from 2022-2023 and beyond; identified as “High Priority” by OSM TBM TAC (Sup 2); completed during 2023-2024 and beyond.

The Data and Integration Analytics TAC SoW for 2023-2024 priority geospatial data products include “LiDAR and high-resolution temporal remote sensing data, which are required to enable watershed-

scale and site-specific assessments." This LiDAR based habitat mapping work generates these priority geospatial data products and executes key geospatial activities as core monitoring for the geospatial program.

For the 2023-2024 TBM core program, one of the deliverables in the SoW is to integrate geospatial habitat monitoring directly into TBM activities and expand the program to include targeted footprint attribution and land recovery information.

Description: Forest regeneration is a critical component of oil sands disturbance management and is fundamental in the long term regulatory approach to mitigation for habitat and wildlife. Rates of habitat regeneration may alter local responses of many taxa to disturbance features (Lankau et al. 2013, Tattersall 2020), thus determining change via the quality and duration of effects of footprint on indicator species. To ignore vegetation recovery on disturbance features could, for many taxa, result in mis- or over-estimations of local impacts if regeneration is not considered. In many respects, the original human use of the feature is secondary to the ecological character of the feature. Thus, moving beyond the mapping and attribution of disturbances to the character and ecological quality of disturbances could produce stronger explanatory models where feature attributes such as regeneration are useful explanatory variables (Roberts et al. 2022).

The 2023-2024 Habitat Monitoring represents the second year of this initiative, which is being developed at the request of the TBM TAC. The 2023-2024 project will continue to focus on the measurement of indicators related to habitat recovery work on seismic lines, well pads, and other footprint associated with oil sands exploration and production. This information is critical for measuring the effectiveness of regulation of these two types of activities, which operate under differing regulatory frameworks. This work has been identified as a high priority by the TBM TAC due to the growing evidence that alternative successional pathways are resulting in shifts in wildlife communities. In 2023-2024, the Habitat Monitoring project will continue in the Athabasca Oil Sands Area while also expanding to include the Cold Lake Oil Sands Area. Stressor monitoring to date has captured the amount and distribution of oil sands footprint. However, to understand and manage cumulative effects, trends in land surface trajectories with a targeted evaluation of drivers of change are needed at multiple temporal and spatial scales. This project directly supports the assessment of cumulative effects that are already present, enables assessment of the incremental cumulative effects, and improves cumulative effects assessment over time.

Using a combination of LiDAR, photogrammetry, and ground-truthing approaches, forest regeneration will be measured according to the guiding principles of the Provincial Restoration and Establishment Framework for Legacy Seismic Lines in Alberta. We will use newly acquired high-resolution aerial imagery along with existing and recently developed geospatial products to generate vegetation metrics (eg., height; density; canopy cover) on oil sands footprint. These metrics will be generated using a standardized workflow that incorporates semi-automated processes with both ground and imagery-based validation datasets. Priority for monitoring and analysis will be footprint features directly associated with oil sands exploration and production, such as seismic lines and well pads.

References:

Lankau H.E., Bayne E.M., Machtans C.S. 2013. Ovenbird (Seiurus aurocapilla) territory placement near seismic lines is influenced by forest regeneration and conspecific density. Avian Conservation and Ecology. 8(1). doi:10.5751/ACE-00596-080105.

Roberts, D.R., Bayne, E.M., Beausoleil, D.L., Dennett, J.M., Fisher, J.T.,Hazewinkel, R.R.O., Sayanda, D., Wyatt, F., & Dubé, M. G. 2022. "A synthetic review of terrestrial biological research from the Alberta oil sands region: ten years of published literature." Integrated Environmental Assessment and Management. 18(2): 388-406.

Tattersall E.R., Burgar J.M., Fisher J.T., Burton A.C. 2020. Mammal seismic line use varies with restoration: applying habitat restoration to species at risk conservation in a working landscape. Biological Conservation. 241:108295. doi:10.1016/j.biocon.2019.108295.

Task 2.3 Groundwater dependent ecosystem (GDE) mapping. Develop a geospatial and indicator-based approach to map GDEs across the oil sands region to support refinement of groundwater monitoring to ensure these important receptors are monitored for changes due to direct and cumulative impacts of oil sands activities.

Note on Interdependencies: Delivered by ABMI and InnoTech Alberta; collaboration with OSM Integrated Geospatial Program, Groundwater TBM and Wetland TACs.

Status: Proposed 2023-2024 work plan and beyond; Identified as "High Priority" by OSM Groundwater TAC (Sup 2); to be completed in 2023-2024 and beyond.

Description: The 2022 SoW for the Groundwater TAC identified the following key questions related to GDEs: (1) Where are the significant areas (e.g., GDEs) of groundwater connectivity (i.e., groundwater discharge/recharge) to surface waters such as streams, wetlands, springs and lakes? (2) Has the quality and quantity of groundwater discharge to GDEs, or other surface waters of interest, changed? (3) What is the cause of any unexpected changes identified in preceding items…?

The 2022 SoW for the Groundwater TAC also states that "identifying GDEs remains a key knowledge gap in OSM monitoring". The Groundwater TAC continued to recommend and prioritize efforts to address the significant knowledge gaps required to design and monitor for changes in GDEs: "Identifying and understanding GDEs (where groundwater discharge quality and quantity supports ecosystems) is still poorly understood in the region and it remains in its initial stages of development for monitoring." The scope of work priorities for implementation in year one include developing approaches for identifying GDEs. This project meets these TAC-identified high priority 2023-24 needs by developing approaches for and mapping GDEs.

This work also directly addresses several OSM key questions related to this pathway (as circulated by OSM Program Office, November 2020), including those of specific importance to Indigenous communities (Sup02). GDEs provide critical ecosystem functions and services and support species of special importance to Indigenous communities. By understanding the distribution and potential exposure of GDEs to oil sands impacts through changes to groundwater quality and quantity, monitoring can be focused to assess changes to groundwater discharge and resultant changes to ecosystems. Assessing the impact on GDEs and their component or reliant species will support evaluation of impacts to Indigenous harvesting and knowledge sharing and may be used to support maintenance of Indigenous practices on the landscape.

Description: Groundwater dependent ecosystems (GDE) are ecosystems which rely on groundwater sources for their continued existence. GDEs can include terrestrial, aquatic or subterranean ecosystems. GDEs are sensitive to changes in both the quality and quantity of groundwater discharge (Kløve et al. 2011), both of which can be affected by oil sands stressors such as landscape disturbance, groundwater withdrawals, and tailings pond seepage.

This work is of high value to the OSM program because GDEs are the most important groundwater "user" or "receptor" as there are few domestic groundwater wells in the oil sands region. GDEs support unique vegetation communities that contribute to the biodiversity of an area, vegetation communities used for Indigenous harvesting, and wildlife communities (e.g. ungulate watering holes, salt sources, waterbird habitat). This work will identify and raise awareness of areas where GDEs form a large component of the landscape and perform important ecosystem functions.

The long term objective of this work is to map GDEs across the oil sands region so that they can be used to refine a long-term monitoring plan for groundwater and contribute to identification of cumulative effects in aquatic and terrestrial environments. The objectives for the 2023-2024 activities are to: (1) develop an approach for mapping GDEs in the Oil Sands Region, (2) evaluate data availability, and (3) apply these methods to complete preliminary mapping of GDEs on a pilot scale to make recommendations for next steps and oil sands region-wide GDE mapping.

GDE evaluation is initially focused on a geospatial approach (e.g. Martinez-Santos et al. 2021), integrating mapping of (a) surface expressions of groundwater, such as rivers and springs; (b) other

groundwater indicators likely to indicate groundwater-surface water interactions, including water table elevation, gaining/ losing reaches of rivers, aufeis (Huryn et al. 2020), precipitation deficits; and (c) biological indicators including vegetation (e.g., key species) and wildlife reliant on the water table in boreal ecosystems. Together these hydrogeological and biological indicators will be used to map at least one of the aquatic, terrestrial, and subterranean GDE-types in a watershed with sufficient available data, and make recommendations for next steps to fill data gaps and expand GDE mapping across the Oil Sands Region.

References:

Huryn A.D., Gooseff M.N., Hendrikson P.J, Briggs M.A, Tape K.D., Terry N.C. Aufeis fields as novel groundwater-dependent ecosystems in the arctic cryosphere. 2020. Limnol. Oceanogr. 66:607-624. https://doi.org/10.1002/lno.11626.

Kløve, P.A., Bertrand G., Boukalova Z., Ertürk A., Goldscheider N., Ilmonen J., Karakaya N., Kupfersberger H., Kvœrner J., Lundberg A., Mileusnić M., Moszczynska A., Muotka T., Preda E., Rossi P., Siergieiev D., Šimek J., Wachniew P., Angheluta V., Widerlund A. Groundwater dependent ecosystems. 2011. Part I: Hydroecological status and trends. Environmental Science & Policy. 14(7):770-781, https://doi.org/10.1016/j.envsci.2011.04.002.

Martínez-Santos P., Díaz-Alcaide S., De la Hera-Portillo A., Gómez-Escalonilla V. Mapping groundwater-dependent ecosystems by means of multi-layer supervised classification. 2021. Journal of Hydrology. 603 (A): 126873. https://doi.org/10.1016/j.jhydrol.2021.126873.

Task 2.4. Microbasin Human footprint mapping to support OSM Benthic Invertebrate Biomonitoring. Conduct geospatial analysis to extract human footprint data for selected sites by the Benthic program. Note on Interdependencies: Delivered by OSM Integrated Geospatial Program; collaboration with OSM Benthic Invertebrate Biomonitoring under the Surface Water TAC.

Status: Proposed 2023-2024 work plan and beyond; completed during 2023-2024 and beyond.
The Surface Water TAC has identified this task as a high priority to fulfill the OSM Program mandate to deliver analyses and adaptive study design in both the Athabasca Oil Sands Area's mineable and in situ regions and related reference locations. This task is aligned with the Data and Integrated Analytics TAC SoW document to support theme –area projects with geospatial science deliveries. In accordance with SIKIC's instructions, projects included under the Data Integration TAC have been compiled based on close communication with OSM TACs. This task is closely linked to Task 1.1a.

Description: This project is to support a measure of human impact for sub-watersheds or within a prescribed buffer region around each benthic sampling location. This includes high resolution measures of anthropogenic impact of disturbances (HF) within each HUC 8s or 10s watersheds and/or delineated microbasins within the benthic study area.
The selected study areas are within the Athabasca Oil Sands Area encompassing the areas of active surface mining north of Fort McMurray and the areas of active in situ mining south of Fort McMurray towards Christina Lake. Also "reference areas" northwest of Fort McMurray towards the Birch Mountains Wildland Provincial Park and "reference areas" located outside of active in situ plants south of Fort McMurray toward Christina Lake. An additional evaluation will be conducted to extend the spatial extent to cover the full extent of rivers and streams that are monitored as part of OSM's aquatic programs: Lower Athabasca (from Smith, AB to Lake Athabasca), Athabasca tributaries (Dover, Ells, Firebag, High Hills, Hangingstone, Horse, Jackpine, Joselyn, Mackay, Muskeg, Steepbank), and southern in situ region (Christina, Cottonwood, Gregoire, Jackfish, Kettle, Meadow, Pony, Waddell). Final bounds can be determined after discussion with the Benthic program and the OSM geospatial team. In the future, there is also longer-term interest in quantifying disturbance in the Cold Lake Oil Sands Area in the Oil Sands Region.

This project will deliver a technical report and geospatial data models (e.g. shapefiles; Google Earth) for visualization of potential impacts and supporting the selection of monitoring sites (new/revised monitoring locations), especially in the in situ region south of Fort McMurray.

Task 2.5 Snowpack/wintertime contaminant deposition mapping. Develop and update snowpack/wintertime contaminant deposition maps for 2015, 2017, 2020 in the Oil Sands Region.
Note on Interdependencies: Delivered by OSM Integrated Geospatial Program; collaboration with Air and Deposition TAC.

Status: Proposed 2023-2024 work plan and beyond; identified as "High Priority" by OSM Air and Deposition TAC (Sup02); completed during 2023-2024 and beyond.

The Air and Deposition TAC has identified this task as a high priority to fulfill the OSM Program mandate to deliver deposition maps, as directed by the SIKIC and OC in funding decisions. This task is aligned with the Data and Integrated Analytics TAC SoW document to support theme –area projects with geospatial science deliveries. In accordance with SIKIC's instructions, projects included under the Data Integration TAC have been compiled based on close communication with OSM TACs.

Description: This project includes the development and update of snowpack/wintertime contaminant deposition maps for 2015, 2017, and 2020, required as part of the Air Deposition work plan proposal. These maps reflect on snow monitoring in the Oil Sands Region through the OSM Program and all contribute to the major objectives of the Air Deposition program to determine levels and changes of atmospheric deposition for specific pollutants that pose a likely risk for forest, river, lake, and wetland ecosystem function (Air Deposition work plan: Objective #1 and #2). Additionally, these maps are considered an important part of program-wide integration within and across OSM theme areas such as supporting ecological monitoring site selections (Air Deposition work plan: Objectives 1 and 2), stressor analysis (Task 2.1 of this project), and improving continued model comparison and delivering deposition maps required by other theme area projects (Air Deposition work plan: Objectives 1).
The analysis and outcome of this project will be included in a peer-reviewed manuscript, developed by Air Deposition TAC (this deliverable is included in 2023-2024 Air Deposition work plan proposal). The snow deposition maps will be included in OSM Geospatial Data Portal for access and use by other OSM projects, including surface aquatics, groundwater, terrestrial biological, and wetland for supporting an adaptive monitoring framework. Additionally, it is expected that the inclusion of these maps in the Geospatial Portal, stakeholders (industry, Indigenous groups, and the general public) use these maps, as they not only provide key scientific information to other OSM projects, they also provide a visual representation of data that is understandable to a general audience. The maps will include data attributes and metadata information and will become available on the Geospatial Portal by support from Service Alberta.

Task 2.6 Support State of Environment (SoE) reporting. Provide geospatial support to the development of SoE by producing static and interactive maps and providing updates to the geospatial chapter.
Note on Interdependencies: Delivered by OSM Integrated Geospatial Program; collaboration with OSM TACs.

Status: Proposed 2021-2022 work plan and beyond; completed during 2023-2024 and beyond.
Description: This Task will support the SoE by conducting geospatial analysis and producing maps. This will require close collaboration with the technical committee and OSM project PIs. Additionally, the SoE geospatial chapter will be updated based on updated and new data developed through this project (e.g. Task 2.1).

Task 2.7. Identify, assess, and strategize geospatial needs required to deliver the OSM Program. Support the integration and delivery of the OSM Program by identifying program-wide geospatial science needs.

Note on Interdependencies: Delivered by OSM Integrated Geospatial Program; collaboration with OSM TACs.

Status: Proposed 2021-2022 work plan and beyond; completed during 2023-2024 and beyond.
This task is aligned with the Data and Integrated Analytics TAC SoW document, reviewed and supported by SIKIC. In accordance with SIKIC's instructions, projects included under the Data Integration TAC will be compiled based on close communication with OSM TACs.

Description: Develop a technical report and presentation on gap and need for a regional remote

sensing/GIS strategy to ensure continuous support from the OSM Program for high priority stressor products, response products, and geospatial science tasks to support the theme area programs. This will include exploring potential remote sensing/GIS indicator or tool development (e.g. open water area extent and change over time), identified by theme area programs. The aim is to identify hotspots of change and the relationships between areas of high environmental changes and the extent of disturbances in the Oil Sands Region.

The outcome of this task will be summarized in the geospatial needs templates (Sup02) based on various TACs' needs and requirements for geospatial science support including data/tool development and analysis. This information will be used for integration with OSM TACs and for future geospatial work plan proposal development.

The OSM geospatial team will host an all TAC meeting/workshop (or a series of TAC meetings) to discuss geospatial products. Additionally, the geospatial team will work directly with OSM TACs for identifying theme area needs for geospatial science and for future collaborations.

Budget requests for the above tasks are included in Section 16 (Project Human Resources and Financing) of this work plan and OSM budget spreadsheet (Sup09).

The tasks and deliverables included in this revised work plan are reviewed and approved by OC. Additional tasks and deliverables included in Sup02 will not be delivered in 2023-2024. These items are removed from the updated versions of Sup04 (Sup04-revised) and Sup05 (Sup05-revised) documents and are as follows:
- Industrial oil sands water usage inventory.
- Wetlands inventory.
- Ground truth remote sensing of vegetation health monitoring.
- Characterization of regional variability in selected measures of ecosystem conditions (hydrological variability tool).
- Geosptial assessment of ecystem structure and function.
- Online mapping services and web-based implementation of geospatial tools.

10.5 List the Key Indicators Measured, If Not Applicable, State N/A *****

As a part of cumulative assessments of pressures, stressors and receptors (responses), this project will collect geospatial data from external and internal sources. These data are grouped as follow:
Hydrologic Alteration:
- N/A

Land Disturbance:
- Land Modification
- Surface mining lease
- Transportation / Service Corridors

Contaminants:
- Air deposition and emissions
- Disposal (e.g. deep well disposal)
- Operational spill/leak, accidents, and tailing seepage

Human Pressure:
- Human Settlement (population)
- Human Activities (e.g. light, noise, traffic volume)

Natural Landscape / Vegetation Cover:
- N/A

11.0 Knowledge Translation

In the space below, please provide the following:

- *Describe the plan for knowledge transfer and distribution of learnings from the project. This could include workshops, publications, best practice documentation, marketing plan, etc.*
- *Demonstrate that the knowledge transfer plan is appropriate for the intended end-users.*

The knowledge produced under this work plan will be made available to the public using five main knowledge translation techniques, appropriate for different end users including:

• Presenting results of all analyses to the scientific community at regional/national/international conferences and in peer reviewed scientific journals. These products will be targeted to end-users with strong scientific and technical knowledge.

• Developing technical reports targeting scientific and technical audiences. These technical reports will be targeted to end-users with intermediate scientific and technical knowledge.

• Future production of publicly available curated OSM geospatial data package. This data package will be suitable for use by end users interested in accessing the raw data, typically scientists and end users with specialist technical skills.

• Future development of geospatial web (online) mapping will allow end users with no technical skills or specialist software to view and interact with the curated OSM geospatial data package. This product will be targeted toward the public at large, with no need for technical or scientific skills.

• A pilot public reporting tool will be developed/planned for development under this project to present the results of the geospatial stressor analysis to the public at large using an online data visualization and interactive mapping tool when developed in 2024-205. These tools will be targeted toward end-users with no need for technical or scientific skills, presenting the knowledge with summaries and interactive data visualization targeted to end users with no need for technical or scientific skills.

12.0 External Partners

List by project or project phase each component that will be delivered by an external party (including analytical laboratories) and name the party. Describe and name the associate work plan/grant/contract for these services. * state none if not required

The geospatial science data and products delivered by external collaborators are:

• Objective 1 - Task 1.1a Historical and enhanced human footprint inventory. Historical and enhanced Human Footprint Inventory (HFI) data (1950s, 1980s, and 2021) for the Oil Sands Region through Alberta GRANT for Biodiversity Monitoring Institute (ABMI).

• Objective 1 - Task 1.2. Acquire high-resolution aerial or satellite imagery through two separate contracts. The contractor for LiDAR acquisition remains to be identified. The contractor for purchasing high resolution satellite imagery (RADARSAT-2) is e-geos (https://www.e-geos.it/en/).

*Please note the details of cost categories will be updated at the time of contract development.

• Objective 2 - Task 2.2 Habitat mapping of forest regeneration through ABMI GRANT funded through the Integrated Geosptial Program.

• Objective 2 - Task 2.3 Groundwater dependent ecosystem through ABMI GRANT funded through the

Integrated Geosptial Program.

• Objective 2 – Task 2.4 Microbasin human footpring mapping through the Alberta GRANT.

Please note, Task 1.1a and Task 2.4 are covered by Alberta GRANT, and Task 2.2 and Task 2.3 are covered under ABMI GRANT funded through OSM Integrated Geosptial Program.

*To ensure complete work plan proposal submission, all grants and contracts listed in this section should also be captured in Grants & Contracts.

13.0 Data Sharing and Data Management

For 2022-23 the following approach will be taken by the OSM Program related to data sharing.

For all work plans of a **western science** nature funded under the OSM Program, data sharing is a condition of funding and must align with the principle of **"Open by Default"**. In this case, all data is to be shared with the OSM Program as directed by the OSM Program Data Management work plan.

For all work plans involving **Indigenous Knowledge** as defined below and funded under the OSM Program, data sharing is a condition of funding and the Indigenous Knowledge components of the work plan must align with the principle of **"Protected by Default".** In this case, all data as defined as Indigenous Knowledge, are to be retained by the Indigenous community to which the Indigenous Knowledge is held.

Indigenous Knowledge is defined as:

> "The knowledge held by First Nations, Inuit and Métis peoples, the Aboriginal peoples of Canada. Traditional knowledge is specific to place, usually transmitted orally, and rooted in the experience of multiple generations. It is determined by an Aboriginal community's land, environment, region, culture and language. Traditional knowledge is usually described by Aboriginal peoples as holistic, involving body, mind, feelings and spirit. Knowledge may be expressed in symbols, arts, ceremonial and everyday practices, narratives and, especially, in relationships. The word tradition is not necessarily synonymous with old. Traditional knowledge is held collectively by all members of a community, although some members may have particular responsibility for its transmission. It includes preserved knowledge created by, and received from, past generations and innovations and new knowledge transmitted to subsequent generations. In international or scholarly discourse, the terms traditional knowledge and Indigenous knowledge are sometimes used interchangeably."

This definition was taken from the Canadian Government's Tri-council Policy Statement for Ethical Research involving Humans (Chapter 9, pg. 113) and is an interim definition specific to the Oil Sands Monitoring Program.

Data Sharing and Data Management Continued

13.1 Has there, or will there be, a Data Sharing agreement established through this Project? *

NO

13.2 Type of Quantitative Data Variables:

Discrete

13.3 Frequency of Collection:

Annually

13.4 Estimated Data Collection Start Date:

2023-04-01

13.5 Estimated Data Collection End Date:

2024-03-31

13.6 Estimated Timeline For Upload Start Date:

2023-04-01

13.7 Estimated Timeline For Upload End Date:

2024-03-31

13.8 Will the data Include traditional knowledge as defined by and provided by an Indigenous representative, Community or Organization?

NO

TABLE 13.9 Please describe below the Location of Data and Data Type:

Add a Data Source by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table

Name of Dataset	Location of Dataset (E.g.: Path, Website, Database, etc.)	Data File Formats (E.g.: csv, txt, API, accdb, xlsx, etc.)	Security Classification
2021 Enhanced Human Footprint Inventory	https://www.abmi.ca/home/data-analytics/da-top/da-product-overview/Human-Footprint-Products.html	shp, feature class	Open by Default
Circa 1950s Human Footprint Data	https://www.abmi.ca/home/data-analytics/da-top/da-product-overview/Human-Footprint-Products.html	shp, feature class	Open by Default

Circa 1980s Human Footprint Data	https://www.abmi.ca/home/data-analytics/da-top/da-product-overview/Human-Footprint-Products.html	shp, feature class	Open by Default
Click or tap here to enter text.	Click or tap here to enter text.	Raster	Open by Default
Click or tap here to enter text.	Click or tap here to enter text.	Raster	Open by Default
Click or tap here to enter text.	Click or tap here to enter text.	Raster	Open by Default
Click or tap here to enter text.	Click or tap here to enter text.	Shapefile, feature class	Open by Default

14.0 2023/24 Deliverables

Add an additional deliverable by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table.

Type of Deliverable	Delivery Date	Description
Other (Describe in Description Section)	Q4	Task 1.1a (1) Human Footprint (HF) for the entire Oil Sands Region - Geospatial Data by ABMI: • 2021 Human Footprint Inventory (HFI) including data attributes (e.g., Age; Sector; Noise; Light; State of Vegetation (NDVI)) and metadata; • circa 1950s HF data; • circa 1980s HF data. (2) Technical Report by ABMI: methodological report summarizing 2021 HFI enhancements, and methodology for developing circa 1950s and 1980s HF.
Other (Describe in Description Section)	Choose an item.	Click or tap here to enter text.
Other (Describe in Description Section)	Choose an item.	Click or tap here to enter text.
Other (Describe in Description Section)	Choose an item.	Click or tap here to enter text.
Other (Describe in Description Section)	Choose an item.	Click or tap here to enter text.

Technical Report	Q4	Task 2.2 Technical Report on habitat mapping for forest regeneration by ABMI including a map of the complied data inventory area (existing data; new data collection and field validation), methods of manual interpretation and machine learning to classify oil sands footprint and vegetation regeneration, a summary of results, and data quality measures. The report will also summarize the total length, in km, of seismic lines included in the inventory, as well as a summary of vegetation regeneration on oil sands footprint.

Technical Report	Q4	Task 2.3 Technical report on initial GDE watershed mapping by ABMI, including a thorough literature review (GDE approaches; groundwater and biological indicators), identified data mainly available through ABMI, data gaps, and data review to identify whether the pilot mapping should focus on a single type of GDE, and to identify a watershed with sufficient data for mapping.

Choose an item.	Choose an item.	Click or tap here to enter text.

Choose an item.	Choose an item.	Click or tap here to enter text.

OSM Program Annual Progress Report (required)	Q4	Report by the work plan lead on this work plan's activities and deliverables using OSM annual report template.

15.0 Project Team & Partners

In the space below please provide information on the following:

- *Describe key members of the project team, including roles, responsibilities and expertise relevant to the proposed project.*
- *Describe the competency of this team to complete the project.*
- *Identify any personnel or expertise gaps for successful completion of the project relative to the OSM Program mandate and discuss how these gaps will be addressed.*
- *Describe the project management approach and the management structure.*

Dr. Mina Nasr, Senior Geospatial Scientist, Ph.D. – Resource Stewardship, Alberta Environment and Protected Areas, Calgary Alberta: Mina is experienced in geospatial/image analytics, data interpretation, and synthesis of information for comprehensive visualization and project planning and delivery in a variety of environmental fields such as water resources, soil/sediment, watershed assessments, contaminants and acid rain loads, and climate change and hydrological limits. Mina's role in this work plan is to continue supporting the implementation of OSM geospatial science program by (i) developing partnerships and collaborations within and outside OSM Program and (ii) leading the development of geospatial data collection and acquisition, services, and management for the OSM Program. Additionally, Mina will lead geospatial support to OSM State of Environment reporting, OSM Office, and OSM teams. She will participate in conferences and workshops and will contribute to OSM peer-review publications as an author/co-author. As part of this work plan, she will develop contracts and grants and work directly with OSM TACs, OSM scientists, and projects PIs for delivering this work plan.

Geospatial Scientist, Ph.D or Masters (approved new hire) – it is expected a geospatial scientist experienced in GIS and remote sensing will be hired to support analysis, programming for tool development, and manuscript preparation.

ABMI has been receiving grants from EPA and OSM Program for many years, and the Integrated Geosptial Program will continue this collaboration with ABMI's Geosptial Centre led by Dr. Cynthia McClain. The ABMI work will be done by a team of scientists and geospatial technologists.

Additional human resources will be seek after within the Government of Alberta's Ministry of Environment and Protected Areas (EPA; e.g. Provincial Geospatial Centre; Policy; Planning).

16.0 Project Human Resources & Financing

Section 16.1 Human Resource Estimates

Building off of the competencies listed in the previous section, please complete the table below. Add additional rows as necessary. This table must include **ALL staff involved** in the project, their role and the % of that staff's time allocated to this work plan. The AEP calculated amount is based on an estimate of $120,000/year for FTEs. This number cannot be changed. The OSM program recognizes that this is an estimate.

Table 16.1.1 AEP

Add an additional AEP Staff member by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table. The total FTE (Full Time Equivalent) is Auto Summed (in Table 16.2.1) and converted to a dollar amount.

Name (Last, First)	Role	% Time Allocated to Project
Senior Geospatial Scientist – EPA-Watershed Sciences, Resource Stewardship	Work plan lead	40%
Geospatial Scientist (hiring in process)	Geospatial support including analysis, reporting, peer-reviewed manuscript writing	100%

Table 16.1.2 ECCC

Add an additional ECCC Staff member by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table. The total FTE (Full Time Equivalent) is Auto Summed in Table 16.2.2

Name (Last, First)	Role	% Time Allocated to Project
Click or tap here to enter text.	Click or tap here to enter text.	0%

The tables below are the financial tables for Alberta Environment & Parks (AEP) and Environment & Climate Change Canada. All work plans under the OSM Program require either a government lead or a government coordinator.

Section 16.2 Financing

The OSM Program recognizes that many of these submissions are a result of joint effort and monitoring initiatives. A detailed "PROJECT FINANCE BREAKDOWN" must be provided using the Project Finance Breakdown Template provided, accessible here (ctrl + click the link below). Please note that completion of this Project Finance Breakdown Template is mandatory and must be submitted along with each workplan.

PROJECT FINANCE BREAKDOWN TEMPLATE (CTRL+CLICK HERE)

Table 16.2.1 Funding Requested BY ALBERTA ENVIRONMENT & PARKS

Organization – Alberta Environment & Parks ONLY	Total % time allocated to project for AEP staff	Total Funding Requested from OSM
Salaries and Benefits *(Calculated from Table 16.1.1 above)*	**140.00%**	**$168,000.00**
Operations and Maintenance		
Consumable materials and supplies		$2,000.00
Conferences and meetings travel		$4,000.00
Project-related travel		$3,000.00
Engagement		$0.00
Reporting		$3,000.00
Overhead		$0.00
Total All Grants *(Calculated from Table 16.4 below)*		**$938,600.00**
Total All Contracts *(Calculated from Table 16.5 below)*		**$381,000.00**
Sub- TOTAL *(Calculated)*		**$1,499,600.00**
Capital*		$0.00
AEP TOTAL *(Calculated)*		**$1,499,600.00**

* The Government of Alberta Financial Policies (*Policy # A600*) requires that all **capital asset** purchases comply with governmental and departmental legislation, policies, procedures, directives and guidelines. **Capital assets** (*Financial Policy # A100*, Government of Alberta, January 2014) are tangible assets that: have economic life greater than one year; are acquired, constructed, or developed for use on a continuing basis; are not held for sale in ordinary course of operations; are recorded and tracked centrally; have a cost greater than $5,000.

Some **examples of capital asset equipment include:** laboratory equipment, appliances, boats, motors, field equipment, ATV's/snowmobiles, stationary equipment (pier/sign/weather), fire/safety equipment, pumps/tanks, heavy equipment, irrigation systems, furniture, trailers, vehicles, etc. (*Financial Policy # A100*, Government of Alberta, January 2014).

Table 16.2.2 Funding Requested BY ENVIRONMENT & CLIMATE CHANGE CANADA

Organization – Environment & Climate Change Canada ONLY	Total % time allocated to project for ECCC staff	Total Funding Requested from OSM
Salaries and Benefits FTE *(Please manually provide the number in the space below)*		
Salaries and Benefits		$0.00
Operations and Maintenance		
Consumable materials and supplies		$0.00
Conferences and meetings travel		$0.00
Project-related travel		$0.00
Engagement		$0.00
Reporting		$0.00
Overhead		$0.00
ECCC TOTAL *(Calculated)*		**$0.00**

* ECCC cannot request capital under the OSM program. Any capital requirements to support long-term monitoring under the OSM program should be procured by Alberta and captured in that budget table.

Table 16.3

Complete ONE table per Grant recipient.

Add a Recipient by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table. The total of all Grants is Auto Summed in Table 16.2.1

GRANT RECIPIENT - ONLY: Name	Dr. Cynthia McClain
GRANT RECIPIENT - ONLY: Organization	Alberta Biodiversity Monitoring Institute (ABMI) (Task 2.2 and Task 2.3)
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$497,500.00
Operations and Maintenance	
Consumable materials and supplies	$196,000.00
Conferences and meetings travel	$1,000.00
Project-related travel	$130,000.00
Engagement	$0.00
Reporting	$33,000.00
Overhead	$81,100.00
GRANT TOTAL *(Calculated)*	**$938,600.00**

Table 16.4

Complete ONE table per Contract recipient.

Add a Recipient by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table. This section is only to be completed should the applicant intend to contract components or stages of the project out to external organizations. The total of all Contracts is Auto Summed in Table 16.2.1

CONTRACT RECIPIENT - ONLY: Name	Click or tap here to enter text.
CONTRACT RECIPIENT - ONLY: Organization	Click or tap here to enter text.
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$0.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	$0.00
Project-related travel	$0.00
Engagement	$0.00
Reporting	$0.00
Overhead	$0.00
CONTRACT TOTAL *(Calculated)*	**$0.00**
CONTRACT RECIPIENT - ONLY: Name	Click or tap here to enter text.
CONTRACT RECIPIENT - ONLY: Organization	Click or tap here to enter text.
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$0.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	0
Project-related travel	$0.00
Engagement	$0.00
Reporting	$0.00
Overhead	$0.00
CONTRACT TOTAL *(Calculated)*	**$0.00**
CONTRACT RECIPIENT - ONLY: Name	TBD
CONTRACT RECIPIENT - ONLY: Organization	TBD – LiDAR Acquisition (Task 1.2) *Please note the details of cost categories will be identified by a future contractor. The categories will be updated at the time of contract development.
Category	**Total Funding Requested from OSM**
Salaries and Benefits	0
Operations and Maintenance	
Consumable materials and supplies	$30,000.00
Conferences and meetings travel	0
Project-related travel	$0.00

Engagement	0
Reporting	0
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$30,000.00**
CONTRACT RECIPIENT - ONLY: Name	TBD
CONTRACT RECIPIENT - ONLY: Organization	e-geos (https://www.e-geos.it/en/) – high resolution satellite imagery acquisition (Task 1.2) *Please note the details of cost categories will be updated at the time of contract development.
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$0.00
Operations and Maintenance	
Consumable materials and supplies	$351,000.00
Conferences and meetings travel	0
Project-related travel	$0.00
Engagement	$0.00
Reporting	$0.00
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$351,000.00**
CONTRACT RECIPIENT - ONLY: Name	Click or tap here to enter text.
CONTRACT RECIPIENT - ONLY: Organization	Click or tap here to enter text.
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$0.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	$0.00
Project-related travel	$0.00
Engagement	$0.00
Reporting	$0.00
Overhead	$0.00
CONTRACT TOTAL *(Calculated)*	**$0.00**
CONTRACT RECIPIENT - ONLY: Name	TBD
CONTRACT RECIPIENT - ONLY: Organization	Click or tap here to enter text.
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$0.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	$0.00
Overhead	0
CONTRACT TOTAL	**$0.00**

(Calculated)	

Table 16.5 GRAND TOTAL Project Funding Requested from OSM Program

The table below is auto calculated, please do not try to manually manipulate these contents.

Category	Total Funding Requested from OSM
Salaries and Benefits ***Sums totals for salaries and benefits from AEP and ECCC ONLY***	$168,000.00
Operations and Maintenance	
Consumable materials and supplies *Sums totals for AEP and ECCC ONLY*	$2,000.00
Conferences and meetings travel *Sums totals for AEP and ECCC ONLY*	$4,000.00
Project-related travel *Sums totals for AEP and ECCC ONLY*	$3,000.00
Engagement *Sums totals for AEP and ECCC ONLY*	$0.00
Reporting *Sums totals for AEP and ECCC ONLY*	$3,000.00
Overhead *Sums totals for AEP and ECCC ONLY*	$0.00
Total All Grants (from table 16.2.1 above) *Sums totals for AEP Tables ONLY*	$938,600.00
Total All Contracts (from table 16.2.1 above) *Sums totals for AEP Tables ONLY*	$381,000.00
Sub- TOTAL	$1,499,600.00
Capital* *Sums total for AEP*	$0.00
GRAND PROJECT TOTAL	$1,499,600.00

Some **examples of capital asset equipment include:** laboratory equipment, appliances, boats, motors, field equipment, ATV's/snowmobiles, stationary equipment (pier/sign/weather), fire/safety equipment, pumps/tanks, heavy equipment, irrigation systems, furniture, trailers, vehicles, etc. (*Financial Policy # A100*, Government of Alberta, January 2014).

17.0 FINANCIAL MANAGEMENT

The OSM Program reserves the right to reallocate project funding during the current fiscal year on the basis of project performance and financial overspend or underspend.

☒ *Please check this box to acknowledge you have read and understand*

In the space below please describe the following:

- *Discuss how potential cost overruns and cost underruns will be managed.*
- *If this is a continuing project from last year, identify if this project was overspent or underspent in the previous year and explain why.*
- *Describe what risks and/or barriers may affect this project.*

The budget of this 2023-2024 OSM Program work plan is due to the direction of the OSM Program to compile all geospatial projects under one geospatial work plan to avoid duplication of efforts among different TACs. As a result, an agreement was made between OSM TAC leads and project leads including the Air and Deposition TAC, Terrestrial Biological Monitoring TAC, Groundwater TAC, Water TAC, Wetland TAC, and Data Services work plan to capture all geospatial projects in a newly developed work plan proposal (this project).

18.0 Alternate Sources of Project Financing – In-Kind Contributions

Table 18.1 In-kind Contributions

Add an In Kind Contribution by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table.

DESCRIPTION	SOURCE	EQUIVALENT AMOUNT ($CAD)
Task 1.1a (Human footpring mapping) and Task 2.4 (Microbasin human footprint mapping)	Government of Alberta through ABMI GRANT	$827,200.00
	TOTAL	**$827,200.00**

19.0 Consent & Declaration of Completion

Lead Applicant Name

Mina Nasr

Title/Organization

Senior Geospatial Scientist

Signature

Mina Nasr

Date

2023-06-22

Government Lead / Government Coordinator Name (if different from lead applicant)

Click or tap here to enter text.

Title/Organization

Click or tap here to enter text.

Signature

Click or tap here to enter text.

Date

Click or tap to enter a date.

PROGRAM OFFICE USE ONLY

Governance Review & Decision Process

this phase follows submission and triggers the Governance Review

TAC Review (Date):

Click or tap to enter a date.

ICBMAC Review (Date):

Click or tap to enter a date.

SIKIC Review (Date):

Click or tap to enter a date.

OC Review (Date):

Click or tap to enter a date.

Final Recommendations:

Decision Pool:

Choose an item.

Notes:

Click or tap here to enter text.

Post Decision: Submission Work Plan Revisions Follow-up Process

This phase will only be implemented if the final recommendation requires revisions and follow-up from governance

ICBMAC Review (Date):

Click or tap to enter a date.

SIKIC Review (Date):

Click or tap to enter a date.

OC Review (Date):

Click or tap to enter a date.

Comments:

Decision Pool:

Choose an item.

Notes & Additional Actions for Successful Work Plan Implementation:

Click or tap here to enter text.