Cross-Cutting Items (Geospatial)

For the 2022-23 annual work plan, key geospatial components listed in the Wetlands, Terrestrial Biological Monitoring and Data Services work plans were combined into a single Cross-Cutting Items (Geospatial) plan. The total geospatial budget for 2022-23 is $2,000,000. A summary of key revised scope under this workplan is below:

Wetland geospatial plan

Task 1.1 Updated Inventory and Assessment of Wetlands for the current state of wetland classes and extents in the Oil Sands Region to developing a comprehensive baseline inventory for wetland habitat in the region.

Revised budget: $147,950

Task 1.1.a Develop an updated wetland inventory including class, form and area of wetlands in the Oil Sands Region for assessing the current state of wetland extent and class in the Oil Sands Region.

Status: Proposed 2022-2023 sub-work plan and beyond.

This project will develop geospatial data of wetland inventory (most current) within the Athabasca Oil Sands Area in the Oil Sands Region (Task 1.1a; year 1 deliverable). Current Alberta Merged Wetland Inventory available through Government of Alberta's Open Access data portal is out-of-date (23 years old) and has not been updated since then. Through this project, a combination of manual interpretation and machine learning will be used to classify wetlands, simultaneously adhering to Provincial Restoration and Establishment Framework for Legacy Seismic Lines in Alberta and the Alberta Wetland Classification System (AWCS) mapping standards. In details, through partnership with ABMI and Ducks Unlimited and AEP, this project will implement a field data collection plan working with Indigenous Communities to target field ground-truthing locations in wetlands. This way, the project will develop a comprehensive field validated wetland inventory which will include field validation data of wetlands by collecting ecosite data and georeferenced photos of vegetation at each wetland site. An annual technical report will include map of the wetland inventory (class; area), methodology, a summary of final results, data quality measures, and recommendations for year 2 of this plan. The report will also include a geospatial "Dashboard" of the wetland inventory for interactive data visualization and analysis. The resulting data and products will be submitted to the Integrated Wetland Program to be included in OSM Geospatial Data Portal/Catalogue managed by Service Alberta, accompanied by metadata consistent with international standards.

Task 1.1.b Assess wetlands status (class and extent changes) in the Oil Sands Region.

Status: Proposed 2022-2023 sub-work plan and beyond.

The 2020 wetland inventory developed through Task 1.1.a will be used as a foundational wetland data with the existing historical Alberta Merged Wetland inventory and Human Footprint Inventory to assess changes in wetland classes and areas over time, and to identify hot spots of change (1984-most recent). Maps showing wetlands changes and summary of results will be provided in the State of Environment Reporting.
Task 1.2 Delineate high-resolution small watersheds and improved topography data (digital elevation model, slope, aspect, terrain) using LiDAR data to enable fine-scale analyses of stressors, receptors, and other variables required for investigation of the causes of change in water chemistry and biological indicators, and for watershed-assessment of cumulative effects of oil sands stressors in the Oil Sands Region.

This task will delineate the boundaries of small watersheds of wetland monitoring sites and other watersheds within and around Athabasca, Peace, and Cold Lake areas in the Oil Sands Region. This project will use LiDAR and other topographical model data to develop high-resolution topologically and topographically consistent drainage basins at the HUC6, HUC8,

HUC10 and HUC12 levels (HUC stands for Hydrologic Unit Codes, which are the international standard for hierarchical classification of watersheds ranging from small watersheds to large drainage basins.). This data is fundamental for improved watershed delineation, wetland catchment delineation, which is high priority for assessing effects of hydrologic alteration and land disturbances on wetland ecosystems. The developed geospatial data through this project will be:

Task 1.2.a Enhanced DEM: Digital Elevation Model, terrain, slope, aspect in the wetland monitoring sites (~120 sites) in the Oil Sands Region.

Status: Proposed 2022-2023 sub-work plan; completed by March 31, 2023.

Task 1.2.b Enhanced DEM: Digital Elevation Model, terrain, slope, aspect in the entire Oil Sands Region.

Status: Proposed 2022-2023 sub-work plan; completed by March 31, 2023.

Task 1.2.c High-resolution watershed data: HUC-12 watersheds of the wetland monitoring sites (~120 sites) in the Oil Sands Region.

Status: Proposed 2022-2023 sub-work plan; completed by March 31, 2023.

Task 1.2.d High-resolution watershed data: HUC watersheds in the Oil Sands Region (HUC6, HUC8, HUC10 and HUC12 levels).

Status: Proposed 2022-2023 sub-work plan; completed by March 31, 2023.

In this sub-work plan, this project is only budgeted for 2022-2023 activities and deliverables.

Task 1.3 Characterize regional variability in selected measures of vegetation health (Leaf Area Index, vegetation height, biomass) in wetland sites throughout the Oil Sands Region and assess spatial and temporal changes for priority watersheds selected by wetland scientists and the Wetland TAC to scale up local surveillance monitoring to watershed scale.

Revised budget: $147,000

Status: In Progress; completed during 2022-2023 sub-work plan and beyond.

This task builds on a two-year pilot project (2020-2022) in the Oil Sands Region. In partnership between Hatfield Consultants and AEP OSM, this project will respond to the need for routine and consistent measures of vegetation health in the Oil Sands Region, which are essential to characterize stressor-response pathways, particularly in upland (terrestrial) and lowland (wetland) ecosystems. The project will apply the methods developed and refined over the last two years to estimate vegetation health parameters (monthly Leaf Area Index (LAI), vegetation height, and aboveground biomass). The resulting geospatial data will support water balance modelling, biomass estimations, ecological modelling and other assessments and investigations related to vegetation productivity and provide geospatial data to support trend assessments (both spatially and temporally).

Input data will be acquired from freely open high-resolution satellite-based sensors and ground-based field data. Empirical models to estimate biophysical properties will be calibrated and validated using ground-based field data and advanced geo-statistical techniques (e.g., advanced machine learning methods, such as boosted regression trees, and random forest). Biophysical variables derived include LAI, vegetation biomass and vegetation height during the growing season throughout the Oil Sands Region.

Calibration of the empirical LAI model will be completed using field measured LAI collected across the study area as well as selectively identifying locations for multiple visits (spring, summer, and fall) to capture seasonal variation. Monthly LAI will be estimated for the 2022 summer months (i.e., May to October) and will cover the Oil Sands Monitoring area (Athabasca, Peace River, and Cold Lake) based on HUC-8 watershed boundaries.

For select wetland watersheds (e.g., Poplar Creek Watershed), vegetation canopy heights will be estimated based on the use and refinement of an existing empirical model. These estimated canopy heights will be validated using field collected data (i.e., canopy heights derived from digital aerial photogrammetry of drone imagery and existing terrain model). Aboveground biomass will be obtained using these canopy heights and the allometric equations published by Ung et al. 2008 for softwoods and hardwoods. If available, concurrent data obtained from permanent sample plot (Alberta Agriculture and Forestry) will be used to validate biomass estimates.

The outcomes and results from this Task, will be shared with interested parties through peer-reviewed publication. Data products included in Section 14 will be released via the OSM Program Geospatial Data Portal/Catalogue managed by Service Alberta, accompanied by metadata consistent with international standards.

In this sub-work plan, this project is only budgeted for 2022-2023 activities and deliverables.

Reference: Ung, C-H., Bernier, P., Guo, X-J. 2008. Canadian national biomass equations: new parameter estimates that include British Columbia data. Canadian Journal of Forest Research. https://cdnsciencepub.com/doi/10.1139/X07-224.

Task 1.4 Develop an annual industrial water usage inventory including type of activity, time of allocation, volume, and location of water withdrawals to assess hydrological alteration for wetland study design and site selection, and for water usage wetland response relationships.

Revised budget: $71,000

Status: Proposed 2022-2023 sub-work plan; completed during 2022-2023 sub-work plan and beyond.

In partnership with the Groundwater TAC, InnoTech Alberta, ABMI, and the Wetland team, this task will develop an inventory of oil sands industrial water allocations and use, both groundwater and surface water, focusing on surface mining areas in the northern Athabasca Area in the Oil Sands Region. Depending on data availability, groundwater use from all aquifers (deeper Cretaceous aquifers, and shallower Quaternary aquifers) will be collected while making sure shallower quaternary groundwater data are completed, as these are priority aquifers for GW-SW interactions. The inventory attribution will include oil sands activity type, water extracted from Quaternary aquifers and mine operation and planning withdrawals for depressurization and dewatering, time of allocation, depth of allocation, location, source and estimate of annual volumes.

In 2022-3023, an inventory of Oil Sands Water Use Inventory in the North Athabasca Area in the Oil Sands Region will be completed. The estimates of water budgets of wetlands and map of recharge and discharge across the landscape including surface water and groundwater Quaternary withdrawals will be done based on a DEM-based characterization of wetlands, lakes, streams, and peatlands. The wetlands-groundwater interactions indicators assessments will be done by (i) evaluating wetland isotopic (d18O, d2H) water balance discharging or recharging to the groundwater and (ii) the assessment of wetlands water quality.

In this work plan, this project is only budgeted for 2022-2023 activities and deliverables. In the following year (2023-2024), similar plans will be develop for the South Athabasca Oil Sands Area and Peace River Area in the Oil Sands Region.

Terrestrial Biological Monitoring Plan

1.1 Adaptive Monitoring Framework (EEM BADR)

Revised budget: $120,000

We continue to build the adaptive monitoring component of BADR in order to fully integrate with the environmental-effects monitoring (EEM) framework. This includes a strong need for human footprint data, analysis and modelling, which are essential assets for site selection activities and ongoing adaptive development and optimization of the TBM's monitoring design.

In 2022/23, cross-cutting work on adaptive development of the BADR EEM design will include:

- Collaborative review of the BADR EEM disturbance and habitat categories and updated footprint layers to support ongoing adaptive monitoring. This will include improving spatial definitions of different oil sands stressors, improving resolution and data available on terrestrial upland habitat classes and how they are incorporated into JEM sites, and exploring potential missing footprint stressors such as pipelines.
- Evaluation of options for incorporation of natural disturbance factors such as wildfire into the BADR EEM design.
- Facilitated team JEM selection process, including a team review of existing sites selected, as well as a collaborative review process for 2023-24 monitoring locations and site selection parameters such as access constraints.
- Continued work on automating and documenting site selection procedures under the BADR EEM design.
- Scoping and development of coarse-filter habitat and landscape indicators using a remote sensing approach to habitat monitoring under the BADR EEM design.
- Establishment of approaches to the development of (a) baseline/reference conditions and (b) monitoring triggers. Initiation of indicator selection and baseline/monitoring trigger development to test approaches using priority indicators with sufficient data. Engagement with key stakeholders as part of these tasks.

Site selection for terrestrial monitoring under the BADR EEM design is highly reliant on consistent and current human footprint data, including high resolution LiDAR-based Hydrologic Unit Code watershed for the OSR, a geospatial data product included for development within the Integrated Wetland Monitoring Program workplan.

1.3.1 Habitat Mapping of Forest Regeneration

Revised budget: $624,208

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. At the direct request of the TBM Technical Advisory Committee (TAC), we are adding a surveillance monitoring system for measuring forest regeneration over time at a regional scale on oil sands footprints. There is growing evidence that alternative successional pathways are connected to shifts in wildlife communities, and while there are existing triggers established for vegetation regeneration for height and stocking densities, it is unknown if these triggers are appropriate for ensuring recovery from a wildlife perspective.

The long term goal of this project is large-scale operational implementation of geospatial techniques currently being developed by the Boreal Ecosystem Recovery and Assessment (BERA) group to monitor and report on the effectiveness of forest regeneration as a mitigation strategy at the regional scale. BERA is a research and development group testing automated and remote sensing approaches for detailed assessments of vegetation regeneration, and measuring the corresponding response by wildlife. Much of this remote sensing research and development is now reaching the implementation stage where it is fit to integrate into regional monitoring efforts. We envision a multi-year, multi-sensor data collection effort, with a focus on the Athabasca Oil Sands Region in year 1.

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 in order to generate vegetation metrics on energy footprint (e.g., height, density, canopy cover). Priority for monitoring and analysis will be footprint features directly associated with oil sands exploration and production, such as seismic lines and well pads.