Acid Deposition Monitoring Program Expansion Committee (ADMPEC)

Meeting Support Slides

October 21, 2021

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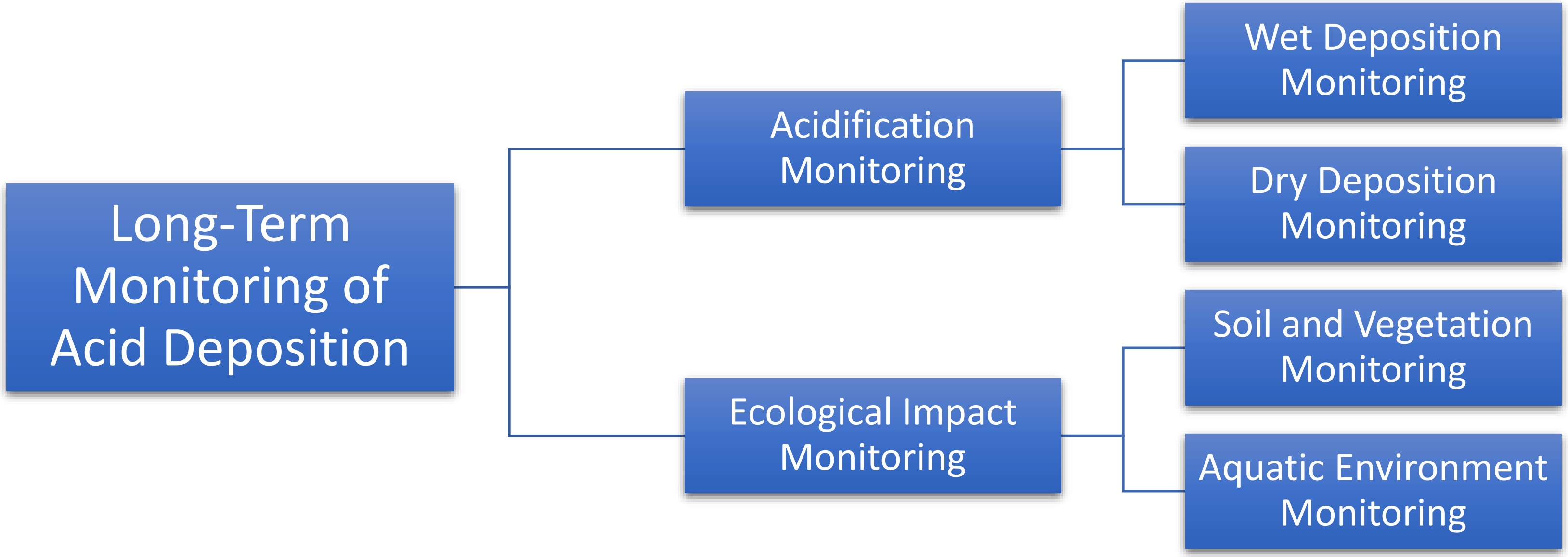
2.1.1 Objectives of monitoring program and monitoring sites

Proposed Objective

- To develop, implement, and operate a long-term program to detect and characterize the effects of acidifying emissions on terrestrial and aquatic ecosystems, and traditional resources.



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Oil Sands Monitoring Program Objectives

- To Track Impacts from Oil Sands Development
- To Conduct Comprehensive and Inclusive Monitoring
- To Inform Management and Regulatory Action
- To Implement Rigorous Monitoring
- To be Cost-effective
- To Inform Trans-boundary Issues
- To Ensure Transparency
- To Incorporate Indigenous Monitoring, Endpoints, and Community-Based Monitoring

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Regulatory Needs

a) for air:
   a) a plan to monitor dry and wet deposition from project activities;

b) for soil:
   i. identification of soils that are sensitive to acid deposition and will likely receive aerial deposition inputs from project activities;
   ii. a plan to monitor soil quality at locations representative of the soils identified in (b) (i);
   iii. a description of how soil quality data collected under this program will be used to determine potential acidification effects under periods of increased sulphur dioxide emissions;

c) for water:
   i. a summary of existing water quality data collected to date and analysis of the results;
   ii. a plan to monitor water quality for water bodies which will likely receive aerial deposition inputs from project activities;
   iii. identification of local water bodies that are sensitive to acidification;
   iv. a description of how water quality data collected under this program will be used to determine potential acidification effects under periods of increased SO2 emissions;
   v. a plan to develop triggers for further enhanced surface water quality monitoring to determine impacts of aerial deposition inputs;

d) reporting schedule for monitoring activities conducted for (a) through (c)

2.1.2 Monitoring agricultural soils vs forest soils

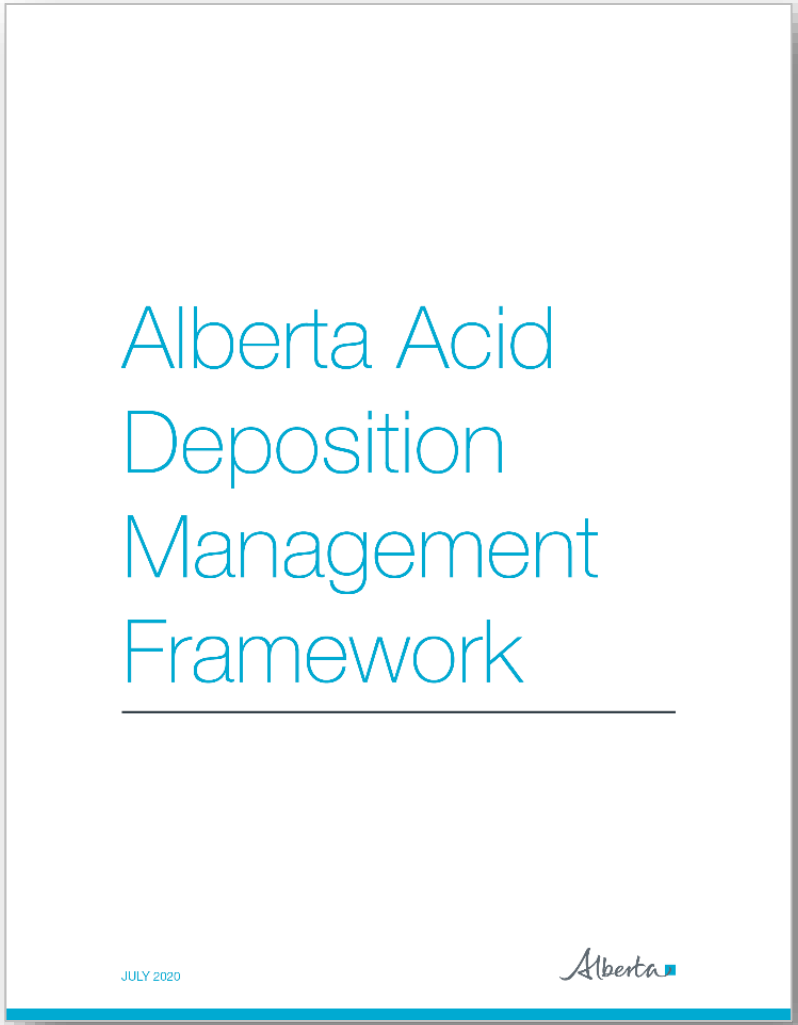
Determination of Critical Loads of Acidity for Terrestrial Ecosystems in Alberta, 2020 AEP

- This work does not take into account the high nitrogen input and removal, and base cation removal associated with fertilizer application and agricultural production on cultivated agricultural land.
- Critical loads of acidity were not derived for cultivated agricultural land.
- Areas identified as rock, exposed soil, water, ice or developed were also not included.

2.1.3 Clarity on critical loads and ADMF

ADMF: Critical Loads

- <u>A quantitative estimate of an exposure below which significant harmful effects do not occur.</u>
- Alberta soil characteristics, dominant vegetation cover, run off, base cation deposition and the impact of wildfires were used to derive critical loads of acidity for sulphur and nitrogen.
- The critical loads approach is useful in environmental management.
- Determination of exceedances of critical load values are part of management framework implementation.


Alberta Acid Deposition Management Framework

JULY 2020

Alberta

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2.1.4 Water chemistry and aquatic ecosystems monitoring from an acid deposition perspective

Current Status

- ADMF focuses on soil sensitivity and critical loads.
- An Alberta framework to guide surface water acidification effects monitoring and management does not exist.
- 2018 GEM-MACH modelling study:
  - Aquatic ecosystem critical load data suggest that the buffering capacity within watersheds is insufficient.
  - Potential ecosystem changes may be taking place.
  - Future work:
    - models to determine damage and/or recovery.
    - monitoring studies to detect the presence of ecosystem change.

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Atmospheric Chemistry and Physics
Open Access
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Estimates of exceedances of critical loads for acidifying deposition in Alberta and Saskatchewan

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Abstract. Estimates of potential harmful effects on ecosystems in the Canadian provinces of Alberta and Saskatchewan due to acidifying deposition were calculated, using a 1-year simulation of a high-resolution implementation of the Global Environmental Multiscale-Modelling Air-quality and Chemistry (GEM-MACH) model, and estimates of aquatic and terrestrial ecosystem critical loads. The model simulation was evaluated against two different sources of deposition data: total deposition in precipitation and total deposition to snowpack in the vicinity of the Athabasca oil sands. The model captured much of the variability of observed ions in wet deposition in precipitation (observed versus model sulfur, nitrogen and base cation R^2 values of 0.90, 0.76 and 0.72, respectively), while being biased high for sulfur deposition, and low for nitrogen and base cations (slopes 2.2, 0.89 and 0.40, respectively). Aircraft-based estimates of fugitive dust emissions, shown to be a factor of 10 higher than reported to national emissions inventories (Zhang et al., 2018), were used to estimate the impact of increased levels of fugitive dust on model results. Model comparisons to open snowpack observations were shown to be biased high, but in reasonable agreement for sulfur deposition when observations were corrected to account for throughfall in needleleaf forests. The model–observation relationships for precipitation deposition data, along with the expected effects of increased (unreported) base cation emissions, were used to provide a simple observation-based correction to model deposition fields. Base cation deposition was estimated using published observations of base cation fractions in surface-collected particles (Wang et al., 2015).

Both original and observation-corrected model estimates of sulfur, nitrogen, and base cation deposition were used in conjunction with critical load data created using the NEG-ECP (2001) and CLRTAP (2017) methods for calculating critical loads, using variations on the Simple Mass Balance model for terrestrial ecosystems, and the Steady State Water Chemistry and First-order Acidity Balance models for aquatic ecosystems. Potential ecosystem damage was predicted within each of the regions represented by the ecosystem critical load datasets used here, using a combination of 2011 and 2013 emissions inventories. The spatial extent of the regions in exceedance of critical loads varied between 1×10^4 and 3.3×10^5 km^2, for the more conservative observation-corrected estimates of deposition, with the variation dependent on the ecosystem and critical load calculation methodology. The larger estimates (for aquatic ecosystems) represent a substantial fraction of the area of the provinces examined.

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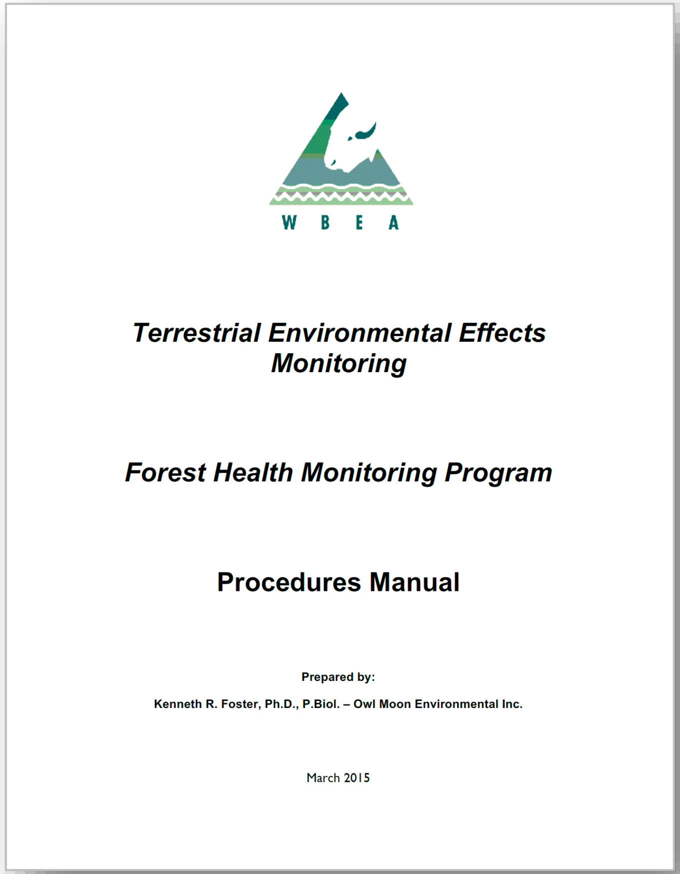
2.1.5 WBEA: Deposition monitoring program

Wood Buffalo Environmental Association (WBEA):
Terrestrial Environmental Effects Monitoring Program

- The WBEA's Terrestrial Environmental Effects Monitoring (TEEM) program is designed to detect, characterize, quantify, and report on emission-related effects to terrestrial ecosystems and traditional land resources in the region.
- The TEEM program monitors air related (cause) impacts on natural ecosystems (effects) so that stakeholders can make informed decisions.
- This work is carried out through the Forest Health Monitoring Program.


W B E A

Terrestrial Environmental Effects Monitoring

Forest Health Monitoring Program

Procedures Manual

Prepared by:

Kenneth R. Foster, Ph.D., P.Biol. – Owl Moon Environmental Inc.

March 2015

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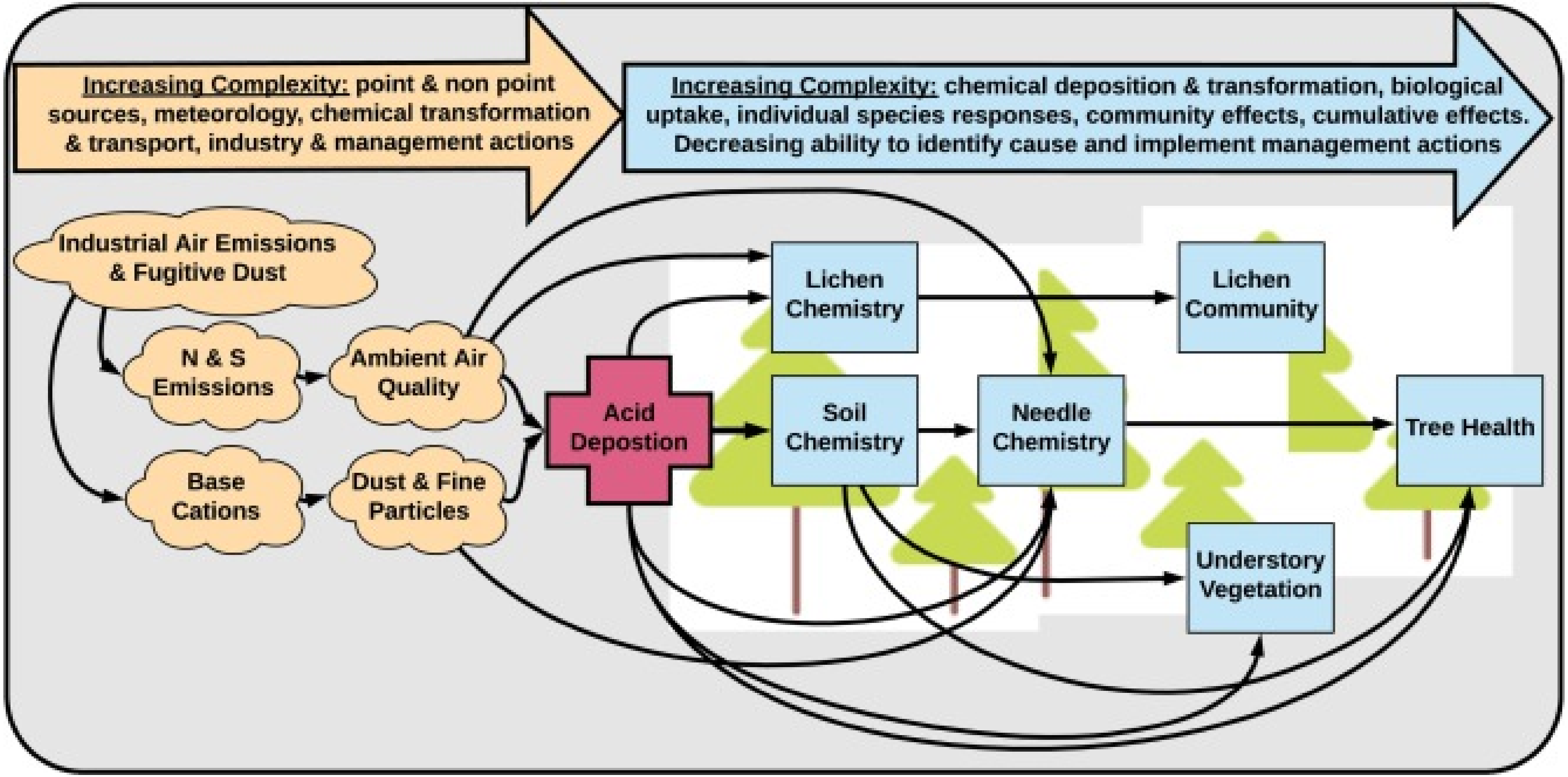

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2.2 Initial results of GIS/mapping overlay
2.3 Identification of potential monitoring areas

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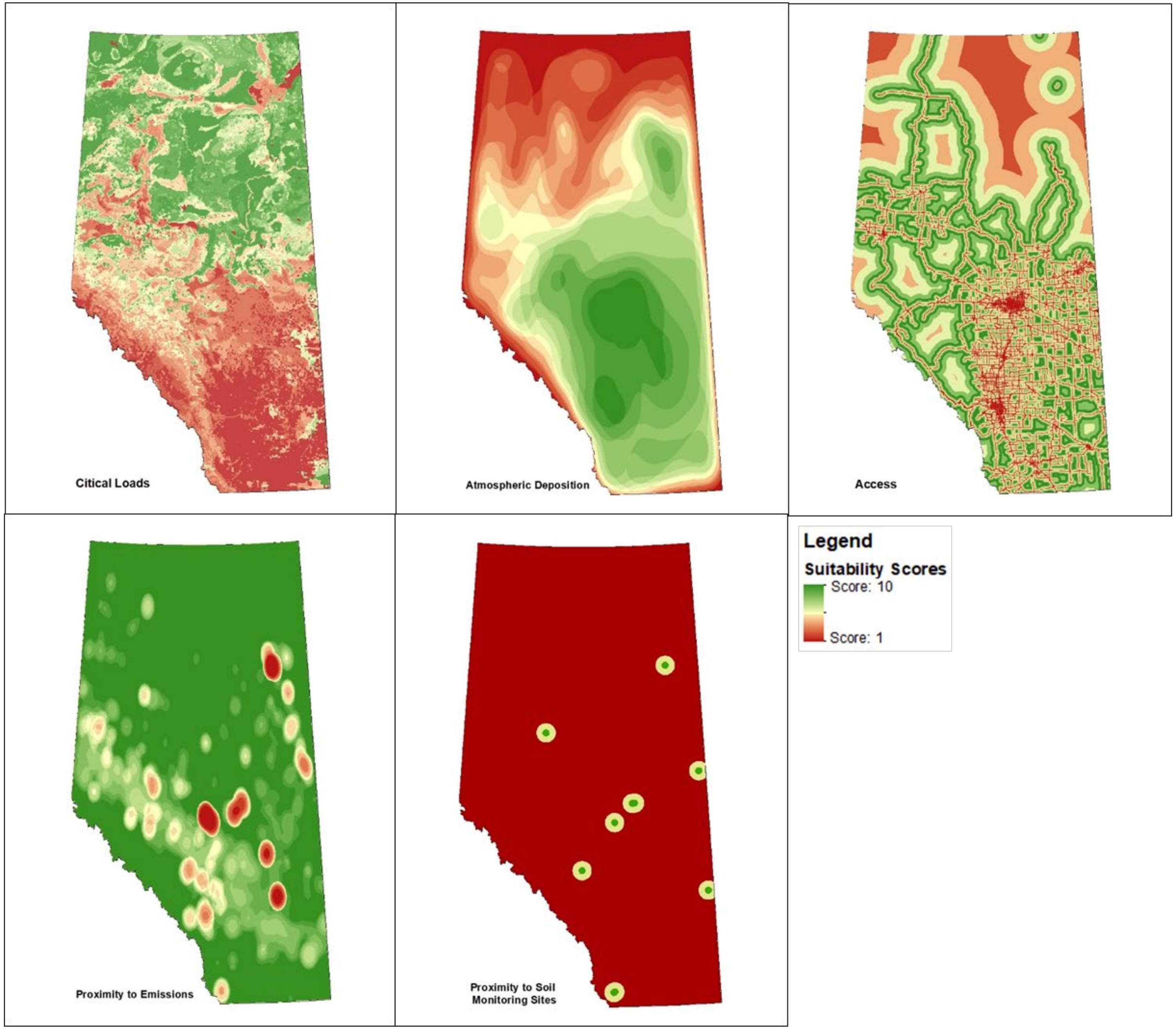

Classification input layer maps

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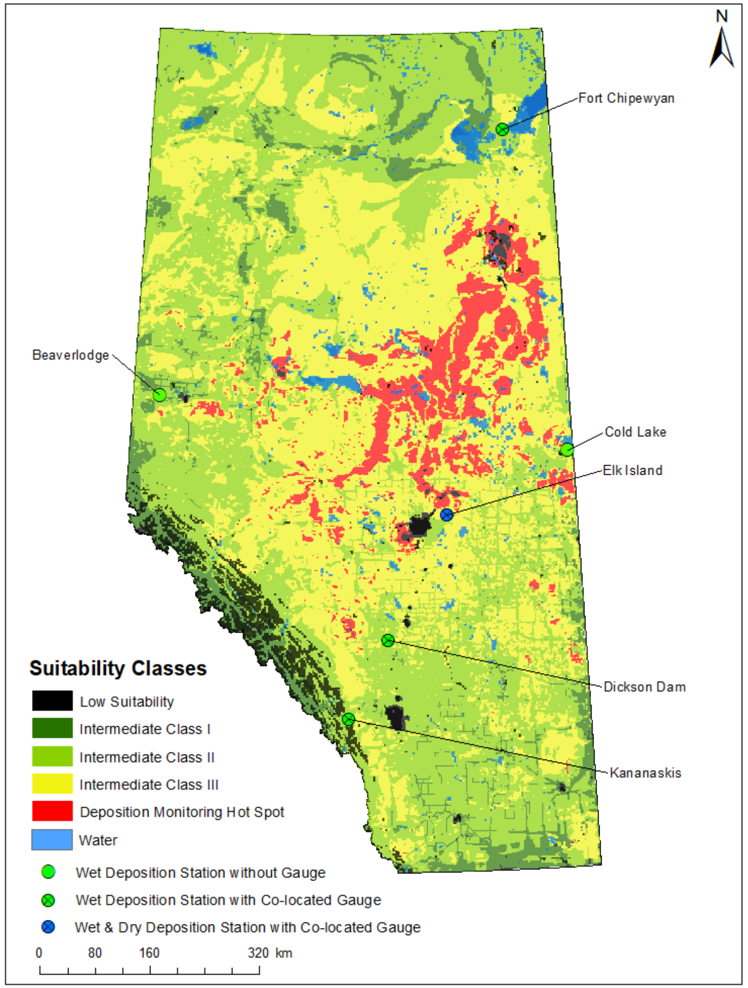
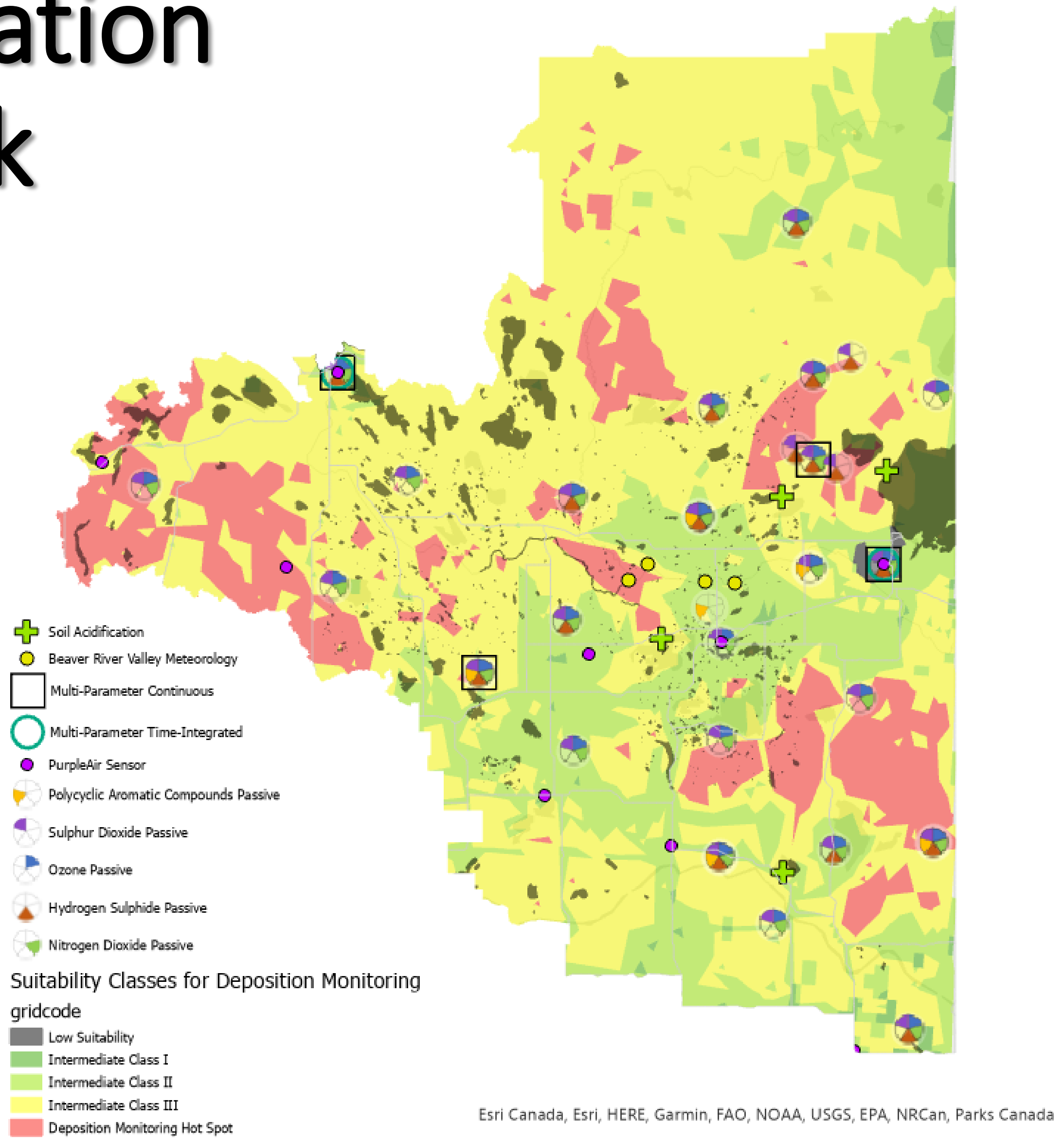
Alberta Monitoring Evaluation and Reporting Framework





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Next Meeting:

- WBEA/TEEM: Forest Health Monitoring Program
- ECCC/TrentU: GEM-MACH Estimates of Critical Load Exceedance of Acid Deposition (aquatic environment).

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