Ecological Recovery Monitoring of Reclaimed Wellsites

Spring 2015

OVERVIEW

Alberta has over 100,000 wellsites that have been certified as reclaimed or are considered exempt over the past 50 years. To date, there hasn't been a comprehensive program to revisit certified wellsites to evaluate their ecological recovery. It is estimated that full ecological recovery can be expected when the biological, physical and chemical properties of the soil and vegetation of a reclaimed site are similar to the properties of an undisturbed reference or pre-disturbance site. With the lack of long-term monitoring of wellsites in Alberta, there is currently no way of knowing the extent to which ecological recovery has been achieved on these reclaimed sites. The absence of this information is a potential liability that detracts from the government's stewardship commitments, and from industry's social license to operate on public lands.

OBJECTIVES

1. *Conduct field research to evaluate ecological recovery on reclaimed wellsites.*
2. *Explore the potential of using remotely sensed data as a proxy for field collected data.*
3. *Develop a framework to monitor oil and gas wellsites in the long-term.*

HIGHLIGHTS

- *Stakeholders expect that reclaimed/certificed sites will support land use, function and capability equivalent to pre-disturbance for sustaining crops, range, timber, habitat and biodiversity.*
- *Data from the first 2 years of fieldwork show that impacts to soil and vegetation from wellsite construction are long lasting and may remain for more than 45 years after reclamation.*
- *Preliminary data from the Dry Mixedgrass region suggest that wellsites in this region reclaimed using more recent techniques are in better ecological condition than those reclaimed several decades ago.*
- *Long term monitoring of reclaimed sites is essential to validate assumptions that ecological recovery is geographically universal, rapid and positive.*

Our goal is to develop a provincial scale, long-term monitoring program that assesses the ecological recovery of reclaimed wellsites after certification.

EVALUATING ECOLOGICAL RECOVERY IN THE FIELD

We assess ecological recovery by measuring soil and vegetation properties on the wellsite, which provides an indication of the ecological condition of the wellsite. We also sample and monitor the same soil and vegetation properties at nearby reference areas where the land hasn't been disturbed by industrial activity, and compare the two sets of samples to see how the wellsite is recovering.

Where have we sampled?

We've sampled in native grasslands and forested lands and plan to sample wellsites in cultivated lands. Sampling across these vegetation types allows us to understand how rates of ecological recovery differ between ecosystem types and natural regions across the province.

In the 2013-14 field season we sampled 18 wellsites and adjacent, undisturbed reference areas from three different age-classes; 10, 20 and 30 years post-certification in the Dry Mixedgrass prairie in the Brooks area of Alberta. In 2014-15, we sampled 15 wellsites in the Central Mixedwood and 15 wellsites in the Lower Foothills ranging from 7-45 years post-certification in the Slave Lake and Whitecourt/Fox Creek areas of Alberta (Figure 1).

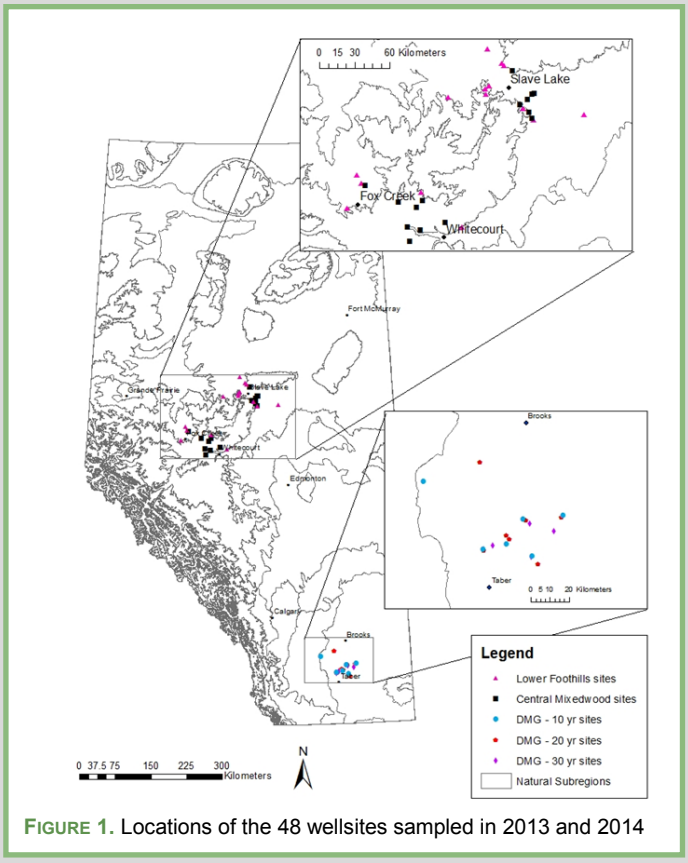

Figure 1. Locations of the 48 wellsites sampled in 2013 and 2014

What do we measure?

Our field soil sampling protocols measure the electrical conductivity, total organic carbon, total nitrogen, pH, bulk density and penetration resistance of the soil for up to four soil depths. We measure plant species richness, diversity and percent cover by species. In forested sites, we also measure stem density, basal area of stems and downed woody material.

What have we found?

Soil Characteristics

Both the bulk density and the electrical conductivity were higher on the wellsites than they were in the reference areas in both ecosystem types.

Vegetation Characteristics

Wellsites in forests and native grasslands had lower total plant cover, species richness and diversity than reference areas, and the non-native plant species cover was higher on the wellsites compared to the reference areas, regardless of the post-certification age. In the forested sites, downed woody material and the overall tree basal area was also significantly greater on the reference sites.

Overall, there was a lack of recovery evident across the reclaimed wellsites of different ages in forested and grassland ecosystems. These research findings are being prepared for publication in the Journal of Environmental Management and Restoration Ecology.

EVALUATING ECOLOGICAL RECOVERY FROM THE AIR

Near-surface imaging from unmanned aerial vehicles (UAVs) is an important new development in remote sensing technology, bridging the gap between ground-based observations and high altitude image data acquired from satellites and piloted aircraft. UAVs are rapidly becoming an affordable data collection tool, useful in locations with limited accessibility and where long-term repeatable measurements are required. We have explored the potential for remote sensing data from UAV's to evaluate the ecological recovery of wellsites on both forested lands and grass-

Aerial Photography

Remote sensing data obtained with UAVs could be used as an additional source of ecological recovery information in forested areas. To assess this potential, we collaborated with the labs of Dr. Greg McDermid at the University of Calgary and Dr. Scott Nielsen at the University of Alberta to use UAVs to collect sets of overlapping digital photographs at 13 of our forested wellsites. Using photogrammetric methods, these sets of photographs were combined to produce three-dimensional images of the ground and vegetation surface (Figure 2). These data were used to derive a set of metrics describing vegetation structure that have demonstrated significant potential to provide information on ecological recovery that supplements field data.

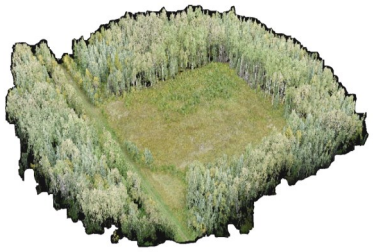

Figure 2. Three-dimensional image generated from UAV photographs for a forested reclaimed wellsite. Source: ABMI Geospatial Centre, 2015.

Multispectral imaging

In 2014, we also used UAV's to collect multispectral data (i.e., the reflectance from the ground of specific wavelengths of light in the visible light spectrum) at the wellsites sampled in the Dry Mixedgrass in 2013 (e.g., Figure 3). We are comparing proxies developed from these reflectance data with the field measurements like vegetation cover to determine if data collected from UAVs can supplement or substitute for more costly ground sampling.

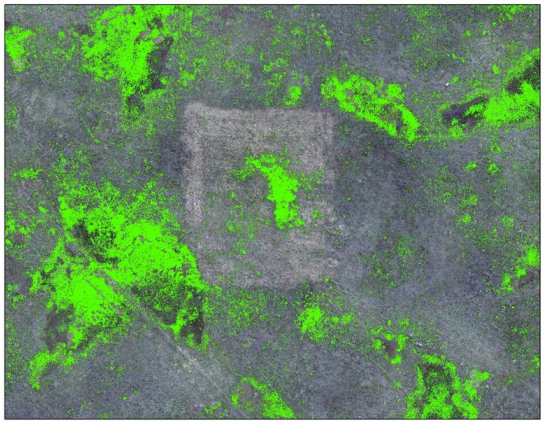

Figure 3. Vegetation on and around a reclaimed wellsite, as detected by UAV multispectral sensors, Source: Ventus Geomatics Inc.).

Photo: Anne McIntosh

A LONG-TERM MONITORING FRAMEWORK FOR ECOLOGICAL RECOVERY

Taking what we have learned from sampling oil and gas wellsites both in the field and using UAVs, the Ecological Recovery Monitoring (ERM) project will develop a framework for long-term monitoring of oil and gas wellsites provincially, including protocols and analysis methods. This project is helping to fill the current knowledge gap around ecological recovery of certified reclaimed wellsites in Alberta and, over the longer term, will provide Albertans with a better understanding of how these wellsites recover after they have been reclaimed.

Once a long-term monitoring program for reclaimed oil and gas wellsites is implemented, the ERM project intends to expand the monitoring framework to other industrially disturbed landscapes, such as decommissioned plant sites, mines, sand and gravel quarries, access roads, pipelines and seismic lines.

To Learn More

Visit our website:
www.abmi.ca/home/projects/applied-research-projects/ecological-recovery-monitoring-project.htm.

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About the Project

The Ecological Recovery Monitoring (ERM) project was initiated in 2012 by Alberta Environment and Sustainable Resource Development's Land Monitoring Team. The project is led by the ABMI in collaboration with Alberta Innovates – Technology Futures, the University of Calgary, and the University of Alberta.

In 2014 the Government of Alberta established a new environmental monitoring agency, the Alberta Environmental Monitoring, Evaluation, and Reporting Agency (AEMERA), with a mandate to monitor and report on the condition of and long-term trends in land, air, water and biodiversity in the province (www.aemera.org). The information obtained and recommendations made by the ERM project are expected to support the development of a province-wide monitoring program, administered by AEMERA. Additional funding was provided by the Alberta Upstream Petroleum