Conservation Offset Opportunities of Legacy Seismic Lines:

Assessing the ecosystem service benefits of linear restoration in the boreal forest

ALBERTA INNOVATES

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ECOSYSTEM SERVICES +
BIODIVERSITY NETWORK

FOREWORD

Ecosystem services are the benefits people derive from nature. They support our health and wellbeing, from basic needs like access to clean water and food to more intangible benefits such as viewscapes. While some of these services are bought and sold in traditional markets (e.g. the sale of food, lumber, etc.), others are not. Ecosystem service analysis helps identify and measure both tangible and intangible benefits in a full spectrum approach to land use planning.

Ecosystem services can be utilized in a market-based approach to land management as a mechanism to further support sustainable development practices and cumulative effects management. In 2013, the Alberta government released the new wetland policy for the province, showing significant interest from policy makers to shift towards offset-based conservation. It harnessed the mitigation hierarchy as a center point of the policy, where wetlands must be avoided by developers, and when avoidance is not feasible, impacts must be mitigated then offset. The policy was the first of its kind to recognize that not all wetlands are created equal and must be managed in a way that sustains the benefits they provide to the environment, society and the economy.

Conservation offsets are one tool that can support resource development, while also protecting biodiversity, species at risk (e.g. sage grouse, woodland caribou), and other ecosystem services. The purpose of this project was to assess the potential ecosystem service benefits generated from the restoration of legacy seismic lines and discuss the opportunities for linear restoration in an offset framework, should one be adopted by the province in the coming years.

This project was supported by Alberta Innovates through the Ecosystem Service and Biodiversity Network (ESBN) which exists to advance Alberta's knowledge surrounding ecosystem services and biodiversity and the use of market-based approaches to enhance land management. The network builds on the foundational work developed through the Institute for Agriculture, Forestry and Environment's Ecosystem Services Roadmap, and addresses the identified knowledge and capacity gaps through pilot studies, discussion papers and other decision support tools.

HUMAN WELL-BEING

Security, material needs, health, social relations, etc.

Regulating Climate regulation, flood regulation, disease regulation, water purification, etc.	**Supporting** Nutrient cycling, soil formation, etc.
Provisioning Food, freshwater, wood and fiber, fuel, etc.	**Cultural** Aesthetic, spiritual, educational, recreational, etc.

ECOSYSTEM SERVICES

BIODIVERSITY

Species richness, species rarity, biomass density, primary productivity and genetic diversity.

Introduction

This project was part of a multi-phase, multi-year research initiative. Phase 1 of 'Assessing the Ecosystem Services of the Algar Landscape Ecological Assessment and Planning (LEAP) Project' (Algar ES Phase 1) was a proof of concept pilot program, established in 2013 and designed to assess the ecosystem service benefits derived from linear restoration in species at risk habitat (i.e. the East Side Athabasca River caribou range). Algar ES Phase 1 provided a critical perspective on how projects that seek to derive ecosystem services and biodiversity benefits perform under a rigorous environmental and economic assessment. The findings of the pilot revealed that there are gains to be realized from undertaking linear restoration. These results spurred interest in understanding how linear restoration may fit into a potential conservation offset scheme in Alberta.

Phase 2 of this project sought to further the development of a repeatable, transferable, and implementable approach to evaluating the net benefits of restoration activities in the boreal region and assess the potential use of conservation offsets from the restoration of legacy seismic lines. As part of the success of this project, a repeatable framework was developed to incorporate ecosystem service concepts into linear restoration projects and potential upcoming conservation offset policy. Furthermore, methods were developed to prioritize areas for restoration based on the suite of ecosystem services provided by the landscape, rather than focusing on just one land value (e.g. species at risk).

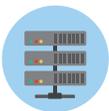## Phase 2 focused on answering four key questions:

01 BENEFITS
What are the potential ecosystem service benefits of large scale linear restoration?

02 CONCEPTS
How can ecosystem service concepts be used to prioritize areas for restoration?

03 MODELLING PLATFORMS
Do different ecosystem service modelling platforms provide similar, repeatable results?

04 ASSESS VALUE
How could ecosystem services be used to assess the value of restoration in conservation offset planning?

The Algar Case Study

The Algar Caribou Habitat Restoration Project was launched in 2011, with a goal to restore approximately 340 km of legacy seismic lines in a remote area in the boreal forest of northeast Alberta. Over the following four years, over 161,700 trees were planted, existing natural vegetation was protected, and coarse woody debris applied to improve microsites and create access barriers. The program was aimed at restoring functional caribou habitat in the East Side Athabasca River range. In addition to functional caribou habitat, program partners recognized that restoration efforts may improve many other ecological functions that can benefit local communities. It was thought benefits could include a number of things including, but not limited to the provision of food and fiber, pollution control and water purification, aesthetic and recreational benefits, and other wildlife habitat, among others.

There was significant interest from project partners to leverage these potential benefits to spark large-scale restoration efforts and potentially include linear restoration of legacy seismic lines in an offset framework, should one be adopted by the province in the coming years.

Approach

The first step was to clarify what additional benefits can be impacted by linear restoration. A scan of the literature was completed and the project team developed a repeatable, transferable approach to identify appropriate benefits to measure for linear restoration projects, dependent on their scale and regional location.
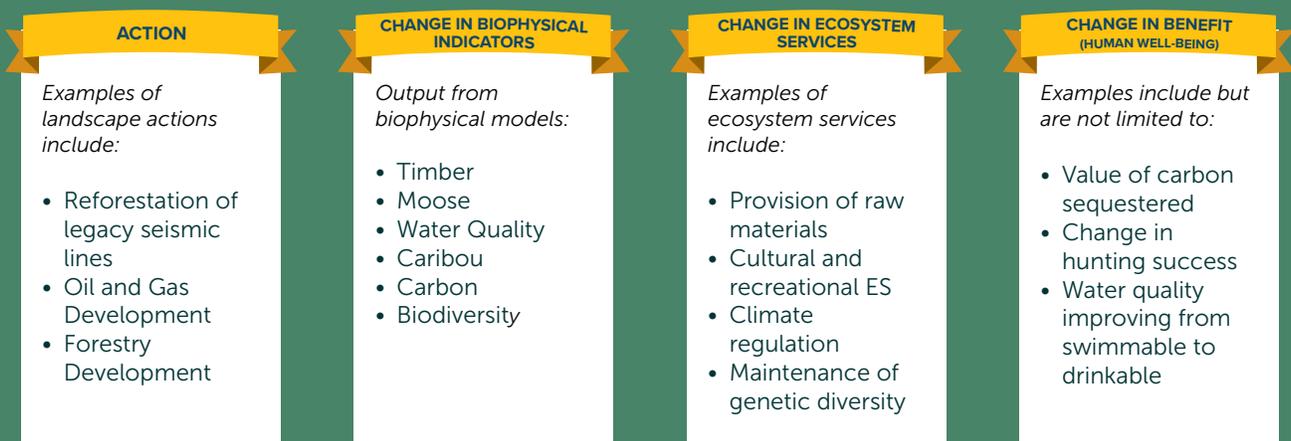
Scaling Up

Initial analysis was completed for the Algar restoration area, then scaled up to the Southern Athabasca Oil Sands Area, and finally the Lower Athabasca watershed. The modelling approach assumed legacy seismic lines in the area of interest would be restored over five years

while development continued on the landscape, under different development scenarios.

Scaling the Analysis

Linking Actions on the Landscape to Ecosystem Service Benefits

ACTION	CHANGE IN BIOPHYSICAL INDICATORS	CHANGE IN ECOSYSTEM SERVICES	CHANGE IN BENEFIT (HUMAN WELL-BEING)
Examples of landscape actions include: • Reforestation of legacy seismic lines • Oil and Gas Development • Forestry Development	Output from biophysical models: • Timber • Moose • Water Quality • Caribou • Carbon • Biodiversity	Examples of ecosystem services include: • Provision of raw materials • Cultural and recreational ES • Climate regulation • Maintenance of genetic diversity	Examples include but are not limited to: • Value of carbon sequestered • Change in hunting success • Water quality improving from swimmable to drinkable

Kilometers Restored → *Value (benefit) of restoration*

Ecosystem Service Benefits Framework, modified from Keeler et al. (2012)

Key Learnings

Potential Benefits of Linear Restoration

Results of the analysis showed that large scale linear restoration can generate ecosystem service benefits including the provision of timber supply, carbon sequestration and cultural and traditional use services related to functional caribou habitat. Other measured ecosystems services including water quality, biodiversity intactness and hunting success related to moose habitat showed little to no change from large scale restoration.

Restoring additional footprint (e.g. orphan well sites or well sites reclaimed to old standards) would likely be required to improve additional services in remote areas of the province. As restoration projects move closer to local communities, restoration impacts may influence other services not measured in the Algar region (e.g. flood control (water storage), recreational values, etc.).

Using Ecosystem Service Concepts to Prioritize Areas for Restoration

While linear restoration significantly improved functional caribou habitat in the Lower Athabasca watershed, select ranges remained below the recommended Environment Canada disturbance threshold, even if all legacy seismic lines were restored. As such, mapping potential benefits and costs indicators from linear restoration programs, in addition to potential ecosystem services, can help prioritize areas for restoration across large landscapes which will help focus restoration efforts and investments in high value areas that are important to stakeholders in the region.

Estimating Benefits using Different Modelling Platforms

Scaling the analysis to the Lower Athabasca watershed highlighted some of the variability between modelling platform requirements, including data constraints when modelling at such a large scale. Understanding the limitations of the modelling approach, including the model inputs, the model itself, and its outputs, when interpreting ecosystem service benefits will be essential for conservation offset planning. In addition, it is recommended that validation of modelling results take place, with long-term monitoring of restoration projects as they are implemented.

## The Value of Restoration in Conservation Offset Platforms

Nevertheless, linear restoration of legacy seismic lines on public land provides a unique opportunity for the Government of Alberta to extend conservation offset policies. It is well known that legacy seismic lines in the boreal forest are a contributing factor to the decline in caribou populations. Large scale restoration is needed to increase the probability of herd survival in the province. Offsets may provide the necessary incentive for the private sector to begin large scale restoration as a way to ensure development can continue in resource-rich areas.

Biophysical Response

Timber Supply
Increased timber supply by an estimated
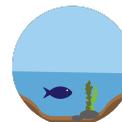### 8,100 m³
at year 30
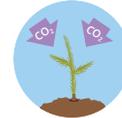
Climate Regulation
Increased carbon sequestration by an estimated
18,300 tonnes of CO_2 at year 30

Caribou Habitat
Improved habitat intactness
by **29%** to **62%** for the Algar Area at year 30

Water Purification
Estimated Reduction
Phosphorus - 1,400 kg/yr
Nitrogen - 1,300 kg/yr
Total Suspended Solids - 131,000 kg/yr

Genetic Diversity
Increase biodiversity intactness by
0.77%

Provision of Wild Foods (Moose)
Linear restoration did not significantly improve moose habitat

Estimated Benefits of the Algar Caribou Habitat Restoration Project

Offsets & Linear Restoration

Challenges

Permanence & Ownership of Restored Footprint

Because much of the linear restoration efforts will be conducted on public land and the long-term nature of restoration, there remain some uncertainties from regulators and proponents on how to manage the permanence and balance of restored footprint over time. There may be a need to design a reservation (e.g. consultation notation) specific to linear restoration efforts, especially as more restoration projects are scaled up. In addition, there remain uncertainties around wildfire risk and pest outbreaks and who will be responsible for managing these risks.

The Flow of Benefits

The location of restoration efforts on the landscape doesn't always align with where the benefit to people occurs. For example, investing in water quality improvements must occur upstream to support recreational opportunities and the provision of clean drinking water downstream. In terms of linear restoration, investment may impact one or more caribou ranges, have direct impacts on timber supply, and global impacts on the ability to sequester carbon. Depending on the goal of the offset program (e.g. a caribou offset, a carbon offset, or both) the flow of benefits, and the investment impacts, will likely need to be considered differently.

Aggregating Benefits Across Project Sponsors

Some ecosystem service benefits may be non-linear. For example, water quality improvements are nominal until a threshold is reached; other benefits may plateau after a threshold is reached (e.g. caribou habitat improves to support self-sustaining herds). Other benefits will continue to accrue as restoration is increased (e.g. timber supply). More research is needed to address how non-linear benefits derived from multiple linear restoration programs should be aggregated to ensure all project sponsors receive appropriate compensation for their efforts.

Modelling Approach

There are numerous modelling platforms available to assess changes in ecosystem services and each are suitable for different regional scales. The model chosen needs to reflect the most appropriate scale for the ecosystem service to be properly captured in the project effects. In addition, the proper data resolution will be required to capture changes in ecosystem services effectively. It will be essential that the appropriate data and models are selected for the scale of the project to ensure benefits are not over or under stated and remain comparable across projects.

Opportunities

Stakeholder Engagement

The project team developed a repeatable, transparent, and transferable process to connect stakeholder values to ecosystem services and biophysical change from land use activities. The approach will not only help encourage local buy-in for restoration programs and improve the probability of success for the initiative, it can also be applied in other settings, such as the environmental assessment process, and company-specific stakeholder engagement.

Environmental markets and mitigation banking

By measuring and quantifying values associated with caribou habitat restoration that are not normally traded in the marketplace, restoration credits can be bought and sold like traditional goods and services. This provides proponents with the incentive to complete voluntary restoration. Proponents would incur an upfront cost associated with restoration in return for the ability to continue development elsewhere on the landscape. Environmental markets provide the opportunity to help manage ecological risks from industrial development (linear disturbance) while also providing a new revenue stream for proponents who are most efficient at completing restoration activities. They support green investment and can potentially diversify the economy. If markets for restoration are created, it may advance business opportunities, and improve caribou habitat, among other ecosystem services. Markets can also be linked to local or regionally defined outcomes like those in the Land Use Framework regional plans.

Offsetting Future Development

Similar to above, if an environmental market or offset system was adopted in Alberta, the results of this analysis estimated that linear restoration alone could help offset functional caribou habitat impacts from future development 4:1 based on today's landscape condition. This highlights the potential for an offset scheme to improve functional caribou habitat, while still allowing sustainable development on the landscape.

Enabling Conditions

If a conservation offset approach is taken to help spark large scale linear restoration, enabling conditions may include:

- **Development of a linear restoration offsets protocol.** Protocol documents serve as a standardized approach for the quantification of potential offsets. The protocol should consider key factors including scalability, transparency and repeatability of linear restoration offset calculations. For example, under the wetland policy, a wetland offset must incorporate design, validation, and verification protocols. Using these protocols, the proponent provides the offset objectives, the rationale for predicted success, and if the offset has met the outlined objectives in the design.

- **A monitoring program.** It is recommended that monitoring and reporting tracks all the ecosystem service benefits of restoration efforts and remains a high priority into the future. In doing so, key learnings and successes from previous projects can be applied as new projects are implemented.

- **Data & Information.** There is a significant need for the ability to validate and disclose results using agreed upon data in an effort to mitigate risk. Full disclosure of the expectations, results and validated metrics provides the information and confidence required to make investments that are designed to achieve desired environmental impacts.

Through the multiple phases of Assessing the Ecosystem Service Benefits of Linear Restoration, we have been able to identify the potential ecosystem service benefits of linear restoration in a repeatable, transparent, and scalable manner. These learnings suggest that should the province pursue a conservation offset framework, linear restoration with an ecosystem services approach could be one mechanism for generating offsets.

Next Steps

This research initiative focused on answering key questions on how linear restoration can fit into an offset framework, should the province move in this direction to support sustainable development. The work completed to-date has shown that large-scale linear restoration can generate ecosystem service benefits which could be applied to an offset framework. Taking these learnings, a decision support tool was developed to help prioritize areas for restoration considering the potential benefits, costs, and ecosystem services generated from linear restoration programs. This tool has the ability to help focus restoration efforts and investments in high value areas that are important to stakeholders in the region.

Moving into the next phases of this initiative, more research is needed to address how benefits derived from multiple linear restoration programs should be aggregated. This analysis assumed all linear restoration in the watershed was completed by one project sponsor, where, realistically, the landscape is managed under multiple forms of tenure. Benefits may overlap or interact with adjoining tenures and this was not considered in the initial analysis.

Data availability and resolution remains a gap in modelling results at larger scales. Modelling is essential to understand what outcomes are feasible through restoration work and will help measure the success of restoration initiatives. Future investment in open data and/or automated land inventories would greatly benefit this type of analysis and provide linear restoration proponents with the confidence needed to make large-scale investments needed to support caribou recovery efforts in the province.

Lastly, it is recommended that a pilot project or demonstration project is launched to show how different players will interact in an offset system. A pilot project will help enforce what efficiencies can be gained and help prove the business value in taking this approach.
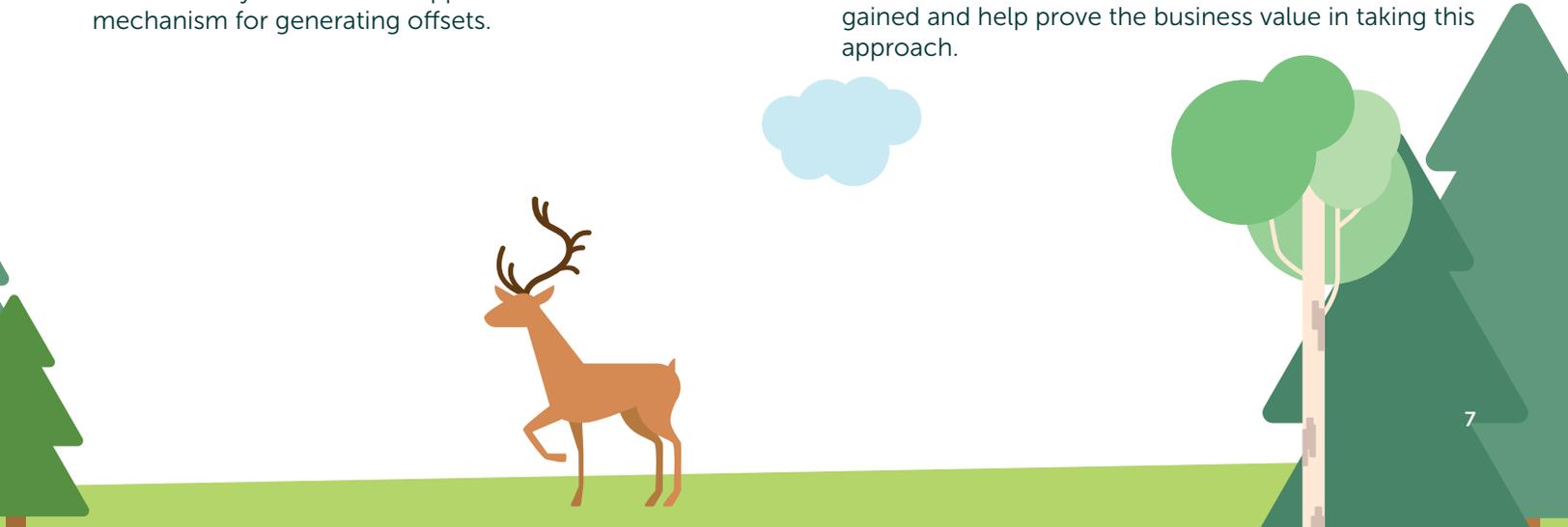
Acknowledgments

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- Alberta Biodiversity Monitoring Institute
- Alberta Environment and Parks
- InnoTech Alberta
- Silvacom

Additional Reading

Please refer to the Ecosystem Service and Biodiversity Network (ESBN) toolkit, for further reading related to this project.

- Assessing the Ecosystem Service Benefits of the Algar LEAP Project: Phase 1
- Assessing the Ecosystem Service Benefits of the COSIA LEAP Program *Phase 2: Interim Report 1 of 3*
- Assessing the Ecosystem Service Benefits of the COSIA LEAP Program *Phase 2: Interim Report 2 of 3*
- Assessing the Ecosystem Service Benefits of the COSIA LEAP Program *Phase 2: Interim Report 3 of 3*
- Comparing an Offset Framework to Alternative Funding Models: A Linear Restoration Case Study

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