The Restoration Market in Northern British Columbia:

With a Focus on the Northeast Region

Summary Report

May 2024

Preface and Acknowledgements

This is the summary report that provides an overview of the project and outcomes. A full report was created that includes more details related to input received, data and analyses, and detailed discussion to support the outcomes.

The project involved interviews of 69 people who provided input anonymously. The consultants are entirely responsible for the project design, synthesis of input, and analysis that were used to generate the project outcomes.

Abstract

Most of the demand for restoration services and products is from legally required restoration with recent commitments to cultural-ecological restoration in B.C.'s Northeast Region anticipated to increase demand. The B.C. Oil and Gas Research and Innovation Society funded this project to define the restoration economy within a northern B.C. context, develop prototypes for describing demand and supply chains for restoration, assess the strengths and vulnerabilities of the supply chains, and identify short-term actions to help optimize the restoration market. Supply chains often support demand from numerous sectors and initiatives; therefore, the project explored what may be required to develop comprehensive, integrated demand forecasts. As there is considerable uncertainty associated with demand forecasts, the project has proposed three future scenarios for restoration that may influence demand. The project has proposed a structure for describing and assessing the multiple interconnected supply chains that are required to meet demand for restoration. Finally, short-term actions are identified for addressing gaps and to support pursuing future restoration scenarios.

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1. Project Objectives

- Define the restoration economy within a northern B.C. context
- Develop prototypes for describing demand and supply chains for restoration
- Assess the strengths and vulnerabilities of the supply chains, and
- Identify short-term actions to help optimize the restoration market.

2. Project Rationale

In 2023, the Province of British Columbia (the Province) announced major commitments to cultural-ecological restoration in B.C.'s Northeast Region to address the cumulative impacts from industrial development on Treaty rights. Most restoration is legally required or policy driven. The recent commitments create unprecedented opportunities that are increasing demand for human resources, equipment, and materials, which in turn, are increasing competitive pressures on the supply chains that support restoration across northern B.C. and beyond. Currently, there is a lack of knowledge about the restoration market, which is a barrier to aligning demand and supply, increasing the resilience of supply chains, and maximizing the benefits for local communities. As a result, the B.C. Oil and Gas Research and Innovation Society (BC OGRIS) supported this project to better understand opportunities and challenges of some key components of northern B.C.'s restoration market.

3 Project Scope

The project explored what is required to develop integrated demand forecasts and assess supply chains at a regional scale. The Northeast Region was selected as the primary focus given the level of activity and recent commitments, which led to a focus on impacts from oil and gas, forestry, and wildfires. Where possible, the project considered the issues and implications for the restoration market in north area, which includes the Omineca and Skeena natural resource regions. The project explored implications for the restoration market from scaling up restoration activities from the project/site to the program/landscape scale as that was a key focus for many interviewees.

4 Project Methodology

The project team reviewed related studies and participated in forums that were discussing the restoration economy in B.C. to ensure this project would be complementary to and build on efforts to date. Publicly available quantitative data from government sources, including the Ministry of Forests (FOR) and the BC Energy Regulator (BCER), were used to develop prototypes for demand forecasts. Reviews of relevant studies and online interviews of 69 people who reflect a cross section of the roles and participants in the restoration supply chain ecosystem were used to gather qualitative data to:

- Augment the quantitative data about demand
- As the basis for assessing the strengths and vulnerabilities of the restoration supply chain ecosystem, and
- Identify short-term actions that could help optimize the restoration market.

5   The Restoration Market in Northern B.C.

Definition: A restoration market is a system that generates and facilitates the exchange of products and services through the restoration of altered and/or at-risk assets (natural, built, and socio-cultural assets).

While the term restoration economy is commonly used, this project uses it in relation to macroeconomics, which is concerned with how the overall economy works. The restoration market refers to microeconomics, which is concerned with how supply and demand interact. This project focuses on the restoration market because it best aligns with the interests expressed by interviewees, and it creates a pragmatic approach for assessing the current situation and developing short-term actions to address gaps.

Goal: To optimize the restoration market through a focus on efficiency, innovation, and effectiveness.

While there is interest in growing the restoration market, many inefficiencies and missed opportunities have been identified in how the restoration market currently functions. Therefore, it is proposed that a pragmatic short-term goal is to optimize the restoration market, which could create the conditions necessary for future growth.

Scale: Attempts have been made to measure demand for restoration in B.C. at various scales. Methodologies and assumptions diverge considerably, thus providing a variety of results. Estimates include: $2.795 billion in total liabilities as of 2019 (Powter et al., undated); at least $132 billion over the long-term across B.C. (Restoration Conference 2023, October 2023, Vancouver, B.C.); and between $900 million and $1.39 billion in total costs for boreal caribou habitat restoration in B.C. (Anielski, 2019). There are also multiple sources for estimates of public liabilities in B.C., based on different methodologies and approaches, which relate to specific issues such as abandoned mines, orphan wells, legacy seismic lines, etc.

Generalized information about the potential scale of demand for restoration can be useful in strategic-level decision-making for defining the relative priority of restoration compared to other needs, for example housing and health care, and for allocating resources across the range of natural resource stewardship activities. The information does not, however, assess actual commitments to restoration and is, therefore, less useful to most decision-makers in the restoration supply chains who need more specific data at the regional and more local scales.

Supply chain: A network of individuals, organizations, resources, activities, and technologies that are involved in the creation and exchange of products and services.

Restoration supply chain ecosystem: The multiple interconnected supply chains that are required to meet the demands for restoration in northern B.C. This project has identified two types of supply chains that, together, comprise the restoration supply chain ecosystem:

1. *Enabling activities supply chains*: planning and decision-support processes (services) to create restoration plans and programs (products). These activities interpret macro scale drivers (e.g., factors such as climate change that are beyond the control of the restoration market but can impact it) and integrate them with micro scale drivers (e.g., local restoration

priorities) to create products that define demand for the restorative activities supply chains.

2. ***Restorative activities supply chains*** (Figure 1): The basis for describing the supply chains, including the human resources, equipment, and materials needed to complete specific tasks that, taken together, result in implementation of on-the-ground activities. Figure 2 is an example of a restorative activities supply chain for vegetation. The full report includes descriptions of the supply chains for all restorative activities.

Figure 1 Restorative Activities

Infrastructure	Access management
	Facilities management
Hydrology	Decontamination
	Flow management
Soils	Erosion control
	Site preparation
Invasive Species	Eradicate
	Contain & control
Vegetation	Revegetation
	Forest health & stand structure
	Prescribed fire
Fish & Wildlife	Habitat structures
	Population management

Restorative activities: the actions taken to achieve recovery objectives and targets.

There are a limited number of actions that humans take to support restoration, which are commonly used across most restoration initiatives and could support:

- A consistent framework for restoration planning to facilitate communication, integration, and coordination

- A structure for describing and assessing the strengths and vulnerabilities of the associated supply chains

Source: Figure developed by the authors

Figure 2 Example of a Restorative Activities Supply Chain: Vegetation

	Restorative Activity	Supply Chains					
Vegetation	Revegetation	Seed Collection	Wild/unmanaged populations	Processing	Certification	Storage	Distribution
			Managed areas				
		Propagation	Conifer seedlings	Storage	Distribution		
			Deciduous seedlings				
			Shrubs				
			Seed				
			Seed balls, pucks				
		Planting	Manual				
			Mechanical				
			Technology				
		Seeding	Manual				
			Mechanical				
			Technology				
		Irrigation					
	Forest health and stand structure	Mechanical, manual	Danger tree removal				
			Coarse woody debris removal				
			Salvage harvesting				
			Thinning				
			Brushing				
			Pruning				
		Chemical	Manual				
			Mechanical				
	Prescribed fire	Manual ignition					
		Mechanical ignition					

Source: Figure developed by the authors

Restoration demand forecasts use the best available information to communicate anticipated demand. Where demand forecasts exist, they tend to be sector specific (e.g., forestry or oil and gas), relate to specific impacts (e.g., orphan wells, wildfire recovery), or for specific ecological values (e.g., caribou recovery). As the supply chains may support demand from a diversity of sources, optimizing the restoration market would benefit from integrated demand forecasts at the regional scale. Demand forecasting is challenging because there are many uncertainties that create pulses or fluctuations in demand. Also, while demand has typically considered the *amount*

of restoration planning and restorative activities, there can also be change in demand for the *complexity* of what restoration is to achieve (e.g., to support a broader range of objectives) and how it is to be implemented (e.g., greater integration and coordination across initiatives), which is more difficult to quantify.

Risks occur when demand and supply are not aligned. If demand exceeds the capacity of the supply chains, then costs increase, demand can decrease and there could be a greater reliance on passive restoration. If supply exceeds demand, there could be job loss, business failures, and loss of skilled workers to other markets.

Strategies to reduce risks and help optimize the restoration market include:
- Minimize fluctuations in demand
- Generate comprehensive, integrated demand forecasts that provide the information needed for the restoration supply chain ecosystem to adapt or transform, and
- Design policies and supports to incentivize efficiency, innovation, and effectiveness while improving the resilience of the supply chain ecosystem.

6   The Process of Forecasting Demand

Current demand forecasting reflects the silos associated with resource development, the distinctions between remediation, rehabilitation, and ecological restoration, and that multiple, unconnected restoration initiatives are pursued in response to the multi value needs defined through policy and cultural planning. Supply chains, however, often support demand from numerous sectors and initiatives. Therefore, a comprehensive, integrated demand forecast would provide the information needed to maximize the cumulative benefits from investments in restoration as it will promote efficiencies, innovation, and effectiveness across the range of restoration initiatives.

Development of a comprehensive demand forecast for restoration was outside the scope of this project, rather the focus has been to develop prototypes for generating the type of information that participants in the supply chains have stated they need. The prototypes can then be reviewed to determine if and how improvements could be made. Input from interviewees, reviews of related initiatives, and economic theory guided development of the prototypes. Interviewees also identified ongoing work that could improve demand forecasts, including the use of Artificial Intelligence (A.I.) that could increase the complexity of data analyses and develop real-time forecasts.

Ideally, demand forecasts for implementation of on-the-ground restorative activities involve real-time assessments of need, opportunities, and priorities, including the associated drivers of change, at multiple interconnected scales (Figure 6).

Figure 3 Process for Forecasting Demand for Restorative Activities
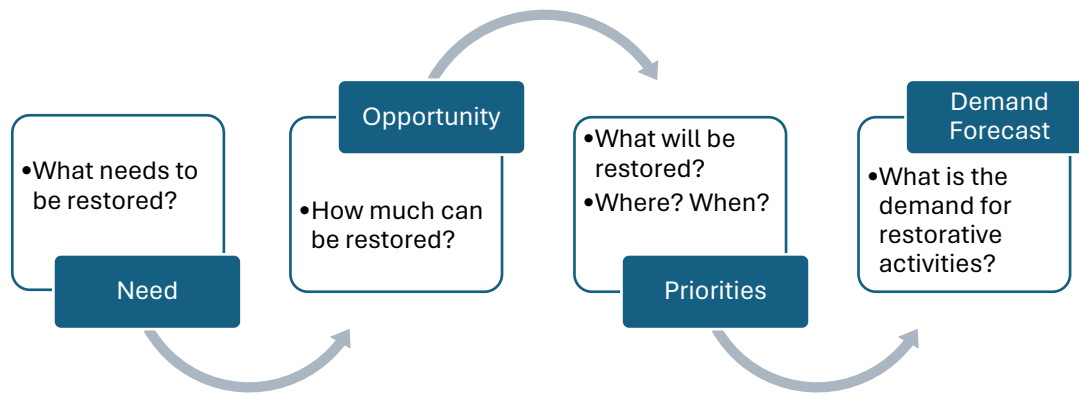
A needs assessment ideally considers the cumulative disturbances or stressors, including their known significance relative to stated objectives or targets for a range of ecosystem services, some of which are defined through legal obligations. An assessment would include:

- Total footprint from resource use and development as well as large scale climate events
- Risks to resilience from climate events, such as large scale wildfires or floods
- Net down adjustments as not all altered areas or impacts would benefit from investments in active restoration. For example, recovery has already been initiated (through passive and/or active restoration), some impacts will be repurposed (e.g., maintaining roads for recreation), or the area is anticipated to be subject to future disturbances.

Opportunities to implement restorative activities are created by the set of circumstances and decisions that, taken together, determine the type, level, and amount of investment in active restoration and, therefore, to what extent passive restoration will determine the recovery trajectory.

There are clearly identified opportunities, such as legally required activities. The associated permitting and engagement requirements can impact not only costs, but also opportunities to leverage the legal obligations to support broader restoration objectives. There are policies and programs that have a greater degree of flexibility in determining what opportunities will be pursued. Differing governance structures, the selected priorities of the respective programs, and funding mechanisms are important factors in creating the resulting opportunities. There is also interest in if and how global markets for ecosystem services and carbon might create opportunities for restoration in B.C.

The project summarized the opportunities identified by interviewees, including discussions on if and how the opportunities might support optimization of the restoration market.

Priorities must be defined because the need for restoration generally exceeds the opportunities. Hence, funders and other decision-makers define priorities for making best use of the available opportunities relative to needs. While needs and opportunities provide important context, the restorative activities supply chains require more detailed information about priorities to determine what, if any, changes to their operations may be required to help align supply and demand.

Demand Drivers consider the interconnected drivers of need, opportunity, and priorities that, taken together, can impact the overall pace and intensity of changes in demand on the restoration supply chains. As there is considerable uncertainty associated with demand forecasting, it is proposed to consider four categories for the relationship between drivers and their significance. Table 1 outlines the theoretical concept of describing the probability of occurrence and the significance of impact that drivers could have on demand for services and products provided by the restoration supply chains.

Table 1 Demand Drivers: Probability and Significance Concept

1. High Probability & High Impact	2. Lower Probability & High Impact

• These drivers are already creating some change in demand or are highly likely to do so without any new intentional interventions
• May need strategic actions to:
  o Maximize the cumulative benefits
  o Minimize undesirable risks
• Impacts on demand are at multiple scales:
  o Strategic, tactical, operational
  o Local, regional, provincial
  o Short and longer-terms
 	
Management Responses
• Identify leadership & accountabilities
• Identify/establish processes, align resources to
  o Plan and implement responses and/or support other processes to do so
  o Communicate to supply chains
  o Monitor, evaluate and integrate into decision-making
	• These drivers have the potential to significantly impact demand (increase or decrease) but are less likely to do so without new intentional interventions
	• Could result from significant and unexpected shocks to the system or changes in the context for restoration
	• Likely would require a shift in priorities and strategic investments to maximize the cumulative benefits and/or minimize risks
	• Impacts on demand would be at multiple scales
	
	Management Responses
	• Monitor for early detection of change through a diversity of ongoing processes, e.g., issues being explored through pilots and independent initiatives
	• Create issue tracking protocols and relationships across a network of participants and with leadership and processes established for #1 to co-develop responses as need and opportunities arise

3. High Probability & Focused Impact	4. Lower Probability & Focused Impact
• As per #1 above but scale of impact is more focused, at least in the short-term • May be potential for scale of impact to increase Management Responses • Support leads of processes that are resulting in the focused impacts, including creating clear issue tracking protocols and relationships with leadership and processes established for #1 • Identify and communicate potential cumulative impacts on demand to support and supply chains at multiple scales	• Unlikely to impact demand without intentional interventions, but if they do, impacts are anticipated to be focused, at least in the short-term • The lowest priority at the strategic level, but may be significant at a local level Management Responses • Support existing organizations/ processes/ key positions to track and monitor • Create clear communications and reporting relationships with leadership and processes established for #1 to periodically review trends • Use a cost-benefit analysis to evaluate possible responses at the strategic level

Table 2: Current Assessment of Restoration Drivers in the Northeast Region
Blue are drivers that are anticipated to increase demand
Red are drivers that are anticipated to decrease demand

1. High Probability & High Impact	2. Lower Probability & High Impact
a. Increase in standards from • Legal decisions (e.g., Yahey) • Negotiated agreements with multiple First Nations (e.g., BCER ESSG) • Outcomes of ongoing processes (e.g., changes to stocking standards) b. Increase in large-scale climate events c. Permitting, including both upward and downward pressures on demand: • Efforts to streamline permitting processes • Lack of needed change • Increases in some permitting requirements d. Less resource development due to: • Increasing conservation (e.g., 30 by 30) • Lack of clarity on social choice issues • Fragmented decision-making • Lower demand for resources due to changes in technology, consumption patterns, etc. e. Increased restoration costs in the short-term if demand exceeds supply	a. Create a consistent framework for incorporating restoration into strategic and tactical scale planning across sectors/initiatives that are designed to increase the clarity of demand forecasts b. Facilitate the use of emerging technologies and A.I. • Modeling to support identification and prioritization of candidate impacts/areas for active restoration and post-treatment monitoring • Increased efficiencies, innovation, and decreased costs for integrated, coordinated restoration c. Improve incentives for industry proponents to assume responsibility for broader restoration objectives (e.g., stumpage, pricing, restoration as a commodity) d. Create a clear process and accountability for incorporating lessons learned into decision-making to improve: • Restoration practices • Best Management Practices for resource development to reduce need for future restoration
3. High Probability & Focused Impact	4. Lower Probability & Focused Impact
a. Development proponents negotiate individual agreements with one or more First Nations for increased standards b. Short-term ("pulse") funding continues to • Support worker transition/ job creation • Address legacy impacts • Support pilots but not scaling up • Support projects but not long-term programs c. Restrictions on safe access for restoration crews from large-scale climate events (wildfires, smoke, floods, landslides)	a. Restoration trusts to address legacy and incremental issues and effective governance to administer them b. Increased restoration costs result in innovation in resource development, less impacts, and reduction in future demand c. Market-based opportunities, including: • Convergence at global and national scales on sustainability platforms but likely a limited amount of funding coming to a developed country like Canada • B.C.'s Conservation Funding Strategy to access non-governmental funding

7 Restoration Demand Scenarios

Three restoration demand scenarios were created, including the current scenario (base case); wildfire resilience and recovery; and comprehensive, integrated restoration and economic development. The scenarios, together with the drivers of demand, provide a structure for individuals and collaborative groups within the supply chains to track uncertainties and pro-actively consider options to respond to likely changes in future demand. The demand drivers are

fluid, which will result in the scenarios evolving over time. Hence, tracking changes could support participants in the supply chain ecosystem to determine the magnitude of change and, therefore, the type of required response, ranging from minor modifications, adaptations, to transformations in their operations.

The current scenario includes fluctuations in demand that create challenges for the supply chains. While fluctuations cannot be eliminated, reducing the severity of the pulses will help optimize the restoration market. Therefore, the two additional scenarios are proposed based on input from interviewees about how the drivers of demand and management responses to them could shape future demand. In the full report, the scenarios are discussed in terms of the likelihood that they might reduce fluctuations and help stabilize demand for restoration services and products, the amount of work likely required to pursue the scenarios, and the opportunities and challenges for doing so. The intention is to support a discussion on the value of the proposed approach, including the prototypes and scenarios.

7.1   Current Scenario or Base Case

To develop an integrated demand forecast across different types of impacts, a common measure of demand was required. Hence, best available information was used to develop cost estimates for restoration of the impacts from oil and gas and forestry. Information about wildfires and road liabilities that could be used to develop similar cost estimates was unavailable. Developing cost estimates required making assumptions, which introduce uncertainties into the demand forecast. The assumptions and assessments of certainty are included in the full project report to support improvements of the prototypes.

The current scenario includes a prototype for describing needs and opportunities. Currently, there is insufficient data to develop a prototype for priorities, but how different scenarios could be used to support the prioritization process is discussed in the full report.

Current Needs

As shown in Figures 4 and 5, highlights from this base case exercise include:

- The 2019-2050 accumulated cost of restoring dormant wells, orphan sites, pipelines. and seismic lines is estimated at $19.5 billion
- 74% of the total need corresponds to the restoration of dormant wells
- Of the total anticipated costs for restoring wells, 40% is estimated to involve downhole activities, which involve specialized skills and specific participants in the restorative activities supply chains. 60% is estimated to involve surface restoration, which involves activities that may be common with other restoration initiatives, including forestry's site preparation and planting and, therefore, are part of the cumulative demand on the restorative activities supply chains
- Reforestation activities associated with timber harvesting are likely less than the 9% shown in Figure 5 ss the need for site preparation, planting, and brushing associated with forestry is likely overestimated.

Figure 4 Estimated Total Restoration Needs from Oil and Gas and Forestry Activities in the Northeast Region
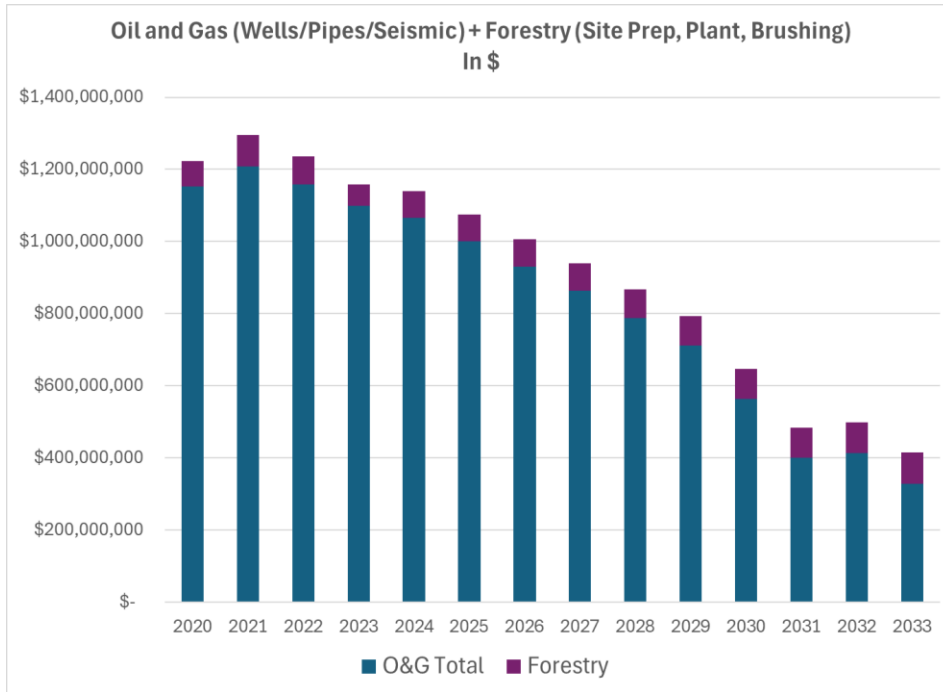
Source: Figure developed by the authors

Figure 5 Estimated Total for Specific Restoration Needs from Oil and Gas and Forestry in Northeast Region
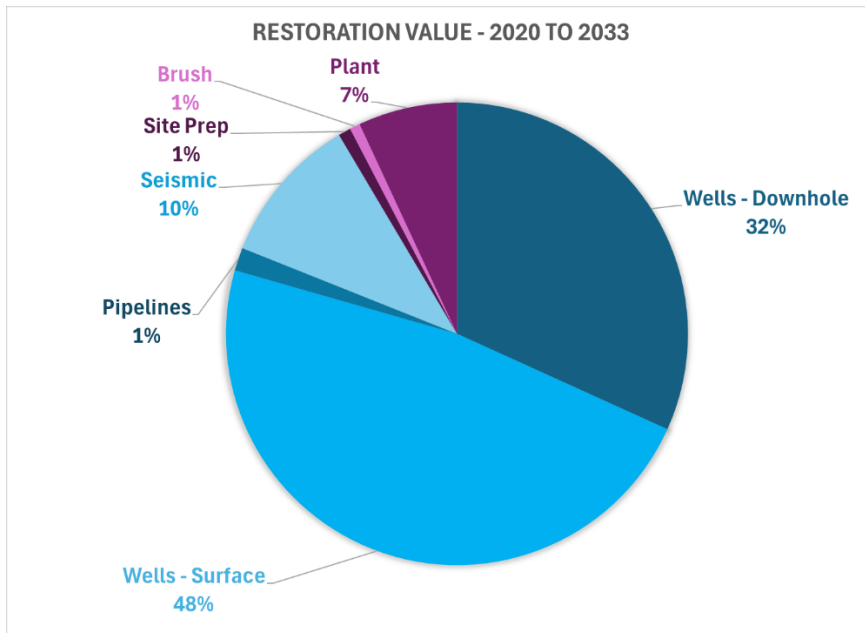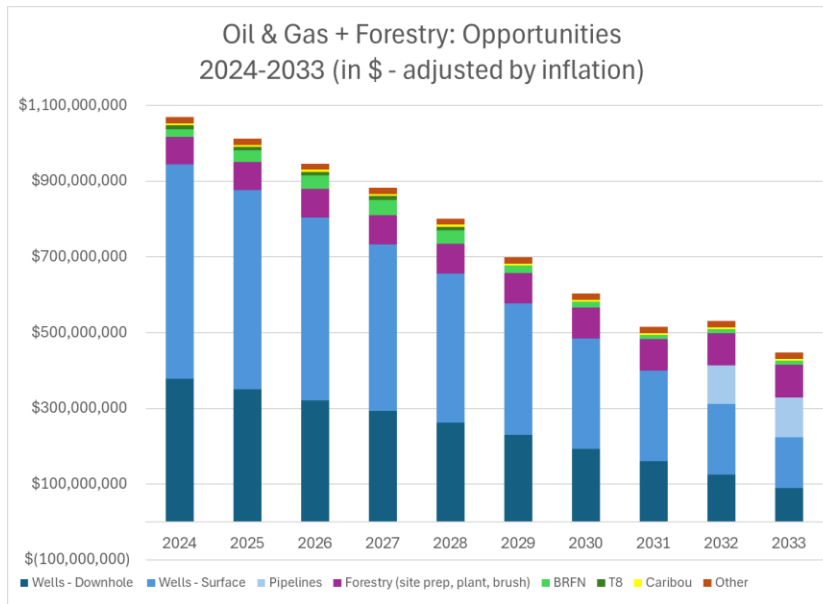

Source: Figure developed by the authors

Current Opportunities

Current opportunities for restoration combine the forecasts for legal obligations with the best available information about "pulse" funding that results from:

- One-time or short-term commitments
- Fluctuations in how programs allocate funding, for example based on an application process or desire to balance opportunities across geographic areas, issues, etc.
- Responses to emergencies, such as wildfires.

Assumptions have been made as to the potential amount and time horizons for spending of pulse funding, some of which are speculative. Hence, the prototype is a starting point for determining if and how improvements could generate valuable information for decision-makers within the restoration supply chain ecosystem. The assumptions are outlined in the full report.

Figure 6 Estimated Opportunities for Restoration in the Northeast Region

Source: Figure developed by the authors

The base case exercise confirms that the majority of demand for restoration is a result of legal obligations and in the Northeast Region for those associated with oil and gas activities. While there are greater uncertainties associated with the non-oil and gas demand projections, the relative significance to overall demand remains valid.

7.2   Wildfire Resiliency and Recovery Scenario

In June 2023, The Forest Practices Board of B.C. released a report that advocates for broad-scale implementation of Landscape Fire Management (LFM) to restore landscape and community resilience beyond the current focus in the Wildland Urban Interface (WUI). Implementing broad scale LFM would require transformative changes at the strategic and tactical scales and so it is unlikely in the short-term. A focused approach may be possible in the short-term with lessons

learned used to consider how to expand LFM if the required policies and funding models are developed. Suggestions for a focused approach in the short-term are included in the full report.

Although wildfires are unpredictable and, therefore, create spikes in demand for restoration, wildfire recovery could be designed to create more predictable demands on supply chains. This could include better integrating wildfire recovery with broader restoration objectives, consistency in the types of products that result from planning processes, including their content, structure, and timing of their release relative to defined stages of wildfire suppression. Feedback from participants in the supply chains could inform the evolution of the products so they effectively communicate demand to supply chains in a timely manner.

Short-term opportunities to support this scenario are discussed in the full report and in section 9 of this summary report.

7.3 Comprehensive, Integrated Restoration and Economic Development Scenario

A third possible scenario would use comprehensive, integrated planning for both restoration and economic development to generate better information about demand and support resilience across the supply chains. The proposed structure of enabling services and common restorative activities is applicable to both types of planning and can serve as a common foundation. Treating restoration as a market, which seeks to align demand (as defined through restoration planning) with the capacity of the supply chains (supported by economic development planning), is a means to facilitate integration between the planning processes. The full report discusses what may be required to pursue this scenario with short-term actions identified in section 9 of this report.

8   Assessment of the Restoration Supply Chain Ecosystem

An assessment of the supply chain ecosystem is intended to support participants across the supply chain ecosystem to:
- Understand the strengths and vulnerabilities of the system to meet current demand and the resilience to respond to changes in demand
- Clarify their specific strengths (opportunities) and vulnerabilities (risks)
- Identify individual actions and collaborations for responding to the opportunities and risks.

There are complex interactions within and across the supply chains, which makes assessing vulnerabilities and strengths challenging. Therefore, a vulnerability/ strength matrix has been developed as a prototype for a basic assessment of the restoration supply chain ecosystem (Table 6). The matrix uses a ranking from 1-9 depending on the significance of the vulnerability and scale of impact. Taking action to address a vulnerability can transform it into a strength with a similar scale of impact. For example, a vulnerability that creates risks for the entire restoration supply chain ecosystem could be transformed into a strength that benefits the entire ecosystem.

Table 3 Vulnerability and Strength Matrix for Supply Chains Assessment

	High Vulnerability or Strength	Moderate Vulnerability or Strength	Low Vulnerability or Strength
Supply chain ecosystem impact	9	7	4
Supply chain impact	8	5	2
Individual impact	6	3	1

Source: Table developed by the authors

Matrix Category	Basic Description
Low vulnerability	Can be managed within the existing system and business operations
Moderate vulnerability	Involves adaptation that can likely be achieved within the existing system and business operations
High vulnerability	Involves a transformative level of change to systems and business operations
Individual impact	Impacts one organization or a cluster of organizations at one point on a supply chain
Supply chain impact	Implications along a supply chain
Supply chain ecosystem impact	Ripple or cascading impacts across multiple supply chains

Source: Table developed by the authors

The full report includes more detailed discussion of the vulnerability and strength matrix. Input from interviewees was used to undertake a subjective assessment of both the enabling activities and restorative activities supply chains. A summary of the rankings is presented in Tables 7 and 8. The full report includes more detailed assessments, including a discussion on common vulnerabilities and strengths across the supply chain ecosystem related to communication and coordination, human resources, and training and education.

Table 4 Ranking of Enabling Supply Chains

Enabling Supply Chain Products	Ranking		
	Strategic	Tactical	Operational
Restoration policies and strategies to support efficiencies			
• Strategic level restoration objectives, targets, definitions of success	7	7	7
• Define relationships between restoration and major policy initiatives	7	7	7
• Decision-making support for restoration: formalized system for evaluating lessons learned and integrating into decision-making	7	7	7
Integrated demand forecasts			
• Across sectors/impacts at multiple, connected scales	9	9	7
• In real-time	7	7	7
Comprehensive, integrated restoration plans			
• Framework to support scaling up restoration and incorporating it into planning processes	9	9	9
• Landscape level plans		9	7

	Human Resources	Equipment/ Infrastructure	Materials
Regulatory framework to support efficiencies across sectors/ impacts			
• Modernized framework that rationalizes the use of available tools under existing Acts and regulations as well as addresses gaps to support a comprehensive, integrated approach to restoration	9	7	9
• Streamlined processes, including to support approvals of comprehensive, integrated landscape-level plans and programs, which can include multiple, nested projects that may be impacted by multiple Acts and regulations	9	7	9
Economic development policies to help optimize the restoration market			
• Taxation policies that incentivize restoration	7	7	
• Socio-economic assessment methodology that incorporates a broad range of ecosystem services	7	7	

• Clear roles and responsibilities, including which opportunities are best:
  o Led by governments, including First Nations
  o Pursued through public-private partnerships
  o Managed through the private sector market
	7	7	4

• Framework for reporting that will link restoration to global targets and frameworks and associated federal and provincial policies to help align financial flows with restoration opportunities	4	4	4
Strategies to support alignment of demand forecasts and supply chains			
• Co-management & reconciliation strategy within the context of a restoration market and associated First Nations goals	7	7	7
• A.I. & technology strategy	7	7	7
• Education & training strategy	7	7	7
• Funding & partnerships strategy	8	8	7

Source: Table developed by the authors

Table 5 Ranking of Restorative Activities Supply Chains
Note: no rankings are provided where interviews did not generate sufficient information to do so.

Category	Restorative Activity	Human Resources	Equipment/ Infrastructure	Materials
Infrastructure	Access management			
	Facilities management			
Hydrology	Decontamination			
	Flows	3	3	3
Soils	Erosion control	5	5	
	Site preparation	8	5	
Invasive species	Eradicate	3		
	Contain and control	3		
Vegetation	Revegetation	8	7	9
	Forest health and stand structure	5	5	
	Prescribed fire			
Fish and Wildlife	Habitat structures	3		
	Population management			

9   Actions to Strengthen the Supply Chain Ecosystem

Participants in the supply chain ecosystem are addressing vulnerabilities through individual or collaborative efforts. One option is to accept the outcomes of leaving it to the market to address vulnerabilities and capitalize on opportunities. The restoration market does not, however, function like a normal market. Demand for restoration services and products is created by enabling activities, not consumer choices, and as a response to social issues, (e.g., impacts on Treaty Rights). As a result, the signals about demand to the supply chains can be complex, require interpretation, and often require more than individual responses to achieve the desired benefits.

Optimization of the restoration market would benefit from scaling up coordination across the supply chain ecosystem with the current efforts providing a foundation for doing so. Active facilitation could be used for perhaps a period of 3 years to improve communication and coordination across existing initiatives, identify efficiencies, and add value. After that time, the short-term opportunities will, to the extent possible, be incorporated into regular business operations and longer-term issues will have been identified, including the processes that will be used to address the priority issues.

Interviewees identified numerous actions that could be taken to strengthen the supply chain ecosystem, both through existing efforts as well as new initiatives that could be pursued.

Mandates and Champions

- Explore the benefits of incorporating clear mandates for comprehensive, integrated restoration into the mandate letters of provincial natural resource and economic development agencies
- Identify a team of champions with clear accountabilities and mechanisms for consistent reporting to senior leaders

Improving Demand Forecasts

First steps in developing comprehensive, integrated demand forecasts would include reviewing and assessing:

- Existing systems and processes for defining demand, which are typically focused on specific sectors, types of impacts, or types of ecosystems. The outcome would be to identify opportunities to integrate the available information into a comprehensive, integrated demand forecast at multiple scales, including the regional scale
- Existing and emerging technologies, including A.I. Demand forecasting would benefit from a strategy for the use of technologies to support more complex and real-time analyses
- The use of climate and wildfire refugia mapping to help prioritize needs for the restoration of resilience within at-risk landscapes. As wetlands are a key factor for identifying refugia areas in the Northeast Region, a review of methodologies used in other jurisdictions to assess the likely impacts on the future viability of wetlands could be used inform improvements of the refugia mapping and its use in helping to prioritize restoration investments
- Existing regulations and policies, including gaps, that need to provide guidance for incorporating passive restoration into the assessment of needs and priorities relative to available opportunities.

Wildfire Resiliency and Recovery

Implementing broad scale Landscape Fire Management (LFM) would require transformative changes at the strategic and tactical scales. A focused approach could be pursued in the short-term with lessons learned used to consider how to expand LFM if the required policies and funding models are developed. A pilot project could explore:

- Synergies with implementation of other restoration, conservation, or resource development activities to leverage equipment and human resources to reduce costs, create longer seasons for seasonal employees, and more consistent demand on the supply chains
- Use of LFM to help protect investments in other restoration initiatives that could be undermined if subjected to a wildfire with LFM being incorporated into restoration program and project budgets. This would increase costs and could reduce overall demand for restoration, but it could improve effectiveness
- Prioritizing LFM treatment areas, for example a focus on climate and wildfire refugia areas. This would increase the effectiveness of treatments to support broader and longer-term restoration needs
- The type, intensity, and location of LFM activities that align demand with the capacity of the supply chains to avoid inflating short-term prices and help guiding investments in capacity building.

For wildfire recovery, a pilot project could involve a collaboration between wildfire recovery planners and participants across the supply chain ecosystem to define prototypes for consistent products, such wildfire recovery plans, that are intentionally designed to communicate demand for restoration services and products.

A review of strategic level policies, objectives, and criteria for wildfire recovery would also help clarify priorities for restoration services and products, including:
- To guide the extent to which passive restoration will be a primary strategy, including where and over what timeframe(s) as discussed above
- How wildfire recovery fits relative to broader restoration objectives.

Comprehensive, Integrated Restoration Planning

The following short-term actions could be used to build and test a framework for improving the incorporation of restoration into existing planning processes or, where necessary, development of a restoration plan:

- Review of existing regulations and policies across different Acts, government agencies, and sectors to:
    - Identify gaps
    - Prioritize gaps
    - Identify processes or mechanisms for addressing the priority gaps
- A strategic review of the full report from this project and other sources to:
    - Develop agreements on common terminology and concepts

- o Determine if and how the proposed common restorative activities and associated supply chains (section 5) could be used to support consistency across restoration plans and programs.
  - o Design a prototype for the structure and content of a comprehensive, integrated restoration plan
- While developing a consistent framework, an interim measure could be to select one or more existing planning processes as pilots for including comprehensive, integrated restoration into landscape-scale plans. The pilot(s) could engage landscape ecologists, restoration practitioners, program (rather than project) managers, suppliers, and trainers/educators. If these discussions occurred in parallel with the development of a consistent framework, both efforts could benefit, and lessons learned would be generated faster
- Decision-support:
  - o Review existing monitoring programs to assess how they are currently supporting restoration and could be integrated and leveraged to create a comprehensive, integrated program
  - o Determine if existing systems can be used and/or a new intentionally designed system is needed for evaluating lessons learned from the broad array of restoration initiatives, which are then used to inform decision-making to:
    - ▪ Improve integrated restoration planning, permitting, and practices
    - ▪ Inform the evolution of best management practices for resource use and development, which might reduce demand for future restoration and/or improve restoration outcomes.

Economic Development Planning

Optimizing the restoration market would benefit from a strategic-level economic development plan, which could be refined through implementation at the regional and local scales. Short-term opportunities to support development of a strategic-level economic development plan include:

- Develop agreements on the appropriate roles to address key gaps, including what would benefit from direct government and/or First Nations leadership, public-private partnerships, and competitive market-based responses
- Review work-to-date to incorporate a broad range of ecosystem services into analyses and decision-making to determine if changes may be required to support complimentary restoration and economic development planning and decision-making
- Review policies and prioritize opportunities to improve incentives for restoration, including as they relate to taxation, the creation of restoration tenures, transforming restoration into a market commodity to be traded or sold, etc.
- Review efforts to date to modernize and streamline permitting in B.C. Use lessons learned to develop a comprehensive strategy to support restoration across different sectors, Acts and regulations, and decision-making processes
- Review work-to-date in B.C. on reporting to support global targets and frameworks to inform the development of restoration and economic develop plans so they are structured to support consistent reporting

- Collaborate with relevant participants in the supply chains to develop strategies to support alignment of demand forecasts and supply chains, for example:
    - Co-management & reconciliation strategy within the context of a restoration market and associated First Nations goals
    - A.I. & technology strategy to support both demand forecasting and supply chain management
    - Education & training strategy
    - Funding & partnerships strategy
    - Procurement strategy, including development of a registry of supply chain participants and facilitation of collaborative purchases to create sufficient demand for specialty services and products (e.g., native plants).

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