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Towards

Malahat First Nation's

Natural Asset Inventory

Malahat

Natural Assets Initiative
MAKING NATURE COUNT

Summary of inventory results and recommendations

June 2025

Invest in Nature

The Natural Assets Initiative (NAI) is a Canadian not-for-profit that is changing the way communities deliver everyday services - increasing the quality and resilience of infrastructure at lower costs and reduced risk. The NAI team provides scientific, economic and ecological/environmental expertise to support and guide communities in identifying, valuing and accounting for natural assets in their financial planning and asset management programs, and developing leading-edge, sustainable and climate-resilient infrastructure.

NAI works in partnership with local governments, Indigenous Nations, watershed agencies and many others, to move nature from the periphery to the core of decision-making. It does so by helping these entities to identify, understand, account for, and ultimately maintain and protect a wide range of natural assets (e.g., aquifers, wetlands, forests, foreshores) and the services that natural assets provide for communities. Natural asset management is a counterpoint to decades-long, business-as-usual approaches in which community services are delivered through engineered solutions alone and nature is excluded from investment, planning and land-use decisions except for narrow considerations like aesthetics, recreation or natural resource extraction to support local economies. NAI is dedicated to the development of tools and an emergent professional practice that seeks to account for the wide range of benefits nature provides in a community to support life (e.g., carbon sequestration, flood protection, air quality, clean drinking water, cultural revitalization and food sovereignty).

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This Project was led by a multi-disciplinary, multi-organization team:

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1.0 Purpose

This report describes an initiative in which Malahat First Nation (MFN) and the Natural Assets Initiative (NAI) worked in partnership to create the *Malahat First Nation Natural Asset Inventory Project* (hereafter, "the Project").

The purpose of the Project is to support MFN in the development of a natural asset inventory based on public sources, and to develop an initial roadmap of next steps in MFN's natural asset journey.

The Project had the following deliverables:

- Natural asset inventory, including online dashboard and registry
- Condition assessment
- Risk identification
- Engagement with community to improve and refine the inventory
- Engagement with the community to identify possible subsequent phases
- Training in the maintenance of the inventory
- Documentation of possible elements of the next phase of the work
- Brief final report (this document)

2.0 Introduction

Natural assets management (NAM) is an evolving process that includes actions taken by local governments, watershed agencies and others to identify, value and account for natural assets in their financial planning and asset management programs, and develop forward-thinking, sustainable and climate-resilient infrastructure.

NAM is a counterpoint to business-as-usual approaches in which community services are delivered through engineered solutions alone and nature is excluded from most investment, planning and land-use decisions. NAM is based on standard asset management processes, which are comparable, replicable and thus allow for scale.

NAM emerged as a primarily Western, science-based concept. However, NAI is beginning to use Etuaptmumk/Two-Eyed Seeing to develop a process that embeds Indigenous knowledge and approaches into natural asset inventories and other aspects of NAM. This approach recognizes the interconnectedness of the natural environment, interweaves Indigenous knowledge and values as described in Section 3.

What is a natural asset inventory?

A starting place in asset management – and thus the NAM methodology—is the development of a natural asset inventory.

Natural asset inventories provide details on the types of natural assets that are relied upon within the jurisdiction of a First Nation, regional government, local government or other entity. As depicted in Figure 1, a natural asset inventory is the first component of the Assessment phase, which in turn is the first of three phases of a full natural asset management project.

Natural asset inventories include:

- **Natural asset types:** A list of natural features that provide services to the community, e.g., wetland, streams, forests, and agriculture
- **Ecosystem services:** A high-level understanding of the priority services natural features provide in the community, e.g., water filtration, flood protection/mitigation, food from agricultural activities, carbon sequestration and atmospheric benefits
- **Condition and risk assessment:** An understanding of the present condition the natural features are in and the risks (both natural and human-caused) they may face

All groups—whether First Nation, local government or other—are affected by at least some natural assets that are outside their traditional territory, or region or municipal boundaries, thus potentially outside their jurisdiction. Therefore, the condition and risk aspects of the inventory recognize that some cumulative

effects and risks have factors outside of the control of the entity developing the inventory.

Canada now has National Standard of Canada CSA W218:23, "*Specifications for Natural Asset Inventories,*" a voluntary Standard, published through CSA Group that outlines minimum requirements and provides guidance to complete natural asset inventories. The natural asset inventory completed for this project aligns with this[1].

Beyond inventories

As illustrated in Figure 1, NAM is an iterative, continuous improvement process. Following a natural asset inventory, communities have many options to deepen their understanding and integrate knowledge from the inventory into organizational and watershed level action. Options, for which there is a growing body of supporting tools, guidance and case examples, might include:

- Analyzing the people, governance processes and structures that support the ongoing monitoring, maintenance, restoration and enhancement of natural assets
- Understanding staff and resources supporting natural assets in the watershed and what staff and resources may be required to maintain and improve these ecosystem services for the long-term
- Undertaking valuations of the services provided by natural assets; determining levels of service, and developing investment and management plans.

This list of "beyond inventories" activities may differ in a First Nation context, as described in more detail below.

In addition, the principles Ownership, Control, Access, and Protection (OCAP)[2], which must be interpreted by MFN according to its values and belief systems, inherently incorporates the understanding that MFN has jurisdiction over any and all of its cultural knowledge, scientific data, oral teachings or any other form of data (Ermine, Sinclair & Jeffery, 2004; Konczi & Bill, 2024).

1 Note that National Standard of Canada CSA W218:23 had no Indigenous engagement and thus not all aspects may be relevant. Access the standard at *www.csagroup.org/store/product/2430709/?srsltid=AfmBOoq92QWq1zBiNrXjRCnvrWv_hWX2VzEgA7N623zSCKu5xcNqlJz4*

2 OCAP asserts First Nation control over data collection processes, use and ownership; for details see *fnigc.ca/ocap-training/*

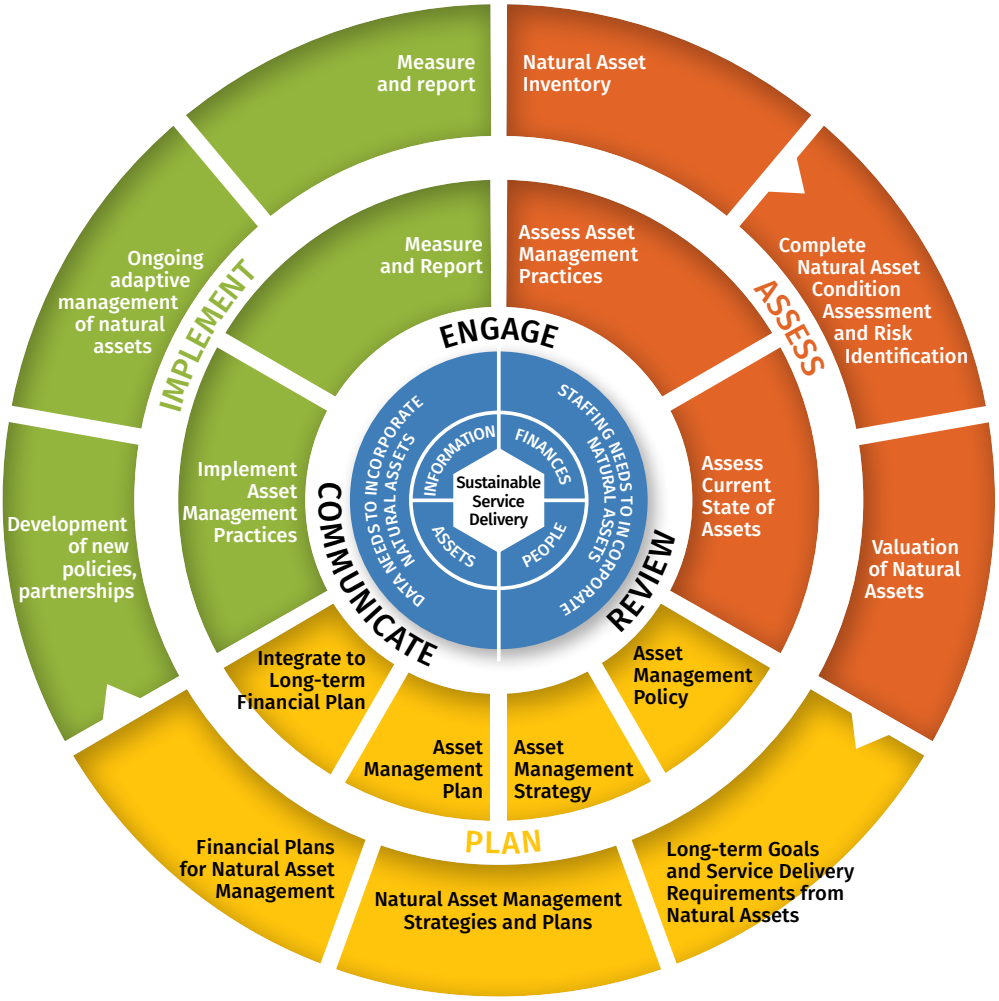

Figure 1: *The natural asset management process (MNAI 2017), adapted from Asset Management BC's asset management wheel*

photo credit: David Seibold cc-BY-NC 2.0

3.0 Towards an Etuaptmumk/ Two-Eyed Seeing Approach

As noted, NAM began as a primarily Western, science-based approach. However, NAI is undertaking efforts to interweave Indigenous worldviews, knowledge and perspectives into NAM to help it evolve to uphold Indigenous rights.

For example, the report, *The Journey So Far* (Bear and Bill, 2023), describes NAI's initial efforts to develop a collaborative natural asset inventory with Treaty 1 First Nations and the Winnipeg Metropolitan Region, with facilitation from the Centre for Indigenous Environmental Resources (CIER) through the Collaborative Leadership Initiative (CLI). Learnings from the Treaty 1 experience contributed to the current Project. The ambition was to build on the learnings from work with Treaty 1 First Nations, apply learnings from previous Western natural asset inventory projects; find ways to both center Indigenous knowledge and perspectives; and, be guided by existing and emerging concepts from Indigenous-led land, water and other natural resource protection best practices.

As an example of the latter, *Etuaptmumk* is the Mi'kmaw word for Two-Eyed Seeing. This concept was brought to the forefront of Integrative Science by Mi'kmaw Elder Albert Marshall in 2004. The approach is often described as a way of learning to see from one eye with the strengths of Indigenous science and knowledge, and from the other eye with the strengths of Western knowledge and ways of knowing, and then learning to use both eyes together, for the benefit of all.

To apply an Etuaptmumk/Two-Eyed Seeing approach, community partners must commit to creating an Ethical Space, a term coined by the Indigenous philosopher, Willie Ermine, from the Sturgeon Lake First Nation. The 2018 report, *We Rise Together*, by the Indigenous Circle of Experts (ICA) described ethical space as "avenue for collaboration and advice, sharing and cross-validation (where one side validated the other's decisions)". Ethical Space is about creating a place for knowledge systems to interact with mutual respect, kindness and generosity.

photo credit: Malahat First Nation

4.0 Malahat First Nation Community Context

MFN is a Coast Salish Indigenous community and one of the five W̱SÁNEĆ (Saanich) Nations. MFN is located between Victoria and Mill Bay, British Columbia, with two reserve lands located on the western shore of Saanich Inlet. Malahat Nation has inherent Aboriginal rights (including title) throughout its territory, which arise from the Nation's longterm use and occupancy of the territory prior to colonization. These rights include, but are not limited to, the right to traditional, cultural and ceremonial practices, the right to access the land and resources of the territory, the right to self-determination and self-government, and the right to enter into treaties.

In 2015, Malahat Nation acquired a portion of their traditional homelands through a loan from the First Nations Finance Authority. This land purchase encompassed locations such as Bamberton and Oliphant Lake, while also tripling the amount of territory they own in total. MFN signed the Framework Agreement on First Nation Land Management and adopted its Land Code in October 2014. The Land Code affirms MFN's right to govern and manage their land, which includes Indigenous Reserve (IR) 11, south of Mill Bay, BC. Malahat Nation has the power to develop and enact laws pertaining to the development, conservation, protection, management, use and possession of First Nation land, and interests or land rights and licenses in relation to that land . MFN is part of the BC Treaty Process through the Te'mexw Treaty Association which handles Treaty negotiations for a number of First Nations located in the area.

A key focus of MFN is to reclaim pre-colonization governance over traditional lands. Much of MFN territory has been and continues to be utilized for resource development; on reserve, there was relatively recent logging activity, and two sites used as soil deposit locations, leaving behind a series of access roads and skidder trails. The forested lands have traditionally been a location for hunting and gathering activities, and access to the ocean has provided a base for marine harvesting. MFN developed an environmental management plan in 2022 that places a high emphasis on stewardship as well as cultural monitoring and protection. This, in turn, inherently requires that MFN understand the broader

ecological context they inhabit, with integrated data to support a range of decisions.

Therefore, MFN is turning its focus outwards across its broader traditional territory to understand connection between past, or proposed actions of stakeholders such as BC Hydro, and the upholding of MFN rights and title. A natural asset management project will help MFN understand this larger scale, including unique ecosystems, the connection to ecological services, and actions that MFN my wish to take to protect them – not simply when there is a referral but on a proactive and ongoing basis. This could help specifically in MFN's participation in a working group they have with the Province of BC to look jointly at applications and referrals.

REFERRALS: A PROJECT DRIVER

'Referrals' are the process that the Province of British Columbia uses as part of its 'Duty to Consult' First Nations when there are proposed developments in a First Nation's territory. Most development applications have this duty. Depending on the resources and uses of a First Nations territory, the number of referrals vary significantly. Referral type can vary from replacing a culvert to forestry harvesting plans and industrial developments such as mines, and the ability of a First Nation to respond to referrals also varies widely.

Referrals are looking for permission to develop and typically accompanied by information specific to, and supportive of, that development. Referrals do not normally refer to adjacent developments or address cumulative effects associated with other developments. It is therefore up to the First Nation to understand potential consequences to the land, resources, community traditional use and long-term impacts.

MFN's efforts to reclaim pre-colonization governance and stewardship over traditional lands emphasizes cultural monitoring, protection, and requires a broad understanding of land uses and ecological integrity—both past and present—to support proactive and informed decision making.

Enhancing the effectiveness of MFN's participation in referrals with their working group is a significant Project driver. More specifically, the resulting inventory can be viewed as a tool to "level the playing field" for MFN and empower it in its dealings with those seeking to undertake development on its territory.

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5.0 Natural Asset Inventory

5.1 Developing the Inventory

The natural asset inventory developed for MFN has three main components: an asset registry (which is a tabular representation of the data); spatial data (which is a spatially explicit geodatabase demonstrating the location and extent of natural assets); and, an online dashboard. This section of the report describes the approach used to define natural assets within the Malahat Benchlands, the Satellite Channel Benchlands, and Shawnigan Creek, which is the geographic scope for this project (see Figure 2).

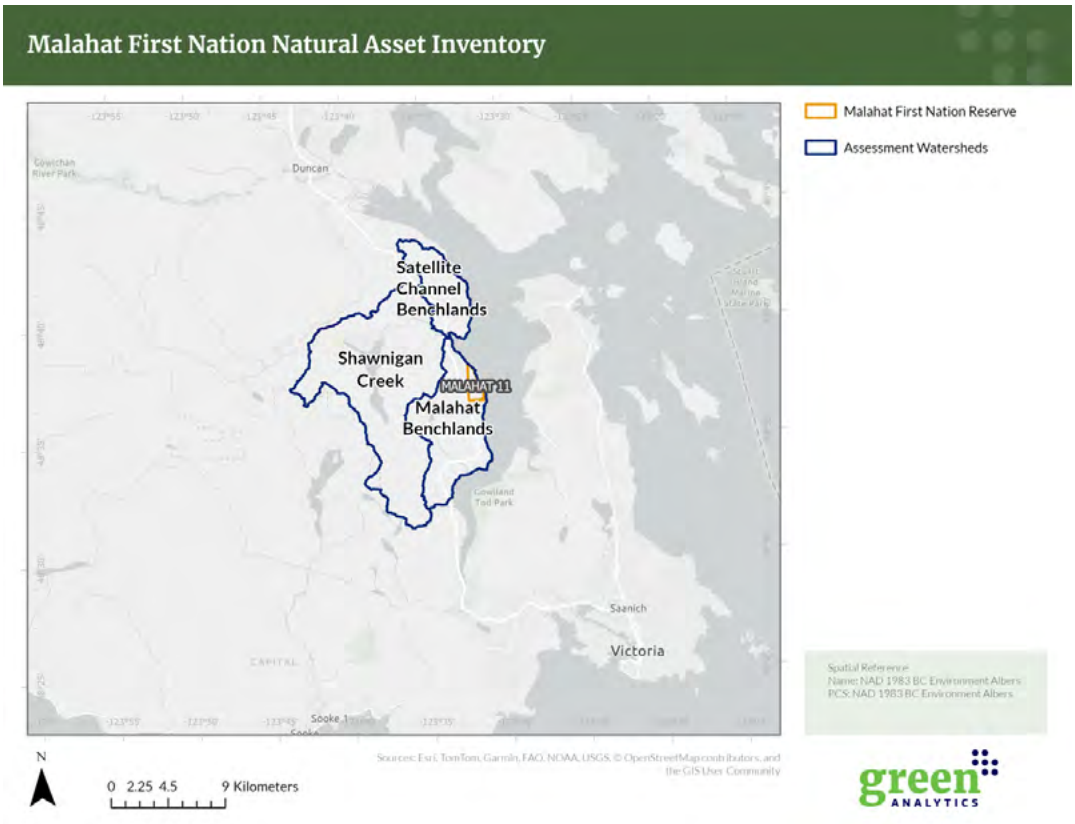

Figure 2: *The Malahat Benchlands, the Satellite Channel Benchlands, and Shawnigan Creek are the geographic scope for this Project*

DEFINING THE SCALE OF ANALYSIS

The first step in the approach was to define the level of detail needed for the natural asset inventory. Natural assets within the watersheds were defined at both the fundamental and assessment watershed levels. The terms fundamental watersheds and assessment watersheds relate to how watersheds are delineated and used for environmental monitoring and management, with the former being the smallest unit of delineation and draining into a single outlet and the latter being an aggregation of fundamental watersheds. Assessment watersheds are delineated by the Cowichan Valley Regional District. Fundamental watersheds are defined in the BC Freshwater Atlas (2024) hierarchical watershed framework.

Figure 3 depicts the assessment and fundamental watersheds within the area of study.

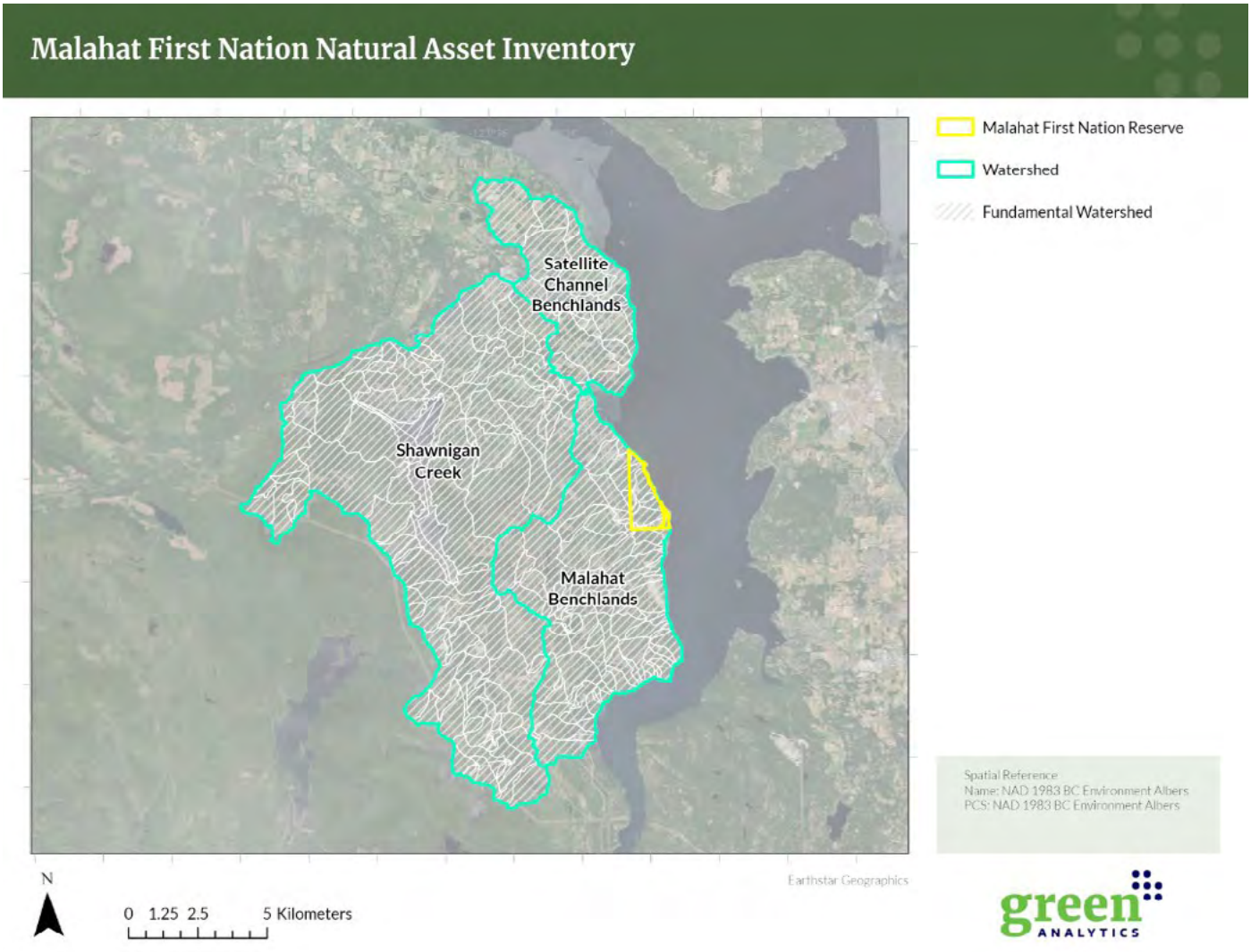

Figure 3: *Map of Assessment and Fundamental Watersheds Within the Study Area*

Figure 4 provides an overview of the asset hierarchy used to define natural assets within the assessment and fundamental watersheds. Within each watershed unit, natural and enhanced asset classes were defined. These classes were further classified by asset types.

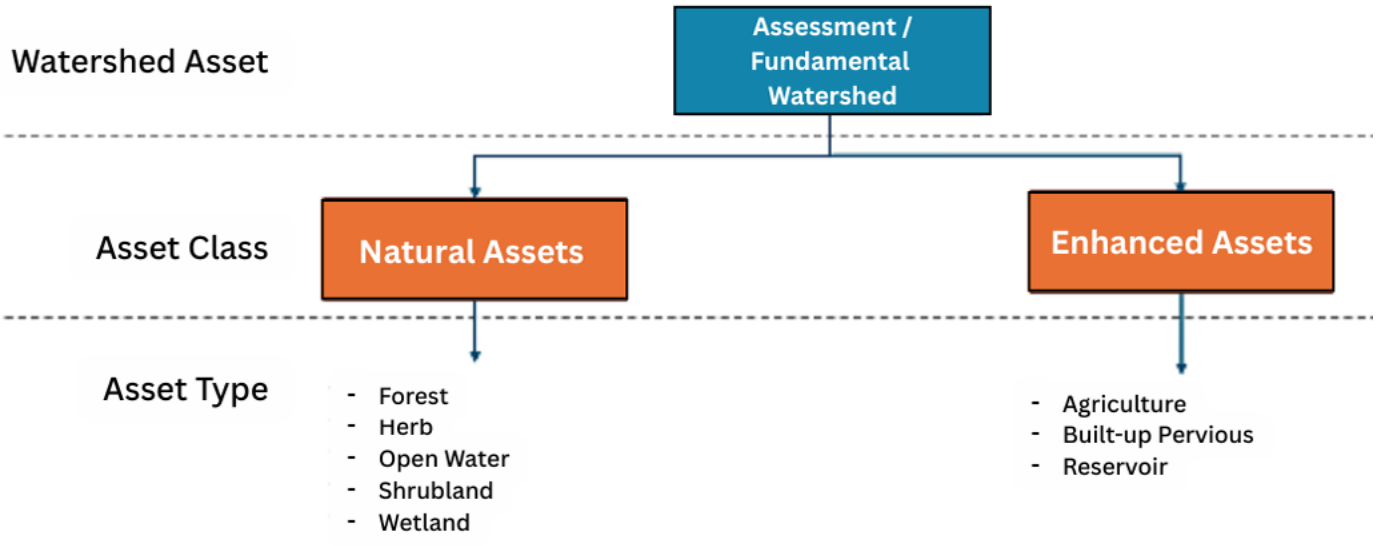

Figure 4: *Asset Hierarchy*

The scale of analysis for the natural asset inventory as depicted above allows for fine-scale resolution information to be captured, and higher resolution data to be employed for the purposes of analysis (e.g., condition assessment) or display. This approach also provides flexibility for MFN to store, utilize, and assess detailed information where available and applicable, while generating more aggregated outputs better suited to informing broader land use planning decisions when desirable.

DATA STRUCTURE

Figure 5 depicts how data was integrated to establish the natural asset inventory in a geospatial database, which can be thought of as the centralized location where the data is stored.

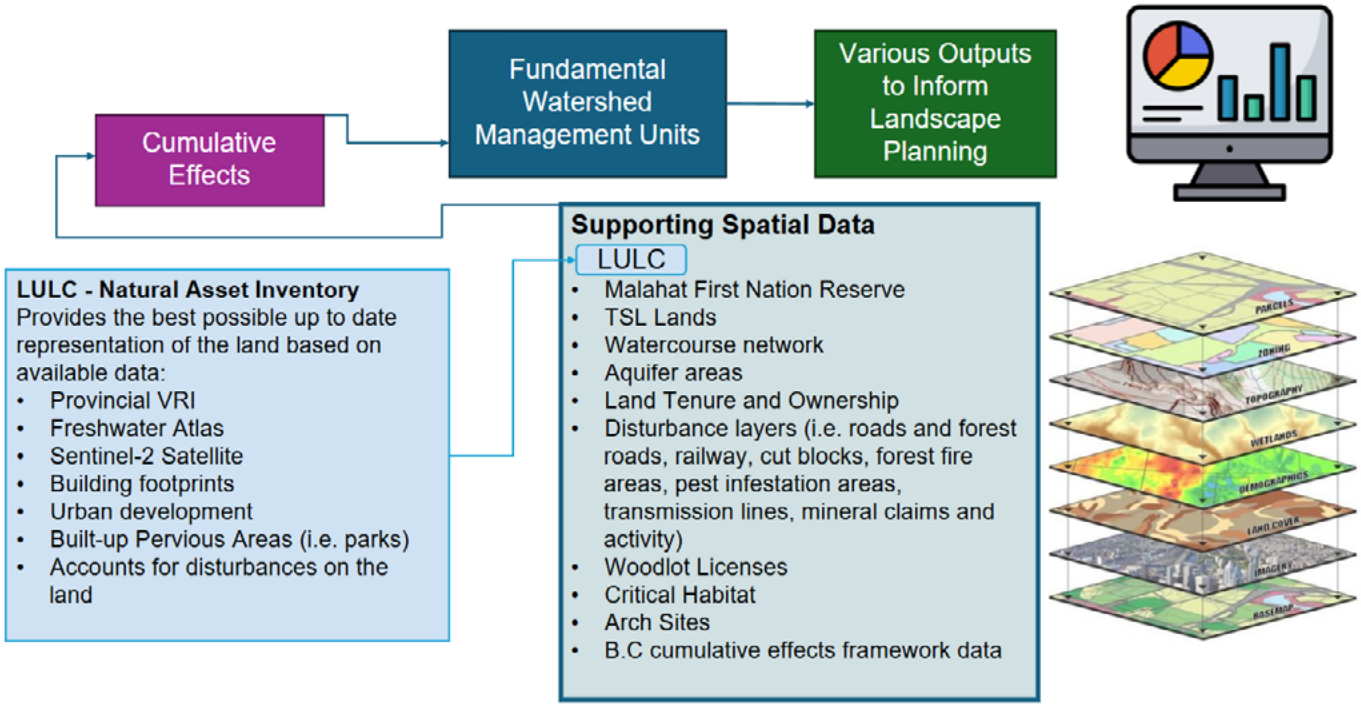

Figure 5: *Conceptual Overview of the Natural Asset Management Data Structure*

A key part of the geospatial database is land cover data, which combines information on how land is used (e.g., built-up or agricultural areas) with data on the physical material of the Earth's surface (e.g., forest or wetlands). Within the MFN inventory, classifications are largely based on three data sets:

1/ BC Vegetation Resource Inventory
2/ BC Freshwater Atlas
3/ Agri-Foods Canada Crop Inventory

INVENTORY OUTPUTS

Figure 6 provides a summary map of the MFN natural asset inventory. As evident in the figure, the area is dominated by forest assets. Other natural features such as wetlands, open water, shrublands, and low-lying vegetation are found throughout the area. These assets provide numerous services to residents including water storage and filtration, carbon storage and sequestration, and recreational opportunities.

Table 1 provides a numerical overview of natural assets by area. The area figures are grouped by asset class, type and feature. The area of the Malahat Benchlands, Satellite Channel Benchlands, and Shawnigan Creek watersheds spans about 18,100 hectares (ha) with 77%, or approximately 13,945 ha designated as natural assets. Forest assets dominate the natural land base covering about 11,849 ha.

Ecosystem services provided by these natural assets play critical roles in promoting environmental sustainability and strengthening community resilience. For instance, forests capture carbon and help control the climate while providing habitat. Wetlands improve water quality by filtering water and reduce flood risks.

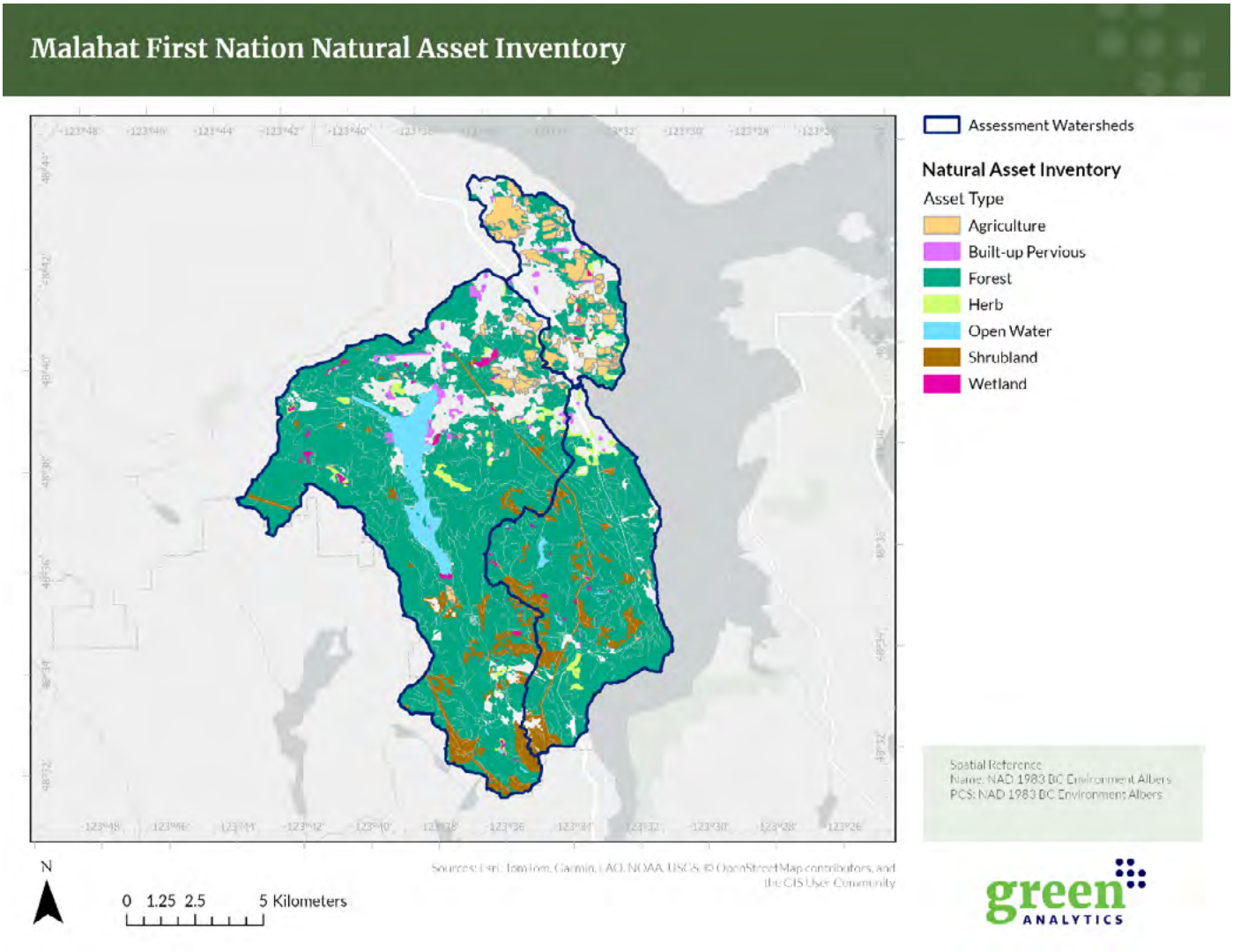

Figure 6: *Map of Malahat First Nation Natural Asset Types*

Table 1: *Summary of Land Cover Using Natural Asset Hierarchy*

Asset Class	Asset Type	Asset Feature	Area (ha)
Natural	**Open Water**	Lake	581.96
	Forest	Broadleaf Forest	976.85
		Coniferous Forest	9,342.10
		Mixed Forest	1,410.92
		Unknown Forest	119.48
	Shrubland	Low	1,116.46
		Tall	133.58
	Herb		153.39
	Wetland		110.37
Enhanced	**Agriculture**	Agriculture	856.97
	Built-Up Pervious	Park	62.10
Total			**14,865.82**

5.2 Condition Assessment

Information about the ecological health or condition of natural assets is vital to understanding the actions or interventions that can help to ensure services continue to be provided from the assets over time. For example, condition assessments can help users:

- Assess and rank the relative condition of natural assets
- Prioritize areas for restoration or rehabilitation
- Monitor and track changes in land cover and condition overtime
- Inform land use management and planning decisions

Natural asset condition assessments can use several indicators to assess the relative condition of a natural asset, and then rate it on a scale from very poor to very good.

Table 2 provides an example of the rating scale as outlined in CSA's natural asset inventory standard (CSA 2023).

Table 2: *Sample Condition Rating Scale Definitions*

Rating	Explanation
Very Good	Well-maintained, good condition, no signs of deterioration in ecological conditions. Natural asset service provision is high.
Good	Ecological conditions appear to be sufficient; some minor localized (or isolated) impacts noticeable, which might be a warning sign of possible decline. Natural asset service provision is acceptable.
Fair	Clear signs of deterioration in ecological function and service-influencing factors. Natural asset service provision, while still functional, is at risk of failing.
Poor	Condition is below standard with large portion(s) of the system exhibiting significant deterioration in ecological function. Natural asset service provision is impacted, and some services might be non-functioning.
Very Poor	Widespread signs of advanced deterioration; unlikely that the natural asset is providing any functional service.

A condition assessment such as the one in Table 2 can be useful for prioritizing restoration or management activities. However, applying natural asset management approaches to a large land base also requires alternative considerations.

Specifically, to help inform MFN landscape management decisions, cumulative effects considerations are also important. In the context of natural asset management, cumulative effects and asset condition are strongly related.

Cumulative effects refer to the collective impact of individual environments or ecosystems over time. Mahon and Pelech (2021) describe cumulative effects as the combined effects of multiple stressors on species or ecosystems over time and/or space, where stressors are all human-induced activities and drivers.

There are many approaches to inform and measure cumulative effects. They vary in complexity and scope ranging from qualitative approaches like questionnaires, interviews, checklists, matrices, and diagrams, to quantitative approaches like habitat suitability models, species stressor models, and simulation models (Mahon & Pelech 2021). The Province of BC has established a Cumulative Effects Framework (BC CEF) and has started assessing and reporting on cumulative effects across BC[3]. The Province describes this framework as policies, procedures and decision-support tools to help identify and manage cumulative effects consistently and transparently across its natural resource sector.

3 See details on BC's Cumulative Effects Framework: *www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework/overview*

While natural asset condition assessment differs from a cumulative effects assessment, they are related. For example, geographic areas that are more disturbed (and therefore have higher cumulative effects) have lower condition ratings, and areas of lower condition are likely to have reduced resilience and greater sensitivity to any additional impacts. The condition assessment applied to the MFN study area, focused on ranking relative impacts to the assets (rather than ranking the relative condition of the assets).

To help MFN better understand the condition of their natural assets and the level of disturbance on the landscape, impact indicators were identified that could be measured with the data contained in the geospatial database that forms the basis of the natural asset inventory. This approach:

1/ Drew from typical natural asset management approaches to identify a suite of indicators that can be combined or stacked to rank the natural assets.
2/ Identified potential indicators from the BC CEF metrics.
3/ Selected indicators (from 1 and 2 above) to provide insights on the relative condition of the natural assets and the degree to which the assets have been disturbed by industrial development and other disturbances.

The indicators employed are as follows; each was applied to the fundamental watersheds:

1/ Density of watercourse crossings
2/ Road density
3/ Density of linear disturbances
4/ Equivalent clearcut area[4]
5/ Old growth forest
6/ Watershed intactness (human disturbance)

A five-point rating system scored the indicators as either having either very low, low, moderate, high, or very high impacts.

Finally, an overall impact score was established by averaging the six indicators above and assuming an equal weighting. Figure 7 maps the results by fundamental watershed highlighting that much of the study area is highly impacted.

4 Equivalent clearcut area factors in the area impacted by clear-cutting, area burnt by forest fires, and area impacted by pest outbreaks.

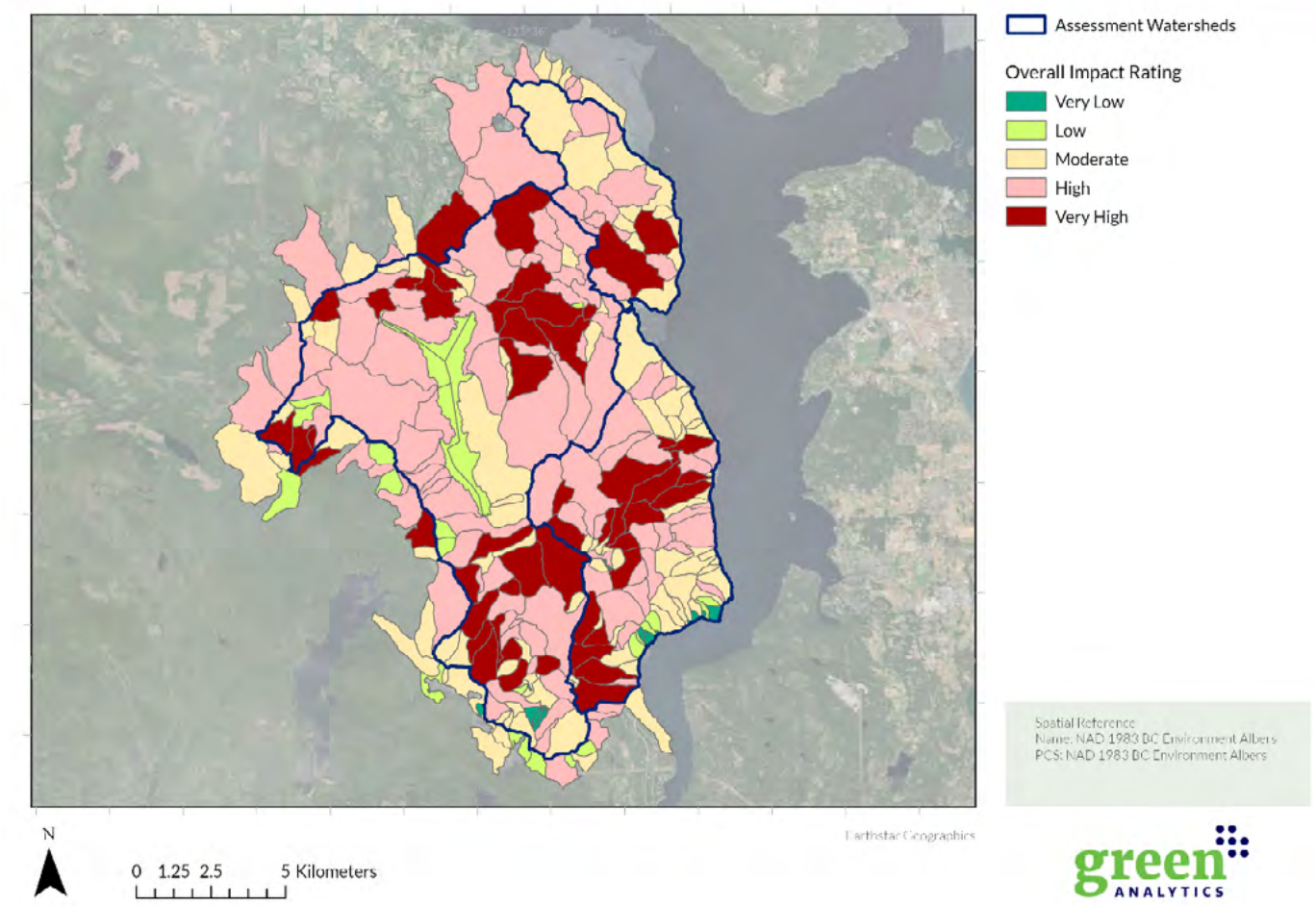

Figure 7: *Map of Overall Fundamental Watershed Impact Rating Results*

Table 3: *Impact Ratings by Area (ha)*

Impact Rating	Area (ha)	Percent of Fundamental Watershed Area
Very Low Impact	111	0.48%
Low Impact	1,182	5.09%
Moderate Impact	5,556	23.93%
High Impact	11,383	49.03%
Very High Impact	4,984	21.47%
Total	**23,216**	**100%**

5.3 Online Dashboard

Inventories may provide more insights when characterized visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by location or asset type. Figure 8 is a screenshot from the natural asset inventory dashboard.

Within the dashboard, various filters are accessible throughout the different sections of the dashboard. Filtering allows a user to create custom subsets of data based on a selection of attributes within the natural asset inventory dataset.

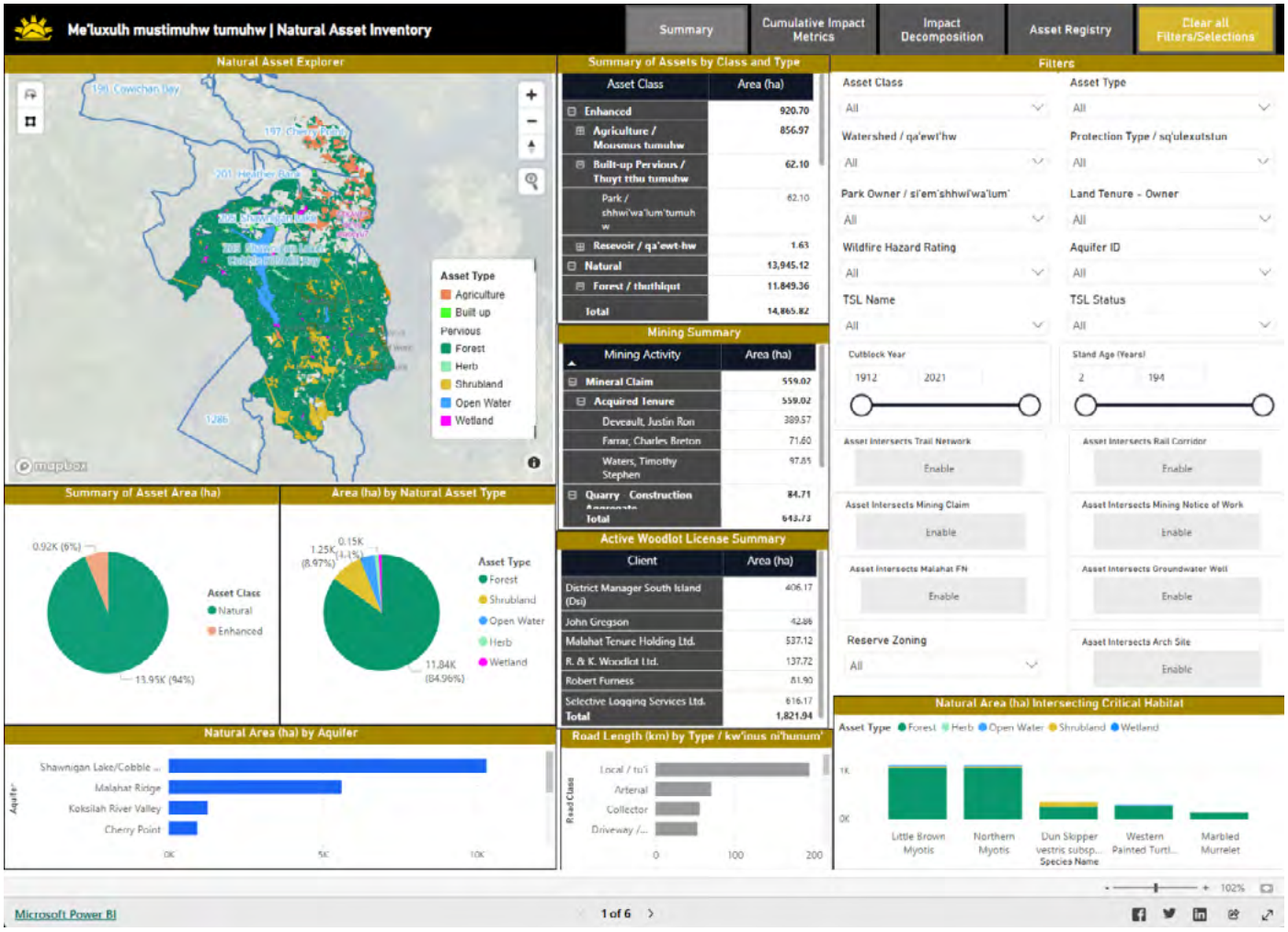

Figure 8: *Screenshot of the Cumulative Impact Summary from the Online Dashboard*

5.4 Maintaining the Inventory

Inventories are not static. Both the registry and the dashboard can be expanded as new information becomes available. For example, asset condition might improve as a result of restoration efforts, or new studies may add insights on the condition of the assets. New data can be reflected in the asset registry and subsequently in the online dashboard as it becomes available. Furthermore, the level of desired detail may evolve as asset management readiness increases or as areas of natural asset management focus emerge.

That said, inventories should grow in detail and sophistication only insofar as they remain aligned with the capacity of the communities to maintain them and the uses to which they will be put. Their evolution and development should be a function of the monitoring, reporting and lessons of the asset management cycle and be driven by the imperative of ensuring sustainable, cost-effective delivery of services to the community, which is the core of asset management.

photo credit: DominikRH-via pexels

6.0 Analysis and Conclusions

The focus of this Project was the development of a natural asset inventory to identify priority natural assets, and some related ecosystem services that MFN wants to collaboratively care for, monitor and enhance. It resulted in an inventory that can support MFN in taking and/or advancing better land use and landscape management decisions within their traditional territories and ideally support the upholding of their ancestral and ongoing stewardship roles and the upholding of Indigenous rights.

MFN will need to determine how best to use the tool. The primary advantage to having the information collected into the inventory is that MFN now can create reports on specific areas that identify their priorities and can include recognition of traditional use where that information is available. It should also be noted that in areas where there are not traditional use studies currently does NOT mean that area was not used for traditional activities, it simply means that information has not yet been collected or is not being shared for that area.

6.1 Analysis

This project has been guided utilizing a Etuaptmumk/Two-Eyed Seeing approach – with the specific intention of finding ways to recognize that managing natural assets within an Indigenous context requires a systems approach. This is not just looking at one system, but at the interconnectedness of all systems, recognizing that changing, mitigating, or extracting a resource within any part of the system will have consequences in all other systems.

The process of working through this project has provided significant understanding of how an Etuaptmumk/Two-Eyed Seeing approach can support Indigenous concepts as it relates to the responsibility to care for the land for future generations. It has reinforced Robin Wall Kimmerer's (2013) idea of Reciprocity as a moral covenant; that we go beyond cultures of gratitude to becoming cultures of reciprocity, actively engaging in giving back and caring for the land.

This concept was clearly represented in the focus group meeting and the community meeting held in the MFN community. The focus group participants were very clear about how they saw value in the dashboard. One focus group member indicated that they were aware of areas where there used to be a favourite food for harvesting. They wondered if the dashboard could help understand what has happened in those areas and how to recreate the conditions that food harvest could be recreated. Another participant at the focus group wondered if it was possible to be able to have the dashboard on their phone, which would allow them to look at it while they were out and then compare what was on the maps to what they were seeing on the land, becoming citizen guardians.

The community presentation and feedback for the completion of Phase 1 provided significant feedback on how valuable the community sees this tool.

6.2 Learnings

Several things were learned in the Project, which are expanded on below.

1. MALAHAT FIRST NATION LEARNINGS

For MFN, the biggest takeaway from this project was learning how to use a Western framework—asset mapping—to build a communications tool for conveying Indigenous knowledge and priorities. Incorporating language and community values into the framework brought the tool closer to Malahat's snuwuyulh, while simultaneously incorporating a mechanistic analysis that can be easily understood by external parties.

The intersection of these knowledge systems highlighted shared and differing values between Western and Indigenous ways of knowing. Malahat's focus was largely on water and connectivity between systems – terrestrial and aquatic, freshwater and marine. The asset framework broke these larger systems down into smaller sections for analysis, which had to be brought back into the context of the larger landscape to represent the values Malahat wished to communicate.

Future work to incorporate cultural spaces will require continual changes to this method of analysis to accurately capture the holistic nature of these spaces.

2. REFINEMENT OF TWO-EYED SEEING CONCEPT AS IT RELATES TO NATURAL ASSET MANAGEMENT

Experience with Two-Eyed Seeing as it relates to NAM is still limited to a handful of projects across Canada and it thus too early to draw substantial conclusions. Nevertheless, the Project allowed NAI to refine the concept slightly to better understand where the overlap between TEK and Western Science lies. Specifically, a series of questions emerged to shape the common area between the two worldviews. These were discussed by all Project partners and could be useful to consider in the context of future projects.

- **Ethics:** What are our values – how do we work together from the heart?
- **Relationality:** What are the stories that we have heard and know from the land?
- **Practice:** How are we approaching the work, what can we observe and verify – what are our ways of knowing?
- **Knowledge:** How do we share what we know? How do we hear each other's stories?

This is illustrated in Figure 9.

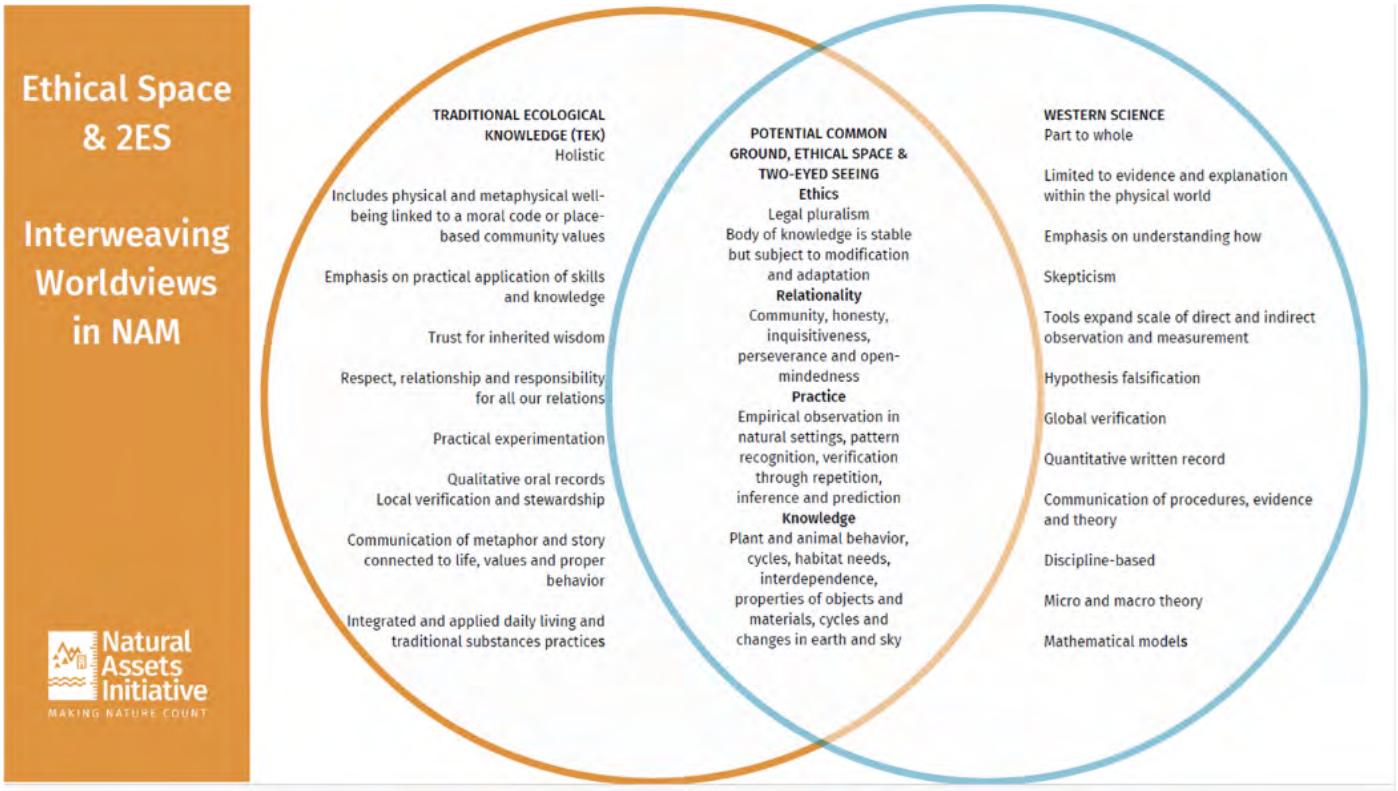

Figure 9: *Initial Concept Refinements of Two-Eyed Seeing and Natural Asset Management (NAI & Neale, 2024)*

3. REFERRALS

A learning from the Project as it related to referrals is that having NAM information integrated into a single dashboard will allow the MFN Guardians to plan where they will focus their ground-truthing efforts. It also allows for MFN to not rely solely on information provided by project proponents and government, and develop and used their own data and analyses thereof.

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7.0 Potential Next Steps

There are several potential next steps for MFN's work on NAM, including adding TEK, conducting a risk identification, and valuations, as follows.

7.1 Incorporating Traditional Ecological Knowledge (TEK)

MFN may wish to including sources beyond public data in their inventory, specifically TEK and/or sites of cultural significance based on engagement with Elders, Guardians, and the community. This would likely require: community consultations to determine an appropriate way to gather and represent traditional knowledge/sites of cultural significance; an understanding of how the community wants information about the site to be protected; and, an understanding of how condition assessments can be improved to include Indigenous metrics.

7.2 Risk Identification

Risk identification was not completed for the MFN natural asset inventory but may be completed in a future phase of work. Initial suggestions for an approach that incorporates MFN perspectives and worldviews into NAI's risk identification approach are provided here for consideration. They include:

- Community consultation
- Addition of a third dimension of risk
- Capturing stories that capture cascading impacts of risk on MFN
- Mitigation strategies

COMMUNITY CONSULTATION

Hosting community engagement events as a part of developing an Etuaptmumk/Two-Eyed Seeing approach to risk will provide a space to gather insights on hazards, build relationships, test novel approaches, and develop strategies for managing risk. Ethical Space engagement with community members may provide a space for gathering information on hazards facing MFN, and the opportunity to develop a risk assessment framework that reflects the concerns

and worldviews of Indigenous Peoples. An open space for the community to join should be identified and communicated with a brief explanation of the goals of the risk assessment, a timeline for project completion and ways to contribute.

ADDITION OF A THIRD DIMENSION OF RISK

Western risk assessment is driven by the consideration of the likelihood of a hazard and its consequences over a determined timespan to arrive at risk (where risk = likelihood x probability). A third dimension is proposed here for inclusion in future MFN efforts. The third dimension would assess human-based hazards, such as industrial development, and nature-based hazards, such as the natural process of flooding. This added dimension will inform mitigation strategies and assist in the identification of priority management strategies and who is best placed to lead efforts.

This additional concept recognizes that some risks that impact human use of the natural resources are actually positive for the land and can reduce other impacts—for example, regular small burns reduce the risk of large forest fires. Therefore, where fire might fit on a two-dimensional risk register would be different than where it might fit with this third dimension.

CAPTURING STORIES ON CASCADING IMPACTS

'Cascading impacts' refer to a chain reaction of consequences that stem from an initial impact that triggers a series of secondary or tertiary effects across interconnected socio-ecological systems. For example, a major storm event may damage a widely-used bridge, which can lead to traffic disruptions, inability to access emergency services, and damage to personal health and safety. Capturing stories of cascading impacts brings greater clarity to chain reactions that are felt in the community and can elicit stories from others.

Many of the risks to Malahat citizens stem from urbanization and development, forestry practices in upland areas, and the agriculturalization of Malahat's core territory. The hydrophobic effects of dry earth in clearcut areas and the fact that heavy rain runs off the landscape, bringing sediment into their critical waterways, diminishing sturgeon and salmon habitat, areas for wild ginger, wapato, etc. For these risk workshops, MFN should be bringing together the information from Knowledge Holders developed through Reciprocity's previous work, and develop a community-informed list of risks to refine as part of the session.

MITIGATION STRATEGIES

A risk assessment should include the identification of mitigation measures to reduce risk and effectively weave reciprocity into risk.

This should include the types of activities being undertaken, who is responsible, and when activities should be completed. For example, when and where restoration efforts should take place. A part of this process should identify opportunities for MFN to have credible authority (e.g., forest management practices).

Risk management is a four-stage process that includes: risk identification; analysis of probability and consequence; development of risk mitigation strategies; and, control and documentation. The use of the risk identification tool informs the first and second stages of risk management by identifying the top risks to natural assets and their associated services, plus a high-level analysis of impacts and consequences.

Risk types relevant to natural asset management typically include:

- **Service risk:** the risk of an asset failure that directly affects service delivery.
- **Strategic risk:** the risk of an event occurring that impacts the ability to achieve organizational goals.
- **Operations and maintenance risk:** risks related to poor asset controls and oversight, which can lead to poor record-keeping and poor monitoring of asset.
- **Financial risk:** risks related to the financial capacity of the community to maintain services.
- **Political risk:** risks related to the nature of community politics.

Identifying risks facing natural assets can help communities prioritize their management of natural assets. To this end, NAI provides communities with a tool entitled Risk Identification Process in the Development of Natural Asset Inventories and guidance in self-administering it.

7.3 Valuation

MFN may be satisfied with how they can apply the inventory results to support decision making. Alternatively, they may wish to consider the natural asset inventory as a basis to understand values of priority ecosystem services within a watershed. "Values" in this context could include monetary values that are of interest to MFN and non-monetary, non-market values.

There are diverse approaches to value ecosystem services once a natural asset inventory has been created. NAI works with communities to help them choose suitable options. Choosing which valuation method is most appropriate for each ecosystem service can require additional community data, consultation, engagement and funding. Valuations, natural asset plans, and a shared understanding of who is responsible for maintenance, monitoring, restoration and protection of ecosystem services can help advance watershed-scale relationships and lead to increased public and private sector investment to support the long-term care of these services in communities.

As a first step towards finding an Etuaptmumk/Two-Eyed Seeing approach to valuation of ecosystems, NAI, in cooperation with Green Analytics, are exploring ways to understand and represent an Indigenous perspective that states everything is valuable, that all things are part of the system and therefore must considered when determining changes to that system. There is a growing body of research on valuing natural systems, which is part of the underlying premise of natural asset inventories.

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Appendix A: Summary of Spatial Data Used

The following table summarizes the data inputs utilized in this inventory

Table 4: *List of Spatial Data Sources*

Dataset	Source
Vegetation Resource Inventory	Province of British Columbia
Freshwater Atlas	Province of British Columbia
Sentinel-2 Satellite	ESRI, Impact Observatory
Building Footprints	Microsoft, OSM
Watershed Planning Areas	CVRD
Wildfire Hazard	Province of British Columbia
Malahat First Nation Reserve Boundary	Province of British Columbia
Historical Fire	Province of British Columbia
Historical Pest	Province of British Columbia
Historical Cutblock	Province of British Columbia
Cumulative Effects Framework - Human Disturbance 2023	Province of British Columbia
TSL Parcels	TE'MEXW Treaty Association
Trails	CVRD
Rail	Province of British Columbia, Government of Canada
Roads	Province of British Columbia
Parks	CVRD
Woodlot Licenses	Province of British Columbia
Mining Claims and Notices	Province of British Columbia
Protected Areas	Province of British Columbia, Government of Canada
Aquifers	Province of British Columbia
Groundwater Wells	Province of British Columbia
MFN Reserve Zoning	Malahat First Nation
Arch Sites	Malahat First Nation

Appendix B: Cumulative Impacts Metrics

This appendix describes the cumulative impact metrics employed in the condition assessment for Malahat First Nation. For each indicator, the appendix describes the rationale, the approach, the scoring and the results.

Density of Watercourse Crossings

RATIONALE: The density of watercourse crossings (crossings per km²) within a watershed can be a useful measure of watershed condition as it provides insight into human impacts on the watershed's hydrology, ecology, and overall health. For instance, water crossings such as roads, bridges, and culverts, can disrupt the natural flow of water within a watershed. A higher density of crossings can indicate increased alteration of stream networks, potentially leading to changes in stream hydrology. This can affect the timing and magnitude of water flow, contributing to increased erosion, sedimentation, and flooding downstream. Healthy watersheds rely on the connectivity of their ecosystems and water crossings can fragment aquatic habitats by creating barriers that hinder the movement of aquatic organisms, such as fish and amphibians. Culverts and other crossings that are improperly designed or maintained may block species migration and reduce genetic diversity. Roads and crossings can contribute to sediment runoff and introduce pollutants into waterways, including oils, heavy metals, and road salts. By analyzing the density of water crossings, areas can be prioritized for restoration. For instance, areas with high crossing densities but significant ecological value may be targeted for rehabilitation projects, such as improving or replacing problematic culverts, reestablishing natural flow regimes, or restoring connectivity for aquatic species.

APPROACH: Density of watercourse crossings (crossings per km²) can be estimated by intersecting relevant linear features (e.g., roads and pipelines) housed in the geospatial database with the linear features representing the watercourses. Specifically, the following equation was used to measure the density of watercourse crossings. The thresholds and ranking results are detailed in tables 5 and 6.

Crossing Density = count of crossings / watershed areas (km²)

RANKING:

Table 5: *Impact Ranking Thresholds for Watercourse Crossings*

Impact Ranking	Threshold Criteria
Very Low	Crossing density = 0
Low	Crossing density < 0.24 crossings/km²
Moderate	Crossing density between 0.24 and 0.6 crossings/km²
High	Crossing density between 0.6 and 1 crossings/km²
Very High	Crossing density > 1 crossings/km²

RESULTS:

Table 6: *Results of Watercourse Crossing Density Impact Ranking*

Impact Ranking	Watershed Area (ha)	% of Watershed Area
Very Low	4,340	30%
Low	0	0%
Moderate	1,121	6%
High	1,430	8%
Very High	10,163	56%

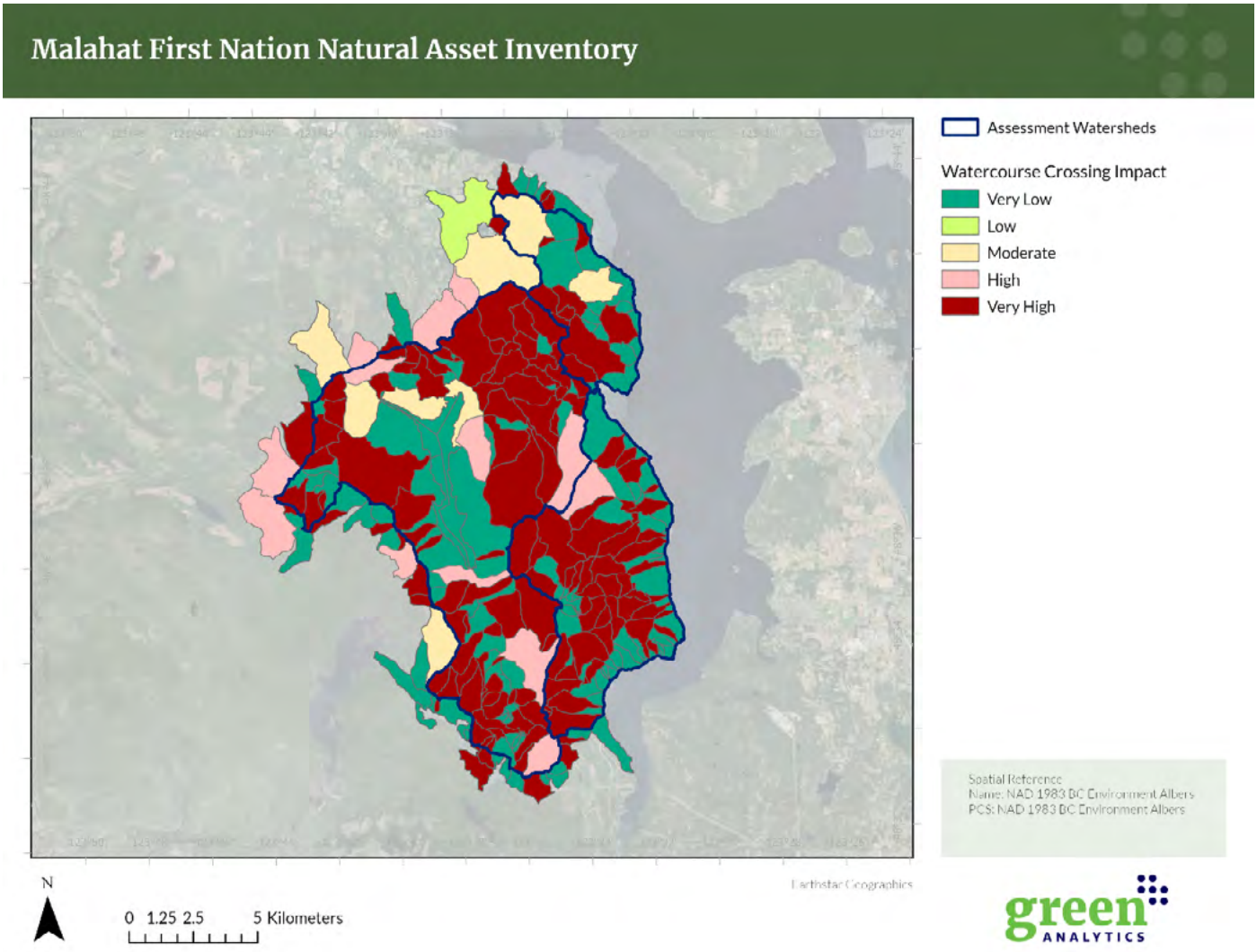

Figure 10: *Map Displaying Watercourse Crossing Impacts Across Malahat First Nation*

Road Density

RATIONALE: Road density is a useful metric for assessing watershed condition since roads have significant environmental impacts and provide an indication of human disturbance on a watershed. Roads, especially unpaved ones, increase soil erosion, which can degrade water quality, harm aquatic habitats, and fill in stream beds. Roads can alter the natural flow of water in a watershed changing drainage patterns, increasing runoff, and reducing groundwater recharge. High road density can fragment natural habitats, limit or modify wildlife movement behaviour and increase the likelihood of wildlife-vehicle collisions. Higher road density often correlates with more intensive land use, which can lead to further degradation of watershed health.

While road density and stream crossing densities are highly correlated. The BC cumulative effects framework uses both.

APPROACH: Road density by watershed management unit was calculated by summing the length of all roads within the watershed and dividing by the watershed areas. Thresholds and ranking results are detailed in tables 7 and 8.

Road density = km/km² of road within each watershed management unit

RANKING:

Table 7*: Impact Ranking Thresholds for Road Density*

Impact Ranking	Threshold Criteria
Very Low	Road density = 0
Low	Road density >0 – 0.3 km/km²
Moderate	Road density between 0.31 and 0.6 km/km²
High	Road density between 0.61 – 0.75 km/km²
Very High	Road density > 0.75 km/km²

RESULTS:

Table 8*: Results of Road Density Impact Ranking*

Impact Ranking	Watershed Area (ha)	% of Watershed Area
Very Low	592	3%
Low	439	2%
Moderate	392	2%
High	238	2%
Very High	16,392	91%

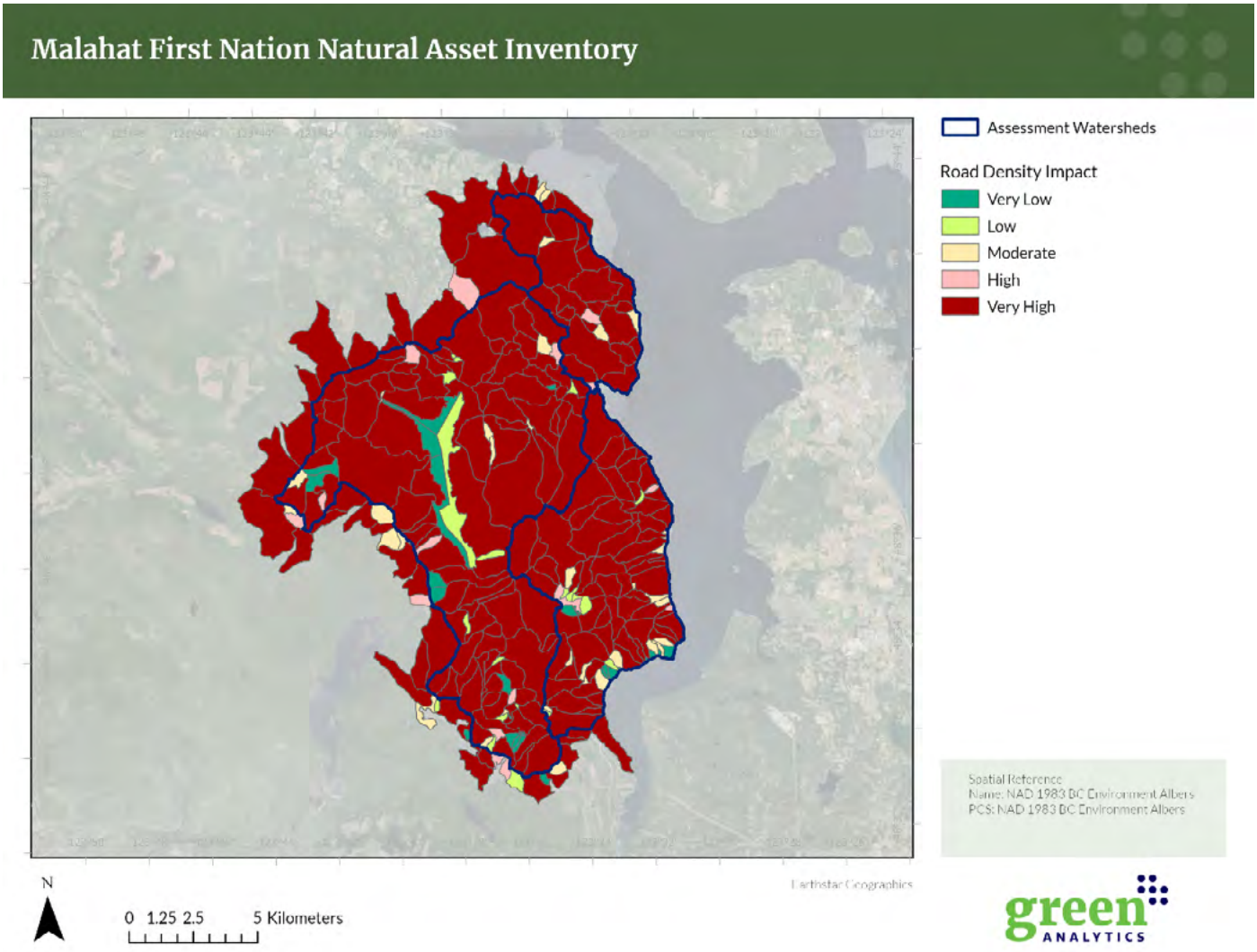

Figure 11: *Map Displaying Impacts from Roads Across Malahat First Nation*

Density of Linear Disturbance

RATIONALE: Linear disturbance is a general metric that can be used to determine the cumulative anthropogenic footprint on a landscape. Linear developments such as oil and gas pipelines, power lines, railway lines, roads, cutlines and trails create corridors that can influence wildlife species in different ways. For instance, by dividing natural habitats into smaller and isolated patches, linear disturbances might lead to habitat fragmentation, higher animal mortality from vehicle collisions, and impact predator-prey dynamics.

APPROACH: Linear disturbance density was calculated by dividing the total length of the linear disturbance (km) by the total watershed area (km²).

RANKING:

Table 9: *Impact Ranking Thresholds for Linear Disturbances*

Impact Ranking	Threshold Criteria
Very Low	All linear feature density < 0.6 km/km²
Low	All linear feature density between 0.6 to 1.2 km/km²
Moderate	All linear feature density between 1.2 to 3 km/km²
High	All linear feature density between 3 to 6 km/km²
Very High	All linear feature density > 6 km/km²

RESULTS:

Table 10: *Results of Linear Disturbance Impact Ranking*

Impact Ranking	Watershed Area (ha)	% of Watershed Area
Very Low	833	5%
Low	25	<1%
Moderate	1,563	9%
High	9,323	52%
Very High	6,310	35%

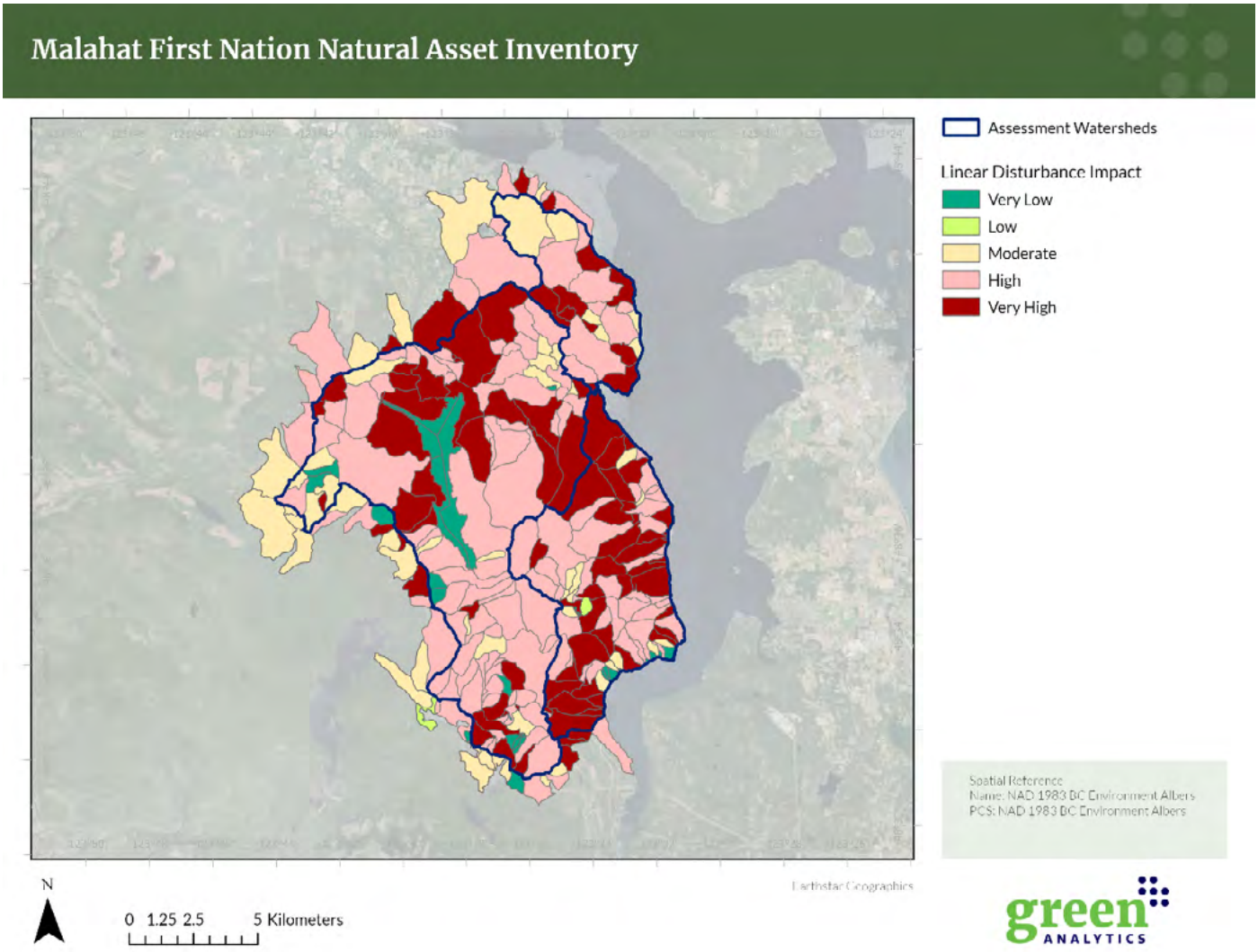

Figure 12: *Map Displaying Impacts from Linear Disturbances Across Malahat First Nation*

Equivalent Clearcut Area

RATIONALE: Watersheds are highly sensitive to disturbances such as clear-cutting, logging and pest outbreaks. Ecological and hydrological impacts can increase non-linearly with the amount of land disturbed. To assess the impact and the risk of forest disturbance, the concept of Equivalent Clearcut Area, or ECA, is a commonly used indicator. ECA is defined as the "area that has been clearcut, with a reduction factor to account for the hydrological recovery due to forest regeneration and subsequent growth" (BC Forest Practice Board, n.d). According to Zhang and Wei (2012), ECA measures can be used to represent the forest disturbance, factoring in hydrological recovery after different types of disturbance (such as wildlife, logging and Mountain Pine Beetle infestations), accumulated across both space and time within the watershed. By measuring disturbances across time and space, ECA provides a powerful indication of how cumulative land disturbances impact water, land, and overall ecological health. It also helps guide decision on the rate of harvesting and informs forest stewardship plans (Davidson et al. 2018).

APPROACH: ECA% was measured by first calculating the ECA, and then dividing the ECA by the area of disturbance. Davidson et al. (2018) used the ECA metric to assess BC aquatic ecosystem cumulative effects, and calculated ECA using the following equation:

ECA =Area * (1 – Hydrological Recovery Rate)

For example, an area of 100 ha that was disturbed 66 years ago would be assigned a 90% hydrological recovery. ECA in this case would be equal to 10 ha, calculated as 100*(1-0.9) = 10 ha. The following table, adapted from Davidson et al. (2018), provides an easy reference of hydrological recovery rate based on the year since disturbance. It indicates that, as more time passes after a forest disturbance, hydrological recovery improves reflecting greater forest regeneration and growth, and results in a lower ECA estimate.

Table 11*: Recovery Percentage for Equivalent Clearcut Areas Based on Time Since Disturbance*

Time since disturbance	ECA Hydrologic Recovery
24	0%
39	25%
48	50%
60	75%
66	90%

After the ECA was calculated, the ECA% was calculated by dividing the ECA values by the area of disturbance, to yield the ECA%.

RANKING:

Table 12: *Impact Threshold Rankings for Equivalent Clearcut Areas*

Impact Ranking	Threshold Criteria
Very Low	ECA% < 10%
Low	ECA% between 10 – 25%
Moderate	ECA% between 25 – 45%
High	ECA% between 45 – 65%
Very High	ECA% >65%

RESULTS:

Table 13: *Results of Impact Ranking for Equivalent Clearcut Areas*

Impact Ranking	Watershed Area (ha)	% of Watershed Area
Very Low	1,144	6%
Low	5,523	31%
Moderate	39	<1%
High	154	1%
Very High	11,194	62%

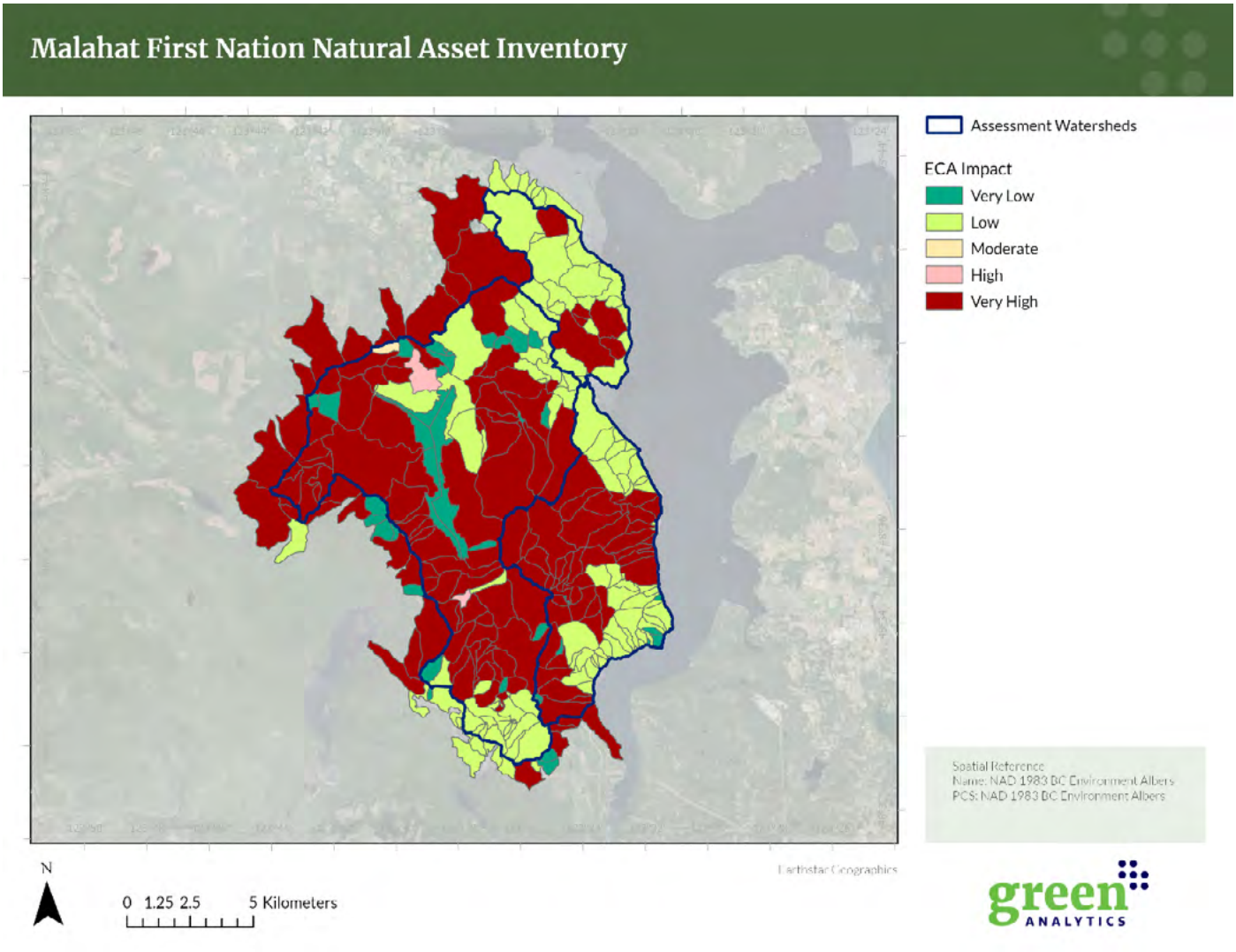

Figure 13*: Map Displaying Impacts from Equivalent Clearcut Areas Across Malahat First Nation*

Percent of Current Old Growth Forest Under Historic Disturbance Regimes

RATIONALE: Old growth forests support high levels of biodiversity. Their complex structures also create unique habitats for numerous species such as a wide range of birds, mammals, insects, fungi and understory plant communities. They also play a critical role in maintaining ecosystem resilience. Old growth forests are crucial to climate regulation, serving as a major carbon sink. They also support water regulation by stabilizing soils, slowing runoff and maintaining hydrological cycles. All those critical functions of old growth forest make it a common proxy for measuring ecological condition.

APPROACH: Price et al. (2021) provided a detailed framework for calculating the old growth forest percent for British Columbia. It can be measured by first determining current old growth forest area based on what qualifies as old forest, which varies by the biogeoclimatic zones: 250 years for wet zones (e.g., Coastal Douglas-Fir), 120 years for drier zones (e.g., Montane Spruce), and 120 years for the Boreal White and Black Spruce (BWBS) zone2. The area of expected old growth is then estimated using provincial government disturbance return intervals based on a negative exponential disturbance model. Finally, the current old growth in each biogeoclimatic zone is compared to the expected values under historic disturbance regimes to assess ecological risk. This approach was applied to the Malahat First Nation's natural asset inventory.

RANKING:

Table 14*: Impact Ranking Thresholds for Old Growth Forests Based on Historic Disturbances*

Impact Ranking	Threshold Criteria
Very Low	>70% of historic disturbance
Low	58% - 70% of historic disturbance
Moderate	44% - 57% of historic disturbance
High	31% - 43% of historic disturbance
Very High	<30% of historic disturbance

RESULTS:

Table 15*: Old Growth Forest Impact Ranking Results*

Impact Ranking	Watershed Area (ha)	% of Watershed Area
Very Low	0	0%
Low	0	0%
Moderate	0	0%
High	0	0%
Very High	18,053	100%

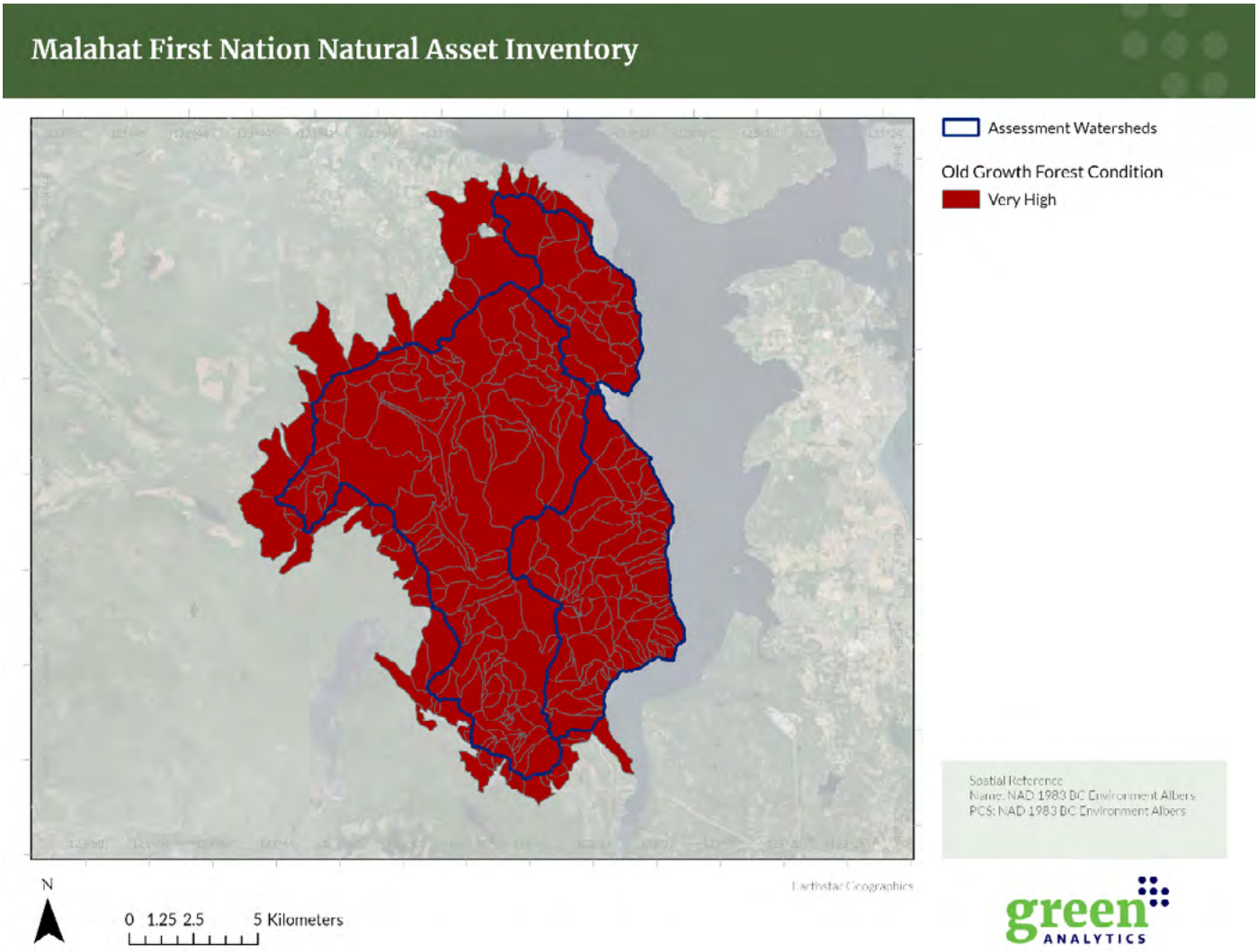

Figure 14*: Map Displaying Condition of Old Growth Forests Across Malahat First Nation*

Percent of a Fundamental Watershed that is Considered 'Intact'

RATIONALE: This indicator draws on provincial disturbance data which captures all known human disturbances on the land base. The data captures a range of disturbances such as cut blocks within the last 20 years, geophysical seismic lines, anything the province indicates is human or built-up areas, transmission lines, pipelines, oil and gas wells, well site, road and rail infrastructure.

For this indicator, the intention is to include a measure that aligns with the precedent set by the June 2021 Supreme Court of British Columbia ruling that the Province of BC had unjustifiably infringed on the Treaty Rights of the Blueberry First Nation. That decision was influenced by the fact that as of 2018, 85% of Blueberry's territory was within 250m of industrial disturbance and that 91% was within 500m of a disturbance. The Court concluded the province had taken up lands so extensively that the Blueberry First Nation could not meaningfully exercise their treaty rights (Hamilton & Ettinger, 2023).

APPROACH: The 2023 Human Disturbance layer of the BC Cumulative Effects Framework was utilized to determine areas of human disturbance. All human disturbances were buffered by distances of 500m. Discrimination between types of disturbances was not undertaken for this exercise because the primary focus of this exercise was to identify intact lands. The area of fundamental watersheds was then compared with the areas of the various disturbance buffers. To determine the area of intact land, the area disturbed was subtracted from the total area of the fundamental watershed within the buffer distance, which was then converted into a percentage value to determine the condition rating threshold of each fundamental watershed.

RANKING: There are no clearly articulated thresholds that could be relied upon to support a ranking approach for this indicator. However, given the similarity of this to percent of area within 500m of industrial disturbance, the inverse of the same threshold boundaries was used. Furthermore, comparing the scoring thresholds to the Blueberry Nation thresholds noted above, it seemed reasonable to assume area that is less than 35% intact would significantly limit a Nation's ability to exercise their traditional land uses. Thus, the ranking thresholds identified below were employed for the Malahat First Nation for this metric.

RANKING:

Table 16: *Impact Ranking Thresholds for Percentage of Watersheds Considerd 'Intact'*

Impact Ranking	Threshold Criteria
Very Low	>75% intact
Low	>45-75% intact
Moderate	>35-45% intact
High	>10-35% intact
Very High	≤10% intact

RESULTS:

Table 17: *Impact Results for Percentage of Watersheds Considered 'Intact'*

Impact Ranking	Watershed Area (ha)	% of Watershed Area
Very Low	1,269	7%
Low	3,487	19%
Moderate	1,787	10%
High	4,075	23%
Very High	7,436	41%

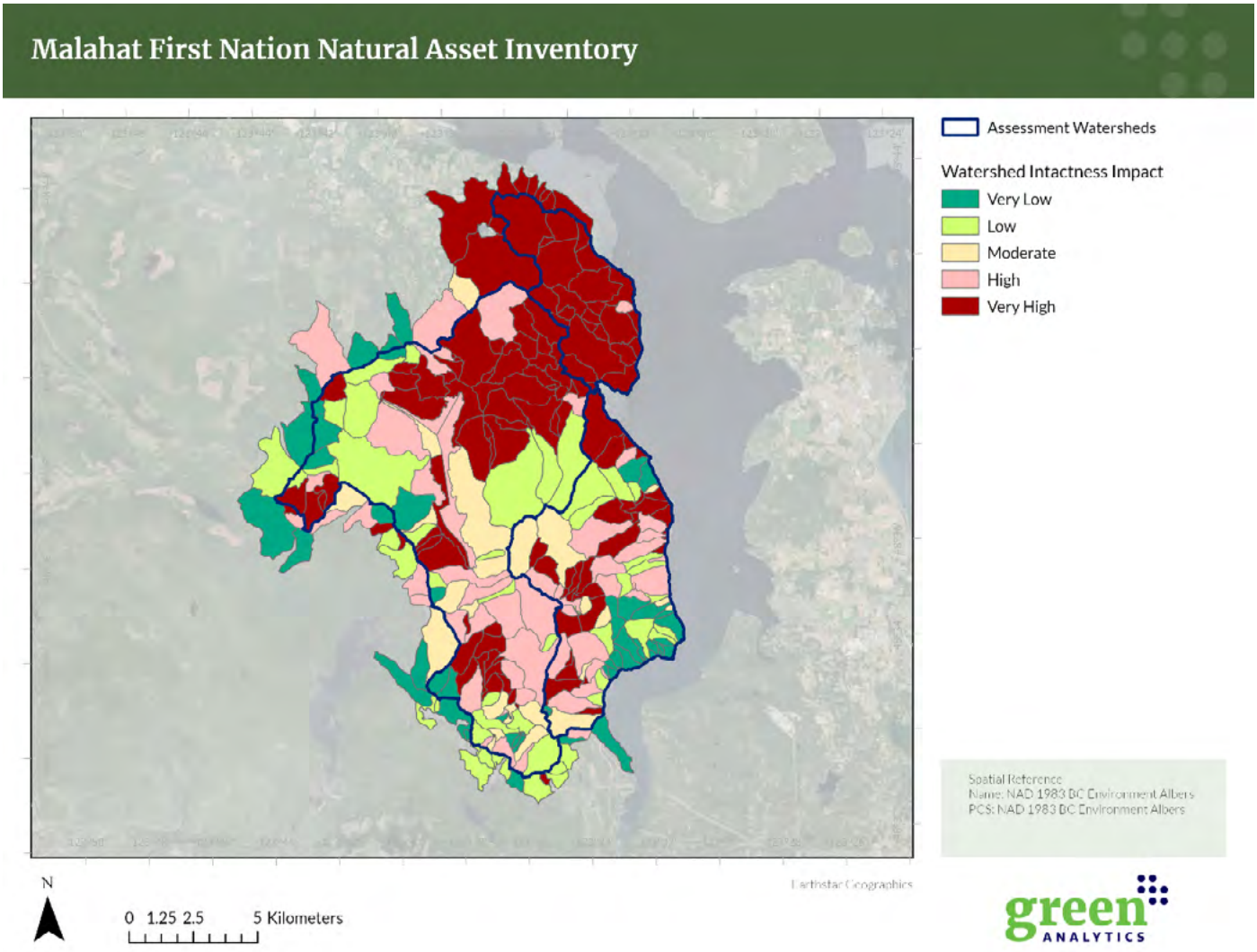

Figure 15*: Map of Watershed Intactness Impact Across Malahat First Nation*

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