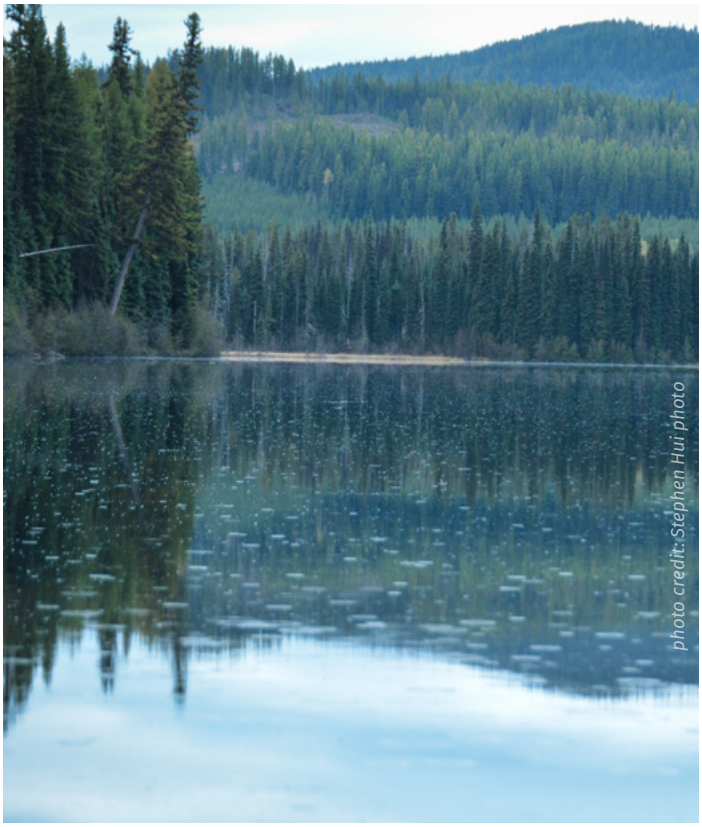
photo credit: Stephen Hui photo

Cranbrook
Golden
Central Kootenay
East Kootenay
Kootenay Boundary
Rossland


photo credit: JohnCE


photo credit: Rod Lafond

Toward natural asset management in Kootenays

British Columbia

Summary of inventory results and recommendations
March 2021

This document features interactive elements! Clicking on a heading or sub-heading in the Table of Contents (ToC) will take you directly to that page. Also, clicking on page numbers in the footer will bring you back to the ToC.


photo credit: Ymblanter

Municipal Natural Assets Initiative

MNAI.CA
Making Nature Count

Invest in Nature

The Municipal Natural Assets Initiative (MNAI) is a Canadian not-for-profit that is changing the way municipalities deliver everyday services - increasing the quality and resilience of infrastructure at lower costs and reduced risk. The MNAI team provides scientific, economic and municipal expertise to support and guide local governments 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.

Please cite as:

Municipal Natural Assets Initiative. (2021). Toward Natural Asset Management in Kootenays British Columbia: Summary of inventory results and recommendations. Victoria, British Columbia, Canada MNAI.ca

Table of Contents

1 Purpose

This report summarizes the results of a project to develop natural asset inventories with six local governments in the Kootenays region of southeastern British Columbia, and documents steps those local governments can take to proceed to implementing full natural asset management initiatives.

2 Introduction

What are municipal natural assets

The term *municipal natural assets* refers to the stock of natural resources or ecosystems that a municipality, regional district, or other form of local government could rely upon or manage for the sustainable provision of one or more local government services[1].

Why manage natural assets

A growing number of local governments recognize that it is as important to understand, measure, manage and account for natural assets as it is for engineered ones. Doing so can enable local governments to provide *core* services such as stormwater management, water filtration, and protection from flooding and erosion, as well as *additional* services such as those related to recreation, biodiversity, health and culture. Outcomes of what is becoming known as *municipal natural asset management* can include cost-effective and reliable delivery of services, support for climate change adaptation and mitigation, and enhanced biodiversity.

How to manage natural assets

There are numerous ways for local governments to manage natural assets. The Municipal Natural Assets Initiative (MNAI) uses methodologies and tools rooted in standard asset management, and provides a range of advisory services to help local governments implement them. MNAI has developed the methods and tools with investments, piloting, refinement, peer review, and documentation of lessons in multiple Canadian provinces. MNAI's mission is to make natural asset management a mainstream practice across Canada, and in support of this, for local governments to accept and use the methodologies and tools in standard ways across the country.

1 *https://mnai.ca/media/2018/02/finaldesignedsept18mnai.pdf*

What is a natural asset inventory

Inventories provide details on the type of natural assets a local government relies upon[2], their condition, and the risks they face. As depicted in Figure 1, a natural asset inventory is the first component of the Assessment phase. The Assessment phase, in turn, is the first of three phases of a full natural asset management project. By itself, an inventory will not give a sense of the value of services from natural assets or how to manage them; however, it is an essential first step in the full natural asset management project.

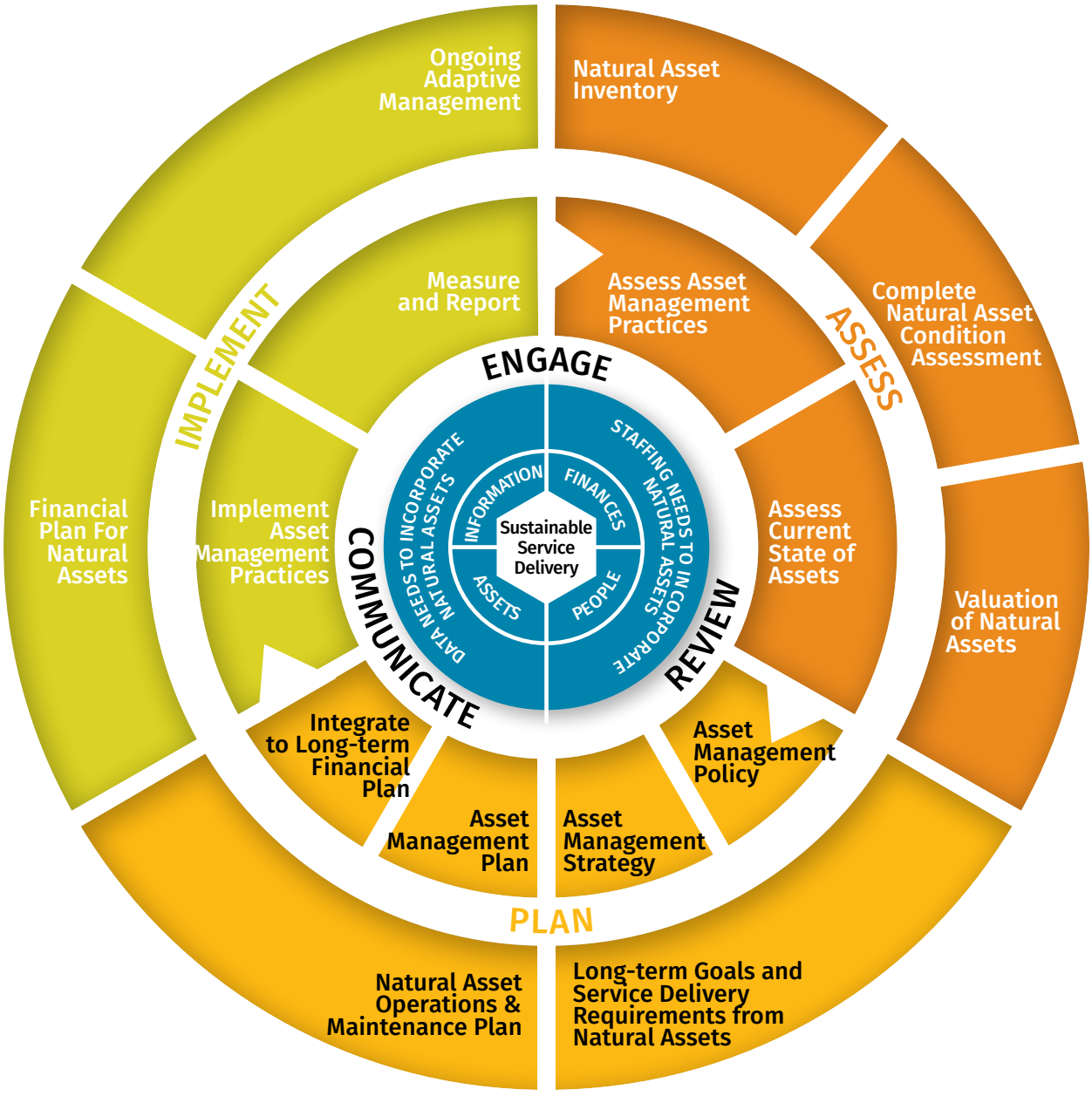

***Figure 1**: The Asset Management Process. MNAI has adapted this for use with natural assets. Source: Adopted from Asset Management BC, 2014.*

2 Note that many local governments rely on services from natural assets they do not own.

3 Local government context: Kootenay region

General

Several local governments in the Kootenays region of British Columbia are beginning to undertake municipal natural asset management. For example, the District of Sparwood (East Kootenay) and the City of Grand Forks (Kootenay Boundary) have both completed full Municipal Natural Assets Initiative projects[3].

Most recently, the Regional District of Central Kootenay (RDCK), Regional District of East Kootenay (RDEK), Regional District of Kootenay Boundary (RDKB), City of Cranbrook, Town of Golden, and City of Rossland (together called the "project communities") decided to work with MNAI to develop a preliminary natural asset inventory. The results of this effort are the subject of this project report.

The impetus for the project communities to develop natural asset inventories was their engagement in a State of Climate Adaptation and Resilience in the Basin (SoCARB) indicator suite project. In collaboration with the Federation of Canadian Municipalities (FCM) and Selkirk College, SoCARB indicators were designed to provide data and insights relating to climate change, including local environmental and community impacts, and community impacts as well as information to help build adaptive capacity and track local actions[4].

The SoCARB project prompted interest on the part of Selkirk College and the project communities to explore the role of natural assets within climate change adaptation. This led to MNAI hosting a webinar in May 2020 to introduce natural asset management to the project communities, and Selkirk College requesting MNAI to support them in developing a *preliminary natural assets inventory*.

The term "preliminary" in this context denotes that (a) within the available budget it was not possible to undertake detailed condition assessments and full risk identifications; and (b) geographic scoping was required in each community given that the Kootenays region covers an area of ~86,000 km^2.

The SoCARB reports provide extensive community background. For example, the report notes that with respect to climate change:

- The climate in the Kootenays is demonstrably changing, with data showing trends toward higher average annual and seasonal temperatures.
- Total annual precipitation is increasing.

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3 See: MNAI.ca

4 Excerpted from State of Climate Adaptation Regional District of Central Kootenay Area H March 2020

- The number of days annually when the temperature exceeds the 90th percentile for the baseline period (1961-1990) is increasing.
- There are more days with heavy rainfall.

The SoCARB report also notes:

- Glacier extent in the Canadian Columbia Basin declined by 15 per cent from 1985 to 2005 and glaciers are projected to mostly disappear by 2100.
- The amount of spring snowpack is declining.

While this report provides insights into the inventories, it is important to note that MNAI provided each community with their own versions of the actual inventory, in both tabular and dashboard formats.

TITLE, OWNERSHIP AND JURISDICTION

Most local governments rely on services from at least some natural assets they do not own or have jurisdiction over.

Therefore, it is vital to include with the scope of natural asset management the natural assets they rely on, not just the ones they own.

A range of collaborative options may be available to manage natural assets that are not owned by local government.

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. The level of desired detail may also evolve as asset management readiness increases, or as areas of natural management focus emerge. However, 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 at the core of asset management.

4 Structure of community sections

The project communities worked with MNAI as one group; however, this report is divided into six “mini-reports” with data specific to each of the six communities.

Each of the six mini-reports is organized in a consistent manner with the following five sections:

1/ Information on **local government readiness for asset management**. MNAI helps local governments determine their overall state of asset management maturity and helps them build asset management capacity across departments. To do this, it has adapted the Federation of Canadian Municipalities (FCM)’s asset management readiness

Figure 2: Five asset management maturity levels correspond to each competence area. Source: FCM

assessment tool[5] for use with natural assets. MNAI's adapted tool helps local governments measure progress on asset management in four competency areas (policy and governance, people and leadership, data and information, and planning and decision making), with each area describing outcomes based on five levels of progress or maturity. The completed natural asset readiness assessment will, in turn, help the local government increase its effectiveness in managing all assets, including natural ones.

2/ Details of the process of inventory development.

3/ Inventory results, including

- Data used
- Registry results
- Dashboard results
- Condition assessment results

4/ A summary of a risk identification self-administered by the local government, using a tool provided by MNAI. 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 risk identification tool informs the first and second stages of risk management by identifying the top risks to natural assets and their associated services, and 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 local government to maintain municipal services.
- **Political risk:** risks related to the nature of municipal politics.

5/ Implications of the inventory for the community including potential priorities, actions and steps towards a full natural asset management project.

5 *See https://fcm.ca/sites/default/files/documents/resources/tool/asset-management-readiness-scale-mamp.pdf for details*

Making Nature Count

City of Cranbrook
Mini-Report

The City of Cranbrook (pop. ~20,000) is located on the west side of the Kootenay River at its confluence with the St. Mary's River. It is the largest urban centre in the region known as the East Kootenays.

Source: *Wikipedia*

City of Cranbrook Mini-Report

The City of Cranbrook's asset management readiness assessment indicates it has already made progress in adopting asset management. For example, it has an asset management policy in place that guides actions for managing some engineered assets. It does not yet have an asset management strategy or roadmap to provide direction for the next 1-3 years. The Public Works department leads asset management and Cranbrook has an asset management champion. While Cranbrook did have a cross-functional asset management team in place previously, this team is not currently operational.

Cranbrook has baseline asset data captured in a GIS system for sewer, water, roads, fleet, parks and buildings. Additional work is needed to fully inventory critical assets for water source and supply, sewer treatment, and parks and recreation. It has compiled some baseline data for natural assets such as groundwater aquifers, watershed and creeks.

In terms of performance data, Cranbrook has information on asset condition and performance for sewer, water, roads and fleet, compiled into asset management plans. Cranbrook uses Cityworks to track its operations and maintenance data to record repair history, service failures, and loss of services for basic water distribution, sewer collection, roads, and some facilities. Baseline levels of service for assets excluding facilities have been established. Cranbrook also has performance data for the watershed and creeks, specifically flow monitoring stations, stormwater management and modelling of Joseph Creek.

Cranbrook's capital budget includes short-term replacements and upgrades and a new financial reserves policy to better relate reserves to short- and long-term asset management needs. It does not yet have financial data that puts a value on services from natural assets.

In terms of the planning and decision-making competency, Cranbrook is at an early stage. Asset management planning isn't standardized through the organization and is done mostly independently at department levels with varying approaches and levels of sophistication. That said, the Finance department does apply high-level common evaluation criteria for new projects and programs through the budget cycle. Cranbrook completed an Asset Management Investment Plan in 2012 which was a base inventory and cost estimate for all linear infrastructure, fleet, buildings, and other assets in groups. Cranbrook updated its linear infrastructure plans through the 2015 Integrated Infrastructure Capital Plans that include more detailed data based on actual

records and some condition assessments. Cranbrook is currently finalizing a water master plan which will include long-term asset management planning for its water distribution system. Cranbrook also has a fleet replacement plan. There are no asset management plans for natural assets yet.

Natural asset inventory

Inventory overview

MNAI gathered data for an area scoped to the Cranbrook municipal boundary to keep the project manageable, although Cranbrook may rely on services from natural assets beyond this boundary. The inventory has two main components: a tabular asset registry, and an online dashboard. MNAI provided the registry as Excel data, and the dashboard in a website format. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

Inventory data

MNAI used the most recently available annual crop inventory data produced by Agriculture and Agri-Food Canada (AAFC) as baseline for land use / land cover[1] and combined this with data Cranbrook provided to depict the natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment.

TABLE 1: SUMMARY OF DATA SOURCES - CRANBROOK

Item	Use	Source
City boundary	To establish the study area boundary.	Cranbrook provided.
AAFC Annual Crop Inventory	To establish a baseline land cover / land use.	Annual Crop Inventory - Open Government Portal (*canada.ca*)
Floodplain	Used to allocate natural assets to known areas of flood risk.	Cranbrook provided.
Zoning	Used to define what zoning has been allocated to the natural assets.	Cranbrook provided.
OCP Schedule B	Used to define the land use and standardized OCP type associated with each natural asset.	Cranbrook provided.
Park (name and type)	To define what assets are located within Cranbrook parks.	Cranbrook provided.

1 *[1] For more information on AAFC annual crop inventory, see: Annual Crop Inventory - Open Government Portal (canada.ca)*

TABLE 1: SUMMARY OF DATA SOURCES - CRANBROOK		
Global Man-made Impervious Surface Dataset	Informed the condition assessment.	NASA *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*.
GeoBC Atlas Integrated Transportation Network (dgtl_road_atlas.gdb)	Used to esablish road density condition variable.	BC Data Catalogue *https://catalogue.data.gov.bc.ca*
LIDAR Data	LIDAR data was processed to determine individual tree locations, tree height and canopy cover. These variables were merged into the asset inventory as (i) tree count – number of trees within the asset, (ii) average tree height – average height of all trees located within the asset, and (iii) total canopy cover area within the asset.	Cranbrook provided.

The inventory defined a total of 2,234 individual assets covering 1,063 hectares (ha) of the municipal area, as noted in Table 2. The majority of the natural asset area is forest cover, followed by grasslands.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE - CRANBROOK			
Natural Asset Type	**Number of Assets**	**Total Area (ha)**	**Average Asset Area (ha)**
Forest	1,029	776	0.75
Grassland	262	126	0.48
Riparian	6	44	7.41
Shrubland	725	81	0.11
Wetland	212	36	0.17
Total	**2,234**	**1,063**	**0.48**

Asset registry

MNAI gathered the data, sorted and analyzed it for relevance, and then delineated the type, location and extent of natural assets within the scoped project area. Each asset was then assigned a unique identification number to allow individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. The information pertaining to each asset was then placed into a tabular asset registry. An excerpt from the registry showing natural asset characteristics is in Table 3.

TABLE 3: NATURAL ASSET REGISTRY

AssetID	Asset Type	Asset Area (ha)	Land Use Designation	Flood Zone Area	Tree Count	Canopy (ha)	Average Tree Height	Adjacent Land Use	Road Density	Relative Size	Permeability	Total Score	Condition Rating
303232	Wetland	0.03		Outside flood zones	0			3	1	1	10	15	3 - Poor
671754	Shrubland	0.02	Institutional	Greatest of following elevations: 899m, GSC, or 0.6m above center line elevation of fronting street, or 0.6m above ground	10	0.03	13.57	4	10	1	5	20	3 - Poor
1064944	Shrubland	0.18	Other	Outside flood zones	0			10	10	10	5	35	1 - Good
1198091	Grassland	0.18	Institutional	Outside flood zones	1	0.01	21.84	6	10	1	10	27	2 - Fair
2641552	Forest	1.71	Single-Family Residential	Outside flood zones	356	1.48	17.18	5	5	1	10	21	2 - Fair
2870395	Forest	0.03	Institutional	Outside flood zones	3	0.02	19.82	3	1	1	10	15	3 - Poor
3300205	Forest	0.18	Other	Outside flood zones	0			5	10	1	10	26	2 - Fair
3379021	Shrubland	0.02		Outside flood zones	0			10	10	1	5	26	2 - Fair
3616878	Forest	0.04		Outside flood zones	0			8	10	1	10	29	2 - Fair
3762637	Forest	0.09	Single-Family Residential	Outside flood zones	37	0.10	14.08	4	5	1	10	20	3 - Poor
3998374	Wetland	0.04	Institutional	Outside flood zones	0			5	1	1	10	17	3 - Poor
4032292	Forest	0.13	Commercial	Outside flood zones	15	0.05	15.33	7	10	1	10	28	2 - Fair
4618258	Shrubland	0.09	Single-Family Residential	Outside flood zones	13	0.02	9.26	8	10	1	5	24	2 - Fair
4934007	Shrubland	0.18	Single-Family Residential	Outside flood zones	35	0.07	12.18	10	10	10	5	35	1 - Good
4958520	Grassland	0.09	Other	Outside flood zones	17	0.01	6.76	8	10	1	10	29	2 - Fair
5608688	Shrubland	0.09	Industrial	Outside flood zones	14	0.04	14.40	4	1	1	5	11	3 - Poor
5831679	Wetland	0.26	Single-Family Residential	Outside flood zones	29	0.06	10.74	7	10	1	10	28	2 - Fair
5988477	Grassland	0.09	Other	Outside flood zones	0			9	10	1	10	30	2 - Fair
6569378	Shrubland	0.18	Other	Outside flood zones	0			10	10	10	5	35	1 - Good
6855938	Wetland	0.02	Single-Family Residential	Outside flood zones	0			8	10	1	10	29	2 - Fair
6950719	Shrubland	0.09	Single-Family Residential	Outside flood zones	3	0.00	6.61	6	1	1	5	13	3 - Poor
6997890	Forest	0.35	Other	Outside flood zones	29	0.17	19.29	4	5	1	10	20	3 - Poor
7632528	Shrubland	0.36	Other	Outside flood zones	0			8	10	10	5	33	1 - Good
9625054	Shrubland	0.01	Single-Family Residential	Outside flood zones	3	0.02	21.76	4	1	1	5	11	3 - Poor
9946344	Shrubland	0.06	Other	Outside flood zones	0			10	10	1	5	26	2 - Fair

Online dashboard

Inventories may provide more insights when characterised visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by watershed area, or, if users want to dive into the specifics of forest assets, they can filter data to focus on that particular asset. Figure 3 and Figure 4 are screen shots from the dashboard that MNAI provided to Cranbrook. The full version can be accessed at *https://go.greenanalytics.ca/cranbrook*.

FIGURE 3: SCREENSHOT OF MAIN INVENTORY SUMMARY

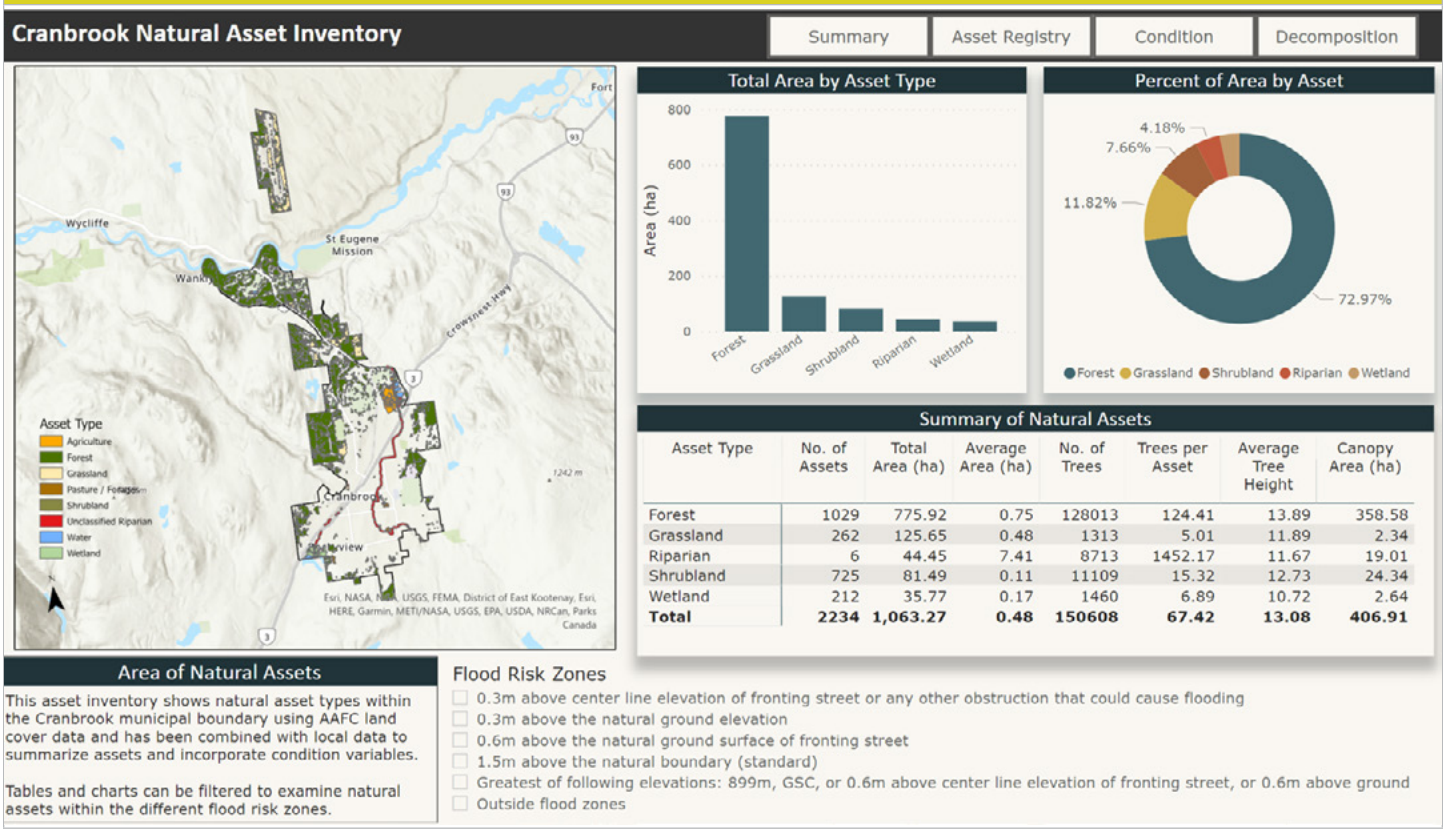


Figure 3: Screenshot of main inventory summary

Condition of natural assets

Condition assessments are a key aspect of natural asset inventories and provide an understanding of both the ecological health of natural assets and their ability to provide services. This information can be reflected in the registry and the dashboard, updated over time, and helps local governments with management decisions.

Condition assessments vary in complexity. MNAI completed a desktop-based condition assessment for Cranbrook and built it into the inventory to provide an initial understanding of the status of the natural assets for the municipality. The condition assessment steps and indicators are summarized in Table 4.

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - CRANBROOK

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Relative asset size	For each natural and semi-natural asset type, total area is calculated and a rank is assigned to the assets within each class based on its percentile score. Natural assets within the top third of the ranking (e.g., the largest assets within a class) received a high (10), those within the middle third of the ranking received a medium (5), and those within the bottom third of the ranking received a low (1).	Natural asset inventory
Surface permeability	The permeability of surfaces is ranked on a scale of low to high depending on the type of landcover present. ■ Assets within impervious surfaces are assigned as low permeability. ■ Agriculture and shrublands are ranked as medium. ■ Wetlands, waterbodies and forests are ranked as high.	Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made impervious surfaces dataset from NASA. *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
Road density	Road density was determined by first establishing a 1 km² hexagonal tessellation of the study areas. Road density was then calculated for each 1 km² hexagon. Natural assets within each hexagon were allocated the corresponding road density and given a condition rating of low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.	Natural asset inventory GeoBC Atlas Integrated Transportation Network

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - CRANBROOK		
Adjacent land use intensity	A 100m buffer is applied to each natural asset to determine what land uses surround each asset. Land use within the 100m buffer is allocated a land use intensity rating on a scale of 0 to 100 where 100 is considered the most intense land uses and 0 is natural land cover. Intensity ratings are as follows: ■ Developed = 72.5 ■ Barren (e.g. construction or mining areas) = 60 ■ Agriculture = 40 ■ Natural areas = 0 Each natural asset is assigned an adjacent land use intensity score out of 100 based on an area weighted average of the surrounding land use intensities. Adjacent land use intensity scores out of 100 are converted to a scale out of 10 by dividing the weighted average score by 10 and rounding to the nearest integer. The condition score is then calculated as 10 minus the adjusted intensity score, so that larger numbers indicated better asset condition, in line with the other indicators.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses.

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- Road density conditions are rated low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.
- Surface permeability rated as high (10), medium (5), or low (1).
- Adjacent intensive land use (scale from 0 to 10 where 10 indicates the asset is surrounded by natural areas and 0 indicates the asset is surrounded by heavily developed area).
- Relative asset size where the largest 3rd areas receive 10, 5 for middle 3rd, and 1 point for the lowest 3rd.

The total condition score was then converted into a rating scale:

- Good - assets with a score of 30 or higher
- Fair - assets with a score between 20 to 29
- Poor - assets with a score between 10 to 19
- Very Poor - assets with a score lower than 10

Figure 4 is a screenshot of the condition assessment results for Cranbrook as presented in the inventory dashboard.

FIGURE 4: SNAPSHOT OF CONDITION ASSESSMENT DETAILS

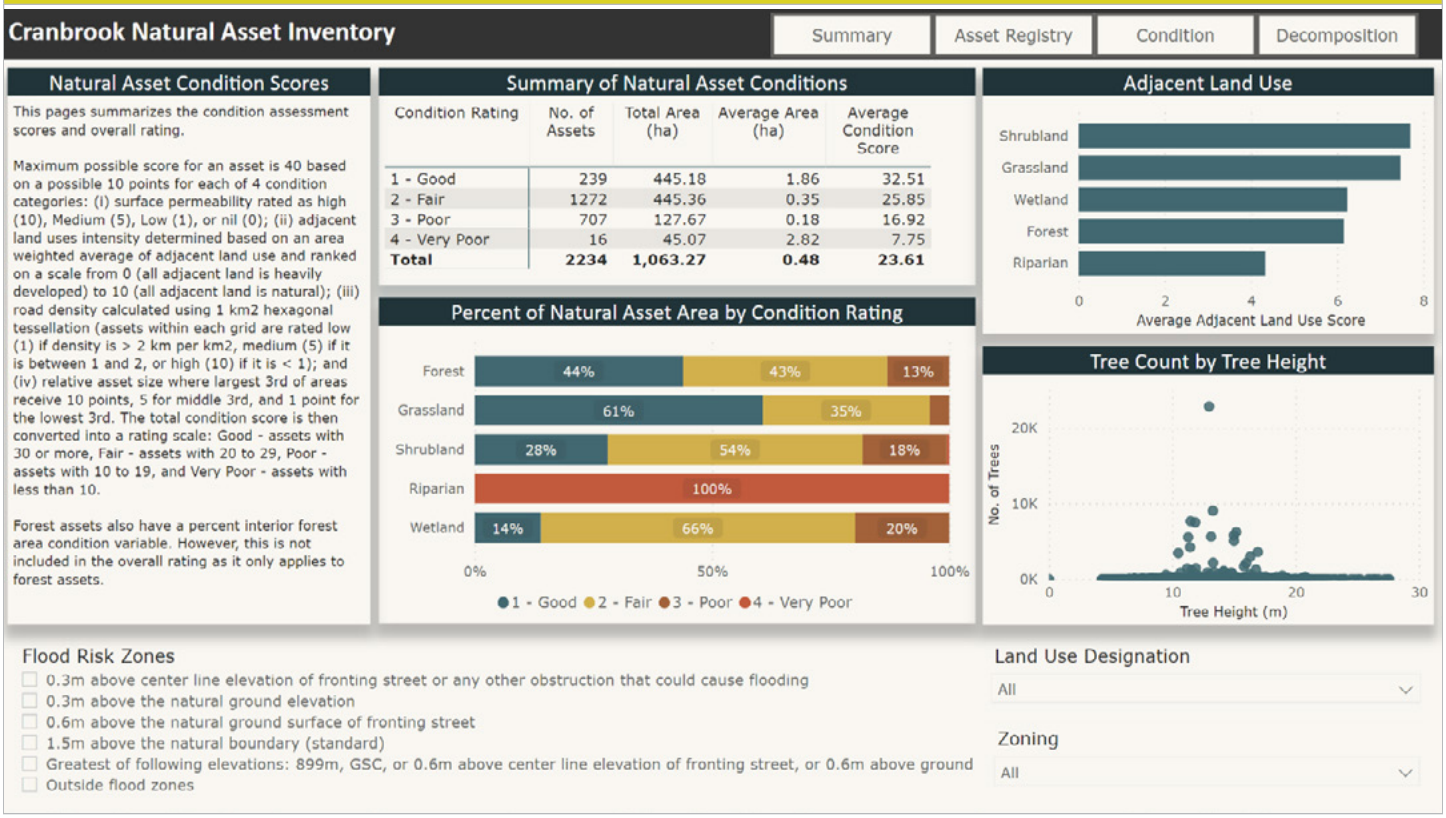


Figure 4: Snapshot of condition assessment details

About 445 ha (or 42 per cent) of Cranbrook's natural assets were assessed in good condition and another 445 ha (or 42 per cent) were assessed in fair condition.

Riparian assets were largely rated very poor due to these assets being relatively small with high road density and in close proximity to intense land uses. Note, however, that these assets only account for a small portion of the overall natural asset area (about 4 per cent).

Forest assets are generally in good or fair condition. The forest assets in poor condition are due to being relatively smaller, with higher road density and in close proximity to intense land uses.

Within the project area, the wetland assets generally rated good or fair.

Table 5 summarizes condition ratings and Figure 5 summarizes condition by natural asset type.

TABLE 5. SUMMARY OF NATURAL ASSET CONDITION RATINGS - CRANBROOK

Condition Rating	Number of Assets	Total Area (ha)	Average Area (ha)	Average Condition Score
1. Good	239	445	1.86	33
2. Fair	1,272	445	0.35	25
3. Poor	707	128	0.18	17
4. Very Poor	16	45	2.82	8
Total	**2,234**	**1,063**	**0.48**	**23**

FIGURE 5. SUMMARY OF CONDITION RATING BY NATURAL ASSET TYPE

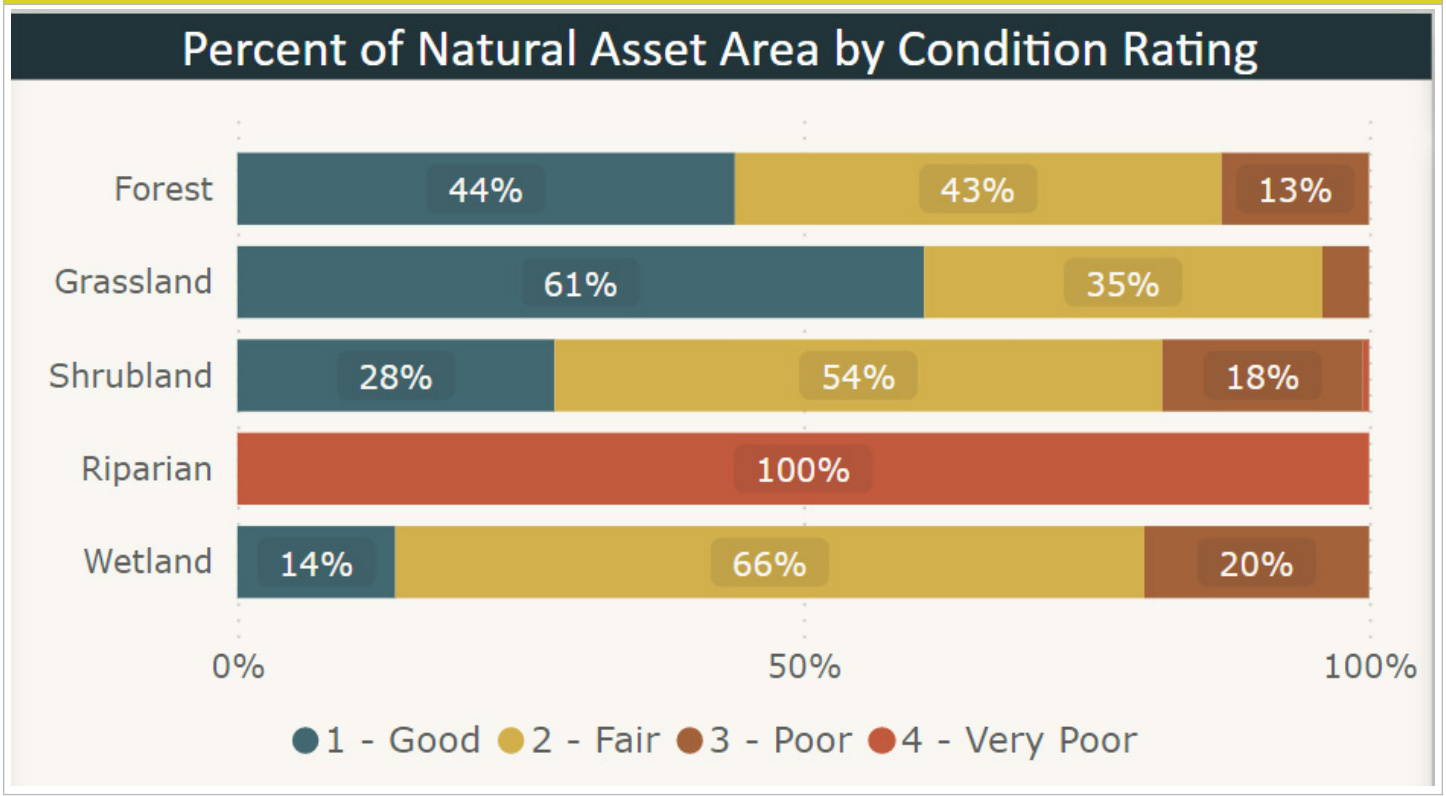


Figure 5. Summary of condition rating by natural asset type

Risk identification

Risk identification tool overview

Identifying risks facing natural assets can help local governments prioritize their management of natural assets. To this end, MNAI provides local governments with a tool entitled *Risk Identification Process in the Development of Natural Asset Inventories* and guidance to assist them in self-administering it. The results follow. Local government responses are in Annex 1.

Using the risk identification tool

Using the risk tool, Cranbrook considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including:

- Overuse of trails
- Dumping on land
- Flooding (current and future)
- Forest fires
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources (e.g., overuse of salt on roads)
- Drought (current and future)
- Erosion
- Construction activity
- Political policy change
- Lack of monitoring reports

MNAI then placed each risk in a risk matrix and positioned it according to the probability of an impact occurring and the relative magnitude of its negative consequences (see Figure 6).

Results of the risk identification process

The risk identification process revealed:

- 2 high-probability-high-consequence risks (forest fire and drought)
- 2 high-probability-medium-consequence risks (overuse of trails and flooding)
- 4 medium-level risks (invasive species, construction activity, pollutant loading – both industrial and urban/rural, and lack of monitoring reports)
- 1 low-probability-medium consequence risk (political policy change)
- 3 low- consequence risks (dumping, development pressure, and erosion)

The identified risks affect natural assets particularly in the areas of Elizabeth Lake Community Forest, 14th Avenue Forest, Shadow Mountain, Tembec Lands, Aquifer Recharge Zones, Reservoirs, Rotary Trail, Joseph Creek, Gold Creek, Baker Park, Idlewild Park, and Pop Price Park. Several of the risks are manageable, with the exception of drought which is considered intolerable, and forest fire, which is characterized as manageable to a certain degree.

FIGURE 6: RESULTS OF RISK MANAGEMENT PROCESS - CRANBROOK

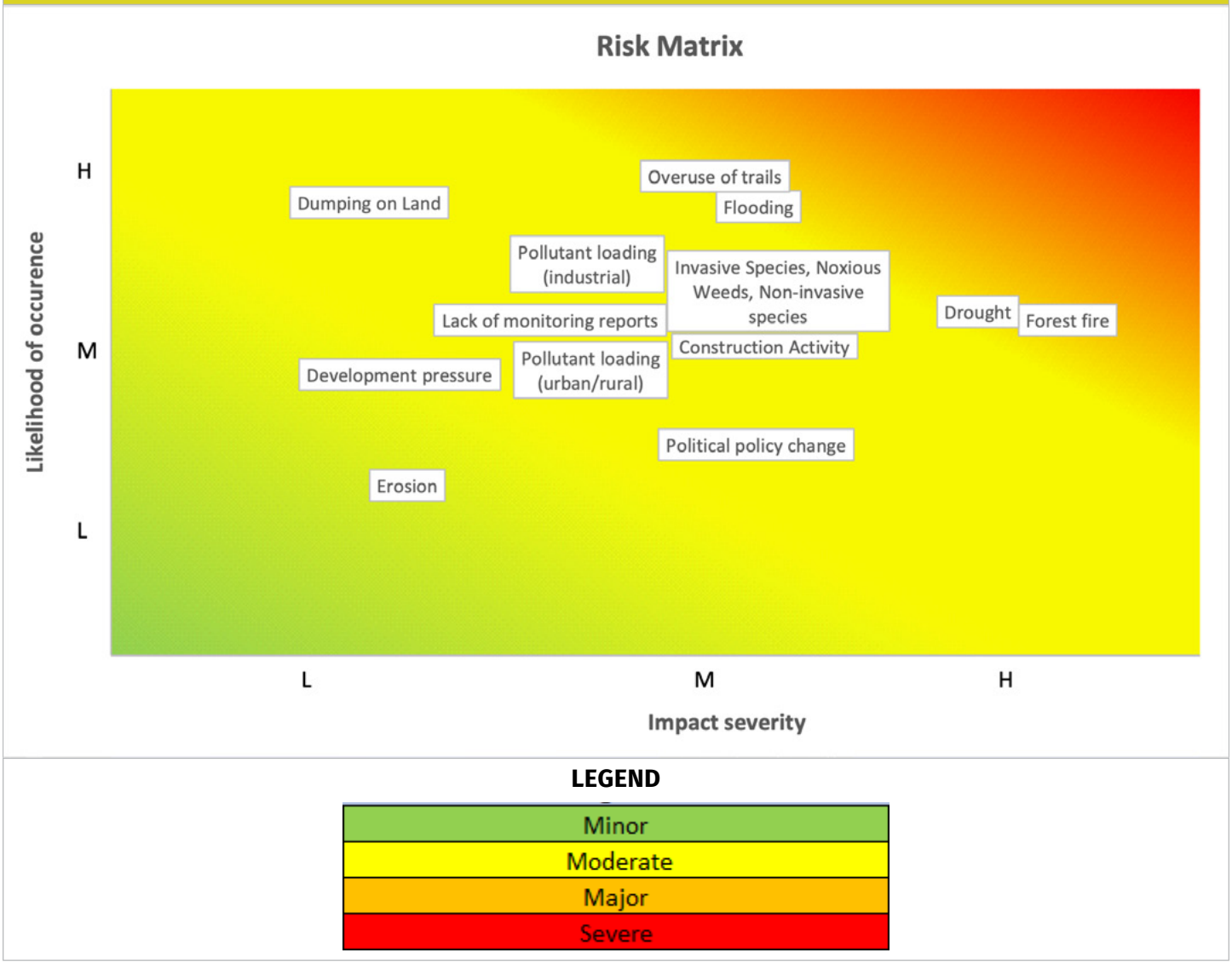


Figure 6: Results of risk management process

Implications

This section offers insights that can be gained from considering both the inventory, condition, risk, and asset management readiness assessment.

Potential priorities for the local government

Potential priorities for Cranbrook to focus their natural asset management efforts are:

- **Forest fire:** Overall, 87 per cent of forest assets are in good or fair condition. However, those that are degraded (~13 per cent) and in close proximity to areas of intense land uses require heightened attention. Regional studies are predicting increasing frequency and size of wildfires. While several measures have been identified to reduce interface fire risk, the engagement of the Government of British Columbia in fire management on crown land is essential, which could be promoted through completion of the Community Wildfire Resiliency Planning process.
- **Drought:** Cranbrook is experiencing a greater number of extreme heat days and a trend toward drier summers. Low elevation watersheds could see prolonged low flow periods, particularly in the Joseph and Gold Creeks. In addition, reduced surface flows may impact the groundwater aquifer. Increasing permeable surfaces, the completion of the Drinking Water Quality and Supply Strategy, the installation of four stream flow monitoring sites for water quality and quantity, and the upgrades to the climate monitoring network will all provide important data for further exploration of this risk to Cranbrook's natural assets.
- **Overuse of trails:** Elizabeth Lake Community Forest, 14th Avenue Forest, Rotary Trail, Joseph Creek, and Gold Creek areas all indicated an overuse of trails. Consequences of overuse may include damage to natural resources, diminishing air quality, water degradation, reduced wildlife, and a decline in trail experience and solitude.
- **Flooding:** Although the risk of generalized flooding in Cranbrook is low, Joseph Creek, Baker Park, Elizabeth Lake, and Pop Price Park have a high probability of flooding. Fortunately, Cranbrook has a comprehensive approach to flood management including a recently completed flood risk assessment, and work underway to complete floodplain mapping, Creek Flow Monitoring, and creek channel upgrades. These initiatives will provide a more accurate understanding of current and future flood risks.

TABLE 6: RISK MITIGATION STRATEGIES - CRANBROOK	
Accept	Risk may be acceptable if probability and consequences are small
Minimize	Risk under local government's control that warrants exposure reduction
Share	Partners in a project permit the sharing of larger risks to reduce it for each
Transfer	Insurance, fixed price contracts, and other risk transfer tools

Opportunities to strengthen natural asset management at an organization-wide level

Cranbrook has identified a number of ways it can strengthen natural asset management (as well as overall asset management practices) at an organization-wide level. These are:

1/ Re-establishing a cross-functional asset management team with a defined terms of reference and accountabilities. It will be important to include a role that is responsible for bringing forward natural asset management considerations so they are well integrated into decision-making.

2/ Developing a one- to three-year roadmap for its asset management system.

3/ Continuing to collect baseline data for natural assets, which should be included in the roadmap to ensure resources are allocated to this task. Cranbrook also plans to review industry standards for performance measurements and begin incorporating these into measurement and monitoring.

4/ Reviewing its asset management policy in detail with staff and management to ensure staff understand their roles.

To develop staff capacity in natural asset management, a key next step could be to complete a staff competency review to identify required skillsets for natural asset management and to fill any essential gaps.

Cranbrook council has directed city staff to identify level of service requirements. It will be important to build an understanding of the contribution of natural assets to service levels to ensure their management is integrated into planning and decision-making. Cranbrook also sees a potential step needed to update its forecasted infrastructure needs and current spending levels. This analysis should include any needs related to operating, maintaining and protecting natural assets.

Finally, Cranbrook is interested in creating a standardized process for asset management throughout the corporation. If this step is taken, then it would be advisable to standardize its processes around natural asset management as well. Cranbrook is also interested in including natural assets in its asset management plans, either as a separate plan or integrated into other service areas.

If Cranbrook wants to use the inventory as the starting place for a full natural asset management project, including implementation, then Annex 2 contains steps to consider.

Possible actions for further development of the inventory

Based on the inventory, Cranbrook could consider the following, regardless of whether or not it pursues a full natural asset management process. These are mostly incremental measures.

- Further develop the condition assessment and risk assessment as refined data and strategies emerge from the Community Wildfire Resiliency Planning process, stream flow monitoring, upgrades to the climate monitoring network, floodplain mapping and creek channel upgrades.
- Identify linkages between services and assets, and assess the condition of, and risks to, the assets from the perspective of their ability to deliver services. From a flooding and stormwater management perspective, the wetlands and forested areas in the watersheds will be key.
- Share the inventory to stimulate collaboration and lessons learned with adjacent local governments.
- Schedule regular updates (e.g., every 3-5 years) of the Inventory, Condition and Risk to understand trends.

Making Nature Count

Town of Golden
Mini-Report

The Town of Golden is located in southeastern British Columbia, 262 kilometres west of Calgary, Alberta, and 713 kilometres east of Vancouver, B.C.

Source: *Wikipedia*

Town of Golden Mini-Report

The Town of Golden's asset management assessment indicates that it has made progress on asset management, with a minor setback after the departure of its Chief Financial Officer (CFO), their asset management champion. The CFO had led a cross-functional team, but that team needs to be reinstated and formalized with terms of reference and accountability. Golden has an asset management policy in place. The policy does not make explicit reference to natural assets but does not exclude them either, given its emphasis on implementing best practices across all service areas. Golden's financial reserves policy stipulates that reserves be used for core infrastructure renewal and resource asset management activities.

Golden has a five-year capital planning budget that it updates annually. It has also completed asset management plans for core infrastructure but has no funding plan in place for them yet. Golden has compiled some basic natural assets data but has not yet fully incorporated them into their inventories and plans. They have recently been able to allocate reserves from the Parks and Site Improvements Operating Reserve Fund to save trees from a fir bark beetle infestation.

Natural asset inventory

Inventory overview

MNAI gathered a range of data for an area scoped to the Golden municipal boundary. The inventory has two main components: a tabular asset registry, and an online dashboard. MNAI provided the registry as Excel data, and the dashboard in a website format. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

Inventory data

MNAI used the most recently available annual crop inventory data produced by Agriculture and Agri-Food Canada (AAFC) as baseline for land use / land cover[1] and combined this with data Golden provided to depict the natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment.

1 ***For more information on AAFC annual crop inventory, see:*** *Annual Crop Inventory - Open Government Portal (canada.ca)*

TABLE 1: SUMMARY OF DATA SOURCES - GOLDEN		
Item	**Use**	**Source**
ToG Boundary	To establish the study area boundary.	Golden provided.
AAFC Annual Crop Inventory	To establish a baseline land cover / land use.	Annual Crop Inventory - Open Government Portal (*canada.ca*)
1-in-200-year flood event	Used to allocate natural assets to known areas of flood risk.	Golden provided.
Global Man-made Impervious Surface Dataset	Informed the condition assessment.	NASA *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
GeoBC Atlas Integrated Transportation Network (dgtl_road_atlas.gdb)	Used to establish road density condition variable.	BC Data Catalogue *https://catalogue.data.gov.bc.ca*
LIDAR Data	LIDAR data was processed to determine individual tree locations, tree height, and canopy cover. These variables were merged into the asset inventory as (i) tree count – number of trees within the asset, (ii) average tree height – average height of all trees located within the asset, and (iii) total canopy cover area within the asset.	Golden provided.

The inventory project defined a total of 1,080 individual assets, covering 405 hectares (ha) of the municipal area, as noted in Table 2. The majority of this was forest cover, followed by wetlands.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE - GOLDEN			
Natural Asset Type	**Number of Assets**	**Total Area (ha)**	**Average Asset Area (ha)**
Forest	728	288	0.40
Grassland	1	0.09	0.09
Shrubland	109	12.15	0.11
Wetland	242	105	0.44
Total	**1,080**	**405**	**0.38**

Asset registry

MNAI gathered the data, sorted and analyzed it for relevance, and then delineated the type, location and extent of natural assets within the scoped project area. Each asset was then assigned a unique identification number to allow individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. The information pertaining to each asset was then placed into a tabular asset registry. An excerpt from the registry showing natural asset characteristics is in Table 3.

TABLE 3: NATURAL ASSET REGISTRY

AssetID	Asset Type	Area (ha)	Is Within Flood Extent	Count of Trees	Average Tree Height	Canopy Area (ha)	Adjacent Land Use	Permeability	Relative Size	Total Score	Rating
1685980	Wetland	0.09	Y	45	5.03	0.02	6	10	0	17	3 - Poor
2717218	Forest	0.90	N	170	18.46	0.84	4	10	0	15	3 - Poor
3325565	Forest	0.09	N	29	14.17	0.08	8	10	0	19	3 - Poor
3565866	Forest	0.09	N	35	16.83	0.13	10	10	0	21	2 - Fair
4520196	Forest	0.09	Y	18	7.90	0.03	7	10	0	18	3 - Poor
5058034	Forest	0.09	N	39	15.19	0.12	8	10	0	19	3 - Poor
5811168	Forest	19.71	N	5468	16.13	21.21	6	10	10	27	2 - Fair
6466149	Wetland	0.09	Y	0			5	10	0	16	3 - Poor
6514958	Shrubland	0.09	Y	0			10	5	10	35	1 - Good
7442002	Forest	0.09	N	23	14.33	0.07	4	10	0	15	3 - Poor
9525677	Forest	0.10	Y	7	5.27	0.00	7	10	0	18	3 - Poor
10877915	Forest	0.36	N	87	19.38	0.51	4	10	0	15	3 - Poor
12649638	Wetland	0.09	Y	71	4.54	0.02	10	10	0	30	2 - Fair
15907884	Shrubland	0.01	Y	1	27.36	0.00	10	5	0	16	3 - Poor
15999146	Shrubland	0.01	Y	0		0.00	6	5	0	12	3 - Poor
18755185	Wetland	8.24	N	149	5.11	0.08	7	10	10	28	2 - Fair
18873412	Forest	0.09	N	0			6	10	0	17	3 - Poor
20157362	Shrubland	0.01	N	1	4.74	0.00	3	5	0	9	4 - Very Poor
20288655	Forest	0.09	N	7	10.90	0.01	3	10	0	14	3 - Poor
22275417	Forest	0.81	Y	61	3.60	0.03	6	10	0	17	3 - Poor
23436753	Forest	0.02	N	0			5	10	0	16	3 - Poor
23973596	Wetland	0.09	N	21	8.45	0.03	5	10	0	16	3 - Poor
25141053	Wetland	1.26	Y	585	6.19	0.42	7	10	0	18	3 - Poor
25743538	Wetland	0.09	Y	143	4.73	0.11	10	10	0	25	2 - Fair
26607821	Wetland	0.09	Y	32	5.00	0.02	10	10	0	25	2 - Fair
29521270	Wetland	0.27	Y	171	5.64	0.17	10	10	0	30	2 - Fair
32694172	Forest	0.45	Y	86	6.66	0.07	7	10	0	18	3 - Poor
33821194	Forest	0.09	N	38	12.92	0.09	8	10	0	19	3 - Poor
34009330	Shrubland	0.09	N	6	3.73	0.00	4	5	10	20	3 - Poor
Total		**405.18**		**134569**	**7,534.20**	**284.06**					

Table 3: Screenshot of main inventory registry

Online dashboard

Inventories may provide more insights when characterised visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by asset type or condition rating. Figure 3 and Figure 4 are screen shots from the dashboard that MNAI provided to Golden. The full version can be accessed at *https://go.greenanalytics.ca/golden*.

FIGURE 3: SCREENSHOT OF MAIN INVENTORY SUMMARY

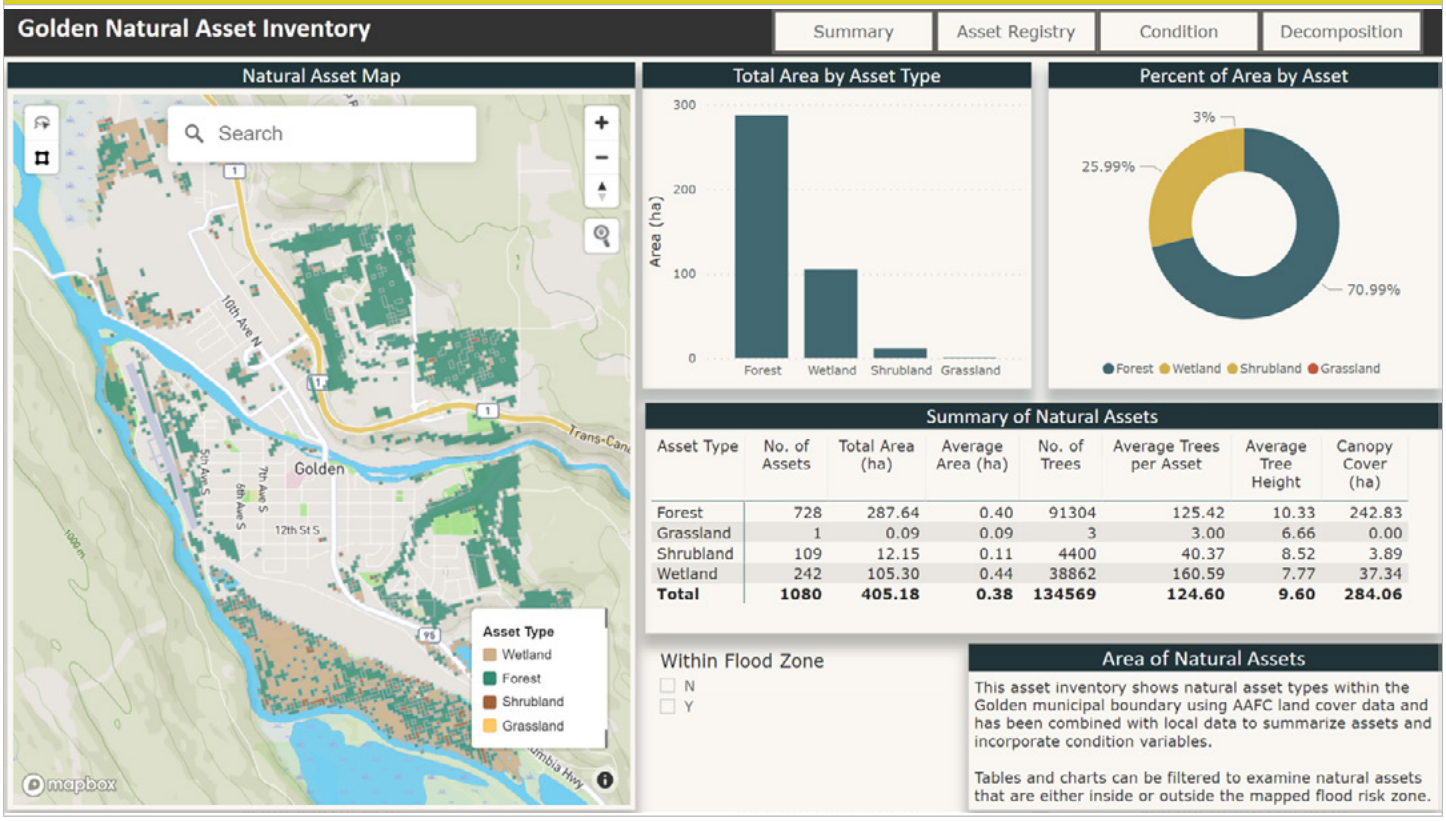


Figure 3: Screenshot of main inventory summary

Condition of natural assets

Condition assessments are key aspect of natural asset inventories and provide an understanding of both the ecological health of natural assets and their ability to provide services. This information can be reflected in the registry and the dashboard, updated over time, and helps local governments with management decisions.

Condition assessments vary in complexity. MNAI completed a desktop-based condition assessment for Golden and built it into the inventory to provide an initial understanding of the status of the natural assets for the municipality. The condition assessment steps and indicators are summarized in Table 4.

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - GOLDEN

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Relative asset size	For each natural and semi-natural asset type, total area is calculated and a rank is assigned to the assets within each class based on its percentile score. Natural assets within the top third of the ranking (e.g., the largest assets within a class) received a high (10), those within the middle third of the ranking received a medium (5), and those within the bottom third of the ranking received a low (1).	Natural asset inventory
Surface permeability	The permeability of surfaces is ranked on a scale of low to high depending on the type of landcover present. ■ Assets within impervious surfaces s medium. ■ Wetlands, waterbodies and forests are ranked as high.	Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made impervious surfaces dataset from NASA. *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
Road density	Road density was determined by first establishing a 1 km² hexagonal tessellation of the study areas. Road density was then calculated for each 1km² hexagon. Natural assets within each hexagon were allocated the corresponding road density and given a condition rating of low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.	Natural asset inventory GeoBC Atlas Integrated Transportation Network

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - GOLDEN		
Adjacent land use intensity	A 100m buffer is applied to each natural asset to determined what land uses surround each asset. Land use within the 100m buffer is allocated a land use intensity rating on a scale of 0 to 100 where 100 is considered the most intense land uses and 0 is natural land cover. Intensity ratings are as follows: ■ Developed = 72.5 ■ Barren (e.g., Construction or mining areas) = 60 ■ Agriculture = 40 ■ Natural areas = 0 Each natural asset is assigned an adjacent land use intensity score out of 100 based on an area weighted average of the surrounding land use intensities. Adjacent land use intensity scores out of 100 are converted to a scale out of 10 by dividing the weighted average score by 10 and rounding to the nearest integer. The condition score is then calculated as 10 minus the adjusted intensity score, so that larger numbers indicated better asset condition, in line with the other indicators.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses.

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- Road density conditions are rated low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.
- Surface permeability rated as high (10), medium (5), or low (1).
- Adjacent intensive land use (scale from 0 to 10 where 10 indicates the asset is surrounded by natural areas and 0 indicates the asset is surrounded by heavily developed area).
- Relative asset size where the largest 3rd areas receive 10, 5 for middle 3rd, and 1 point for the lowest 3rd.

The total condition score was then converted into a rating scale:

- Good - assets with a score of 30 or higher
- Fair - assets with a score between 20 to 29
- Poor - assets with a score between 10 to 19
- Very Poor - assets with a score lower than 10

Figure 4 is a snapshot of the condition assessment results as presented in the inventory dashboard for Golden.

FIGURE 4: SNAPSHOT OF CONDITION ASSESSMENT DETAILS

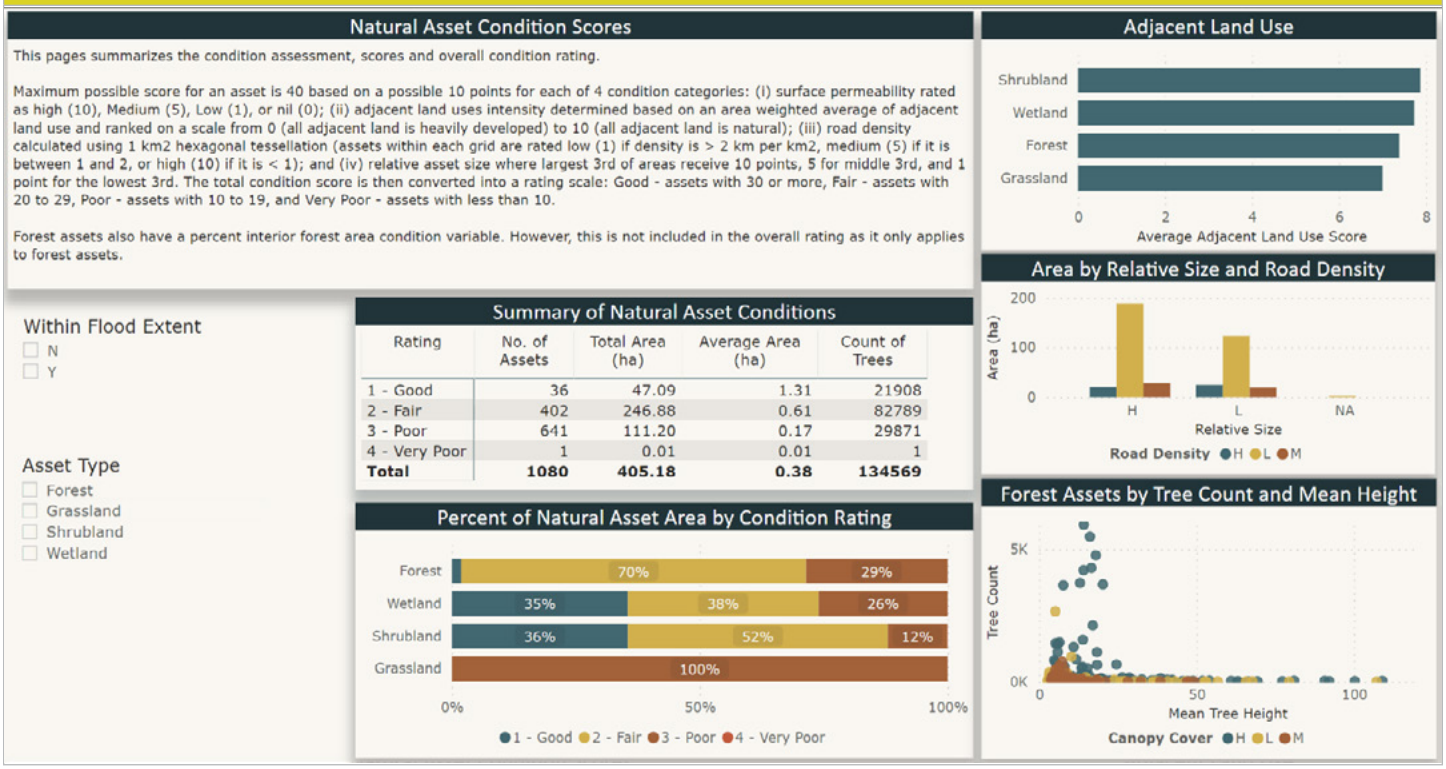


Figure 4: Snapshot of condition assessment details

Overall, about 47 ha (or 12 per cent) of natural assets were assessed in good condition and 247 ha (or 61 per cent) were assessed in fair condition.

The forest assets are generally in fair condition. The forest assets in poor condition are due to being relatively small, with high road density and in close proximity to intense land uses.

Within the project area, the majority of the wetlands rated good or fair. Those that ranked poor are due to being relatively small, with high road density and in close proximity to intense land uses.

Table 5 summarizes the condition ratings and Figure 5 summarizes condition by natural asset type.

TABLE 5. SUMMARY OF NATURAL ASSET CONDITION RATINGS - GOLDEN			
Condition Rating	**Number of Assets**	**Total Area (ha)**	**Average Total Score**
1. Good	36	47	1.31
2. Fair	402	247	0.61
3. Poor	641	111	0.17
4. Very Poor	1	0.01	0.01
Total	**1,080**	**405**	**0.38**

FIGURE 5. SUMMARY OF CONDITION RATING BY NATURAL ASSET TYPE

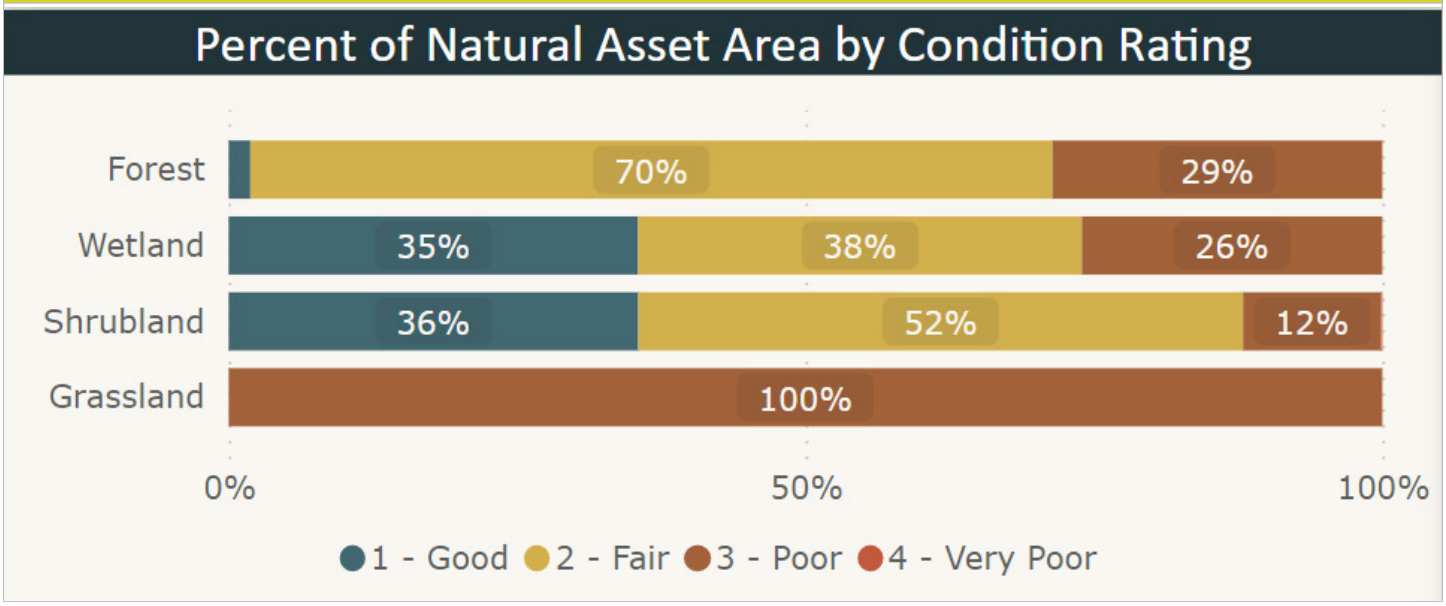


***Figure 5**: Summary of condition rating by natural asset type*

Risk identification

Risk identification tool overview

Identifying risks facing natural assets can help local governments prioritize their management of natural assets. To this end, MNAI provides local governments with a tool entitled *Risk Identification Process in the Development of Natural Asset Inventories* and guidance to assist them in self-administering it. The results follow. Local government responses are in Annex 1.

Using the risk identification tool

Using the risk tool, Golden considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including:

- Overuse of trails
- Illegal dumping
- Flooding (current and future)
- Forest fires
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources (e.g. overuse of salt on roads)
- Drought (current and future)
- Erosion
- Ice jams
- Construction activity
- Political policy change

MNAI then placed each risk in a risk matrix according to the probability of an impact occurring and the relative magnitude of its negative consequences (see Figure 6).

Results of the risk identification process

The risk identification process revealed:

- 1 high-level risk (forest fire)
- 2 medium-level risks (flooding and pollutant loading)
- 1 low-high level risk (invasive species)
- 8 low-level risks (overuse of trails, illegal dumping, development pressure, drought, erosion, ice jams, construction activity, and political policy change)

The identified risks affect natural assets across much of Golden. Priority areas include Kicking Horse River, Hospital Creek, the South and North benches, the northern and eastern municipal boundaries, and municipal wetlands. Private properties throughout Golden also contain various risks to natural assets, especially those related to pollutant loading and policy changes related to water bottling developments, which could impact the aquifer.

FIGURE 6: RESULTS OF RISK MANAGEMENT PROCESS - GOLDEN

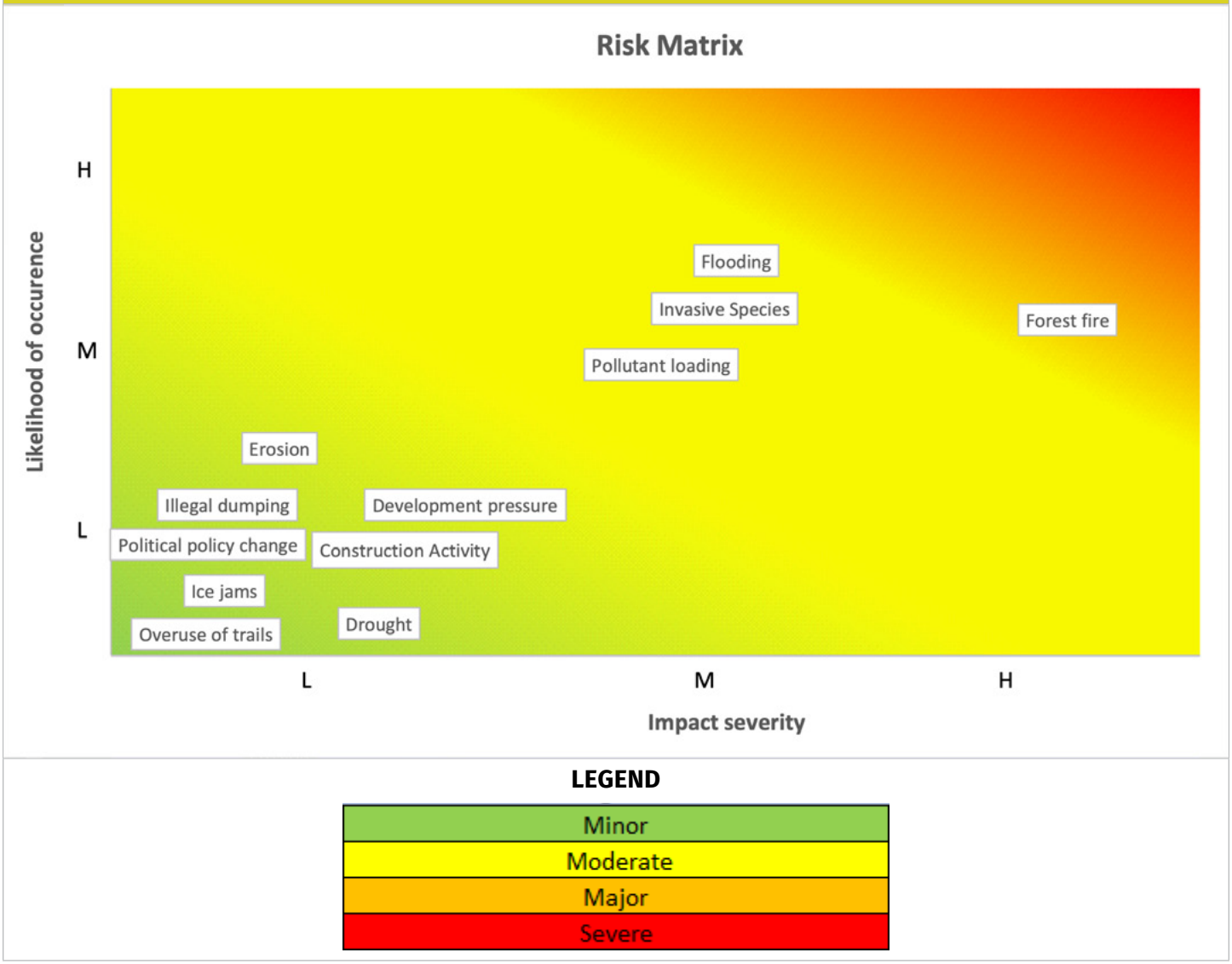


Figure 6: Results of risk management process

Implications

This section offers insights that can be gained from considering the inventory, condition, risk, and asset management readiness assessment.

Potential priorities for the local government

Potential priorities for Golden to focus their natural asset management efforts are as follows:

- **Forest fire:** Overall, forest assets are in good (71 per cent) or fair (44 per cent) condition. Regional studies are predicting an increase in the frequency and size of wildfires. Forests along the northern and eastern lengths of the municipal boundary are areas of current concern. Given the location of these areas, effective management of wildfires will require coordination with neighbouring regions and/or engagement

of the Government of British Columbia in fire management on crown land, which could be promoted through completion of the Community Wildfire Resiliency Planning process.

- **Flooding:** Flooding was ranked as a medium risk, with noted risks to diking along the Kicking Horse River and Hospital Creek. In addition, wetlands in various locations throughout Golden could be a flood risk, with road density having the most significant impact on wetland condition.
- **Invasive species:** Invasive species have been identified as a low-probability-high-consequence risk to natural assets and their associated services. Golden has experienced Fir Bark infestation in southeast forests and have mapped invasive species in the Invasive Alien Plant Program (IAPP) Database. Furthermore, the Community Invasive Plant Program (CIPP), which works in partnership with Golden and the Columbia-Shuswap Invasive Species Society (CSISS), have identified high-priority areas, removed invasive plants, conducted public outreach and identified program areas for improvement[2].
- **Pollutant Loading:** Industrial pollutant loading to Golden's aquifer is ranked as a medium-level risk. Contaminated sites have been mapped, and a monitoring program for landfill performance related to groundwater quality at the landfill boundary, residential well water and surface water quality, and landfill leachate has been completed[3]. Exceedances of drinking water standards were noted for groundwater beneath a portion of Golden's neighbourhoods, as were the potential of surface water flow onto, through, and off the landfill site during spring freshet and high precipitation periods.

TABLE 6: RISK MITIGATION STRATEGIES - GOLDEN

Accept	Risk may be acceptable if probability and consequences are small
Minimize	Risk under local government's control that warrants exposure reduction
Share	Partners in a project permit the sharing of larger risks to reduce it for each
Transfer	Insurance, fixed price contracts, and other risk transfer tools

Opportunities to strengthen natural asset management at an organization-wide level

Golden has identified next steps to help it progress in asset management while integrating natural assets. A cross-functional asset management team or committee needs to be reinstated and it would be advisable to ensure that someone responsible for bringing in natural asset management considerations is included on that team. In order to develop staff capacity in natural asset management, a key next step could be to complete a staff competency review to identify required skillsets for natural asset management and to fill any essential gaps.

2 *Hackett 2019.*

3 *Golder Associates Ltd., 2019.*

Golden has not yet engaged Council on service levels for engineered assets. This would be an important step to support resourcing of asset management activities. Golden will need to develop a full inventory of natural assets and build an understanding of the levels of service they are providing, as well as their value, in order to include natural assets in their service level discussions and in future asset management plans.

Finally, it will be important to identify priority natural assets and the resources required to incorporate natural asset management into Golden's asset management system and requirements to make progress on the asset management readiness scale.

If the local government wants to use the inventory as the starting place for a full natural asset management project, including implementation, then Annex 2 contains steps to consider.

Possible actions for further development of the inventory

Based on the inventory, Golden could consider the following, regardless of whether or not it pursues a full natural asset management process. These are mostly incremental measures.

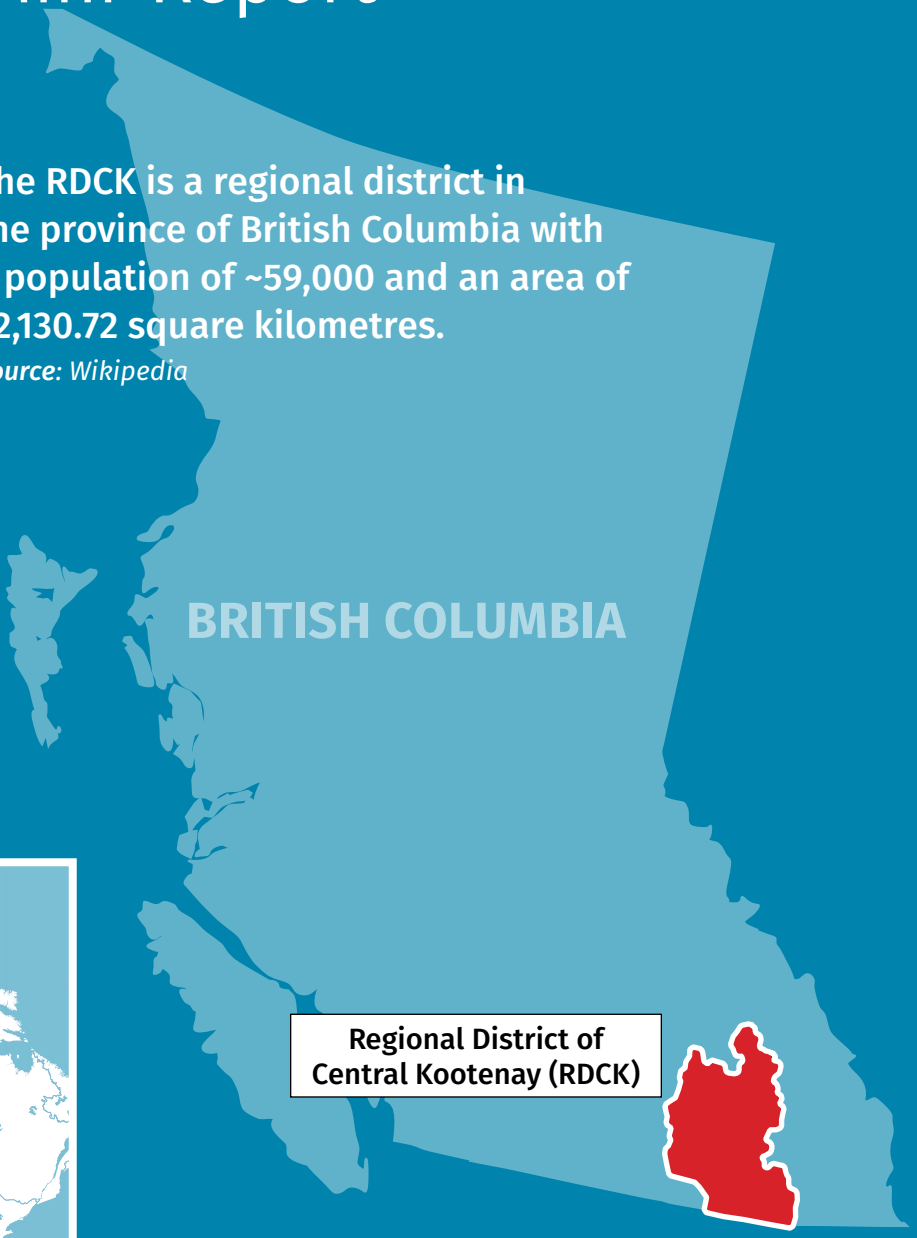
- Determine acceptable levels of risk to inform Golden's risk mitigation strategies.
- Further develop the condition assessment and risk assessment for forest fire, potentially through the completion of the Community Wildfire Resiliency Planning process.
- Share the inventory to stimulate collaboration and lessons learned with adjacent local governments.
- Schedule regular updates (e.g., every 3-5 years) of the Inventory, Condition and Risk to understand trends.

Making Nature Count

Regional District of Central Kootenay (RDCK) Mini-Report

The RDCK is a regional district in the province of British Columbia with a population of ~59,000 and an area of 22,130.72 square kilometres.

Source: *Wikipedia*



Regional District of Central Kootenay (RDCK) Mini-Report

The RDCK completed an asset management readiness assessment that shows that while it is at an early stage of asset management, the Board of Directors and senior management understand the importance of asset management and has committed to formalizing asset management. The RDCK has identified asset management champions to spearhead this work and has identified a cross-functional team that could include someone responsible for incorporating natural asset management considerations. The RDCK does not yet have an asset management policy or roadmap to guide actions but does have basic asset data and information about critical assets for most service areas. It has developed asset investment plans that address short and longer-term needs for engineered assets. Natural asset considerations have not yet been incorporated into asset investment plans.

Natural asset inventory

Inventory overview

The inventory was scoped to the Arrow Creek boundary at the request of the RDCK. The inventory has two main components: a tabular asset registry, and an online dashboard. MNAI provided the registry as Excel data, and the dashboard in a website format. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

Inventory data

MNAI used the most recently available annual crop inventory data produced by Agriculture and Agri-Food Canada (AAFC) as baseline for land use / land cover[1] and combined this with data the RDCK provided to depict the natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment.

1 ***For more information on AAFC annual crop inventory, see:*** *Annual Crop Inventory - Open Government Portal (canada.ca)*

TABLE 1: SUMMARY OF DATA SOURCES - THE RDCK		
Item	**Use**	**Source**
Official Community Plan	To establish the study area boundary.	RDCK provided.
AAFC Annual Crop Inventory	To establish a baseline land cover / land use.	Annual Crop Inventory - Open Government Portal (*canada.ca*)
Zoning	Used to define what zoning has been allocated to the natural assets.	RDCK provided
RDCK Parks	Used to define natural assets that are within Kianuko Park.	RDCK provided
Global Man-made Impervious Surface Dataset	Informed the condition assessment.	NASA *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
GeoBC Atlas Integrated Transportation Network (dgtl_road_atlas.gdb)	Used to establish road density condition variable.	BC Data Catalogue *https://catalogue.data.gov.bc.ca*

The inventory project defined a total of 55,475 individual assets covering 224,304 hectares (ha) of the district area, as noted in Table 2. The majority of this area is forest cover, followed by water.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE - THE RDCK			
Natural Asset Type	**Number of Assets**	**Total Area (ha)**	**Average Asset Area (ha)**
Agriculture	2,297	7,010	3.05
Forest	12,738	178,576	14.02
Grassland	4,302	2,186	0.51
Shrubland	34,234	14,687	0.43
Water	276	21,601	78.27
Wetland	1,628	245	0.15
Total	**55,475**	**224,305**	**4.04**

Asset registry

MNAI gathered the data, sorted and analyzed it for relevance, and then delineated the type, location and extent of natural assets within the scoped project area. Each asset was then assigned a unique identification number to allow individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. The information pertaining to each asset was then placed into a tabular asset registry. An excerpt from the registry showing natural asset characteristics is in Table 3.

TABLE 3: SCREENSHOT OF MAIN INVENTORY REGISTRY

Natural Asset Registry

AssetID	Asset Type	Area (ha)	Zoning Class	Watershed	Protected Area	Interior Forest Area (ha)	Relative Size	Road Density	Permeability	Adjacent Land Use	Total Score	Rating
2445	Shrubland	0.15	AG2	Kootenay Lake			1	1	5	8	15	3 - Poor
15549	Shrubland	0.12	RA	Kootenay Lake			1	1	5	10	17	3 - Poor
18327	Grassland	0.08	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
73609	Shrubland	0.10	R3	Kootenay Lake			1	1	5	7	14	3 - Poor
92159	Forest	0.15		Kootenay Lake			1	10	10	10	31	1 - Good
104740	Shrubland	0.38	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
110166	Shrubland	0.08	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
141875	Forest	0.26	RA	Kootenay Lake			1	1	10	10	22	2 - Fair
161231	Shrubland	0.15	R4	Kootenay Lake			1	1	5	10	17	3 - Poor
169770	Grassland	0.11	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
172475	Shrubland	0.04	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
226243	Shrubland	0.91		Kootenay Lake			1	1	5	10	17	3 - Poor
228920	Shrubland	0.08	RA	Kootenay Lake			1	1	5	10	17	3 - Poor
239413	Shrubland	0.11		Kootenay Lake			1	5	5	10	21	2 - Fair
261207	Shrubland	0.27	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
263685	Shrubland	0.63	RA	Kootenay Lake			1	1	5	10	17	3 - Poor
277494	Shrubland	0.19		Kootenay Lake			1	10	5	10	26	2 - Fair
292816	Forest	0.08	RA	Kootenay Lake			1	10	10	10	31	1 - Good
301714	Shrubland	0.15	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
325005	Shrubland	0.12	RA	Kootenay Lake			1	1	5	10	17	3 - Poor
354785	Forest	1.54	R2	Kootenay Lake			1	1	10	6	18	3 - Poor
358789	Shrubland	0.11		Kootenay Lake			1	5	5	10	21	2 - Fair
359446	Shrubland	0.11	RA	Kootenay Lake			1	1	5	10	17	3 - Poor
360155	Forest	0.11		Kootenay Lake			1	10	10	10	31	1 - Good
373769	Shrubland	0.06	RA	Kootenay Lake			1	1	5	10	17	3 - Poor
385799	Shrubland	0.04	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
386609	Shrubland	0.08	RA	Kootenay Lake			1	1	5	10	17	3 - Poor
399380	Forest	0.19	RA	Kootenay Lake	KIANUKO PARK		1	10	10	10	31	1 - Good
437029	Shrubland	0.50	RA	Kootenay Lake			1	10	5	10	26	2 - Fair
Total		224,304.72				150,056.00						

Table 3: Screenshot of main inventory registry

Online dashboard

Inventories may provide more insights when characterised visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by watershed area, or, if users want to dive into the specifics of forest assets, they can quickly filter the data to focus on that particular asset. Figure 3 and Figure 4 are screen shots from the dashboard that MNAI provided to the RDCK. The full version can be accessed at *https://go.greenanalytics.ca/RDCK-ArrowCreek* for Arrow Creek or at *https://go.greenanalytics.ca/RDCK* for the entire RDCK area.

FIGURE 3: SCREENSHOT OF MAIN INVENTORY SUMMARY

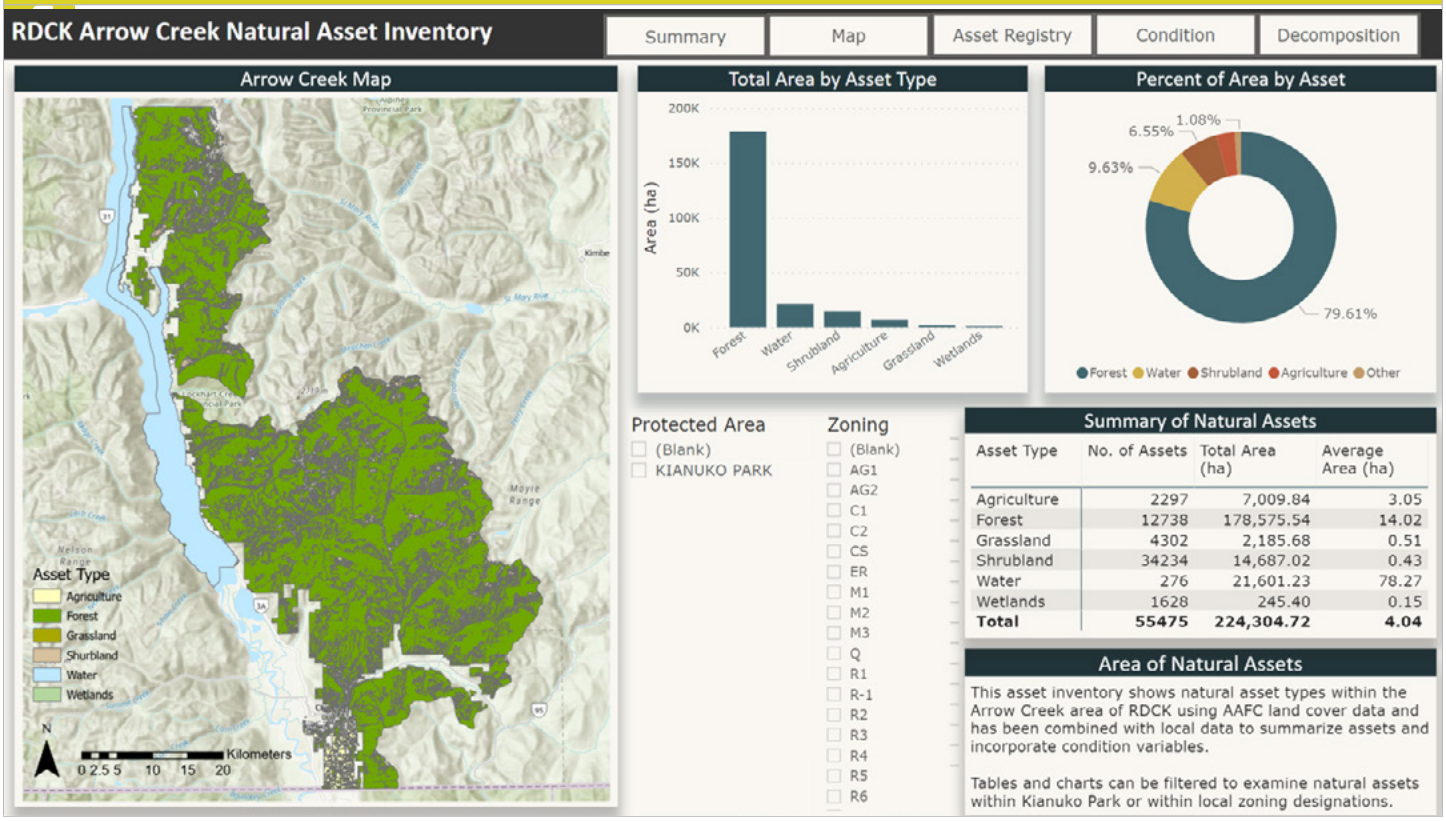


Figure 3: Screenshot of main inventory summary

Condition of natural assets

Condition assessments are a key aspect of natural asset inventories as they provide an understanding of both the ecological health of natural assets and their ability to provide services. This information can be reflected in the registry and the dashboard, updated over time, and helps local governments with management decisions.

Condition assessments can vary in complexity. MNAI completed a desktop-based condition assessment for the RDCK Arrow Creek Watershed and built it into the inventory to provide an initial understanding of the status of the natural assets for the municipality. The condition assessment steps and indicators are summarized in Table 4.

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - RDCK

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Relative asset size	For each natural and semi-natural asset type, total area is calculated and a rank is assigned to the assets within each class based on its percentile score. Natural assets within the top third of the ranking (e.g., the largest assets within a class) received a high (10), those within the middle third of the ranking received a medium (5), and those within the bottom third of the ranking received a low (1).	Natural asset inventory
Surface permeability	The permeability of surfaces is ranked on a scale of low to high depending on the type of landcover present. ■ Assets within impervious surfaces are assigned as low permeability. ■ Agriculture and shrublands are ranked as medium. ■ Wetlands, waterbodies and forests are ranked as high.	Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made Impervious Surface Dataset from NASA. *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
Road density	Road density was determined by first establishing a 1 km² hexagonal tessellation of the study areas. Road density was then calculated for each 1km² hexagon. Natural assets within each hexagon were allocated the corresponding road density and given a condition rating of low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.	Natural asset inventory GeoBC Atlas Integrated Transportation Network

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - RDCK		
Adjacent land use intensity	A 100m buffer is applied to each natural asset to determined what land uses surround each asset. Land use within the 100m buffer is allocated a land use intensity rating on a scale of 0 to 100 where 100 is considered the most intense land uses and 0 is natural land cover. Intensity ratings are as follows: ■ Developed = 72.5 ■ Barren (e.g. Construction, or mining areas) = 60 ■ Agriculture = 40 ■ Natural areas = 0 Each natural asset is assigned an adjacent land use intensity score out of 100 based on an area weighted average of the surrounding land use intensities. Adjacent land use intensity scores out of 100 are converted to a scale out of 10 by dividing the weighted average score by 10 and rounding to the nearest integer. The condition score is then calculated as 10 minus the adjusted intensity score, so that larger numbers indicated better asset condition, in line with the other indicators.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses.

Table 4. Condition assessment approach and indicators - RDCK

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- Road density conditions are rated low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.
- Surface permeability rated as high (10), medium (5), or low (1).
- Adjacent intensive land use (scale from 0 to 10 where 10 indicates the asset is surrounded by natural areas and 0 indicates the asset is surrounded by heavily developed area).
- Relative asset size where the largest 3rd areas receive 10, 5 for middle 3rd, and 1 point for the lowest 3rd.

The total condition score was then converted into a rating scale:

- Good - assets with a score of 30 or higher
- Fair - assets with a score between 20 to 29
- Poor - assets with a score between 10 to 19
- Very Poor - assets with a score lower than 10

Figure 4 is a screenshot of the condition assessment for the Arrow Creek boundary as presented in the RDCK's inventory dashboard.

FIGURE 4: SNAPSHOT OF CONDITION ASSESSMENT DETAILS

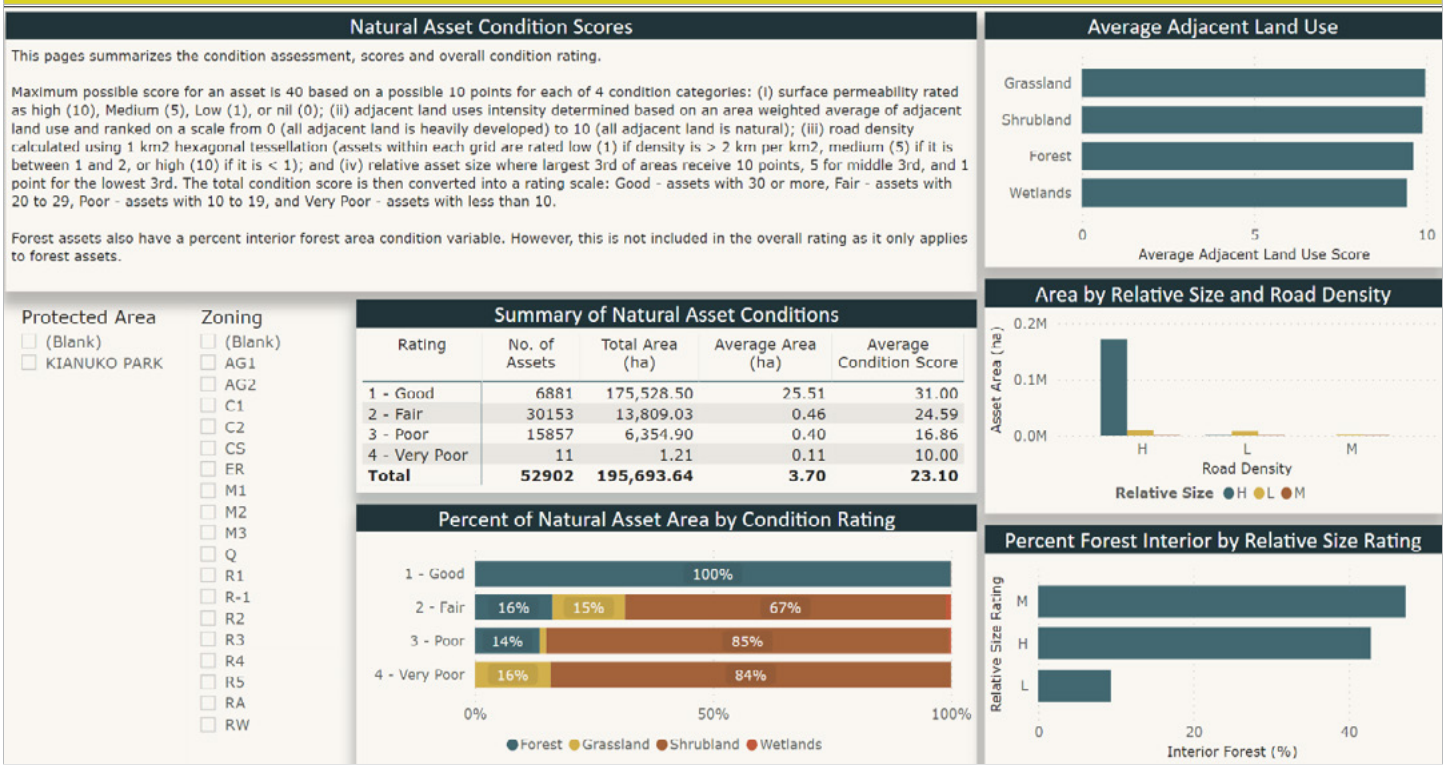


Figure 4: Snapshot of condition assessment details

Within the Arrow Creek boundary, about 175,528 ha (or approximately 90 per cent) of natural assets were assessed in good condition and 13,809 ha (or 7 per cent) were assessed in fair condition.

Shrubland assets were largely rated poor or very poor. This is due to a combination of these assets being relatively small with high road density. Note, however, that these assets only account for a small portion of the overall natural asset area (about 7 per cent).

The forest assets are generally in good condition. The forest assets in poor condition are due to being relatively small, with dense roads and adjacent to relatively more intensive land uses.

Table 5 summarizes condition ratings and Figure 5 summarizes condition by natural asset type.

TABLE 5. SUMMARY OF NATURAL ASSET CONDITION RATINGS - RDCK

Condition Rating	Number of Assets	Total Area (ha)	Average Area (ha)	Average Condition Score
1. Good	6,881	175,529	25.51	31
2. Fair	30,153	13,809	0.46	25
3. Poor	15,857	6,355	0.40	17
4. Very Poor	11	1.21	0.11	10
Total	**52,902**	**195,693**	**3.70**	**23**

Table 5. Summary of natural asset condition ratings - RDCK

FIGURE 5. SUMMARY OF CONDITION RATING BY NATURAL ASSET TYPE

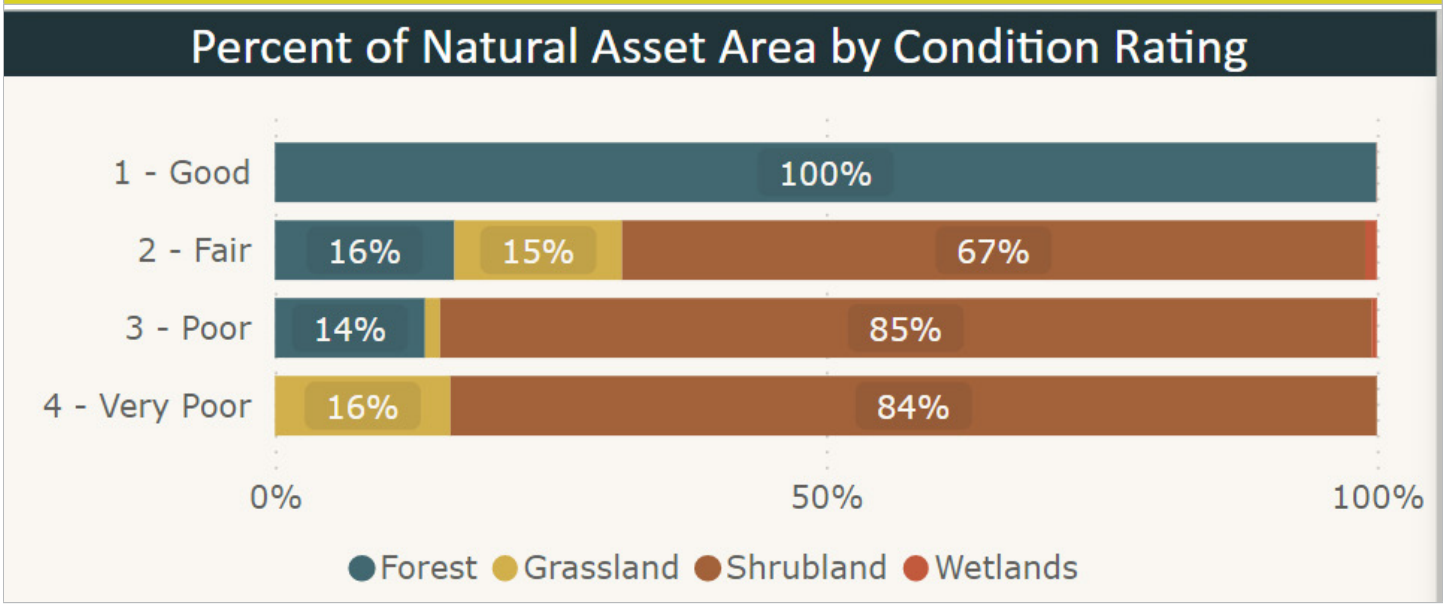


***Figure 5**: Summary of condition rating by natural asset type*

Risk identification

Risk identification tool overview

Identifying risks facing natural assets can help local governments prioritize their management of natural assets. To this end, MNAI provides local governments with a tool entitled *Risk Identification Process in the Development of Natural Asset Inventories* and guidance to assist them in self-administering it. The results follow. Local government responses are in Annex 1.

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 local government to maintain municipal services.
- **Political risk:** risks related to the nature of municipal politics.

Using the risk identification tool

Using the risk tool, RDCK staff considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including:

- Low flows
- Competing demands
- Increasing agricultural use
- Increasing commercial use
- Increasing residential connections
- Clearwater flooding
- Road construction and maintenance
- Recreational impact – overuse
- Introduction of invasive species
- Wildfire

MNAI then placed each risk in a risk matrix and positioned it according to the probability of an impact occurring and the relative magnitude of its negative consequences (see Figure 6).

Results of the risk identification process

The risk identification process revealed:

- 5 high-level risks (low flows, competing demands, increasing agriculture use, clearwater flooding, and wildfire)
- 2 medium-level risks (increasing commercial use, recreational impact - overuse)
- 3 low-level risks (increasing residential connections, road construction and maintenance, and introduction of invasive species)

In terms of scope, the RDCK identified risks that affect natural assets across the entire area of the Arrow Creek watershed.

FIGURE 6: RESULTS OF RISK MANAGEMENT PROCESS - RDCK

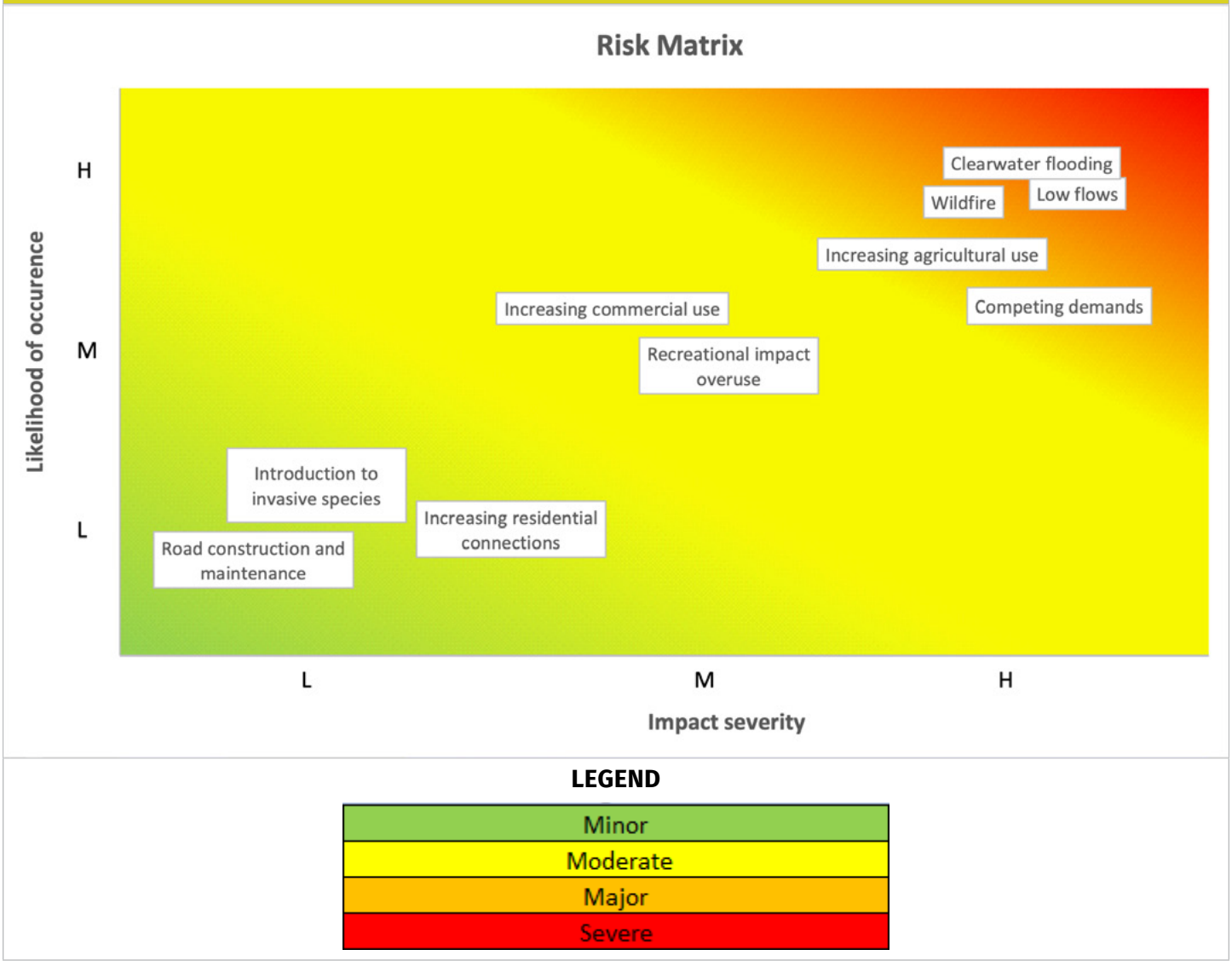


Figure 6: Results of risk management process - RDCK

Implications

This section offers insights that can be gained from considering the inventory, condition, risk and asset management readiness assessment.

Potential priorities for the local government

Potential priorities for the RDCK to focus their natural asset management efforts are as follows:

- **Low flows:** Seasonal low flows are experienced throughout the watershed, with water conservation measures applied every year from June 1 to September 30. The RDCK has recently adopted a Drinking Water Conservation Plan, which includes Demand Forecasts, Water Reduction Targets, Drought Management and Water Shortage

Contingency Planning, as well as a Watershed Management Plan Strategy. Both will provide important data for further exploration of this risk to RDCK's natural assets.

- **Competing demands:** Competing water demand is of concern throughout the Arrow Creek watershed, where low flows can increase water temperatures leading to impacts to fish and other aquatic species. The RDCK is working with the Erickson Water Commission and the Town of Creston to review potential future demands in the service area prior to making a decision to expand the Arrow Creek service area.
- **Increasing agriculture use:** the RDCK has high water demand from agriculture, particularly in Erickson. A Water Conservation Pilot was completed in 2007, an Agricultural Water Demand Model was completed in 2017, and more recently, an update on the Erickson agricultural inventory has been commissioned. While this will provide additional information for addressing water quantity concerns, local initiatives such as Farmland Advantage (https://www.farmlandadvantage.com/) can assist with broader ecosystem impacts by compensating farmers to engage in best management practices.
- **Clearwater flooding:** Riverine flooding is experienced throughout the watershed, most commonly in the spring, which can impact Erickson communities and engineered infrastructure. The RDCK is undertaking a Flood Mapping Study, which will build on a Flood and Steep Creek Geohazard Risk Prioritization Study (2017). This will provide the RDCK with foundational data to inform community planning, risk reduction strategies, and emergency funding.
- **Wildfire:** Wildfire is of concern throughout the watershed, which has led to collaboration efforts to mitigate risk, such as the Nelson & Area Wildfire Risk Reduction partnership, which shares information and resources and collaborates on projects. The aforementioned Flood Mapping Study will provide wildfire-related impacts related to changes in creek and river hydrology. Lastly, the RDCK has also noted the efforts of Community Forest management, the RDCK wildfire mitigation program and the efforts of the Creston Community Forest to reduce wildfire impact.

If the RDCK wants to use the inventory as the starting place for a full natural asset management project, including implementation, then Annex 2 contains steps to consider.

Possible actions for further development of the inventory

Based on the inventory, the RDCK could consider the following, regardless of whether or not it pursues a full natural asset management process. These are mostly incremental measures.

- Determine acceptable levels of risk to inform the RDCK's risk mitigation strategies.
- Further develop the condition assessment and risk assessment by integrating findings from studies and plans being implemented, such as the Drinking Water Conservation Plan, the Watershed Management Plan and the Flood Mapping Study.
- Share the inventory to stimulate collaboration and lessons learned with adjacent local governments.
- Schedule regular updates (e.g. every 3-5 years) of the Inventory, Condition and Risk to understand trends.

Opportunities to strengthen natural asset management at an organization-wide level

The RDCK is at a relatively early stage of formalizing asset management and applying it consistently across the organization. The RDCK has identified asset management champions who are leading the strengthening of asset management, as well as a cross-functional team that could include someone who will be responsible for incorporating natural asset considerations. Some immediate opportunities to strengthen policy and governance could be to develop an asset management policy that incorporates natural asset considerations, and to develop an asset management roadmap that will define key action areas to strengthen over the next 1-2 years. In addition, the cross-functional asset management team would benefit from having clearly defined roles and responsibilities and a terms of reference that defines what the group is responsible for.

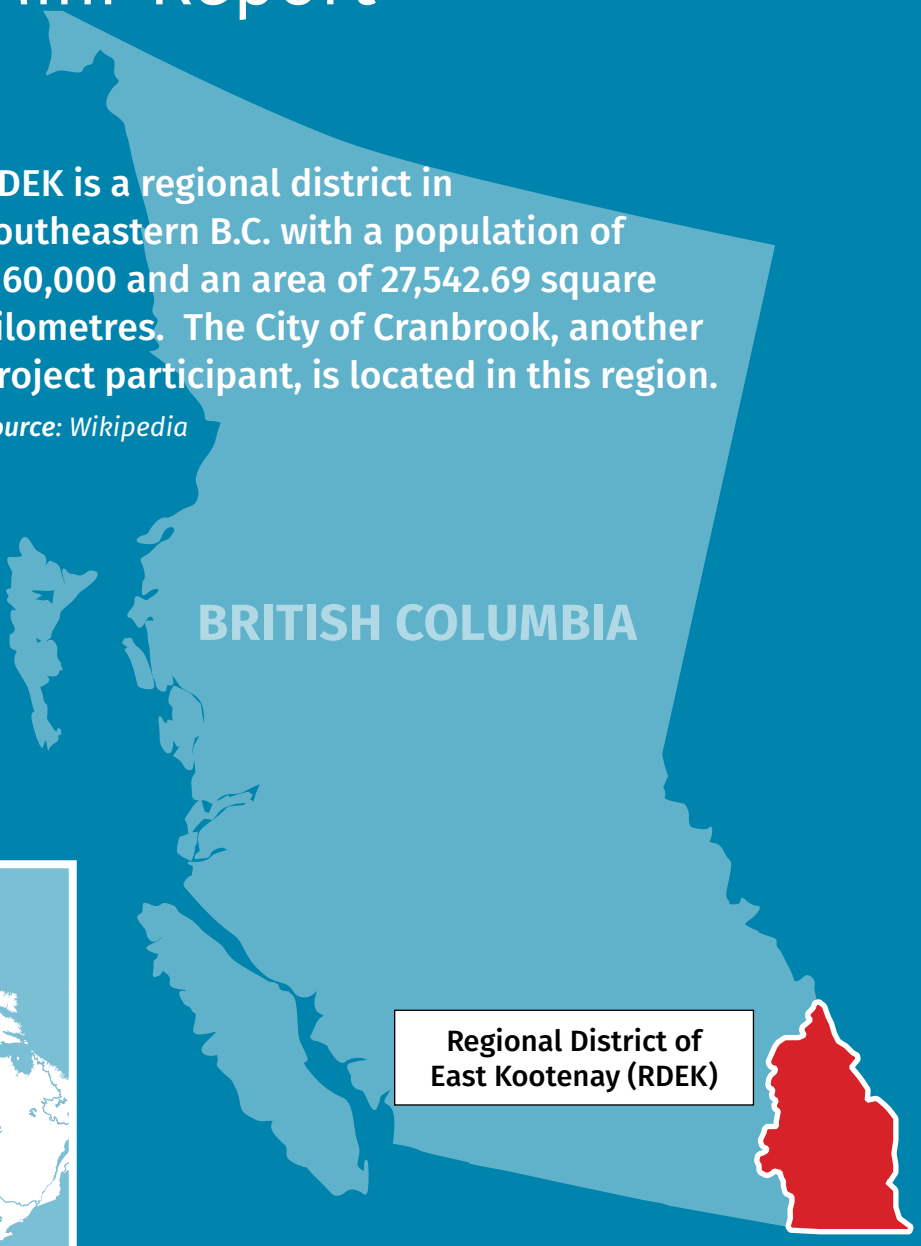
Natural assets have not yet been incorporated into the RDCK's asset investment plans though these plans do exist for most service areas. The RDCK could consider documenting an approach to managing or protecting the natural assets that support service delivery, which shows how they will be incorporated into asset investment plans.

Making Nature Count

Regional District of East Kootenay (RDEK) Mini-Report

RDEK is a regional district in southeastern B.C. with a population of ~ 60,000 and an area of 27,542.69 square kilometres. The City of Cranbrook, another project participant, is located in this region.

Source: *Wikipedia*



Regional District of East Kootenay (RDEK) Mini-Report

The Regional District of East Kootenay (RDEK) is at the beginning of its asset management journey and designated asset management as an organizational priority in 2021. RDEK has begun to compile a basic list of traditional assets and has done this natural asset inventory pilot for Windermere Creek. There are many opportunities to incorporate natural asset management considerations into its progress on asset management in the coming years, some of which are outlined below.

Natural asset inventory

Inventory overview

The inventory for RDEK was scoped to the Windermere boundary. The inventory has two main components: a tabular asset registry, and an online dashboard. MNAI provided the registry as Excel data, and the dashboard in a website format. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

Inventory data

MNAI used the most recently available annual crop inventory data produced by Agriculture and Agri-Food Canada (AAFC) as baseline for land use / land cover[1] and combined this with data RDEK provided to depict the natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment.

TABLE 1: SUMMARY OF DATA SOURCES - RDEK

Item	Use	Source
FairmontCreekAOI2	To establish the study area boundary	RDEK provided.
AAFC Annual Crop Inventory	To establish a baseline land cover / land use	Annual Crop Inventory - Open Government Portal (*canada.ca*)

1 ***For more information on AAFC annual crop inventory, see:*** *Annual Crop Inventory - Open Government Portal (canada.ca)*

TABLE 1: SUMMARY OF DATA SOURCES - RDEK		
Global Man-made Impervious Surface Dataset	Informed the condition assessment	NASA *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
GeoBC Atlas Integrated Transportation Network (dgtl_road_atlas.gdb)	Used to establish road density condition variable	BC Data Catalogue *https://catalogue.data.gov.bc.ca*

The inventory project defined a total of 4,227 individual assets covering 8,094 hectares (ha) of the municipal area, as noted in Table 2. The majority of this area is forest cover.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE - RDEK			
Natural Asset Type	**Number of Assets**	**Total Area (ha)**	**Average Asset Area (ha)**
Agricaulture	52	65	1.26
Forest	1,217	7,604	6.25
Grassland	1,143	194	0.17
Shrubland	1,656	212	0.13
Water	4	0.80	0.2
Wetland	155	18	0.12
Total	**4,227**	**8,094**	**1.91**

Asset registry

MNAI gathered the data, sorted and analyzed it for relevance, and then delineated the type, location and extent of natural assets within the scoped project area. Each asset was then assigned a unique identification number to allow individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. The information pertaining to each asset was then placed into a tabular asset registry. An excerpt from the registry showing natural asset characteristics is in Table 3.

TABLE 3: EXCERPT FROM THE REGISTRY

Natural Asset Registry

AssetID	Asset Type	Asset Area (ha)	Interior Forest (%)	Adjacent Land	Permeability	Relative Size	Road Density	Total Score	Rating
414231	Forest	0.15	0	10	10	1	10	31	1 - Good
425756	Shrubland	0.26	0	10	5	1	1	17	3 - Poor
631509	Shrubland	0.11	0	10	5	1	10	26	2 - Fair
1399995	Grassland	0.04	0	10	5	1	10	26	2 - Fair
1599148	Shrubland	0.40	0	10	5	1	10	26	2 - Fair
1790713	Shrubland	0.18	0	10	5	1	10	26	2 - Fair
1824841	Forest	0.07	0	10	10	1	10	31	1 - Good
1869486	Grassland	0.18	0	10	5	1	1	17	3 - Poor
2095631	Grassland	0.15	0	10	5	1	10	26	2 - Fair
2339888	Forest	0.07	0	10	10	1	10	31	1 - Good
2378278	Grassland	0.04	0	10	5	1	10	26	2 - Fair
2984050	Shrubland	0.26	0	10	5	1	10	26	2 - Fair
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3278342	Shrubland	0.11	0	10	5	1	5	21	2 - Fair
3596041	Forest	0.11	0	10	10	1	10	31	1 - Good
3718361	Forest	0.15	0	10	10	1	1	22	2 - Fair
3776831	Shrubland	0.07	0	10	5	1	1	17	3 - Poor
4169440	Forest	0.11	0	10	10	1	1	22	2 - Fair
4323307	Grassland	0.15	0	10	5	1	10	26	2 - Fair
4340309	Shrubland	0.09	0	9	5	1	1	16	3 - Poor
4629324	Shrubland	0.15	0	10	5	1	1	17	3 - Poor
4645253	Forest	0.15	0	10	10	1	10	31	1 - Good
4748842	Forest	0.07	0	10	10	1	10	31	1 - Good
4791012	Shrubland	0.07	0	10	5	1	10	26	2 - Fair
5659953	Shrubland	0.07	0	10	5	1	1	17	3 - Poor
5933412	Shrubland	0.22	0	10	5	1	10	26	2 - Fair
6216782	Forest	0.07	0	10	10	1	1	22	2 - Fair
6524884	Grassland	0.11	0	10	5	1	10	26	2 - Fair
6717188	Grassland	0.07	0	10	5	1	1	17	3 - Poor
Total		8,094.40							

Table 3: Excerpt from the registry

Online dashboard

Inventories may provide more insights when characterised visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by asset type or condition rating. Figure 3 and Figure 4 are screen shots from the dashboard that MNAI provided to RDEK. The full version can be accessed at *https://go.greenanalytics.ca/RDEK-Windermere*.

FIGURE 3: SCREENSHOT OF MAIN INVENTORY SUMMARY

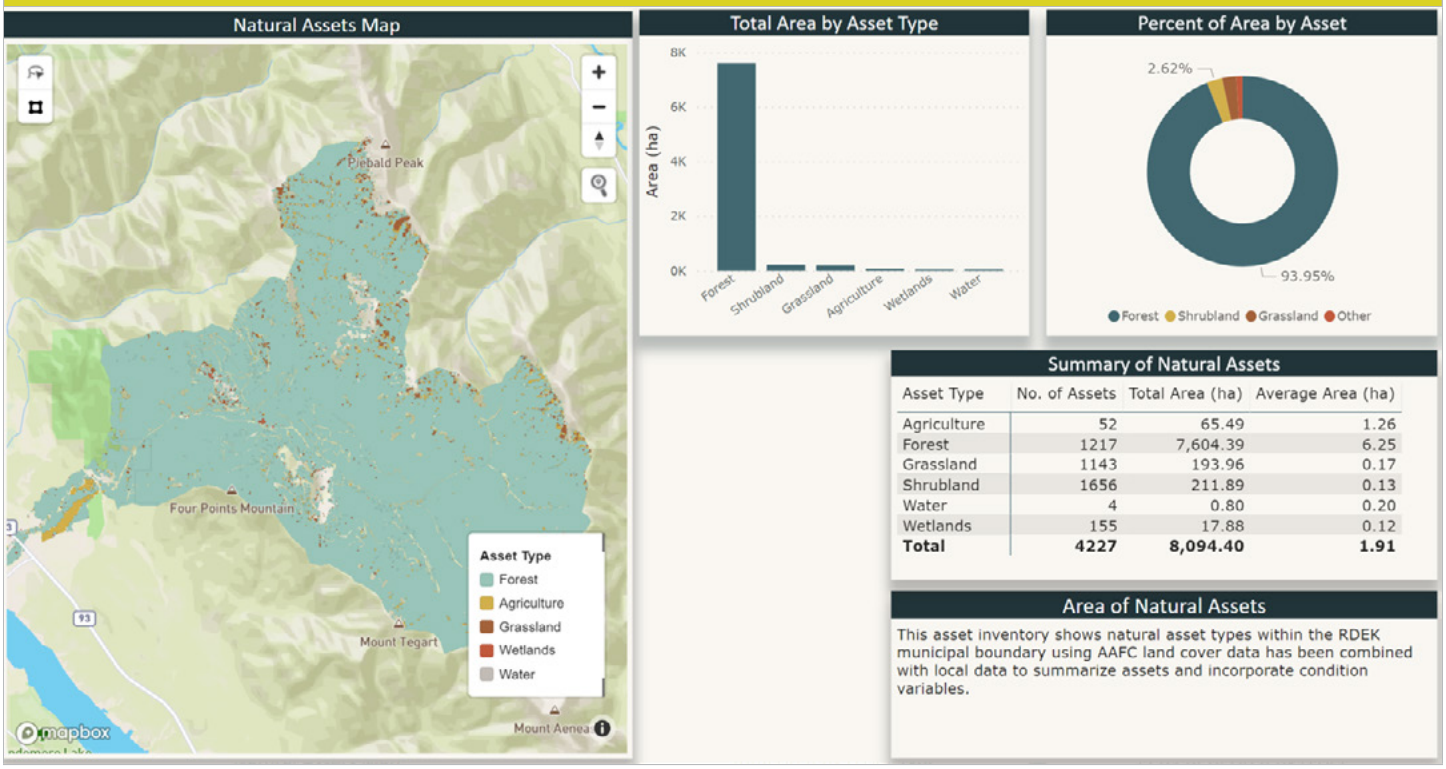

Figure 3: Screenshot of main inventory summary

Condition of natural assets

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Condition assessments vary in complexity. MNAI completed a desktop-based condition assessment for the Windermere area of RDEK and built it into the inventory to provide an initial understanding of the status of the natural assets for the municipality. The condition assessment steps and indicators are summarized in Table 4.

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - RDEK

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Relative asset size	For each natural and semi-natural asset type, total area is calculated and a rank is assigned to the assets within each class based on its percentile score. Natural assets within the top third of the ranking (e.g., the largest assets within a class) received a high (10), those within the middle third of the ranking received a medium (5), and those within the bottom third of the ranking received a low (1).	Natural asset inventory
Surface permeability	The permeability of surfaces is ranked on a scale of low to high depending on the type of landcover present. ■ Assets within impervious surfaces are assigned as low permeability. ■ Agriculture and shrublands are ranked as medium. ■ Wetlands, waterbodies and forests are ranked as high.	Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made impervious surfaces dataset from NASA. *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
Road density	Road density was determined by first establishing a 1 km² hexagonal tessellation of the study areas. Road density was then calculated for each 1km² hexagon. Natural assets within each hexagon were allocated the corresponding road density and given a condition rating of low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.	Natural asset inventory GeoBC Atlas Integrated Transportation Network

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - RDEK			
Regional District of East Kooten	**Adjacent land use intensity**	A 100m buffer is applied to each natural asset to determined what land uses surround each asset. Land use within the 100m buffer is allocated a land use intensity rating on a scale of 0 to 100 where 100 is considered the most intense land uses and 0 is natural land cover. Intensity ratings are as follows: ■ Developed = 72.5 ■ Barren (e.g., construction or mining areas) = 60 ■ Agriculture = 40 ■ Natural areas = 0 Each natural asset is assigned an adjacent land use intensity score out of 100 based on an area weighted average of the surrounding land use intensities. Adjacent land use intensity scores out of 100 are converted to a scale out of 10 by dividing the weighted average score by 10 and rounding to the nearest integer. The condition score is then calculated as 10 minus the adjusted intensity score, so that larger numbers indicated better asset condition, in line with the other indicators.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses.

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- Road density conditions are rated low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.
- Surface permeability rated as high (10), medium (5), or low (1).
- Adjacent intensive land use (scale from 0 to 10 where 10 indicates the asset is surrounded by natural areas and 0 indicates the asset is surrounded by heavily developed area).
- Relative asset size where the largest 3rd areas receive 10, 5 for middle 3rd, and 1 point for the lowest 3rd.

The total condition score was then converted into a rating scale:

- Good - assets with a score of 30 or higher
- Fair - assets with a score between 20 to 29
- Poor - assets with a score between 10 to 19
- Very Poor - assets with a score lower than 10

Figure 4 is a snapshot of the condition assessment results as presented in the inventory dashboard for Golden.

FIGURE 4: SNAPSHOT OF CONDITION ASSESSMENT DETAILS

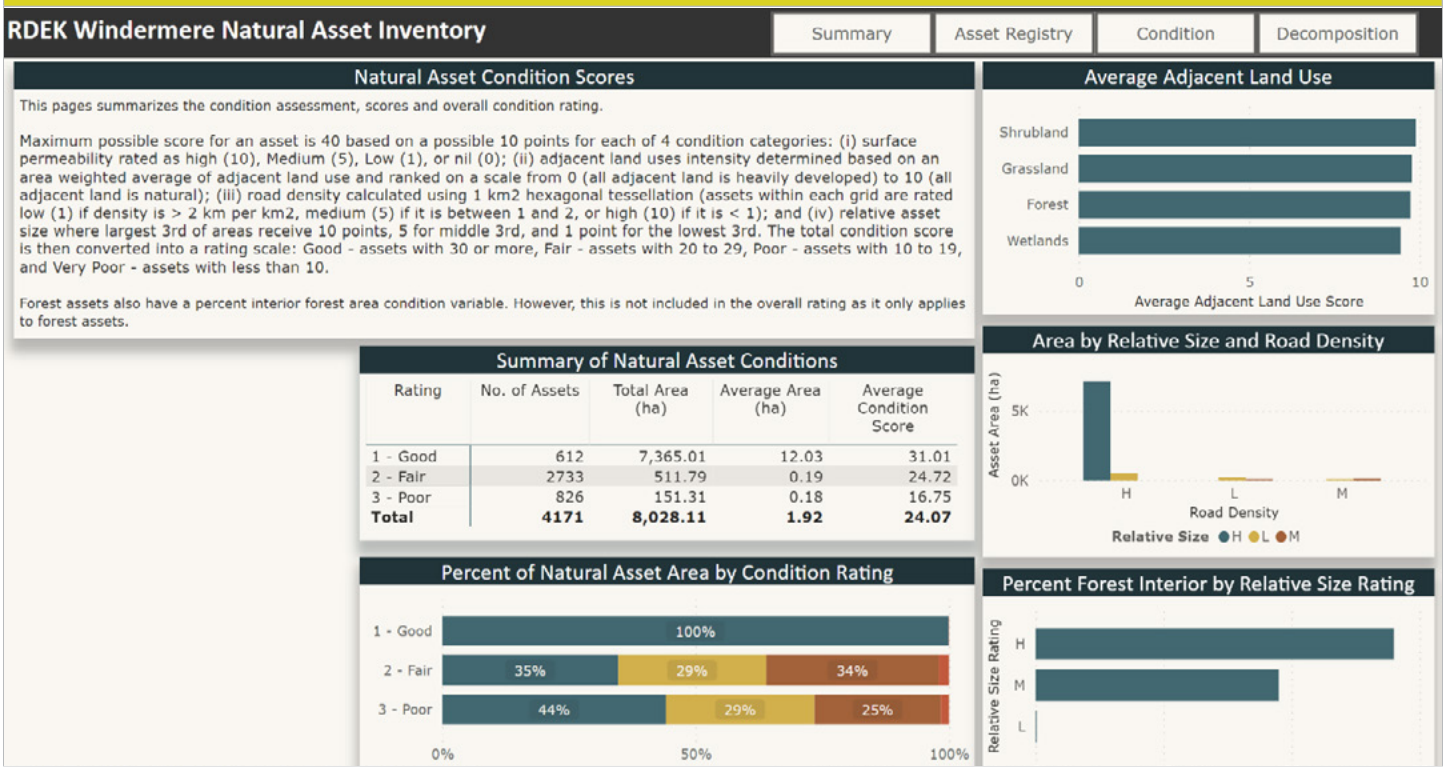


Figure 4: Snapshot of condition assessment details

Overall, about 7,365 ha (or 92 per cent) of natural assets were assessed in good condition and 512 ha (or 6 per cent) were assessed in fair condition.

Grassland, shrubland and wetland assets rated as fair and poor condition and all of the forest assets rated as good condition.

Table 5 summarizes condition ratings and Figure 5 summarizes condition by natural asset type.

TABLE 5. SUMMARY OF NATURAL ASSET CONDITION RATINGS - RDEK

Condition Rating	Number of Assets	Total Area (ha)	Average Area (ha)	Average Condition Score
1. Good	612	7,365	12.03	31
2. Fair	2,733	512	0.19	25
3. Poor	826	151	0.18	17
Total	**4,171**	**8,028**	**1.92**	**24**

FIGURE 5. SUMMARY OF CONDITION RATING BY NATURAL ASSET TYPE

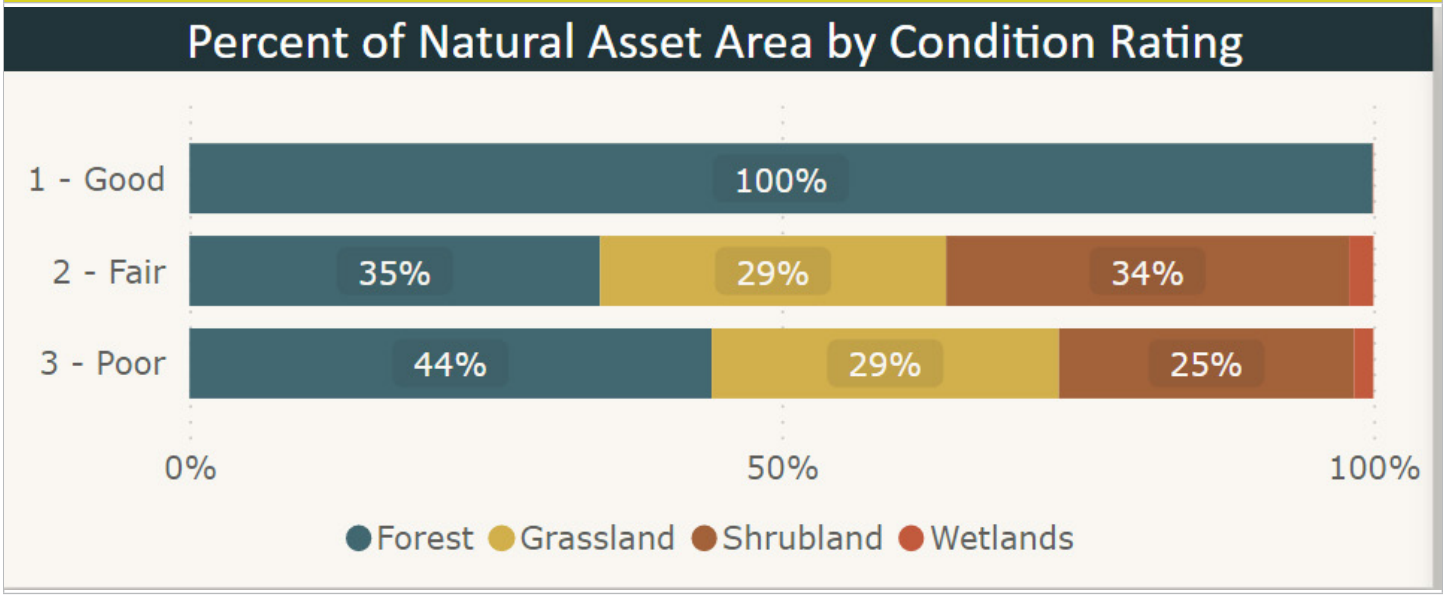


Figure 5: Summary of condition rating by natural asset type

Risk identification

Risk identification tool overview

Identifying risks facing natural assets can help local governments prioritize their management of natural assets. To this end, MNAI provides local governments with a tool entitled *Risk Identification Process in the Development of Natural Asset Inventories* and guidance to assist them in self-administering it. The results follow. Local government responses are in Annex 1.

Using the risk identification tool

Using the risk tool, RDEK considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including:

- Overuse of trails
- Flooding (current and future)
- Forest fire
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources
- Drought (current and future)
- Erosion
- Ice jams
- Lack of funding for proactive mitigation
- Absence of recent flood mapping

Each risk was then ranked low, medium or high according to the probability of an impact occurring, and the relative magnitude of its negative consequences.

Results of the risk identification process

The risk identification process revealed:

- 3 high-level risks (flooding, ice jams, and forest fires)
- 1 medium-high level risk (erosion/debris flow)
- 3 medium-level risks (invasive species, lack of funding for proactive mitigation and absence of recent flood mapping)
- 3 low-medium level risks (development pressure, pollutant loading, and drought)
- 1 low-level risk (overuse of trails)

The identified risks to natural assets impact built infrastructure, including the water treatment plant, highway, culverts, water intakes, and residences, including the RV park. They can also affect community health and safety via septic system impacts, recreational opportunities, and flooding.

FIGURE 6: RESULTS OF RISK MANAGEMENT PROCESS - GOLDEN

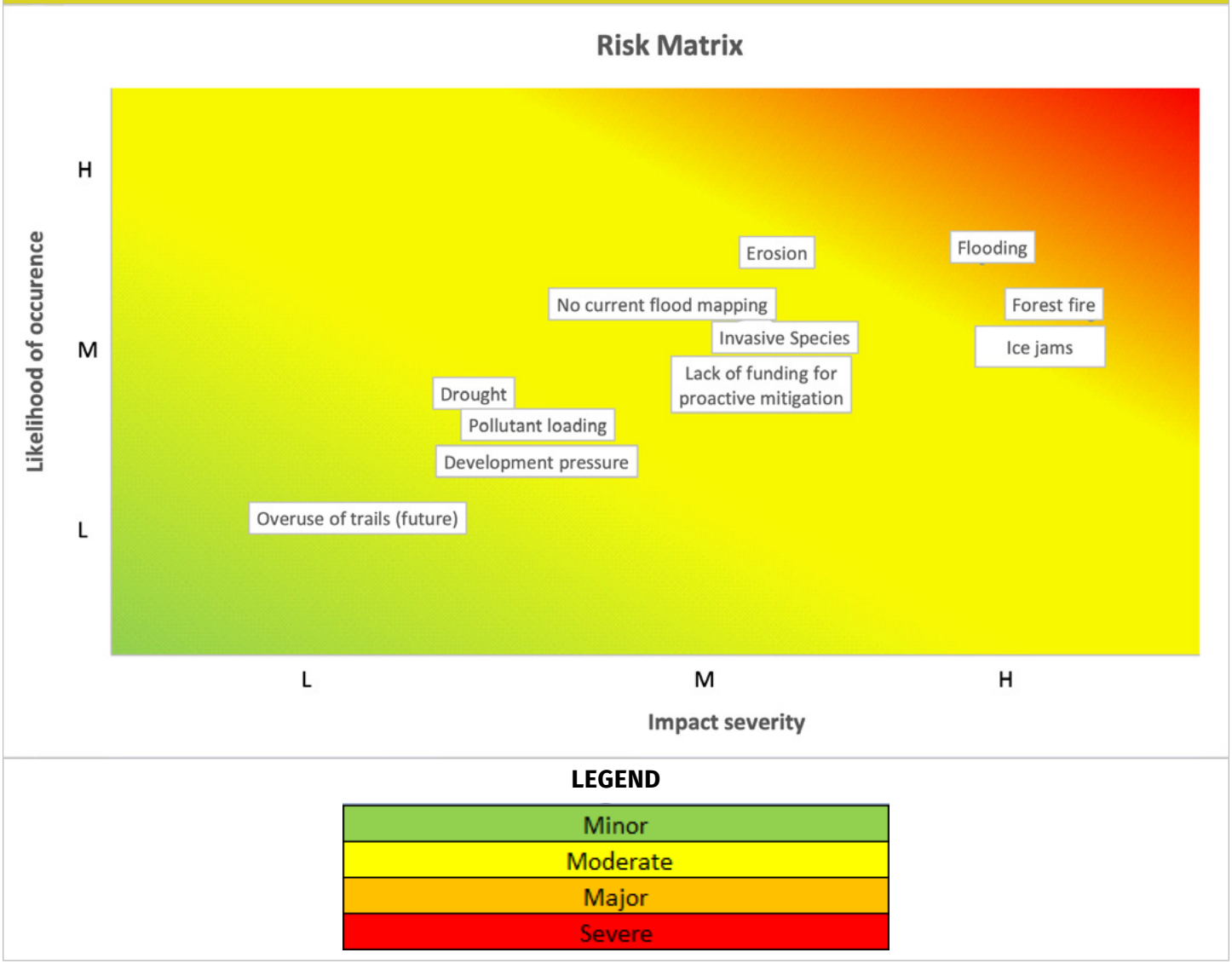


Figure 6: Snapshot of condition assessment details

Implications

This section offers insights that can be gained from considering the inventory, condition, risk and asset management readiness assessment.

Potential priorities for the local government

Potential priorities for RDEK to focus their natural asset management efforts are as follows:

- Flooding: Flooding is ranked as a high-level risk, with potential impacts to the water treatment plant, highway, residences, RV park, and agricultural areas. Restricted recreational opportunities on the lake and health impacts related to degraded water quality resulting from flooded septic systems were also cited as concerns. A full flood risk assessment is recommended that considers risk and risk dynamics, including

changes related to natural system variability, climate change, policy, governance, human activities and economic analysis.

- Ice jams: Ice jams is ranked as a high-level risk. Ice-jamming during spring break-up is a major driver of flood events, and often results in the most damaging and severe flood hazards. As such, the occurrence and impacts of ice jams should be incorporated into a full flooding risk assessment.
- Forest fire: Overall, the majority of forest assets are in good (97 per cent) condition. However, those that are degraded and in close proximity to areas of intense land uses require heightened attention. Impacts to the water treatment plant, residential areas, agricultural land, and riparian vegetation are of particular concern. RDEK has completed a community wildfire protection plan for Electoral Area F and encourages crown land management that minimizes interface fire risk and wildfire.
- Erosion/debris flow: Erosion and debris flow is ranked as a medium-high level risk related to flooding. The areas of Windermere Creek and Lake Windermere, as well as the culvert running under the highway, are noted as vulnerable to erosion and debris flow impacts.

TABLE 6: RISK MITIGATION STRATEGIES - RDEK

Accept	Risk may be acceptable if probability and consequences are small
Minimize	Risk under local government's control that warrants exposure reduction
Share	Partners in a project permit the sharing of larger risks to reduce it for each
Transfer	Insurance, fixed price contracts, and other risk transfer tools

Opportunities to strengthen natural asset management at an organization-wide level

RDEK is at an early stage of asset management. This presents numerous opportunities to integrate natural asset considerations, including the following, which are consistent with accepted asset management competency areas:

- An asset management policy that defines principles and accountabilities around which it will plan and manage its infrastructure. The policy could make reference to the importance of including natural assets as a component of core service delivery.
- A roadmap and strategy that outlines asset management priorities for the next one to three years; natural asset management priorities could be integrated to ensure they are resourced appropriately in annual budgeting.
- Establishing a cross-functional asset management team with formal terms of reference and accountabilities, including responsibilities for integrating natural asset management.

- Proactive planning and management of natural assets to ensure they are properly protected, maintained or restored to deliver core ecosystem services.

In order to develop staff capacity in natural asset management, a key next step could be to complete a staff competency review to identify required skillsets for natural asset management and to fill any essential gaps.

If RDEK wants to use the inventory as the starting place for a full natural asset management project, including implementation, then Annex 2 contains steps to consider.

Possible actions for further development of the inventory

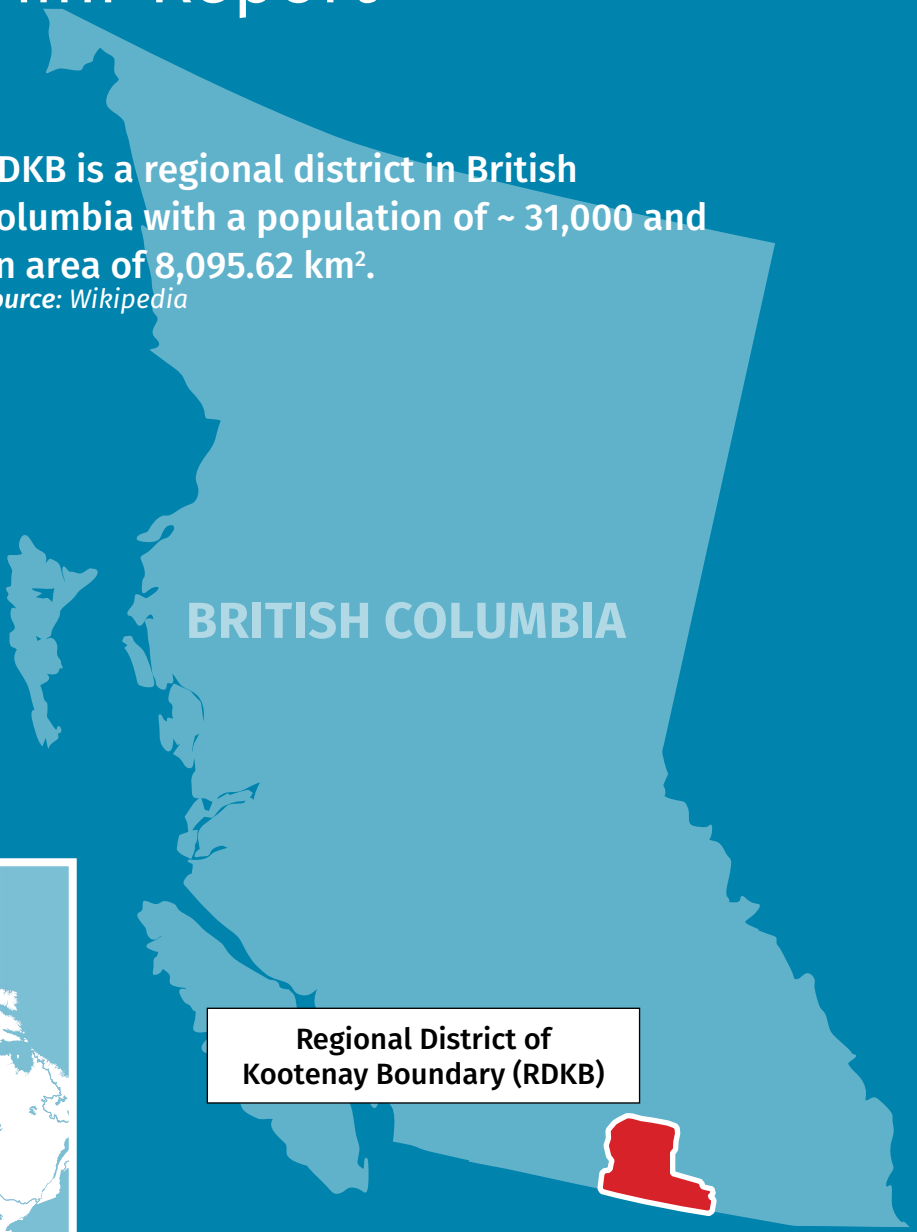
Based on the inventory, RDEK could consider the following, regardless of whether or not it pursues a full natural asset management process. These are mostly incremental measures.

- Determine acceptable levels of risk to inform RDEK's risk mitigation strategies.
- Identify linkages between services and assets, and assess the condition of, and risks to, the assets from the perspective of their ability to deliver services.
- Share the inventory to stimulate collaboration and lessons learned with adjacent local governments.
- Schedule regular updates (e.g., every 3-5 years) of the Inventory, Condition and Risk to understand trends.

Making Nature Count

Regional District of Kootenay Boundary (RDKB) Mini-Report

RDKB is a regional district in British Columbia with a population of ~ 31,000 and an area of 8,095.62 km².
Source: *Wikipedia*



Regional District of Kootenay Boundary (RDKB) Mini-Report

At the time of writing this report, RDKB had not completed a readiness assessment. Completing the assessment would enable RDKB to better understand steps it can take to ensure they integrate natural assets into asset management policies, strategies and plans.

Natural asset inventory

Inventory overview

The inventory was scoped to the RDKB district boundary. The inventory has two main components: a tabular asset registry, and an online dashboard. MNAI provided the registry as Excel data, and the dashboard in a website format. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

Inventory data

MNAI used the most recently available annual crop inventory data produced by Agriculture and Agri-Food Canada (AAFC) as baseline for land use / land cover.[1] Table 1 describes the data sources used to develop the inventory and condition assessment.

TABLE 1: SUMMARY OF DATA SOURCES - RDKB

Item	Use	Source
Regional District Boundary	To establish the study area boundary.	BC Data Catalogue *https://catalogue.data.gov.bc.ca/dataset/regional-district-boundaries-road-centreline-aligned*
Freshwater Atlas Watershed	Used to organize and aggregate natural asset information. The watershed units were treated as the primary asset.	BC Data Catalogue *https://catalogue.data.gov.bc.ca/dataset/freshwater-atlas-watersheds*

1 ***For more information on AAFC annual crop inventory, see:*** *Annual Crop Inventory - Open Government Portal (canada.ca)*

TABLE 1: SUMMARY OF DATA SOURCES - RDKB		
AAFC Annual Crop Inventory	To establish a baseline land cover / land use.	Annual Crop Inventory - Open Government Portal (*canada.ca*)
VRI – 2020 – Forest Vegetation Composite Polygons	Used to establish which forest areas have been harvested within the last 5 years.	BC Data Catalogue *https://catalogue.data.gov.bc.ca/dataset/vri-2020-forest-vegetation-composite-polygons*
GeoBC Atlas Integrated Transportation Network (dgtl_road_atlas.gdb)	Used to establish road density condition variable.	BC Data Catalogue *https://catalogue.data.gov.bc.ca*

The inventory project defined a total of 926,389 hectares (ha) of assets, as noted in Table 2. The vast majority of this is forest cover, followed by shrublands.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE - RDKB	
Natural Asset Type	**Total Area (ha)**
Forest	688,417
Shrubland	60,888
Grassland	10,032
Water	5,072
Agriculture	4,087
Wetland	1,803
Total	**926,389**

Asset registry

MNAI gathered the data, sorted and analyzed it for relevance, and then delineated the type, location and extent of natural assets within the scoped project area. Each asset was then assigned a unique identification number to allow individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. The information pertaining to each asset was then placed into a tabular asset registry. An excerpt from the registry showing natural asset characteristics is in Table 3.

TABLE 3: XCERPT OF NATURAL ASSET REGISTRY FOR RDKB

WTRSHD_FID	Name	Area (ha)	Road Length (m)	Road Density	Forest Area (ha)	Percent Interior Forest	Pecent Harvested	Percent Developed	Percent Natural	Total Score	Rating
5670		3,810.79	138,995.06	0.00	3,302.19	32.80	0.00	0.78	93.87	32.4	1 - Good
5671	Christina Creek	764.70	19,629.93	0.00	663.65	29.43	0.00	5.99	90.78	32.1	1 - Good
5672	Moody Creek	2,199.83	70,202.57	0.00	1,849.25	31.74	0.00	2.53	93.51	32.4	1 - Good
5673	Sutherland Creek	5,766.44	104,116.40	0.00	5,333.71	33.11	0.08	0.83	96.59	27.7	2 - Fair
5674	Italy Creek	3,551.70	69,571.96	0.00	3,358.96	33.23	0.32	0.01	97.06	27.7	2 - Fair
5675	McRae Creek	7,504.69	123,495.46	0.00	6,493.56	32.57	1.24	0.53	97.20	27.7	2 - Fair
5676	McRae Creek	3,955.57	79,011.17	0.00	3,520.64	33.03	0.00	0.45	96.41	32.6	1 - Good
5677	Texas Creek	4,509.68	3,998.88	0.00	4,082.95	33.01	0.72	0.06	99.56	28	2 - Fair
5678	Sandner Creek	8,109.81	8,491.54	0.00	7,219.88	32.72	0.00	0.00	99.06	32.9	1 - Good
5679	Christina Creek	8,546.74	167,270.67	0.00	7,460.90	32.47	0.00	1.00	96.42	32.6	1 - Good
5680	Christina Lake	2,564.07	1,276.48	0.00	28.49	25.26	0.00	0.64	99.25	32.9	1 - Good
5681		4,805.61	57,900.92	0.00	4,226.28	32.68	0.00	2.94	95.37	32.5	1 - Good
5682	Granby River	5,338.52	159,507.83	0.00	3,853.20	28.48	0.00	8.40	81.69	31.2	1 - Good
5683	Sand Creek	2,123.11	52,869.89	0.00	1,899.17	32.46	0.00	0.98	95.44	32.5	1 - Good
5684	Fisherman Creek	2,140.43	78,081.27	0.00	1,837.10	32.80	0.00	1.51	93.07	32.3	1 - Good
5685	Snowball Creek	2,624.34	52,518.89	0.00	2,447.20	32.74	0.00	0.47	96.92	32.7	1 - Good
5686	Brown Creek	2,918.52	86,231.03	0.00	2,467.76	32.57	0.00	1.58	90.09	32	1 - Good
5687	Pass Creek	8,170.00	157,284.96	0.00	7,024.81	32.76	0.00	0.35	95.82	32.6	1 - Good
5688	Miller Creek	3,934.10	65,920.39	0.00	3,684.21	33.09	0.90	0.07	97.50	27.8	2 - Fair
5689	Lynch Creek	5,099.73	37,712.72	0.00	4,785.53	33.12	0.00	0.01	98.24	32.8	1 - Good
5690	Morrell Creek	5,480.63	0.00	0.00	5,204.34	33.10	0.00	0.00	99.91	33	1 - Good
5691		2,424.89	0.00	0.00	2,333.59	33.23	0.00	0.00	99.39	32.9	1 - Good
5692	Lynch Creek	5,249.58	7.28	0.00	4,979.31	33.20	0.01	0.00	99.27	27.9	2 - Fair
5693	Kennedy Creek	3,948.22	68,905.44	0.00	3,603.72	32.83	0.00	0.11	97.35	32.7	1 - Good
5694	Almond Creek	5,606.76	75,541.38	0.00	5,045.65	32.96	0.00	0.00	97.38	32.7	1 - Good
5695	Gibbs Creek	3,059.09	39,895.08	0.00	2,792.36	32.80	0.00	0.00	97.85	32.8	1 - Good
5696	Burrell Creek	5,483.77	136,678.33	0.00	4,849.20	32.96	0.35	0.20	94.76	27.5	2 - Fair
5697	Knappen Creek	3,207.27	53,233.13	0.00	3,037.00	33.19	3.15	0.00	97.83	27.8	2 - Fair
5698	Savage Creek	2,285.73	24,858.18	0.00	2,149.71	32.94	0.00	0.00	98.91	32.9	1 - Good
5699	Bluejoint Creek	5,064.19	54,953.09	0.00	4,641.34	32.55	2.33	0.00	95.80	27.6	2 - Fair

rosoft Power BI 2 of 4

Table 3: Excerpt of natural asset registry for RDKB

Online dashboard

Inventories may provide more insights when characterised visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by watershed area, or, if users want to dive into the specifics of forest assets, they can quickly filter the data to focus on that particular asset. Figure 3 and Figure 4 are screen shots from the dashboard that MNAI provided to RDKB. The full version can be accessed at *https://go.greenanalytics.ca/RDKB*.

FIGURE 3: SCREENSHOT OF MAIN INVENTORY SUMMARY

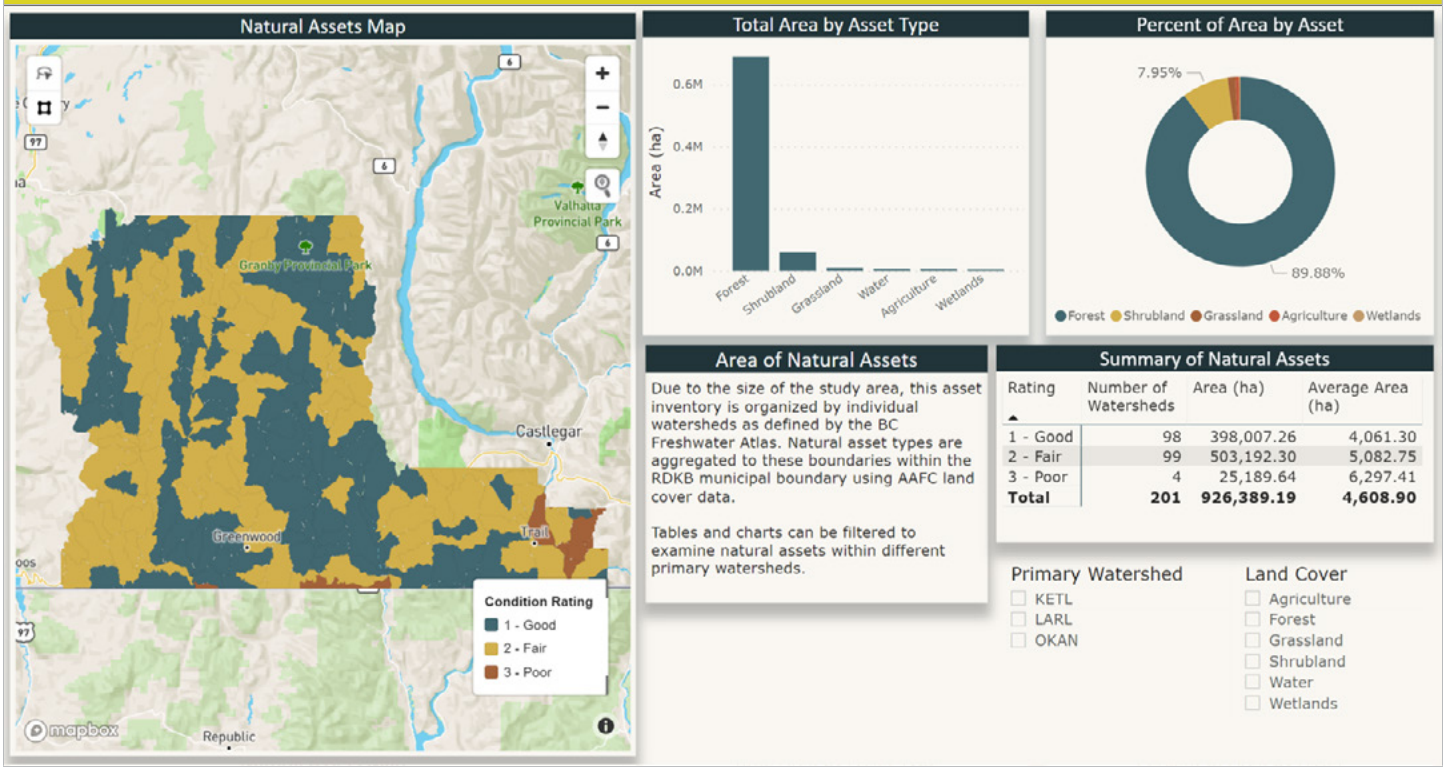


Figure 3: Screenshot of main inventory summary

Condition of natural assets

Condition assessments are key aspect of natural asset inventories as they provide an understanding of both the ecological health of natural assets and their ability to provide services. This information can be reflected in the registry and the dashboard, updated over time, and helps local governments with management decisions.

Condition assessments vary in complexity. MNAI completed a desktop-based condition assessment for RDKB and built it into the inventory to provide an initial understanding of the status of the natural assets for the municipality. The condition assessment steps and indicators are summarized in Table 4.

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - GOLDEN

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Percent Natural	The percent natural cover within each watershed asset area. Measured as the area of natural assets (e.g., forest, wetlands, shrubland) divided by the total area of the watershed.	Natural asset inventory

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - GOLDEN		
Percent Impervious	The percent impervious cover within each watershed asset area. Measured as the area of Impervious area (e.g., developed areas, roads) divided by the total area of the watershed.	Natural asset inventory.
Percent Interior Forest	The percent of interior forest area relative to total forest area within each watershed asset area. Interior forest is considered any forest area within a 100m inward buffer of forest edge. The indicated is measured as the area of interior area divided by the total forest area of each watershed.	Natural asset inventory.
Percent of forest harvested within the last 5 years	Any forest stand that was indicated as having been harvested in 2015 or later was extracted from the VRI dataset and linked to associated natural assets. The indicator is measured as area of forest harvest since 2015 divided by the total area of forest within each watershed.	VRI Data

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- **Natural area:** percent natural area within each watershed (points are allocated based on 1 point for every 10% natural and rounded to the nearest integer).
- **Impervious area:** percent impervious land use area within each watershed (0 points if impervious area is > 20% of watershed, 5 points if > 10%, and 10 points if < 10%).
- **Interior Forest:** percent interior forest area relative to total forest area (points are allocated based on 1 point for every 10% of interior forest area and rounded to the nearest integer).
- **Recently harvested:** percent of Forest Harvested in the last 5 years (0 points if area recently harvested is > 10% of forest area, 5 points if < 10%, and 10 points if no harvesting occurred).

The total condition score was then converted into a rating scale:

- Good - assets with a score of 30 or higher
- Fair - assets with a score between 20 to 29
- Poor - assets with a score between 10 to 19
- Very Poor - assets with a score lower than 10

Figure 4 is a snapshot of the condition assessment results as presented in the inventory dashboard for Golden.

FIGURE 4: SNAPSHOT OF CONDITION ASSESSMENT DETAILS

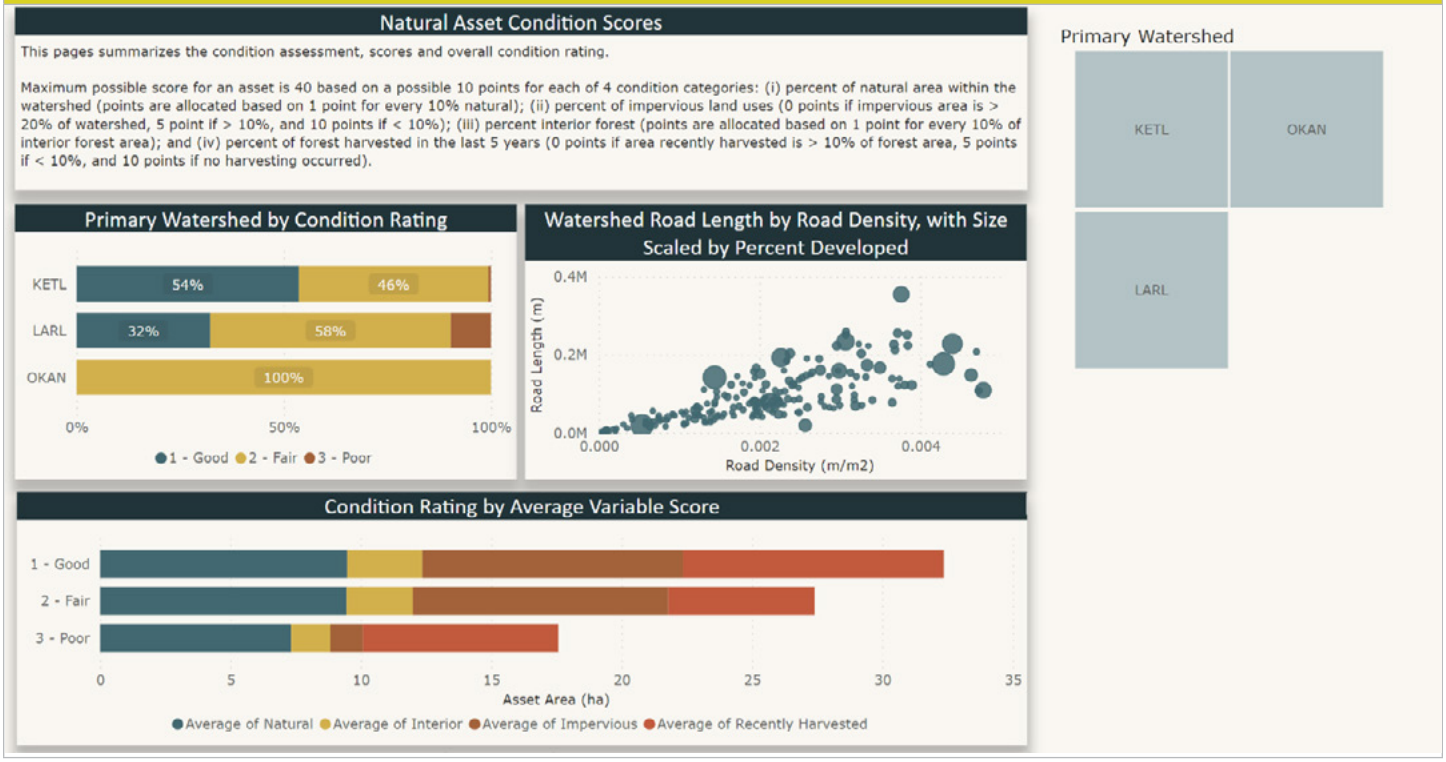


Figure 4: Snapshot of condition assessment details

About 398,007 ha (or 43 per cent) of natural assets were assessed in good condition and 503,192 ha (or 54 per cent) were assessed in fair condition.

Table 5 summarizes condition rating for RDKBs.

TABLE 5. SUMMARY OF NATURAL ASSET CONDITION RATINGS - RDKB

Condition Rating	Area (ha)
1. Good	398,007
2. Fair	503,192
3. Poor	25,198
Total	**926,389**

Risk identification

At the time of writing, RDKB had not completed the risk identification.

Implications

This section offers insights that can be gained from considering the inventory, condition, risk, and asset management readiness assessment. However, since the risks and readiness assessments were not available at the time of writing, it was not possible to complete this section.

Making Nature Count

City of Rossland
Mini-Report

Rossland is a city in the West Kootenay region of south central British Columbia with a population of approximately 3,700.

Source: *Wikipedia*

City of Rossland Mini-Report

The City of Rossland's asset management readiness assessment indicates it has made significant progress in asset management and is well on its way towards embedding it as an organization-wide business process that is applied consistently across different service areas. The assessment also indicates asset management is well aligned with, and informed by, overall organizational policy objectives. Rossland is at an early stage in integrating natural asset management considerations into these processes.

Rossland's cross-functional asset management team includes planning and finance staff that lead, communicate, and support improvements to natural asset management and are working on championing its incorporation into core asset management (AM) practices. Rossland is in the process of making its council aware of the resourcing and funding needed to incorporate natural asset management into the AM system requirements and roadmap.

Natural asset inventory

Inventory overview

The inventory was scoped to the Rossland municipal district boundary. The inventory has two main components: a tabular asset registry and an online dashboard. MNAI provided the registry as Excel data, and the dashboard in a website format. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

Inventory data

MNAI used the most recently available annual crop inventory data produced by Agriculture and Agri-Food Canada (AAFC) as baseline for land use / land cover [1] and combined this with data Rossland provided to depict the natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment.

1 ***For more information on AAFC annual crop inventory, see:*** *Annual Crop Inventory - Open Government Portal (canada.ca)*

TABLE 1: SUMMARY OF DATA SOURCES - ROSSLAND		
Item	**Use**	**Source**
Rossland Boundary	To establish the study area boundary.	Rossland provided.
AAFC Annual Crop Inventory	To establish a baseline land cover / land use.	Annual Crop Inventory - Open Government Portal (*canada.ca*)
Rossland Wetlands	Used to improve the land cover / land use of the AAFC by prioritizing local wetland data in the asset inventory.	Rossland provided.
Rossland OCP Designation	To define what land use activities are permitted around defined natural assets.	Rossland provided.
Soil Survey	To define primary, secondary, and tertiary soil types for each natural asset.	Rossland provided.
Global Man-made Impervious Surface Dataset	Informed the condition assessment.	NASA *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
GeoBC Atlas Integrated Transportation Network (dgtl_road_atlas.gdb)	Used to establish road density condition variable.	BC Data Catalogue *https://catalogue.data.gov.bc.ca*

The inventory project defined a total of 4,299 individual assets covering 5,429 hectares (ha) of the municipal area, as noted in Table 2. The majority of this area is forest cover, followed by shrubland.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE - ROSSLAND			
Natural Asset Type	**Number of Assets**	**Total Area (ha)**	**Average Asset Area (ha)**
Forest	1,465	4,606	3.14
Grassland	88	31	0.35
Greenspace	63	80	1.27
Shrubland	2,378	675	0.28
Water	23	6	0.27
Wetland	282	31	0.11
Total	**4,299**	**5,429**	**1.26**

Asset registry

MNAI gathered the data, sorted and analyzed it for relevance, and then delineated the type, location and extent of natural assets within the scoped project area. Each asset was then assigned a unique identification number to allow individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. The information pertaining to each asset was then placed into a tabular asset registry. An excerpt from the registry showing natural asset characteristics is in Table 3.

TABLE 3: ROSSLAND NATURAL ASSET REGISTRY

Natural Asset Registry

AssetID	Asset Type	Forest Type	Primary Soil Type	Area (ha)	OCP Designation	Permeability	Relative Size	Road Density	Adjacent Land Use	Condition Score	Rating
272734	Shrubland	NA	BOHAN CREEK	3.03	Resort Residential	5	1	1	10	17	3 - Poor
353505	Shrubland	NA	SLOCAN	0.13	Resource Management Area	5	1	5	9	20	3 - Poor
564047	Forest	Coniferous	BEATRICE	0.09	Resource Management Area	10	1	10	10	31	1 - Good
694132	Shrubland	NA	BUHL CREEK	0.18	Resource Management Area	5	1	1	10	17	3 - Poor
707494	Forest	Broadleaf	BOHAN CREEK	0.07	Resort Recreation	10	1	1	10	22	2 - Fair
878737	Forest	Coniferous	BOHAN CREEK	0.06	Rural Residential	10	1	1	5	17	3 - Poor
881135	Forest	Broadleaf	SLOCAN	0.06	Resource Management Area	10	1	5	10	26	2 - Fair
1046358	Forest	Coniferous	SENTINEL	0.01	Resort Recreation	10	1	10	6	27	2 - Fair
1104384	Shrubland	NA	SLOCAN	0.06	Resource Management Area	5	1	5	10	21	2 - Fair
1160312	Greenspace	NA	SENTINEL	10.61	Resort Residential	0	5	10	4	19	3 - Poor
1507667	Shrubland	NA	BUHL CREEK	1.17	Resource Management Area	5	1	10	10	26	2 - Fair
1659507	Shrubland	NA	SLOCAN	0.06	Resource Management Area	5	1	10	10	26	2 - Fair
1928415	Forest	Coniferous	BUHL CREEK	0.09	Resource Management Area	10	1	5	10	26	2 - Fair
2492889	Forest	Broadleaf	BUHL CREEK	0.09	Resource Management Area	10	1	1	10	22	2 - Fair
2576893	Forest	Coniferous	SENTINEL	0.43	Residential	10	1	1	9	21	2 - Fair
2617321	Shrubland	NA	BOHAN CREEK	0.19	Resource Management Area	5	1	10	10	26	2 - Fair
2951964	Wetland	NA	SENTINEL	0.02	Parks, Trails & Open Space	10	1	1	6	18	3 - Poor
3357500	Forest	Broadleaf	BUHL CREEK	0.09	Resource Management Area	10	1	10	10	31	1 - Good
3555947	Forest	Coniferous	SLOCAN	0.10	Resource Management Area	10	1	5	10	26	2 - Fair
3956152	Wetland	NA	BOHAN CREEK	0.10	Resort Recreation	10	1	1	9	21	2 - Fair
4261479	Shrubland	NA	BOHAN CREEK	0.71	Institutional / Public Lands	5	1	5	10	21	2 - Fair
4590911	Shrubland	NA	BOHAN CREEK	0.12	Resource Management Area	5	1	5	10	21	2 - Fair
4771176	Forest	Mixedwood	BOHAN CREEK	0.06	Resort Recreation	10	1	1	10	22	2 - Fair
5064843	Shrubland	NA	BEATRICE	0.06	Resource Management Area	5	1	1	10	17	3 - Poor
5310049	Shrubland	NA	SENTINEL	0.01	Residential	5	1	10	7	23	2 - Fair
5401840	Forest	Coniferous	SENTINEL	0.08	Residential	10	1	1	6	18	3 - Poor
5949637	Shrubland	NA	SLOCAN	0.60	Resource Management Area	5	1	5	10	21	2 - Fair
6217374	Forest	Coniferous	SENTINEL	0.76	Residential	10	1	1	5	17	3 - Poor
6690088	Forest	Broadleaf	BOHAN CREEK	0.06	Resource Management Area	10	1	10	10	31	1 - Good
Total				**5,429.11**							

Table 3: Screenshot of main inventory registry

Online dashboard

Inventories may provide more insights when characterised visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by zoning designation, or, if users want to dive into the specifics of forest assets, they can quickly filter the data to focus on that particular asset. Figure 3 and Figure 4 are screen shots from the dashboard that MNAI provided to Rossland. The full version can be accessed at *https://go.greenanalytics.ca/rossland*.

FIGURE 3: SCREENSHOT OF MAIN INVENTORY SUMMARY

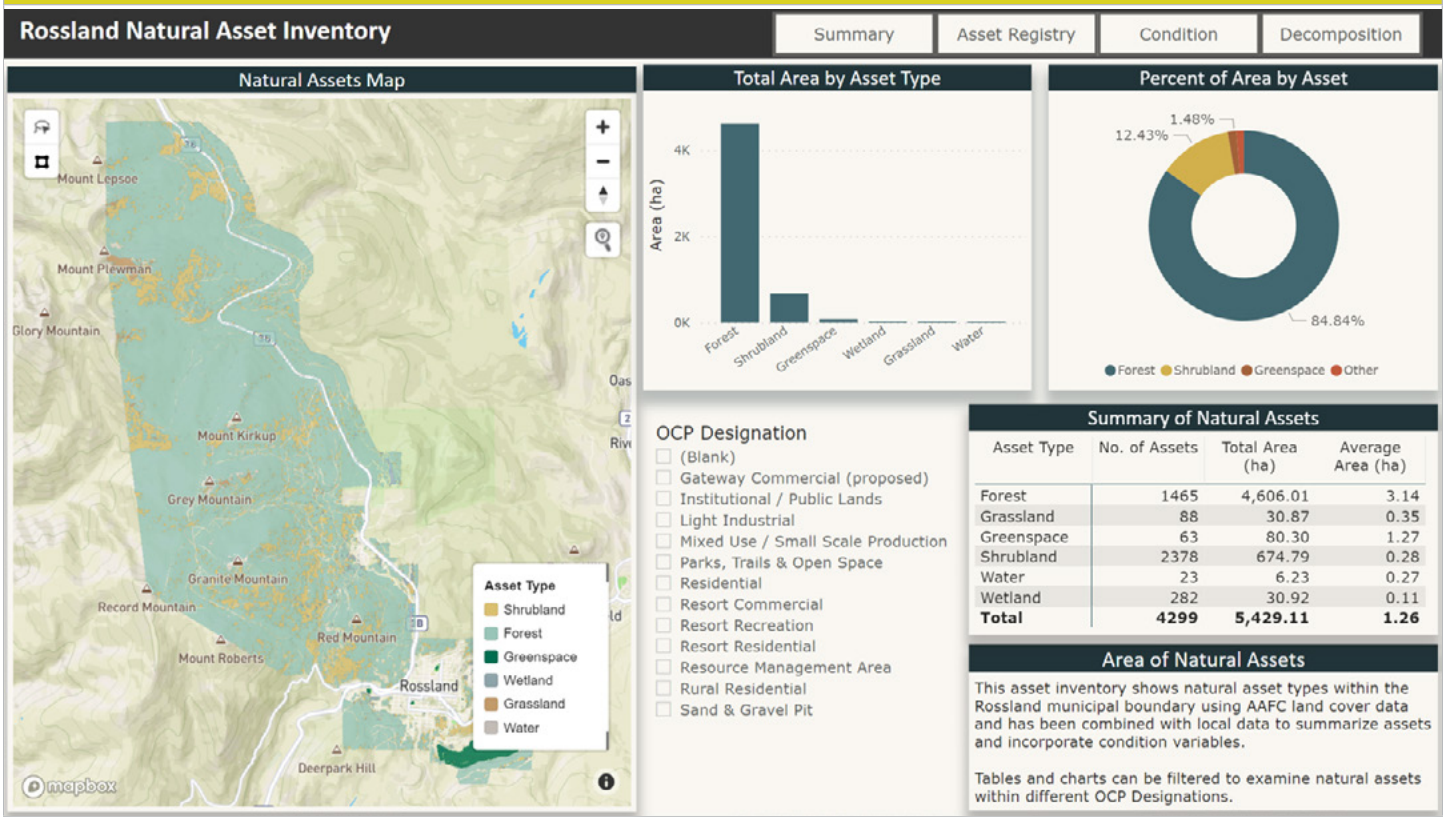


Figure 3: Screenshot of main inventory summary

Condition of natural assets

Condition assessments are key aspect of natural asset inventories as they provide an understanding of both the ecological health of natural assets and their ability to provide services. This information can be reflected in the registry and the dashboard, updated over time, and helps local governments with management decisions.

Condition assessments can vary in complexity. MNAI completed a desktop-based condition assessment for Rossland and built it into the inventory to provide an initial understanding of the status of the natural assets for the municipality. The condition assessment steps and indicators are summarized in Table 4.

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - ROSSLAND

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Relative asset size	For each natural and semi-natural asset type, total area is calculated and a rank is assigned to the assets within each class based on its percentile score. Natural assets within the top third of the ranking (e.g., the largest assets within a class) received a high (10), those within the middle third of the ranking received a medium (5), and those within the bottom third of the ranking received a low (1).	Natural asset inventory
Surface permeability	The permeability of surfaces is ranked on a scale of low to high depending on the type of landcover present. ■ Assets within impervious surfaces are assigned as low permeability. ■ Agriculture and shrublands are ranked as medium. ■ Wetlands, waterbodies and forests are ranked as high.	Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made impervious surfaces dataset from NASA. *https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*
Road density	Road density was determined by first establishing a 1 km2 hexagonal tessellation of the study areas. Road density was then calculated for each 1km2 hexagon. Natural assets within each hexagon were allocated the corresponding road density and given a condition rating of low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.	Natural asset inventory GeoBC Atlas Integrated Transportation Network

TABLE 4. CONDITION ASSESSMENT APPROACH AND INDICATORS - ROSSLAND		
Adjacent land use intensity	A 100m buffer is applied to each natural asset to determined what land uses surround each asset. Land use within the 100m buffer is allocated a land use intensity rating on a scale of 0 to 100 where 100 is considered the most intense land uses and 0 is natural land cover. Intensity ratings are as follows: ■ Developed = 72.5 ■ Barren (e.g., construction or mining areas) = 60 ■ Agriculture = 40 ■ Natural areas = 0 Each natural asset is assigned an adjacent land use intensity score out of 100 based on an area weighted average of the surrounding land use intensities. Adjacent land use intensity scores out of 100 are converted to a scale out of 10 by dividing the weighted average score by 10 and rounding to the nearest integer. The condition score is then calculated as 10 minus the adjusted intensity score, so that larger numbers indicated better asset condition, in line with the other indicators.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses.

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- Road density conditions are rated low (1) if density is > 2 km per km², medium (5) if it is between 1 and 2, or high (10) if it is < 1.
- Surface permeability rated as high (10), medium (5), or low (1).
- Adjacent intensive land use (scale from 0 to 10 where 10 indicates the asset is surrounded by natural areas and 0 indicates the asset is surrounded by heavily developed area).
- Relative asset size where the largest 3rd areas receive 10, 5 for middle 3rd, and 1 point for the lowest 3rd.

The total condition score was then converted into a rating scale:

- Good - assets with a score of 30 or higher
- Fair - assets with a score between 20 to 29
- Poor - assets with a score between 10 to 19
- Very Poor - assets with a score lower than 10

Figure 4 summarizes the condition assessment as presented in Rossland's natural asset inventory dashboard.

FIGURE 4: SNAPSHOT OF CONDITION ASSESSMENT DETAILS

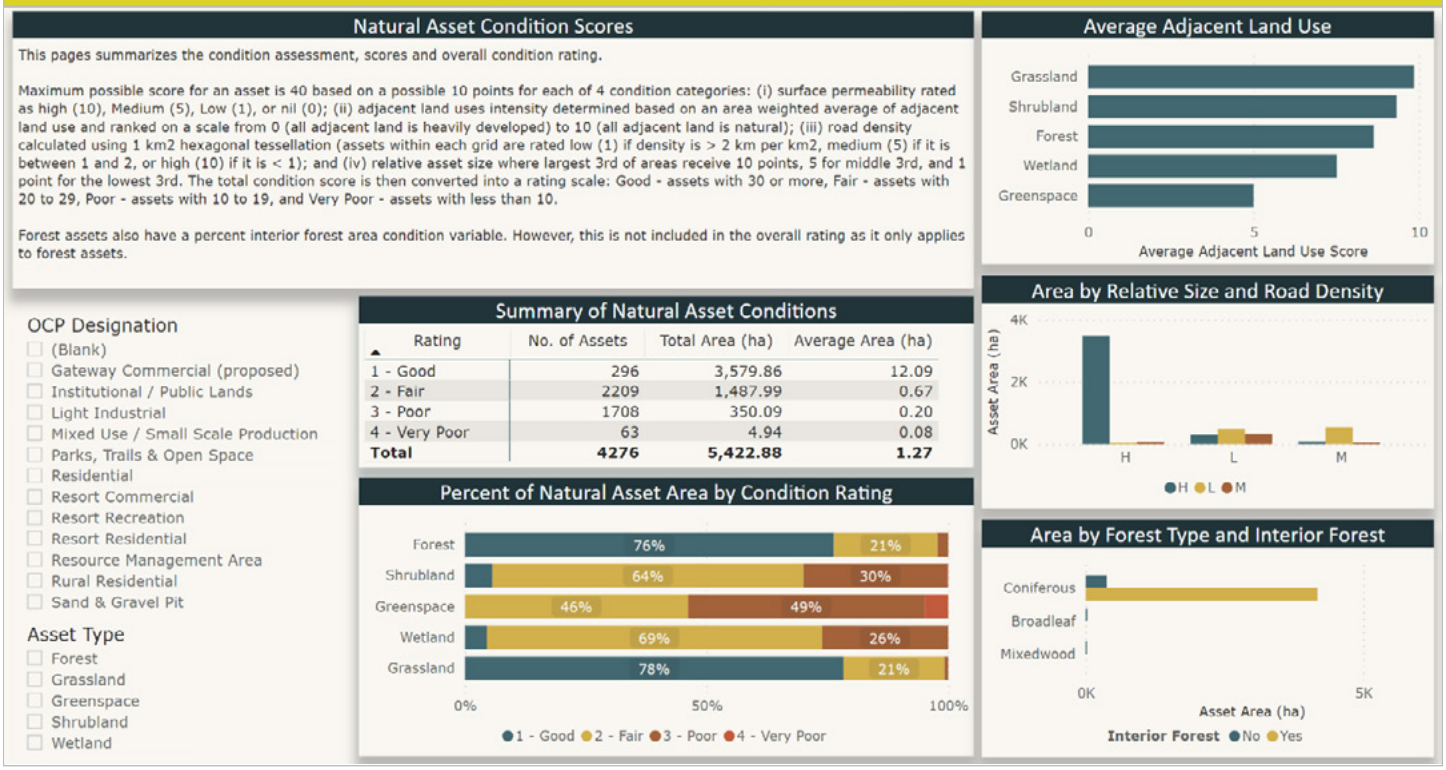


Figure 4: Snapshot of condition assessment details

About 3,580 ha (or 66 per cent) of natural assets were assessed in good condition and 1,488 ha (or 27 per cent) were assessed in fair condition.

Greenspace, shrubland and wetland assets were largely rated fair and poor. This is due to a combination of these assets being in close proximity to intense land uses and being relatively small in size. Note, however, that these assets only account for a small portion of the overall natural asset area (about 14 per cent when combined).

The forest assets are generally in good (76 per cent of forest assets) condition or fair (21 per cent of forest assets) condition. The forest assets in poor condition are due to being next to relatively more intense land uses and being relatively small in size.

Table 5 summarizes condition ratings and Figure 5 summarizes condition by natural asset type.

TABLE 5. SUMMARY OF NATURAL ASSET CONDITION RATINGS - GOLDEN

Condition Rating	Number of Assets	Total Area (ha)	Average Total Score
1. Good	296	3,580	12.09
2. Fair	2,209	1,488	0.67
3. Poor	1,708	350	0.20
4. Very Poor	63	5	0.08
Total	**4,276**	**5,423**	**1.27**

FIGURE 5. SUMMARY OF CONDITION RATING BY NATURAL ASSET TYPE

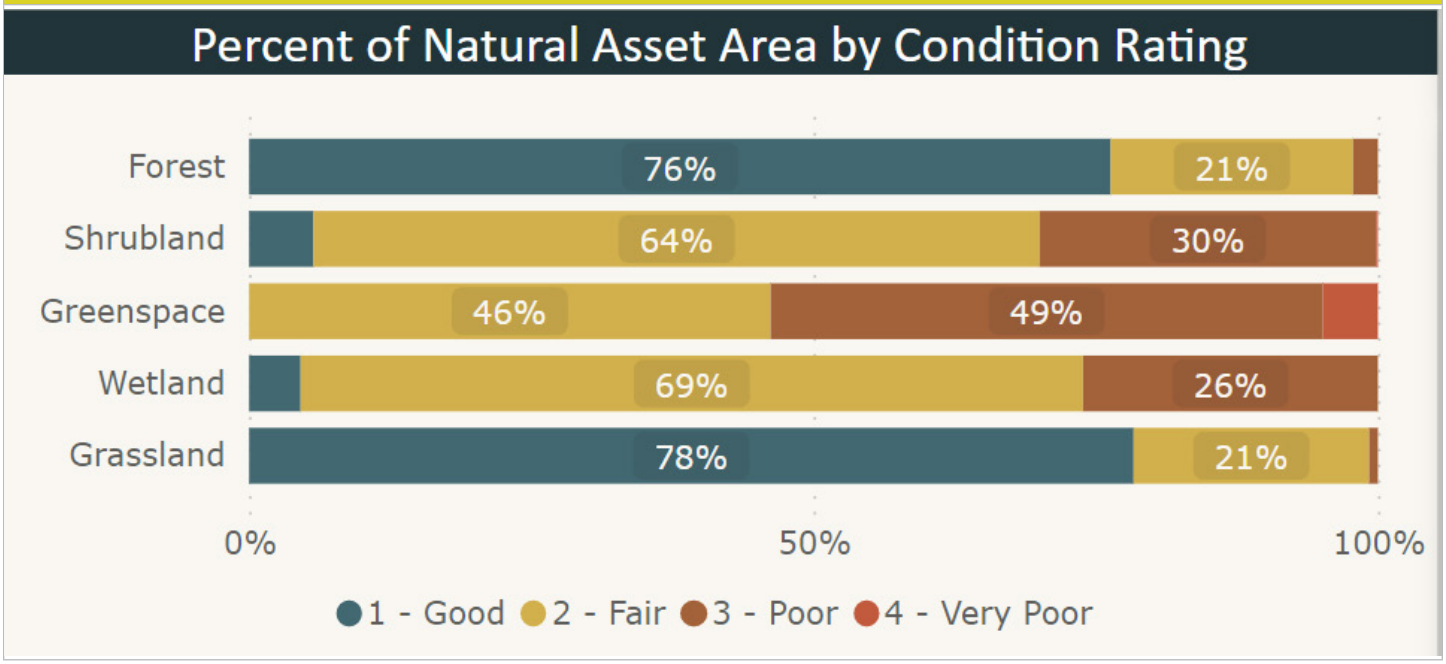


Figure 5: Summary of condition rating by natural asset type

Risk identification

Risk identification tool overview

Identifying risks facing natural assets can help local governments prioritize their management of natural assets. To this end, MNAI provides local governments with a tool entitled *Risk Identification Process in the Development of Natural Asset Inventories* and guidance to assist them in self-administering it. The results follow. Local government responses are in Annex 1.

Using the risk identification tool

Using the risk tool, Rossland considered risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including:

- Overuse of trails
- Dumping
- Flooding (current and future)
- Forest fire
- Invasive species
- Recreational pressure
- Development pressure
- Industrial activity (forestry/mining)
- Pollutant loading from urban, agricultural, or industrial sources (e.g., overuse of salt on roads)
- Drought (current and future)
- Erosion
- Ice jams
- Storm surge
- Construction activity
- Political policy change

MNAI then placed each risk in a risk matrix and positioned it according to the probability of an impact occurring and the relative magnitude of its negative consequences (see Figure 6).

Results of the risk identification process

The risk identification process revealed:

- 6 high-level risks (forest fire, invasive species, pollutant loading, drought, political policy change, and construction activity)
- 6 medium-level risks (overuse of trails, flooding, recreational pressure, development pressure, industrial activity and erosion)
- 1 low-level risk (dumping)

The identified risks affect natural assets across municipal areas, trails, and riparian zones. Rossland has also provided cues, or indicators, for rising risk, as well as the size of risk zones.

FIGURE 6: RESULTS OF RISK MANAGEMENT PROCESS - ROSSLAND

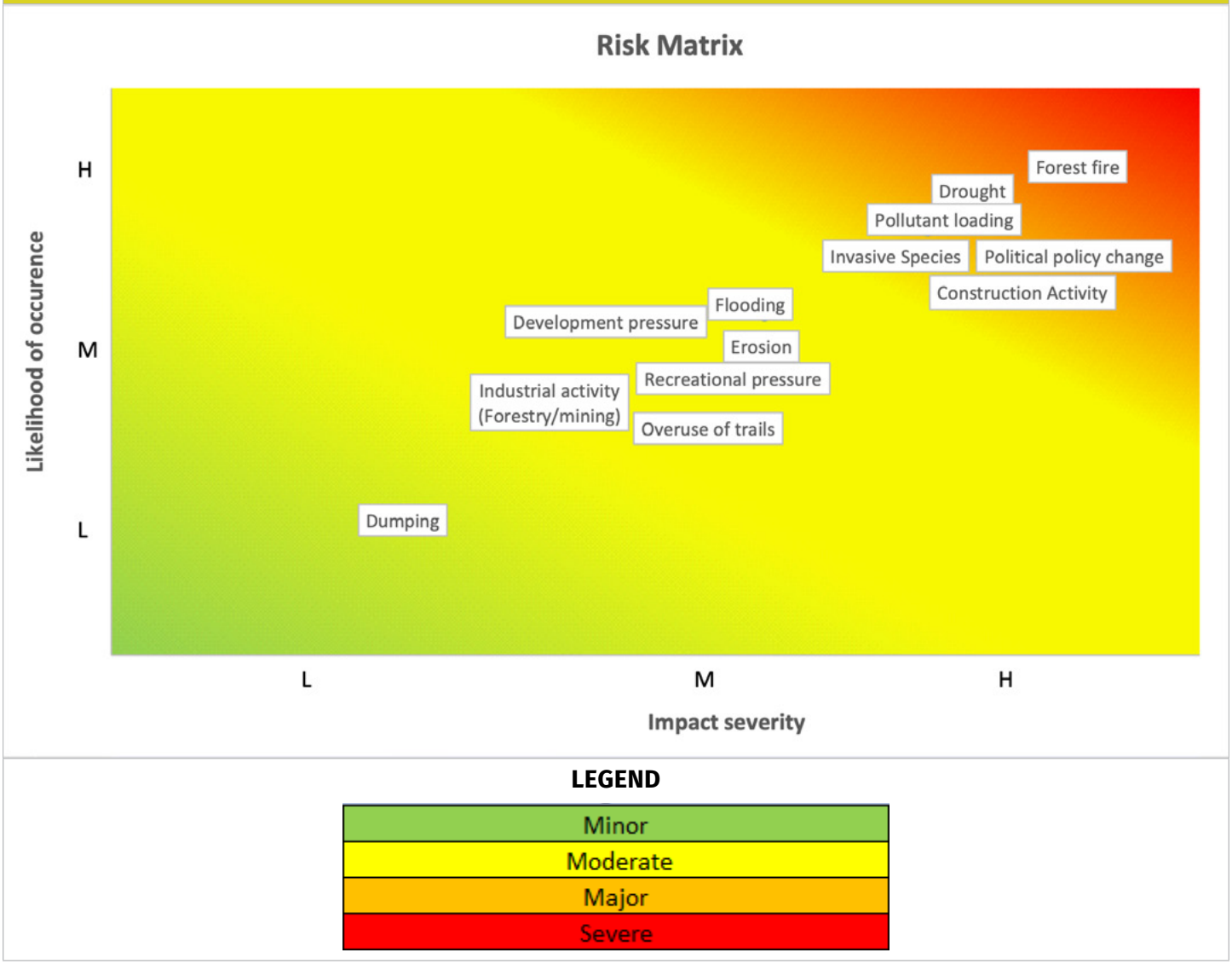


Figure 6: Snapshot of condition assessment details

Implications

This section offers insights that can be gained from considering the inventory, condition, risk and asset management readiness assessment.

Potential priorities for the local government

Potential priorities on which Rossland could focus natural asset management efforts include:

- **Forest fire:** Forest fires associated with hotter summers and low reservoirs could result in catastrophic consequences to municipal areas in the region. With residences and businesses located close to forests and wildlife areas, Rossland participates in the FireSmart program, but has limited opportunities for involvement in the forestry process. Rossland has also completed a Community Wildfire Protection Plan,

with a focus on fuel management to reduce forest fuel buildup around the community[2].

- **Invasive species:** Invasive species impact across all municipal areas, crowding native species; however, limited resources are available to achieve desired monitoring or management. Rossland has adopted a Bylaw requiring its citizens to ensure their property remains free from noxious weeds, which currently include knotweeds[3]. Rossland is tracking indicators that include citizen observations and increased applications for rebates.
- **Pollutant Loading:** Pollutant loading from urban, agricultural and industrial sources is of concern in one quarter of municipal areas. Rossland has a limited formal drainage system, with all stormwater draining into Trail Creek or the Topping Creek Catchment. Excess levels of pollution could impact fish and aquatic species within these creeks, their tributaries and wetlands, and ultimately the Columbia River.
- **Drought:** Rossland recognizes drought driven by hotter temperatures and low reservoirs as a high risk with potentially catastrophic consequences. The need for immediate action is noted. Rossland is fully water metered which has reduced the water usage in the City dramatically. The City has a Water Smart Action Plan to continue to reduce usage and investigate leaks and a bylaw to regulate water use in the summer months based on reservoir levels. Rossland could look to neighbouring communities for additional advice and lessons learned related to water quantity and quality monitoring sites, drought management plans and water reduction targets.
- **Political policy change:** Policy changes can have unintended consequences on natural assets across Rossland, which can take time to emerge. Natural asset management can provide an opportunity to amend bylaws and regulations to protect critical natural assets, such as valley bottoms, steep slopes, and wetlands.
- **Construction activity:** Rossland is experiencing an increase in building permits across all municipal areas. The accompanying increase in impermeable areas and loss of natural assets can exacerbate existing risks, such as pollutant loading and drought.

2 *City of Rossland, 2015.*

3 *City of Rossland, 2018.*

Table 6 lists and provides brief descriptions of risk mitigation strategies.

TABLE 6: RISK MITIGATION STRATEGIES - ROSSLAND	
Accept	Risk may be acceptable if probability and consequences are small
Minimize	Risk under local government's control that warrants exposure reduction
Share	Partners in a project permit the sharing of larger risks to reduce it for each
Transfer	Insurance, fixed price contracts, and other risk transfer tools.

Opportunities to strengthen natural asset management at an organization-wide level

Rossland can use its existing asset management process to integrate natural assets into its overall asset management system. Rossland identified potential areas it is interested in strengthening for both engineered and natural assets. For engineered assets a priority is to develop a roadmap and update planned projects for the next 1-5 years, and to develop accompanying performance measures to measure progress. Rossland also identified the need to add natural asset management to its Strategic Plan and Objectives, incorporate natural assets into policy, and create an inventory of natural assets.

Rossland has captured capital and operating expenditure data for most assets and linked it to financial information for all critical assets. It is in the process of calculating service delivery costs for critical assets. The inventory of natural assets is a first step towards establishing a value for the services natural assets are providing.

Rossland's asset investment planning does not include a documented approach to managing or protecting the natural assets that support municipal service delivery, because asset management plans currently focus on addressing needs related to grey infrastructure assets. Rossland's annual capital and operating budgets do include operations and maintenance costs for some natural assets when they exist alongside grey infrastructure assets that are being maintained (e.g., culverts and roadside ditches).

While some commitments have been made to conserve or protect critical natural assets/areas, they have not yet translated into formal natural asset management plans; this could be an important next step for Rossland to better integrate natural asset considerations into planning, decision-making and the 10-year long-term financial plan it is currently developing.

To develop staff capacity in natural asset management, a key next step could be to complete a staff competency review to identify required skillsets for natural asset management and to fill essential gaps.

Finally, it will be important to identify priority natural assets and the resources required to incorporate natural asset management into Rossland's asset management system and requirements to make progress on the asset management readiness scale.

If the local government wants to use the inventory as the starting place for a full natural asset management project, including implementation, then Annex 2 contains steps to consider.

Possible actions for further development of the inventory

Based on the inventory, Rossland could consider the following, regardless of whether or not it pursues a full natural asset management process. These are mostly incremental measures.

- Determine acceptable levels of risk to inform Rossland's risk mitigation strategies.
- Identify linkages between services and assets and assess the condition of, and risks to, the assets from the perspective of their ability to deliver services.
- Share the inventory to stimulate collaboration and lessons learned with adjacent local governments (e.g., drought management).
- Examine how urban development, forest fire, pollutant loading, and political pressures could increase risk to assets.
- Initiate or enhance monitoring - for example, using gauges, water level sensors, and loggers to improve understanding of trends, feed into condition ratings of assets, and gather information for modelling.
- Schedule regular updates (e.g., every 3-5 years) of the Inventory, Condition and Risk to understand trends.

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Annex 1: Results of local government risk identification

This Annex contains the results of the local governments' use of MNAI's risk identification tool, which they self-administered with guidance from MNAI. Table 1 for each community was the main product that resulted from the exercise and provided by the local government.

Table 1: Simplified risk identification survey - Cranbrook

Risk	Ranking Low (L), Medium (M) High (H)	Assets Affected and ID #	Location (on map, with risk #)	Notes
1/ Overuse of trails	High Probability /Medium Consequence	Forests Wetlands Watershed	Elizabeth Lake Community Forest 14th Avenue Forest Rotary Trail Joseph Creek and Gold Creek	Manageable Tolerable Watershed Management Plan – Includes recreation, ATV's, cattle grazing
2/ Dumping on Land	High Probability / Low Risk	Agriculture Grassland Forest Creek Aquifer	Elizabeth Lake	Manageable Tolerable
3/ Flooding	High Probability /Medium Consequence	Forest Grassland Wetland	Joseph Creek Baker Park Elizabeth Lake Pop Price Park	Imminent Risk - Low Manageable NDMP Flood Risk Assessment – Floodplain Mapping
4/ Forest fire	Medium Probability / High Consequence	Forests Grassland	Elizabeth Lake Community Forest 14th Avenue Forest Watershed & Reservoirs Shadow Mountain Tembec Lands	Imminent Manageable – To a certain degree Interface mitigation and fuel removal
5/ Invasive species, Noxious Weeds, Non-native species	Medium Probability / Medium Consequence	Forests Grassland Agriculture Shrubland Wetland Creeks	Moir Park Elizabeth Lake Above gravel pit Reservoir Joseph Creek Idlewild Park	Imminent Risk Manageable

Table 1: Simplified risk identification survey - Cranbrook

Risk	Ranking Low (L), Medium (M) High (H)	Assets Affected and ID #	Location (on map, with risk #)	Notes
6/ Development pressure	Medium Probability / Low Consequence	Forests Agriculture Grassland Creek Aquifer	Tembec Lands Aquifer Creekside Properties Downtown	Future Risk Manageable Tolerable
7/ Pollutant loading (urban and rural)	Medium Probability / Medium Consequence	Wetland Creek Watershed	Homes along Joseph Creek Ranches Crown Cattle Lease Area	Imminent Risk Unmanageable – to a certain degree
8/ Pollutant loading (industrial)	Medium Probability / Medium Consequence	Forests Agriculture Grassland Creek Wetland	Tembec Lands Surface Runoff Roads/Parking Lots	Future Risk Manageable
9/ Drought	Medium Probability / High Consequence	Forests Grassland Agriculture Wetland Water Shrubland Aquifer Reservoir	Watershed Reservoir Aquifer/Groundwater	Future Risk Unmanageable Intolerable
10/ Erosion	Low Probability / Low Consequence	Wetlands Water Creek Watershed	Joseph Creek Watershed	Future Manageable Tolerable
11/ Political policy change	Low Probability / Medium Consequence	Water Wetlands Forest Watershed Aquifer	Watershed Logging Irrigation use – Water Sustainability Act	Future Manageable – within jurisdiction Tolerable
12/ Construction activity	Medium Probability / Medium Consequence	Wetlands Water Forest Watershed	Logging Roads Land Development Watershed	Future Manageable – within jurisdiction Tolerable
13/ Lack of Monitoring Reports	Medium Probability / Medium Consequence	Water Wetlands Watershed	Watershed Aquifer/Groundwater	Manageable Tolerable

Table 2: Simplified risk identification survey - Golden

Risk	Ranking Low (L), Medium (M) High (H)	Assets Affected and ID #	Location (on map, with risk #)	Notes
1/ Overuse of trails	L	>16km	Throughout Town	Applies primarily to gravel trail
2/ Illegal Dumping	L	2000 m²	South beach	Environmental pollution, potential fire hazard located adjacent to forest
3/ Flooding	M	>5 km	Along Kicking Horse River	Applies to diking.
4/ Flooding	M	800 m	Along Hospital Creek	Applies to diking.
5/ Flooding	M	105.57 ha	Wetlands, various locations within municipal boundary	
6/ Forest fire	H	312.3 ha	Primarily northern and eastern lengths of municipal boundary	Applies to entire Town limits
7/ Invasive species	L – H	475.29 ha	Various locations within municipal boundary	Mapped per IAPP registration. Known infestation of Fir Bark Beatle SE forested area (15.7 ha, mapped)
8/ Development pressure	L	4.5 Ha/ 40 ha	South and north benches, respectively	Existing timber stand subject to removal for development
9/ Pollutant loading from urban, agricultural, or industrial sources	M	Throughout Town	Various private properties	Applies to industrial pollutant potential of aquifer. Aquifer and contaminated sites mapped.
10/ Drought	L	Throughout Town	Various locations within municipal boundary	Applies to municipal trees, forest stands, grasslands and shrub lands
11/ Erosion	L	13 ha, 2400 m	Respectively, South bench and steep erodible slopes adjacent to rail line	Based on potential loss of timber to Fir Bark Beatle infestation and resultant exposure of steep slopes. Second area already exposed.
12/ Ice jams	L	21.6 ha	areas Along Kicking Horse River	Could result in service disruptions to dike pathways

Table 2: Simplified risk identification survey - Golden

Risk	Ranking Low (L), Medium (M) High (H)	Assets Affected and ID #	Location (on map, with risk #)	Notes
13/ Political policy change	L	Throughout Town	Private property	Applies to potential water bottling development/ aquifer impact.
14/ Construction activity	L	Throughout Town	Various locations within municipal boundary	Applies to lack of soil deposit policy/ bylaw and potential for invasive introduction

Table 3: Simplified risk identification survey - RDCK

Risk	Ranking Low (L), Medium (M) High (H)	Assets Affected	Location	Notes
1/ Low flows	H	All of Arrow Creek Watershed	Throughout watershed	Seasonal low flows, drought management strategies in place
2/ Competing demands	H	All of Arrow Creek Watershed	Throughout watershed	Managed by the RDCK, Erickson Water Commission and Town of Creston
3/ Increasing agriculture use	H	All of Arrow Creek Watershed	Throughout watershed	Being assessed to create management plans
4/ Increasing commercial use	M	All of Arrow Creek Watershed	Throughout watershed	Being assessed to create management plans
5/ Increasing residential connections	L	All of Arrow Creek Watershed	Throughout watershed	Requests have been received but cannot be accommodated based on current flows
6/ Clearwater Flooding	H	All of Arrow Creek Watershed	Impact to Erickson communities and engineered infrastructure	Applies to whole watershed
7/ Road construction and maintenance	L	All of Arrow Creek Watershed	Active logging areas	Applies to whole watershed, managed by community forest
8/ Recreational impact - overuse	M	All of Arrow Creek Watershed	In active recreational areas	Unregulated therefore impact could be significant

Table 3: Simplified risk identification survey - RDCK

Risk	Ranking Low (L), Medium (M) High (H)	Assets Affected	Location	Notes
9/ Introduction of invasive species	L	All of Arrow Creek Watershed	Throughout watershed	Unknown if being managed
10/ Wildfire	H	All of Arrow Creek Watershed	Throughout watershed	Community forest is managing

Table 4: Simplified risk identification survey - RDEK

Risk	Ranking Low (L), Medium (M) High (H)	Assets Affected	Location	Notes
1/ Ice Jam	H	Same as below		
2/ Flooding (current & future)	H	Water treatment plant, highway, residences, RV park, agricultural areas, recreation opportunities on the lake (creating a larger alluvial fan), Health risk – septic systems flooded and carried into lake, water intakes affected (quality)		
3/ Overuse of trails (future)	L	Trail (future trails), pressure to construct random/unsanctioned trails		Future risk
4/ Forest Fire	H	Water treatment plan, residences, ag areas, riparian vegetation		Interface fuel management could mitigate risk
5/ Invasive Species	M	Ag areas, habitat		When mitigation happens with machinery, there is heightened opportunity for impacts from or establishment of invasive
6/ Development pressure	L / M	Wildlife, water resources, Creek		

Table 4: Simplified risk identification survey - RDEK

Risk	Ranking Low (L), Medium (M) High (H)	Assets Affected	Location	Notes
7/ Pollutant loading (industrial, agricultural, residential)	L / M	Windermere Creek, Windermere Lake (water source for East Side of Windermere), (Gypsum mine - turbidity, dust, fuels from equipment)		Unsure if risk is actual or perceived
8/ Drought	L / M	Ag have water licences, water sources (groundwater and Lake Windermere)		
9/ Erosion/ debris flow	M / H	Windermere Creek, Lake Windermere, Flooding could result (see flooding risk), Culvert under highway.		
10/ Lack of funding for proactive mitigation (only operate on emergency response)	M			Scoping underway to develop service area for flood mitigation
11/ No current flood mapping (only original provincial mapping from 1982)	M			

Table 5: Simplified risk identification survey - Rossland							
Risk	**Likelihood** Rare Unlikely Possible Likely Certain	**Consequence** Insignificant Minor Moderate Major Catastrophic	**Rank** L-Low M-Med H-High	**Action Required**	**Assets Affected Location throughout city**	**Cues**	**Notes**
1/ Overuse of trails	Likely	Minor	M	Planned action required	180 km	Trail deterioration	Applies to all trails in the Rossland area
2/ Dumping	Possible	Minor	L	Manage by routine procedures	5429 ha	Citizen complaints	Applies to all municipal area
3/ Flooding	Possible	Moderate	M	Manage by routine procedures	542 ha (10%)	Heavy rainfall events	Riparian zones of all streams throughout the municipal area
4/ Forest fire	Possible	Catastrophic	H	Prioritized action required	5429 ha	Hotter summers, low reservoirs	Applies to all municipal areas
5/ Invasive species	Likely	Major	H	Prioritized action required	5429 ha	Increased applications for rebates, Citizen Observations	Applies to all municipal areas
6/ Recreational Pressure	Likely	Moderate	M	Prioritized action required	1357 ha (25%)	Increased recreational activity	Skiing, snow-mobiling, snow-shoeing, hiking, biking etc etc
7/ Development pressure	Possible	Moderate	M	Prioritized action required	1357 ha (25%)	Increased building permit activity	Applies to specific municipal areas
8/ Industrial activity (Forestry/ mining)	Possible	Moderate	M	Provincial standards	1357 ha (25%) watersheds	Obser-vations	Water-sheds

Table 5: Simplified risk identification survey - Rossland							
Risk	**Likelihood** Rare Unlikely Possible Likely Certain	**Consequence** Insignificant Minor Moderate Major Catastrophic	**Rank** L-Low M-Med H-High	**Action Required**	**Assets Affected Location throughout city**	**Cues**	**Notes**
9/ Pollutant loading from urban, agricultural, or industrial sources	Possible	Major	H	Prioritized action required	1357 ha (25%)	Citizen complaints	Applies to specific municipal areas
10/ Drought	Likely	Catastrophic	H	Immediate corrective action	5429 ha	Hotter tempera-tures, low reservoirs	Applies to all municipal areas
11/ Erosion	Likely	Minor	M	Planned action required	5429 ha	Climate extremes	Applies to all municipal areas
12/ Ice jams	–	–	–	–	–	Not applicable	Not applicable
13/ Storm surge	na	na	na	na	na	na	na
14/ Political Policy Change	Possible	Major	H	Prioritized Action Required	5429 ha	Elections	Applies to all municipal areas
15/ Construction Activity (Same as development pressure)	Likely	Major	H	Prioritized Action Required 180 km	5429 ha	Increase in building permits	Applies to all municipal areas

Annex 2: Moving to a full project

Following are steps to consider for local government wishing to use the inventory as the starting place for a full natural asset management project, including implementation

1/ **Confirm scope, roles and responsibilities.** Undertake a meeting or workshop to confirm (a) assumptions [for example, that water management and development pressure are the primary services of concern] (b) roles, responsibilities and capacities (c) community capacity to undertake a larger project.

2/ **Fill essential knowledge gaps.** If discussions on scope and certainty and related data needs for modelling indicate the need for additional data, these could be filled.

3/ **Modelling.** Modelling the levels of service that natural assets currently provide, and the levels of service under different potential management, local climate change projections, and rehabilitation or restoration scenarios, is central to natural asset management as it gives communities the ability to explore how different actions will affect the health and corresponding performance of natural assets.

4/ **Economic assessment.** The economic assessment component provides a market-based indication of (a) the value of the services from natural assets if they had to be provided by an engineered means, and (b) the costs and values of different interventions in terms of service delivery. The latter answers questions such as “what happens to the services provided by the wetland if everyone builds upstream?” or “what happens to the services if the forest is restored?”

5/ **Planning.** Based on the foregoing, the communities will have the opportunity to undertake actions ranging from status quo to planning, regulatory, financial operations, maintenance, acquisition and monitoring interventions. These would occur during the natural asset management planning phase and MNAI would be able to provide technical support as required throughout.

6/ **Implementation.** MNAI can provide ongoing advice / guidance on policy pieces and integration of the above information over a period of 12-18 months. After this point, the local government, together with local partners and service providers, would ideally have the capacity to continue these efforts on their own.

7/ **Ongoing monitoring.** Project monitoring is essential to learn whether interventions are working and to share lessons and learnings from other communities undertaking natural asset management. MNAI would typically stay involved with the community for a period of three years through a monitoring arrangement to be established with the communities.

Municipal Natural Assets Initiative