**REGIONAL DISTRICT OF NANAIMO**

Toward natural asset management in the
Regional District of Nanaimo
British Columbia

Summary of inventory results and recommendations
December 2022

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Municipal Natural Assets Initiative

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Making Nature Count
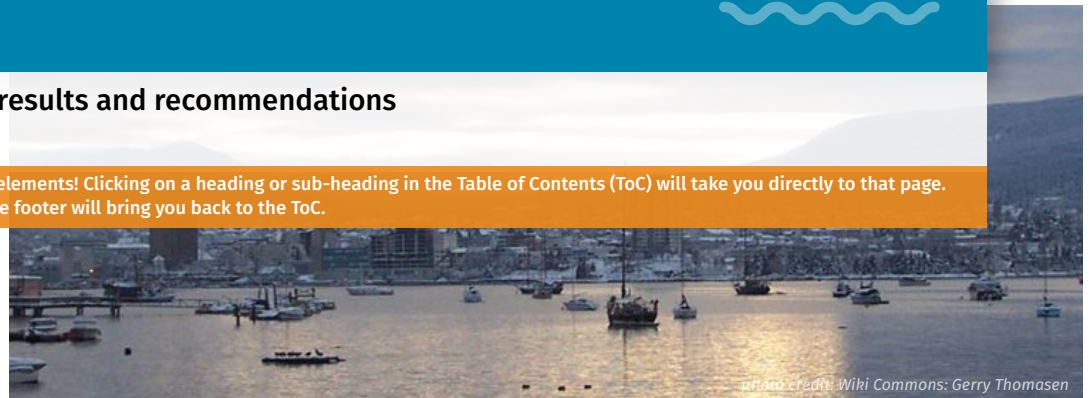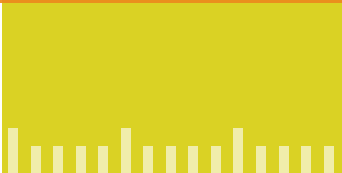
Invest in Nature

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

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Table of Contents

1 Purpose

This document summarizes the results of a project to develop a natural asset inventory in the Regional District of Nanaimo (RDN) and documents steps the local government can take to proceed to a full natural asset management initiative.

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 understanding, measuring, managing and accounting for natural assets is as important as it is for engineered assets. Doing so can enable local governments to better 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, 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 significant 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.

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

What is a natural asset inventory?

Natural asset inventories provide details on the types 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 asset capacity or service values but is an essential first step towards a full natural asset management project.
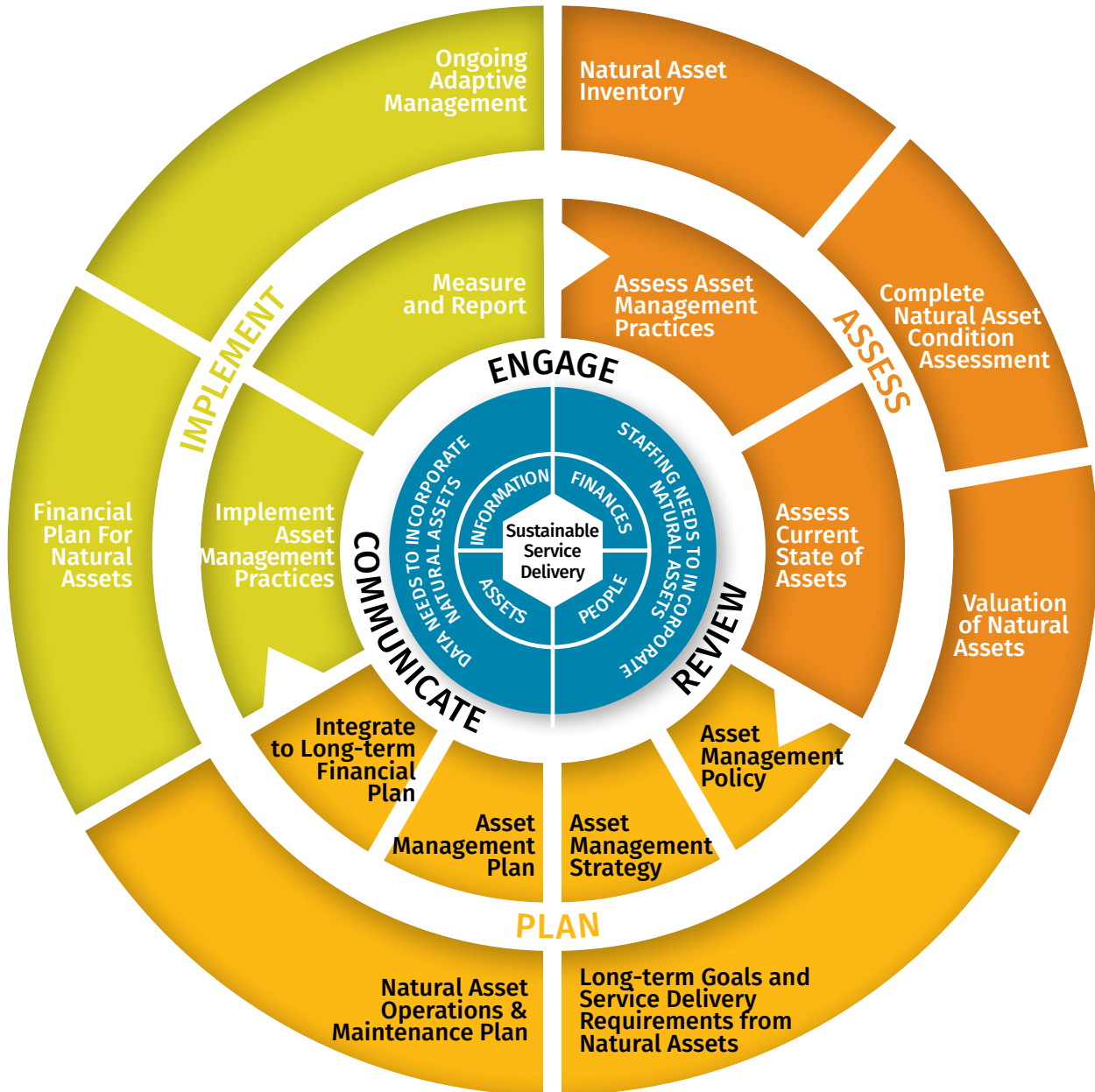
Figure 1: The Asset Management Process.
MNAI has adapted this for use with natural assets.

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

3 Local government context

3.1. General
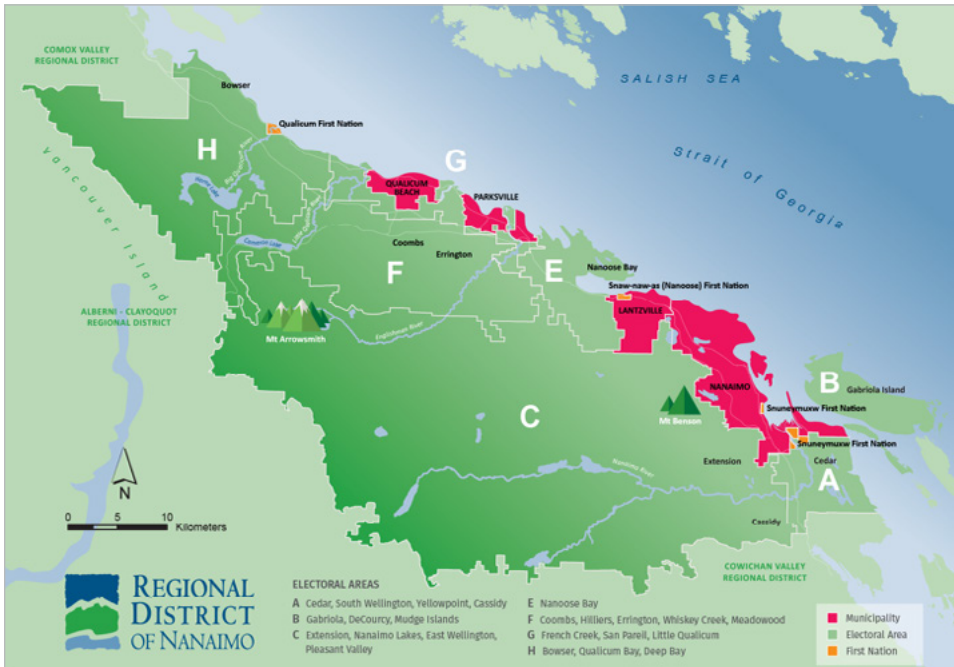
Figure 2: Regional District of Nanaimo[3].

The RDN (population ~155,000) is a regional district located on Vancouver Island, British Columbia. Its members include cities, towns, districts, and seven electoral areas that contain unincorporated municipalities[4].

The RDN has several interests in natural assets management. Overall, it is experiencing the effects of climate change, and would like to understand the role of natural assets in mitigating and adapting to these threats, particularly given the emphasis placed by residents on healthy natural ecosystems. Second, the RDN sees an opportunity to meet multiple water-related objectives through natural asset management. These include drinking water supply resilience and protection, flood mitigation and resilience, and rainwater management. Third, the RDN has several initiatives that could be supported by a natural assets inventory. These include the Climate Action Technical Advisory Committee (CATAC), which will review the RDN's systems and processes through a climate change lens; and, coastal, river system and aquifer mappings. The RDN is also interested in natural assets management as a tool to inform park acquisitions and ensure that growth and urban form are underpinned by a sound understanding of the services provided by nature. It is also progressing on asset management more generally, and so it is a logical time to explore the role of natural assets.

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3   *en.wikipedia.org/wiki/Regional_District_of_Nanaimo*

4   *www.rdn.bc.ca/about-the-rdn*

3.2. Asset management readiness assessment

As part of inventory development, MNAI helps local governments determine their overall state of asset management maturity. To do this, MNAI has adapted the Federation of Canadian Municipalities (FCM)'s asset management readiness assessment tool[5] to help local governments measure their progress on both asset management and natural asset management in four competency areas, with each area describing outcomes based on five levels of progress or maturity.

The RDN had undertaken the FCM readiness assessment in advance of this inventory project. MNAI used these results, and follow-up questions posed to staff, for this report. Overall, the RDN's readiness assessment shows it is at an early stage of adoption of asset management (Level 1). Details follow.

Competency 1: Policy & Governance

In 2016, the RDN's Board of Directors approved a Board-level Asset Management Policy. The RDN completed an asset register with replacement costs for engineered assets and is integrating this information into a Strategic Asset Management Plan for the organization. The RDN has also developed an asset management strategy with short-term actions identified. Data collection projects are planned to measure the effectiveness of the foregoing in terms of supporting infrastructure decisions.

At present, these documents do not include either natural asset management considerations, or natural assets as an asset class. However, the RDN plans to further develop the Strategic Asset Management Plan to include natural assets.

Based on its legislative context, the RDN may only provide services that have been approved by bylaw through its Board. This implies that Board decisions and bylaw changes may be required at future stages of the RDN's natural asset management journey.

Competency 2: People & Leadership

With respect to people and leadership, the RDN established a cross-departmental working group in April 2016. Due to employee turnover, representation has been reduced and is being replenished with the support of "asset champions" and senior leadership. No goals or objectives for natural assets are included in the terms of reference for the cross-departmental working group, nor does anyone have specific responsibility for their integration. The RDN is, however, hiring an asset manager who will be responsible for integrating natural asset considerations into asset management practices. This may have implications for the cross-departmental group.

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

Several reports have been presented to the Board of Directors regarding the financial health of the organization's assets, and the need for a formal asset management program. The Board has supported grant applications to proceed with asset management and has identified the importance of "*fully developing our Asset Management Plan*" in the 2019-2022 Strategic Plan.

The RDN culture reportedly tends to prioritize stewardship of natural assets, and there is a general awareness that this will require investment, including for land acquisition. There is, however, an overall low level of awareness as to what specific expenditures may be required to achieve individual levels of services from natural assets. One exception is the Parks Department, which has defined preservation of natural assets as a level of service and acquired properties for this purpose.

Competency 3: Data & Information

The RDN has undertaken an Asset Replacement Cost Study that provides staff with current asset registry information. Work is still needed to integrate and implement inventory information in the registry consistently across the organization. The registry has some asset condition information for certain asset types; for the remainder, data are housed within individual departments and are not consolidated or always readily available. Criticality and redundancy data is not defined. Collection and management of performance data is rudimentary. There is a tangible asset value database with reasonable records of expenditures made, although this does not include natural assets. Operating and maintenance expenditures are not readily accessible.

Competency 4: Planning & Decision-making

All departments have reasonably good, but differing, undocumented and non-standardized asset planning procedures. Decisions are mostly *ad hoc*. Some departments have their own asset management plans for some infrastructure systems; however, this is not a consistent practice across the RDN.

4   Natural asset inventory

4.1.   Inventory overview

MNAI's natural asset inventories have two main components to express natural asset information: an asset registry (which is a tabular representation of the data) and an online dashboard. MNAI provided the registry to the RDN in an Excel file and the dashboard as a website address. Information on the condition of and risks to the assets is a subset of the inventory and is depicted in both the registry and dashboard.

4.2. Inventory data

To establish the inventory, MNAI obtained data from the RDN, the British Columbia open data portal, the Government of Canada, and the City of Nanaimo. MNAI combined the spatial data layers to establish a comprehensive depiction of natural assets. Table 1 lists the data sources used to develop the inventory and complete the condition and risk assessments.

TABLE 1: SUMMARY OF DATA SOURCES		
FILE NAME	**SOURCE**	**PURPOSE**
RDN_Boundary	RDN	Used as the inventory boundary; final inventory clipped to this area.
VEG_COMP_POLY	BC Open Data	Used as main landcover source for delineating natural assets. The landcover class 1 field was used to define landcover class when available. When landcover class 1 was null then the British Columbia Land Cover Classification Scheme Level 4 field was used.
AgricultureStudy_RDN	RDN	Used as a secondary land-cover source as the VRI does not capture agricultur-al areas. Moreover, this da-taset appeared more accu-rate than the VRI in recent-ly developed urban areas.
WHSE_FOREST_ VEGETATION_VEG_ CONSOLIDATED_CUT_ BLOCKS_SP	BC Open Data	Used to remove cut blocks from areas classified as for-est in the combined land-cover dataset and re-classify these areas as "cleared". Any areas classified as shrub-land or grassland in the VRI were not replaced by cut blocks.
Waterbodies	RDN	Used to add in any water-bodies not accounted for in the VRI and Agricultural Study datasets.
NRN_BC_14_0_ROADSEG	Government of Canada	Area was buffered by 10 m and erased and merged into existing landcover. This dataset was also used to perform road density condition assessment.
WHSE_BASEMAPPING_ FWA_ASSESS-MENT_ WATERSHEDS_POLY	BC Open Data	Used to split assets by watershed and summarize each watershed by natural asset type in the inventory dashboard.
RDN_ElectoralArea	RDN	Used to split assets by electoral district boundary and summarize each district by natural asset type in the inventory dashboard.
Aquifer_Extent	RDN	Used as source of aquifer data for the aquifer tab in the dashboard. This dataset was merged with the older aquifer data below with this newer dataset taking precedence.
Aquifers	RDN	Used as source of aquifer data for the aquifer tab in the dashboard. This dataset was merged with the newer aquifer data above with that newer dataset taking precedence.
GW_Wells	RDN	Count of ground water wells added to merged aquifer data.

TABLE 1: SUMMARY OF DATA SOURCES

FILE NAME	SOURCE	PURPOSE
Pumping_Wells	RDN	Count of pumping wells added to merged aquifer data.
LotsPoly_WithOwnership	RDN	Used to assign area of owner type to each asset and aquifer. For example, area of asset owned by RDN.
ALR_Boundary	RDN	Used to assign area of assets within the ALR and can be used to indicate which assets reside within the ALR.
ProvincialParks	RDN	Used to summarize area of asset overlap with provincial parks and assign park names to relevant assets.
RDN_CommunityParks	RDN	Used to summarize area of asset overlap with community parks and assign park names to relevant assets.
RDN_RegionalParks	RDN	Used to summarize area of asset overlap with regional parks and assign park names to relevant assets.
Parks	City of Nanaimo Open Data	Used to summarize area of asset overlap with City of Nanaimo parks and assign park names to relevant assets.
RDN_WaterLocalServiceAreas	RDN	Used to summarize area of natural assets within a local water service area and assign the name of the local water service area to relevant assets.
RDN_Floodplain	RDN	Used to indicate which assets fall within the floodplain boundary and summarize area of assets within the floodplain.
RD_Zoning	RDN	Used to assign zoning categories to assets based on the zoning category which has the greatest area of overlap with the asset.
WildlifeManagementArea	RDN	Used to summarize the area of assets within the wildlife management area.
Watercourses	RDN	Used to summarize the total length of watercourses within an asset.
RDN_Trails	RDN	Length of RDN and Nanaimo trails summarized for each asset. A trail density was then calculated (total trail length in km / asset area (km²).
Trails	City of Nanaimo Open Data	Length of RDN and Nanaimo trails summarized for each asset. A trail density was then calculated (total trail length in km / asset area (km²).
WHSE_LAND_AND_NATURAL_RESOURCE_PROT_HISTORICAL_INCIDENTS_SP	BC Open Data	The "Fire_Type" column was filtered for "Fire" in order to filter out "smoke chase" fire types thought to be irrelevant. The number of fires within each asset were then counted and assigned to the asset.
FireProtectionAreas	RDN Open Data	Used to summarize area of asset within the fire protection area and to assign the fire protection name to relevant assets.

The inventory project defined a total of 21,964 individual assets, covering 297,966 hectares (ha), as noted in Table 2. An asset is defined as a continuous area of the same land cover type. For example, an intact forested area would be defined as one asset, but a forested area that is bisected by a road would constitute two assets. The majority of this area was forest cover.

TABLE 2: SUMMARY OF NATURAL AND ENHANCED ASSETS

ASSET	ASSET AREA (HA)	AVERAGE ASSET AREA (HA)	NO. OF ASSETS	% OF ASSET AREA	% OF RDN
Agriculture	4,521	3.60	1,257	2%	1%
Artificial Waterbody	69	0.24	293	0%	0%
Bedrock	324	2.19	148	0%	0%
Build-up Pervious	963	0.94	1,020	0%	0%
Ditch	4	0.44	8	0%	0%
Forest (Broadleaf)	3,442	2.82	1,222	1%	1%
Forest (Coniferous)	130,330	27.47	4,744	44%	42%
Forest (Mixed)	8,304	4.07	2,040	3%	3%
Harvested Forest	11,427	14.12	809	4%	4%
Herbaceous	6,017	2.96	2,031	2%	2%
Mudflat Sediment	39	3.88	10	0%	0%
Riparian	15,669	3.06	5,124	5%	5%
Shrubland	6,141	4.54	1,352	2%	2%
Water (Fresh)	3,929	6.54	601	1%	1%
Water (Marine)	105,575	2154.60	49	35%	34%
Wetland	1,211	0.96	1,256	0%	0%
Total	**297,966**	**13.57**	**21,964**	**100%**	**95%**

* Built-up pervious includes manicured lawns and greenspaces (e.g., sports fields)

Figure 3 shows the spatial distribution of the natural assets.
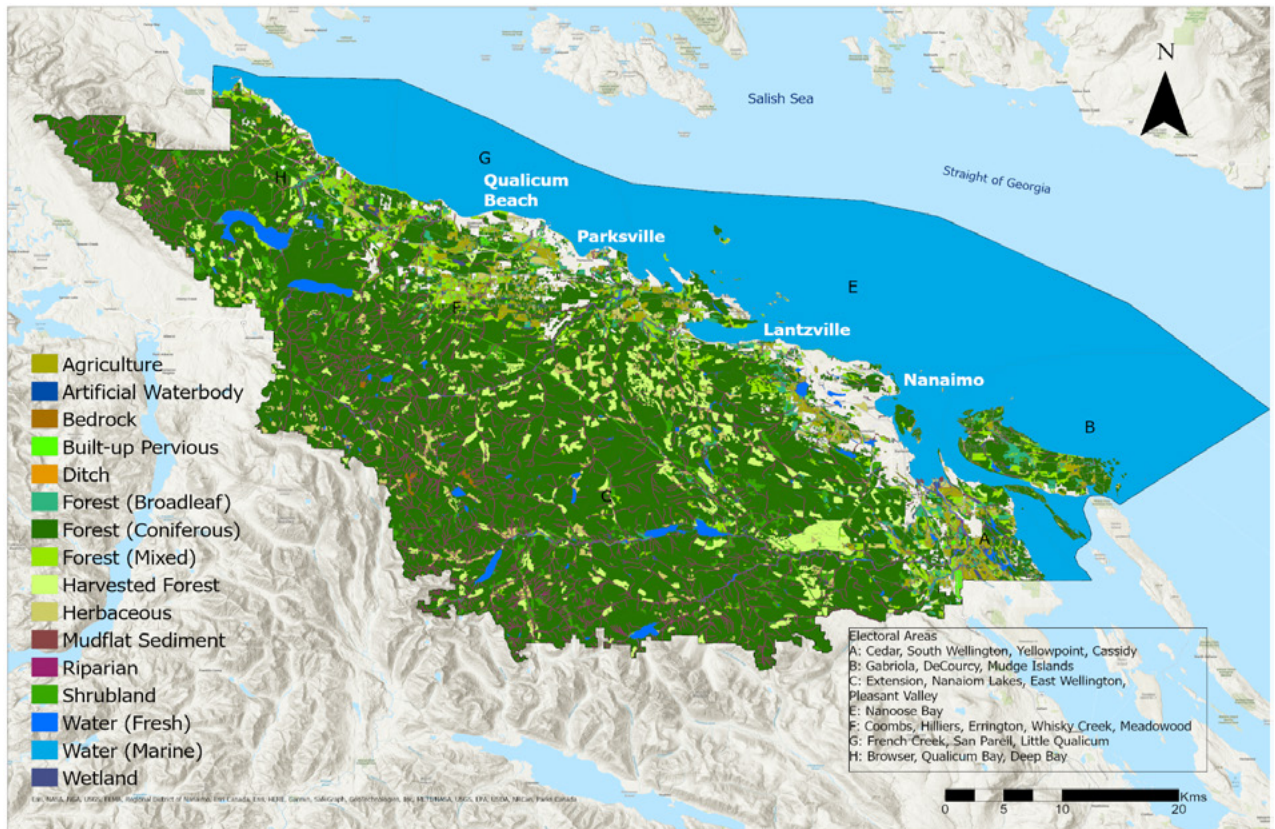
Figure 3: Spatial distribution of natural assets.

4.3. Asset registry

Each asset within the inventory has a unique identification number that allows users to select and analyze individual assets and manipulate the corresponding data as required. For example, changes in condition can be noted for individual assets. Information on each asset is housed in the tabular asset registry. Table 3 is an excerpt from the RDN's online registry showing natural asset characteristics and details. .

Natural Asset Registry

Asset ID	Asset Type	Landcover	Asset Area (ha)	ALR Area (ha)	Watershed	Location	Floodplain Area (ha)	Floodplain Name(s)	Count of Wildfires	Fire Protection Area (ha)	Interior Forest Area (ha)	PMFL Area (ha)	Trail Density (km/km²)	Community Park Area (ha)	Provincial Park Area (ha)	Adjacent Land Score	Permeability Score	Relative Size Score	Road Density Score
AGR1	Agriculture	Pasture	0.64	0.64	Morison Creek	Electoral Area F	0.00		0	0.64	0.00	0.00	0	0.00	0.00	8	5	1	1
AGR10	Agriculture	Pasture	0.84	0.84	Morison Creek	Electoral Area F	0.00		0	0.84	0.00	0.00	0	0.00	0.00	9	5	1	1
AGR100	Agriculture	Crops	0.08	0.08	French Creek	Electoral Area F	0.00		0	0.08	0.00	0.00	0	0.00	0.00	7	5	1	1
AGR1000	Agriculture	Pasture	10.40	10.40	2605	Electoral Area A	0.00		0	10.40	0.00	0.00	0	0.00	0.00	8	5	5	1
AGR1001	Agriculture	Pasture	10.85	0.11	2605	Electoral Area A	0.00		0	10.86	0.00	0.00	0	0.00	0.00	8	5	5	10
AGR1002	Agriculture	Pasture	0.20	0.20	Nanaimo River C	Electoral Area A	0.00		0	0.20	0.00	0.00	0	0.00	0.00	6	5	1	1
AGR1003	Agriculture	Pasture	50.55	50.52	2605	Electoral Area A	0.00		0	50.59	0.00	0.00	0	0.00	0.00	7	5	10	1
AGR1004	Agriculture	Pasture	13.83	13.84	2605	Electoral Area A	0.00		0	13.84	0.00	0.00	0	0.00	0.00	7	5	5	1
AGR1005	Agriculture	Pasture	5.37	0.00	2605	Electoral Area A	0.00		0	5.37	0.00	0.00	0	0.00	0.00	9	5	1	10
AGR1006	Agriculture	Pasture	0.66	0.00	2622	Electoral Area A	0.67	Nanaimo River	0	0.67	0.00	0.00	0	0.00	0.00	8	5	1	1
AGR1007	Agriculture	Pasture	8.41	8.36	2622	Electoral Area A	5.37	Nanaimo River	0	8.42	0.00	0.00	0	0.00	0.00	8	5	1	1
AGR1008	Agriculture	Pasture	16.09	13.36	2622	Electoral Area A	9.61	Nanaimo River	0	16.10	0.00	0.00	0	0.00	0.00	8	5	5	5
AGR1009	Agriculture	Pasture	20.74	18.54	2622	Electoral Area A	9.45	Nanaimo River	0	20.76	0.00	0.00	0	0.00	0.00	8	5	5	5
AGR101	Agriculture	Crops	0.11	0.11	French Creek	Electoral Area F	0.00		0	0.11	0.00	0.00	0	0.00	0.00	7	5	1	1
AGR1010	Agriculture	Pasture	0.74	0.00	2622	Electoral Area A	0.00		0	0.74	0.00	0.00	0	0.00	0.00	8	5	1	1
AGR1011	Agriculture	Pasture	0.64	0.00	2622	Electoral Area A	0.00		0	0.64	0.00	0.00	0	0.00	0.00	8	5	1	1
Total			297,966.20	17,519.50			1,608.95		1,251	75,226.80	105,391.12	132,510.42		753.00	1,611.00				

4.4. Online dashboard

Inventories may provide further insight when characterized visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by watershed area, or, if users want to dive into the specifics of forest assets, they can filter the data to focus on that particular asset. Figure 4 is a screenshot from the dashboard that MNAI provided to the RDN. The full version can be accessed at *go.greenanalytics.ca/RDN*.
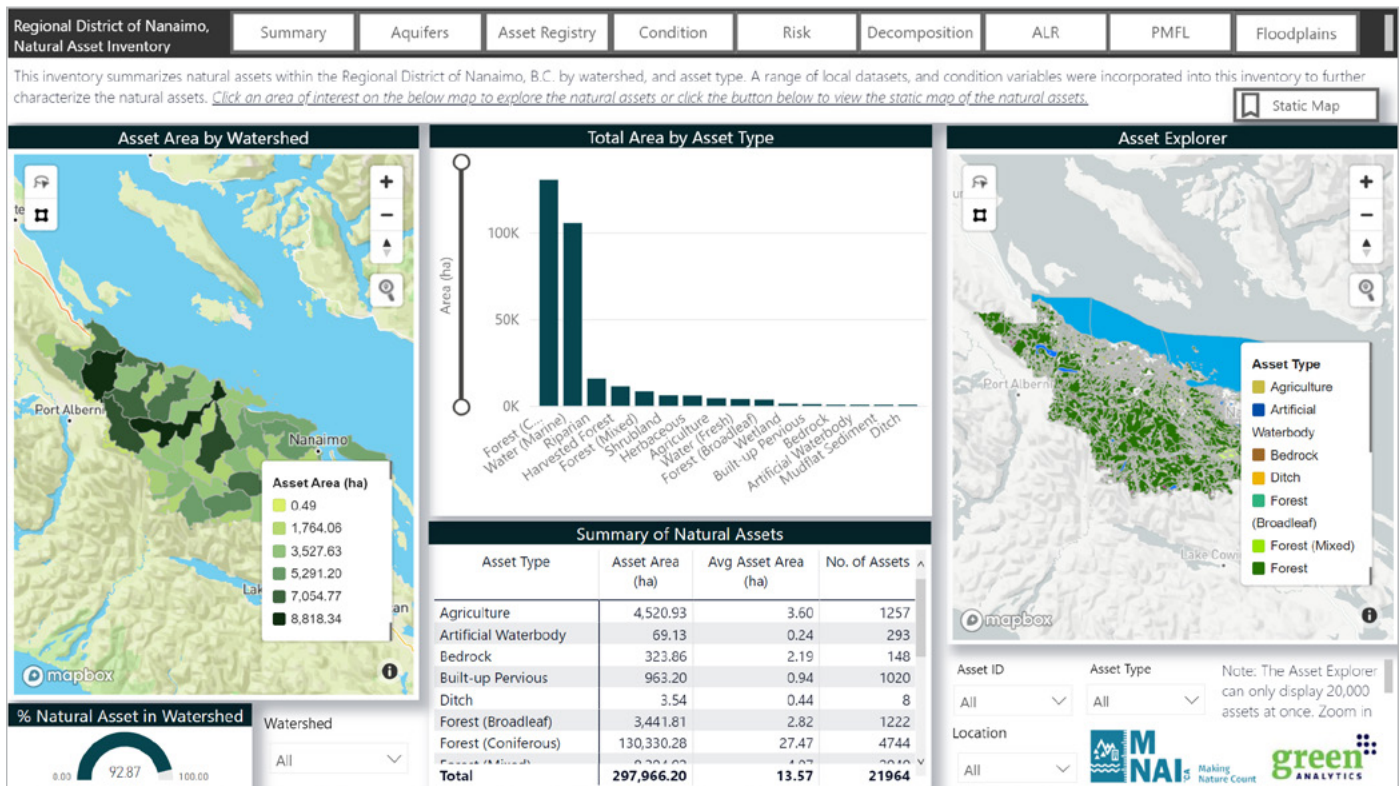
Figure 4: Screenshot of main inventory summary.

4.5. Condition of natural assets

Documenting the condition of natural assets is a key aspect of natural asset inventories. A natural asset condition assessment provides an understanding of both the ecological health of natural assets and the ability of natural assets to provide services. This information can support the effective management of natural assets, be reflected in the registry and dashboard, and updated over time.

MNAI completed a desktop-based condition assessment and built it into the inventory to provide an initial understanding of the status of the natural assets for the RDN. As part of a full natural asset management project, MNAI would expand this assessment to include additional metrics related to condition (e.g., relative biodiversity, riparian and wetland health, soil condition, connectivity, and others) and possibly employ site visits to confirm and verify the condition ratings. The desktop exercise completed as part of this inventory is a reasonable first step in assessing condition and can be used as a foundation for future work in this area.

Table 5 summarizes the condition assessment steps and indicators. MNAI chose these indicators for their relative ease of measurement (given time and budget constraints) and for their relevance to measuring the ecological health and service delivery capabilities of natural assets. They are proxy metrics for these broader ecosystem condition considerations. For example, larger asset size implies more connectivity of natural areas, higher road density implies more fragmentation and higher hydrologic impairment of water flows, and

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more permeability implies greater ability to store water which means more effective stormwater management. The adjacent land use metric measures and distinguishes natural assets that are next to other natural assets from natural assets that are next to built infrastructure. How and the extent to which a given natural asset is influenced by the drainage in the adjacent landscape varies depending on factors such as the local topography and soils, orientation (e.g., upland versus lowland, position in the watershed), and the size and nature of the feature itself. It is well-established, however, that the condition of a natural asset in an urban context tends to be negatively impacted when more of the surrounding land uses are impervious (i.e., paved, concrete or buildings). This tends to alter pre-existing drainage and infiltration pathways, which can cause a natural area to receive much more or much less drainage than prior to being in an urban context. Urban runoff also typically carries a host of sediments and contaminants, and when such runoff is directed to natural areas and not properly treated, it can negatively impact the feature and its functions for plants and wildlife.

TABLE 4: CONDITION ASSESSMENT APPROACH AND INDICATORS

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) re-ceived a 3, those within the middle third of the ranking received a 2, and those within the bottom third of the ranking received a 1.	Natural asset inventory
Road density	Measures the density of the roads in and around the assets according to high density (assets with more than 2km of roads per km²), medium density (assets with between 1km and 2km of roads per km²), and low density (assets with less than 1km of road per km²).	Natural asset inventory plus spatial representations of roads

TABLE 4: CONDITION ASSESSMENT APPROACH AND INDICATORS

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator*
Surface permeability	The permeability of surfaces is ranked on a scale of nil (0) to high (10) depending on the type of landcover present. Urban areas, roads and industrial areas are ranked as nil. 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[6]
Adjacent land use	Considers the distance to, and the nature of, the area surrounding nat-ural assets. Intense land uses (e.g., airports) in close proximity to natural assets result in a poor rating, while distant land uses that are less intense (e.g., agriculture) result in a good rating. If there are no human land uses within 100 m of the assets, the assets are scored 10. If there are intensive land uses within 100 m of the assets, the score is 0.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses.

* Data sources provided in Table 1 unless noted here.

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 as low (10), medium (5) or high (1)
- Surface permeability rated as high (10), medium (5), low (1), or nil (0)
- Adjacent intensive land use (0 for intense land uses, otherwise 10)
- Relative asset size where the largest third of areas receive 10, 5 for the next largest third, and 1 point for the smallest third

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

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6   *NASA Socioeconomic Data and Applications Center (SEDAC). Global Man-made Impervious Surface (GMIS) Dataset from Landsat. Version 1.00. December 2017. Accessed December 2022 at: data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*

Figure 5 summarizes the natural asset condition assessment results per the online dashboard.
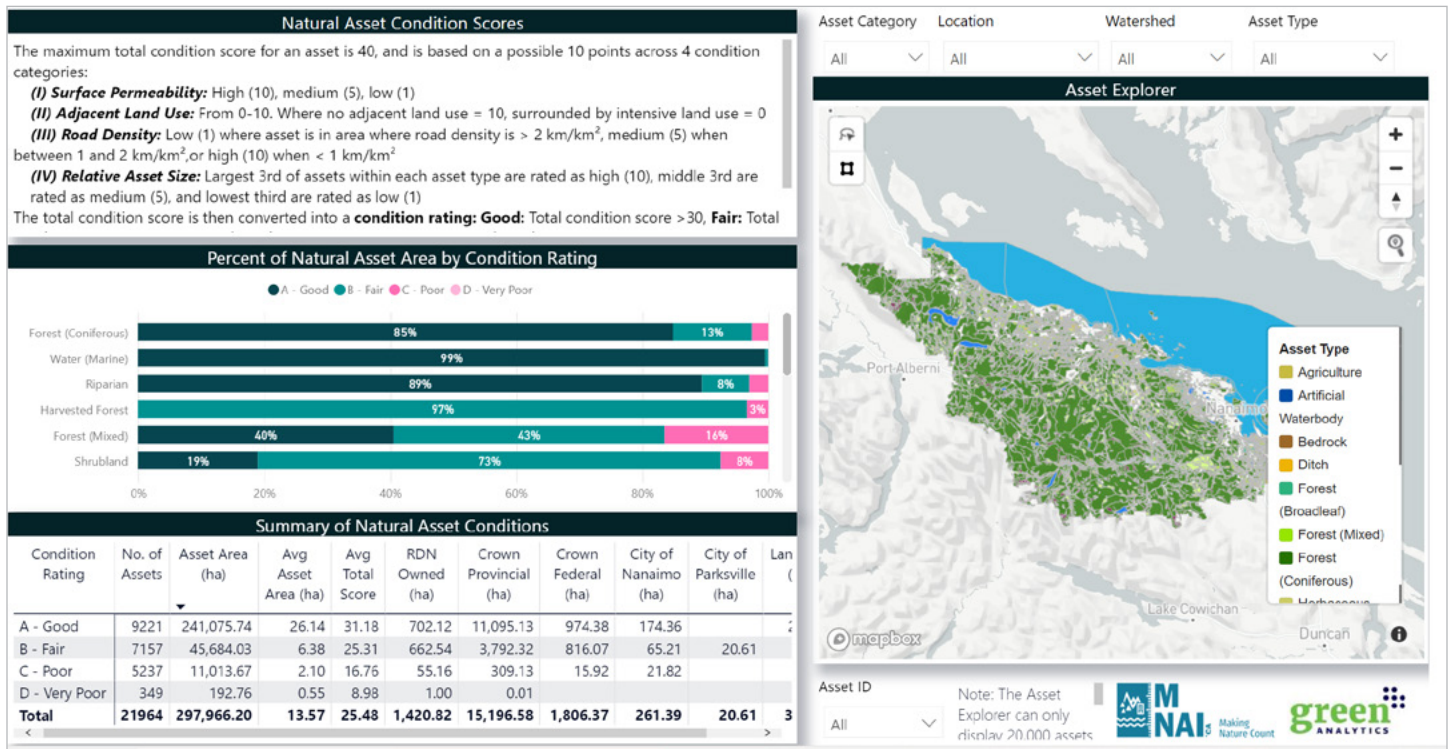
Figure 5: *Screenshot of condition assessment results.*

Overall, about 241,076 ha (or 81 per cent) of natural assets were assessed in good condition and 45,684 ha (or 15 per cent) were assessed in fair condition. Forest (coniferous), water and riparian assets all ranked largely good.

Table 5 summarizes condition ratings and Figure 6 summarizes condition by natural asset type. Additional insights on the condition results can be obtained through the "Decomposition" tab of the online dashboard.

TABLE 5: SUMMARY OF NATURAL ASSET CONDITION RATINGS

Condition Rating	Number of Assets	Total Area (ha)	Average Condition Score
Good	9,221	241,076	31.18
Fair	7,157	45,684	25.31
Poor	5,237	11,014	16.76
Very poor	349	193	8.98
Total	21,964	297,966	25.48

● A - Good ● B - Fair ● C - Poor ● D - Very Poor

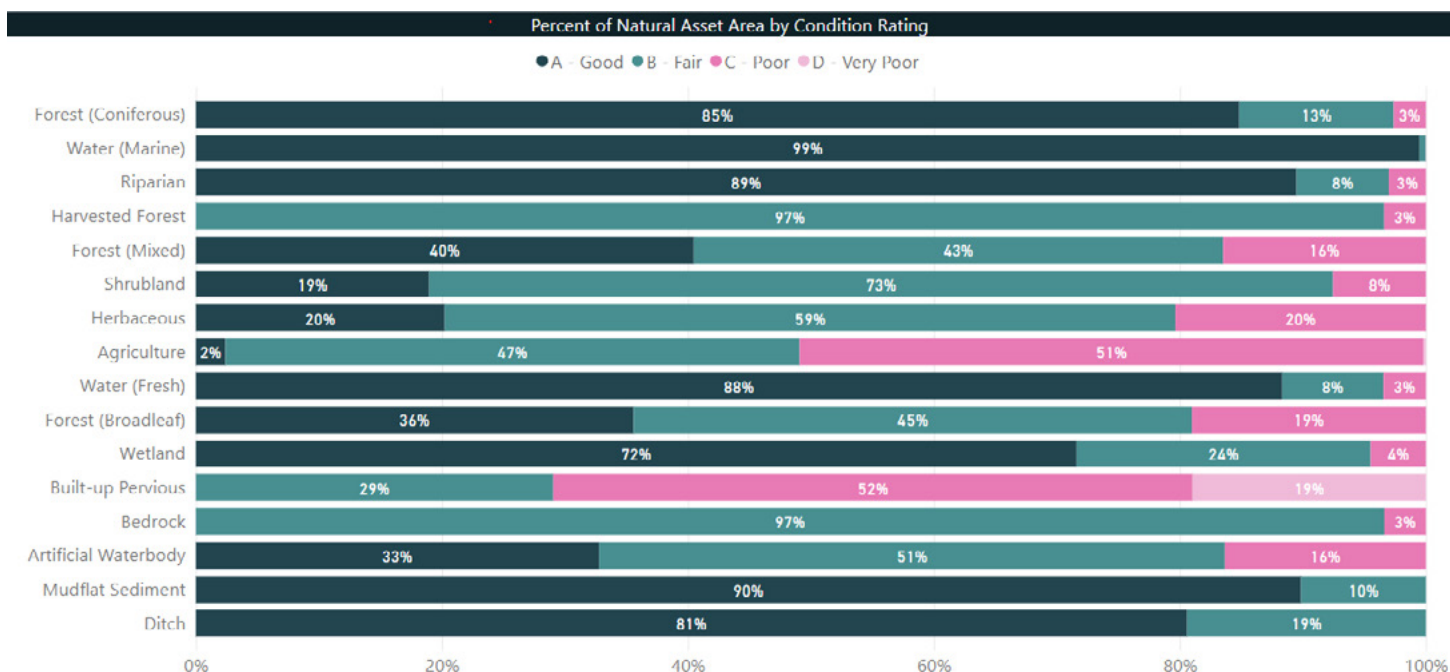| Natural Asset Type	A - Good	B - Fair	C - Poor	D - Very Poor
Forest (Coniferous)	85%	13%	3%	
Water (Marine)	99%			
Riparian	89%	8%	3%	
Harvested Forest	97%		3%	
Forest (Mixed)	40%	43%	16%	
Shrubland	19%	73%	8%	
Herbaceous	20%	59%	20%	
Agriculture	2%	47%	51%	
Water (Fresh)	88%	8%	3%	
Forest (Broadleaf)	36%	45%	19%	
Wetland	72%	24%	4%	
Built-up Pervious	29%	52%	19%	
Bedrock	97%		3%	
Artificial Waterbody	33%	51%	16%	
Mudflat Sediment	90%	10%		
Ditch	81%	19%		

Figure 6: Summary of condition rating by natural asset type.

4.6.   Maintaining the inventory

Inventories are not static. Both the registry and the dashboard can be expanded as new information becomes available. For example, asset condition might improve as a result of restoration efforts, or new studies may add insights on the condition of the assets. New data can be reflected in the asset registry and subsequently in the online dashboard as it becomes available. Furthermore, the level of desired detail may evolve as asset management readiness increases or as areas of natural asset management focus emerge. That said, inventories should grow in detail and sophistication only insofar as they remain aligned with the capacity of the communities to maintain them and the uses to which they will be put. Their evolution and development should be a function of the monitoring, reporting and lessons of the asset management cycle and be driven by the imperative of ensuring sustainable, cost-effective delivery of services to the community, which is the core of asset management.

5 Risk identification

5.1. 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.* In the case of the RDN, MNAI also facilitated two workshops with staff to complete the exercise.

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

Risk types relevant to natural asset management typically include:

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

5.2. Risk Rating Methodology Used for this Project

The following process was followed to arrive at risk ratings for natural assets across the RDN

- **i/** Inventory hazards and affected natural asset classes
- **ii/** Assign identified hazards to relevant natural asset classes and services
- **iii/** Identify priority stressors using risk ratings
- **iv/** Map risk across the RDN

In March and April 2022, the RDN staff participated in MNAI-led risk management workshops to identify hazards to natural assets and their associated services. Staff started by exploring the *Hazard Risk and Vulnerability Analysis*[7] completed for the region in 2019 to consider likelihood and impact severity of hazards to natural assets. Of the 53 hazards identified in the Analysis, 13 were deemed applicable to natural assets.

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7   *RDN, Town of Qualicum Beach, and City of Parksville. Hazard, Risk, and Vulnerability Analysis. September 2019. Accessed March 2022 at: www.rdn.bc.ca/sites/default/ files/inline-files/2019%20RDN%20HRVA%20Report%20FINAL.pdf.*

These include:

- Fires (wildfire & urban interface)
- Overland flooding[8]
- Rivers, lakes, & streams flooding
- Coastal flooding
- Wind event
- Non-point source contaminants[9]
- Saltwater intrusion
- Drought
- Insect infestation, plant disease, and invasive species
- Air quality
- Heat event
- Dam failure
- Tsunami

Staff subsequently added an additional hazard not included in the Analysis, but of relevance to natural assets. The additional hazard was development/land conversion.

For each hazard, natural asset classes at risk and services that could be impacted were documented. Each hazard was then ranked from 0-25 according to the probability of an impact occurring and the relative magnitude of its negative consequences, with 0 being the lowest and 25 being the highest risk. To assess impact and consequence, the RDN considered four questions:

- **i/** What impact is likely to happen?
- **ii/** What is the consequence of that impact happening?
- **iii/** What can be done to mitigate the probability of impact and/or consequence?
- **iv/** What cues will signal the need for mitigation?

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

- Very high - assets with a score between 21 and 25
- High - assets with a score between 16 and 20
- Moderate - assets with a score between 11 and 15
- Low - assets with a score between 6 and 10
- Very low – assets with a score of 5 or less

Through collaboration between the MNAI project team and the project partners, the spatial extent of each risk was defined. Table 6 below provides a summary of risk rankings and how the spatial extent was determined and mapped in the Inventory Dashboard.

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8   *Defined as culvert flooding*

9   *Note: this hazard was 'motor vehicle incident' in HRVA Report*

Table 6: Summary of Risk Ratings and data used to determine spatial extent of risk

TABLE 6: SIMPLIFIED RISK IDENTIFICATION SURVEY				
Hazard	Like-lihood score	Impact score	Risk score	Natural Assets Affected
Fires (wildfire & urban interface)	5	4	20	Applied to all natural assets with Treed Broadleaf, Treed Coniferous, Treed Mixed, Herb, Herb-Forbs, Shrub Low, Shrub Tall, and Cleared (Harvested Forest assets) land cover types that were within electoral areas, A, B, C, and H.
Overland flooding	3	1	3	A 100 m buffer was drawn around all freshwater assets in the inventory, all watercourse lines barring those of minor tributaries (watercourse Types Tributary 1, Tributary 2, and unclassified lines) and around specific points of interests related to overland and river flooding listed in the risk document. All aquifers that intersected this boundary were selected, and any assets that intersected these aquifers or the 100 m watercourse/water feature buffers were flagged as being at risk to overland flooding. *Note:* The 100 m was based on a rough distance that would capture the points of interest related to flooding (Brittian Boulelvard, Macmillan Road, Mason Trail, Lee Road, Grafton Avenue, River Crescent, Martindale Road) were from the watercourses.
Rivers, Lakes, & Streams Flooding	5	3	15	The 100 m buffer around Water (Fresh) assets, watercourses that were not minor tributaries, and the points of interest, used in the previous steps was used to select all natural assets, and a subset of these selected assets which met the following criteria were assigned this risk; assets that were Agriculture, Riparian, or Wetland asset type, or that were land cover type River or that had extents of Nanaimo Park Area, Provincial Park Area, Community Park Area, or Regional Park Area greater than 0 (to capture assets that had park extent within them) and were not Water (Marine) assets.
Coastal flooding	4	2	8	All assets that intersected the boundaries of marine water assets, to capture all assets directly adjacent to ocean water. Water (Marine) assets themselves were not included in this selection.

TABLE 6: SIMPLIFIED RISK IDENTIFICATION SURVEY

Hazard	Like-lihood score	Impact score	Risk score	Natural Assets Affected
Wind event	4	4	16	All assets that belonged to Treed Broadleaf, Treed Coniferous, Treed Mixed, Wetland, Vegetated Wet-land landcover types, and River landcover types, or that had extents of Nanaimo Park Area, Provincial Park Area, Community Park Area, or Regional Park Area greater than 0 (to capture assets that had park extent within them) and were not Water (Marine) assets.
Non-point source contaminants	4	1	4	All assets that belonged to the Water (Fresh) asset class, Riparian, or that had an active groundwater well within their boundaries or that intersected a Moderate-High or High Vulnerability Aquifer were initially selected. Then any of these assets that intersected areas of industrial zoning, sewer features in Nanaimo, RDN sewer services area, or areas of built-up impervious land cover (commercial areas, roads, etc.) determined for the condition assessment were flagged for this risk.
Saltwater intrusion	2	3	6	All assets that either intersected a coastal aquifer (an aquifer that intersects with the boundary of Water (Marine) assets, or assets that have an active groundwater well and intersect Water (Marine) assets.
Drought	5	3	15	All assets belonging to Forest, Agriculture, Riparian, Herbaceous (grassland), Shrubland, Harvested Forest, Built-up Pervious (grasses in more urban areas) Wetland, and Ditch, asset types, or that were Pond or River landcover types, or that intersected with the boundary of a bedrock aquifer were flagged as at risk to drought.
Insect infestation, plant disease, & invasive species	4	4	16	All assets with Treed Broadleaf, Treed Coniferous, Treed Mixed, Herb, Herb-Forbs, or cleared land-cover types, or Wetland asset types, or extents of community and regional parks greater than 0 ha within their boundaries were flagged as at risk.
Air quality	4	1	4	All assets that had Treed Broadleaf, Treed Coniferous, Treed Mixed, Herb, Herb-Forbs, Shrub Low, Shrub Tall, or cleared landcover types were flagged as vulnerable to this risk.

TABLE 6: SIMPLIFIED RISK IDENTIFICATION SURVEY

Hazard	Like-lihood score	Impact score	Risk score	Natural Assets Affected
Heat event	5	4	20	All assets that belonged to Tree Broadleaf, Treed Coniferous, Treed Mixed, River, Pond, Herb, Herb-Forbs, or cleared landcover type, or that had Riparian or Wetland asset type, or that intersected Wa-ter (Marine) assets, and that were not Water (Marine) assets were flagged as at risk.
Dam failure	2	4	8	All assets that are within 1 km of dams of interest and that were Forest, Wetland, Herbaceous, Harvested Forest or Riparian asset types, or that were River landcover.
Tsunami	1	4	4	A 100 m buffer drawn around all Water (Marine) assets and assets intersecting that boundary were flagged as vulnerable to this risk.
Development/land conversion	5	3	15	Buffer permit areas by 100 m, all assets that inter-sect buffers are considered at risk.

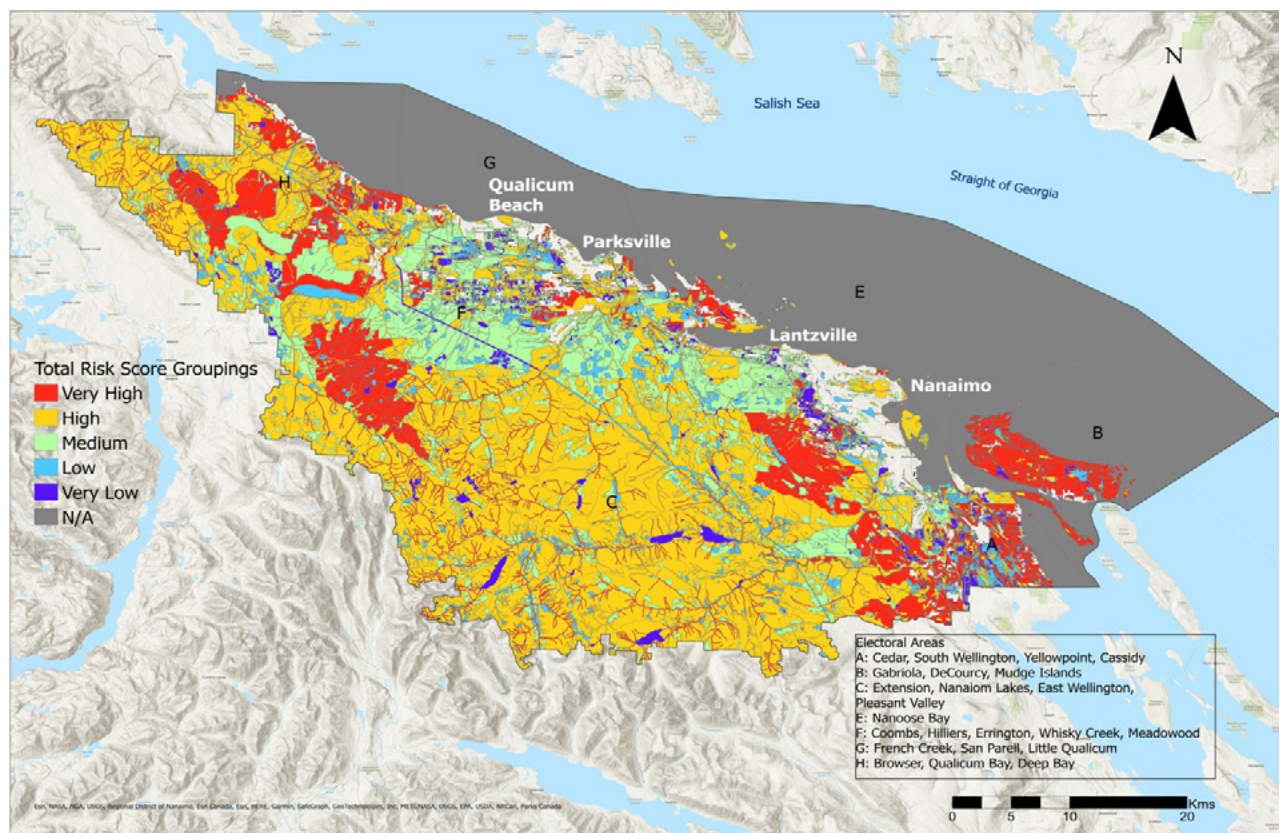Figure 7 is the map of total risk across the RDN.

Figure 7: Map of total risk across the RDN.

5.3. Results of the risk identification process

The risk identification process revealed:

- 0 very high-level risks to natural assets
- 4 high-level risks to natural assets (fires; heat event; wind event; and insect infestation, plant disease, and invasive species)
- 3 moderate-level risks to natural assets (rivers, lakes, and streams flooding; drought; and development/land conversion)
- 3 low level risks to natural assets (coastal flooding, dam failure, and saltwater intrusion)
- 4 very low-level risks to natural assets (non-point source contaminants; air quality; tsunami, and overland flooding)

Table 7 summarizes risk ratings and Figure 8 summarizes risk by natural asset type.

TABLE 7: SUMMARY OF NATURAL ASSET RISK RATINGS			
Risk Rating	Number of Assets	Asset Area (ha)	Average Asset Area (ha)
Very low	2,736	5,910	2
Low	2,574	10,533	4
Moderate	5,986	35,940	6
High	7,965	103,128	13
Very high	2,654	36,879	14
Total	21,915	192,391	9

In terms of scope, the identified hazards affect natural assets across the RDN, with numerous hazards impacting forests, wetlands, watercourses, streams, and grasslands. Services most affected include recreation, habitat for biodiversity, and water supply. The identified hazards also have the potential to negatively impact engineered assets (both city-owned and non-city owned), and personal health and safety.

Many hazards may interact and create cumulative effects as they impact various socio-economic systems via process cascades. Drought, in particular, is noted as exacerbating the impacts of numerous hazards.

RDN Risk Matrix
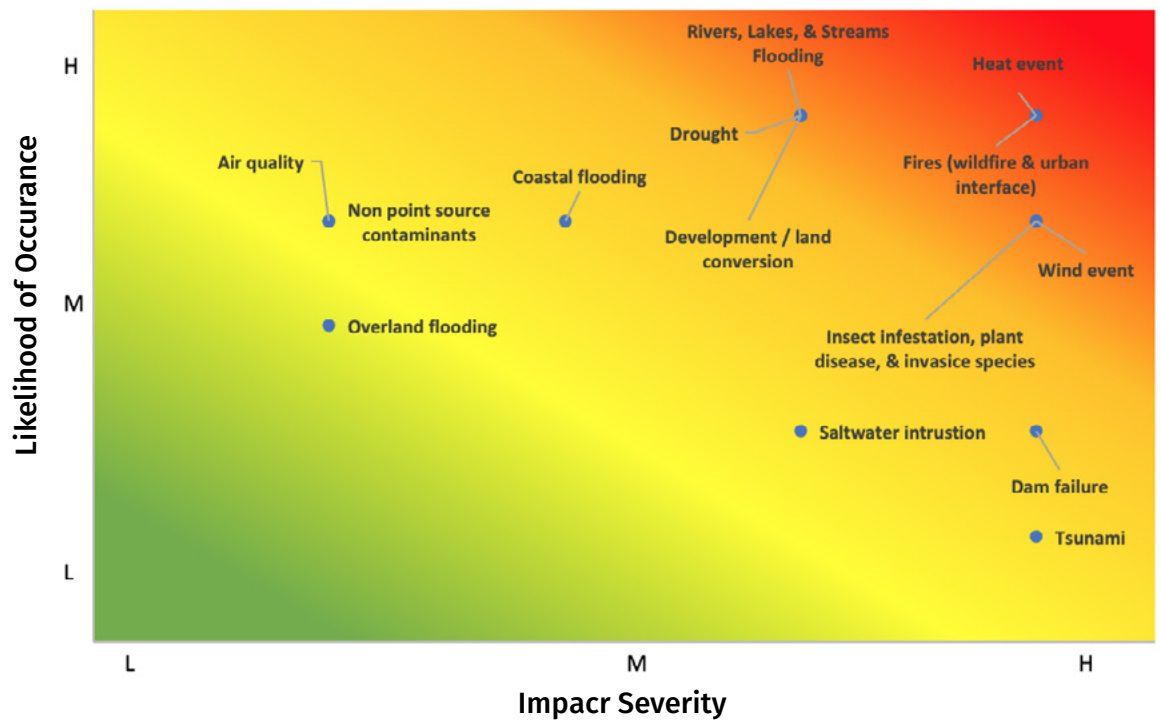
Figure 8: *Results of risk identification process.*

5.4. Potential priorities for the local government

The outcomes of the risk identification process highlight potential priorities on which the RDN could focus its natural asset management efforts. These are:

FIRES (WILDFIRE AND URBAN):

Forests, grasslands, soils, and upland ecosystems were deemed to be at high risk from fires, including both wildfire and urban fires, particularly in Electoral Areas A, B, C, and H (see Figure 9). This may impact water supply, water quality, biodiversity, recreation, air quality, wildfire habitats, cultural and archaeological heritage/sites and economic opportunities (e.g., forest harvesting, eco-tourism, mineral extraction, fish and game). Wildfire risk to natural assets has likely increased with climate change and is exacerbated by drought.

Several risk mitigation measures are in place:

- Community Wildfire Resiliency Plans (2022)[10] for each Electoral Area, which assess wildfire risk in the wildfire urban interface and provide recommendations for a FireSmart community.
- Fuel Management Prescriptions (2022 and ongoing). The RDN is developing recommendations for fuel management activities in

- FireSmart Program. The BC FireSmart Program increases homeowner and community wildfire preparedness through vegetation management events, community outreach, FireSmart home assessments, Neighbourhood Champion Workshops and assessments, and other outreach.
- Critical infrastructure owners and operators have protective measures in place to mitigate impacts from wildfires and are represented in the planning and coordination calls hosted by the Province.

Challenges remain to adequately assess and address risk on private lands. For instance, the Community Wildfire Resiliency Plans did not assess wildfire risk on private lands but note vulnerability is tied to the type and location of development. Development in the wildland-urban interface is often necessary due to geography (e.g., islands or communities with limited developable land), which can create community risk. Proactive measures are being taken through education, public awareness and FireSmart Programming. To further limit risk, the RDN could explore tracking indicators of forest resilience (e.g., presence of native, drought-tolerance species and canopy density).
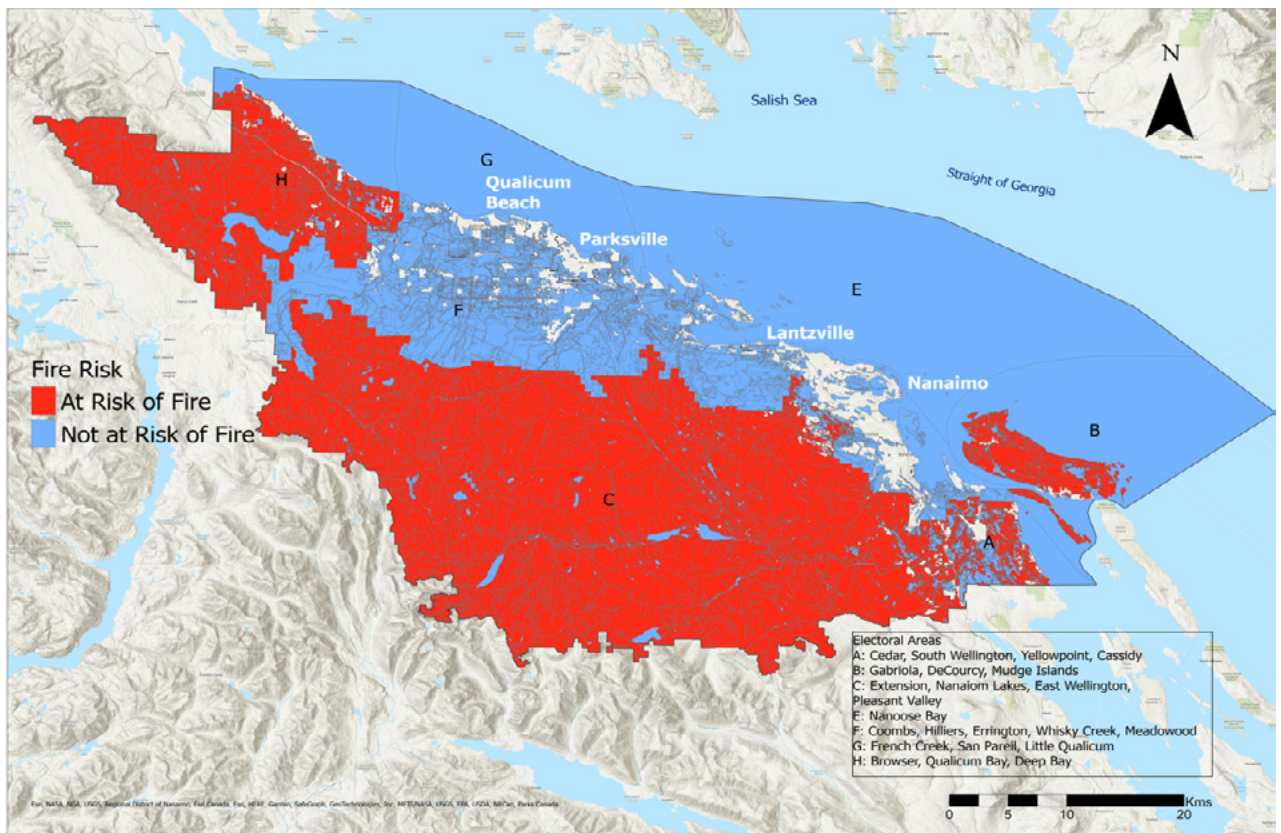

Figure 9: *Map of Fire Risk Areas.*

HEAT EVENT

Forests, wetlands, grasslands, coastal areas, and streams were deemed to be at high-risk from a heat event. This, in turn, may impact the following services: human health and safety; water supply; commercial operations; recreation; and habitat for biodiversity.

Climate change means heat risks will increase and may be exacerbated by droughts. Droughts reduce water availability for evaporation and possibly strengthen the urban heat island effect. A report by Health Canada[11] provides advice to health officials to support local governments and organizations addressing heat events. The report contains advice on changes communities can make to the built environment through planning tools and instruments (e.g., Official Community Plans and regulations, climate change adaptation plans, zoning bylaws, design guidelines) including:

- Expanding vegetation cover
- Implementing climate-sensitive urban design and planning
- Integrating natural ventilation and water features into urban design
- Reducing waste heat

These measures can be targeted to at-risk locations where high population density and high impervious areas intersect. Figure 10 shows a map of heat event areas.
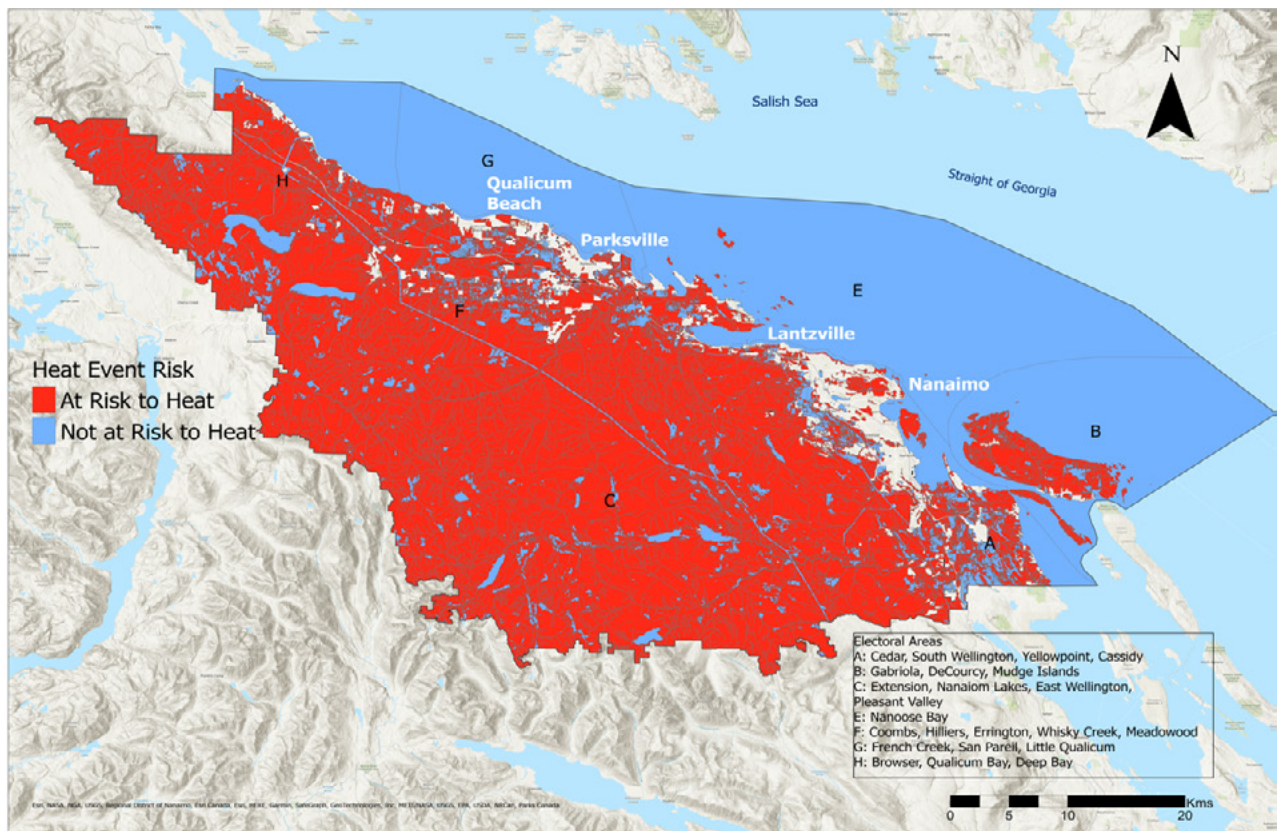

Figure 10: Map of Heat Event Risk Areas

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11   *Health Canada, 2020*

WIND EVENTS

Forests, streams, wetlands, and parks were deemed to be at high risk from a wind event, particularly in the Whiskey Creek corridor and Westley Ridge (see Figure 11). This may impact the following services: habitat for species, carbon sequestration, and recreation (from lost limbs and downed trees).

Risks to natural assets associated with wind events can also be exacerbated by drought. Trees and vegetation suffering from drought and/or are in poor health may be lost or damaged during wind events. Impacts to water and wells will also be heightened under drought conditions preceding a wind event.

Several risk mitigation measures are in place. These include:

■ Tree Management in Parks Policy, which addresses the management of tree removals and tree replacement in regional parks and trails.
■ BC Hydro Electrical Awareness Training to improve safety.
■ Climate monitoring at Mount Arrowsmith and Upper Nanoose Creek, which includes wind measures.

Measures to improve the health, connectivity, and area of natural assets can assist in reducing the impacts of wind events. Increasing public awareness of the role of natural assets in mitigating hazards could help to address risks to private lands and residents.
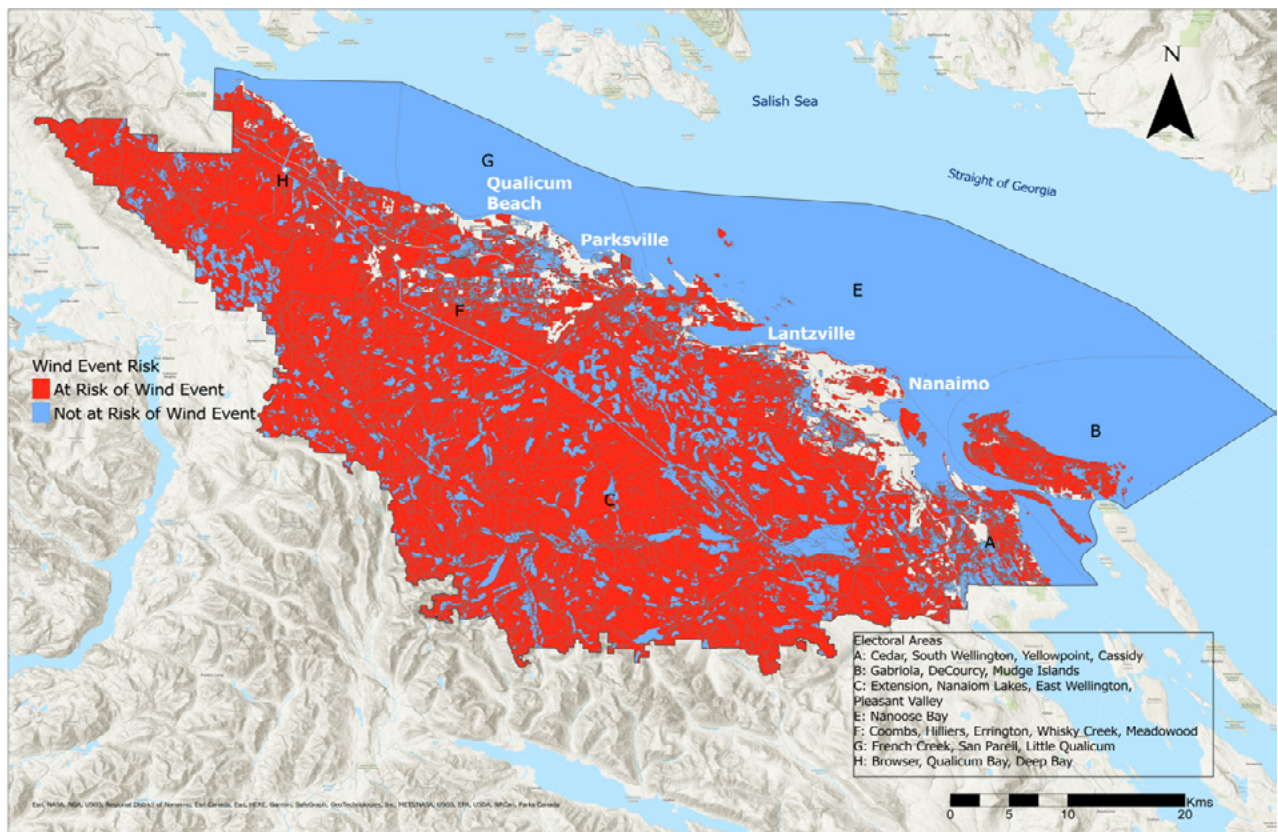

Figure 11: Map of Wind Event Risk Areas

INSECT INFESTATION, PLANT DISEASE, AND INVASIVE SPECIES

Forests, wetlands, grasslands, and regional and community parks were deemed to be at high risk from insect infestation, plant disease, and invasive species. This may impact the following services: recreation; biodiversity; commercial operations; food production; and indigenous plants.

Risks to natural assets associated with insect infestation, plant disease and invasive species interact with forest fires, drought, and wind throw, potentially worsening impacts, such as the introduction of invasive species.

Several risk mitigation measures are in place. These include:

- Sensitive Ecosystem Development Permit Area, which contains designated conservation areas
- Tree Management Policy, which addresses the management of tree removals and tree replacement in regional parks and trails
- RDN Stewardship seed funding
- RDN promotion of native plans via FireSmart, and the WaterSmart Landscape Guide

The RDN also partnered with the BC Agriculture and Food Climate Action Initiative, other island Districts, and agricultural groups in the creation of the *Vancouver Island Agricultural Adaptation Strategy*.[12] The Strategy contains recommendations for completing an emerging pests scan, increased monitoring for emerging pests, and improving access to producer-focused pest management resources.

The RDN could expand invasive species tracking and drawing upon resources and support from the Invasive Species Council of BC and volunteers to conduct vegetation maintenance to remove invasive species from parks, forests, and shrublands.

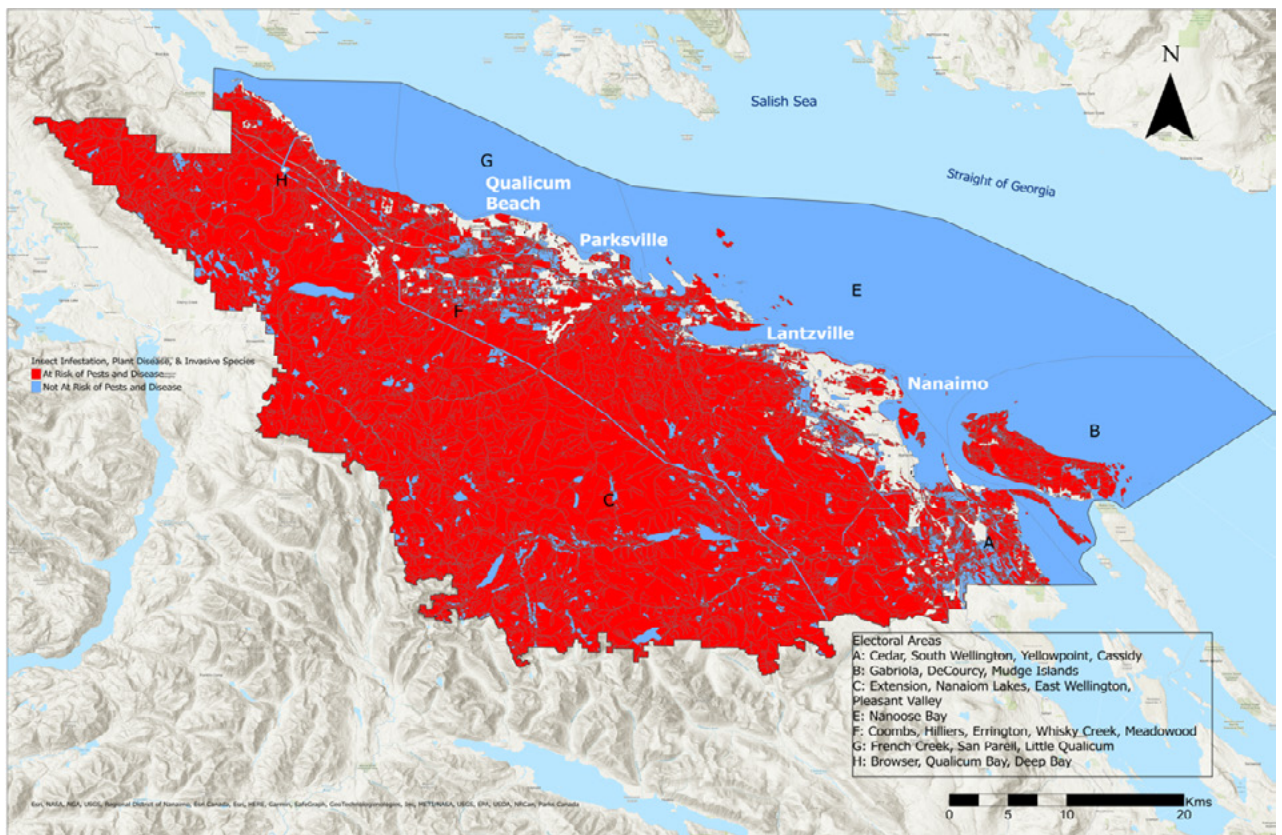12   *BC Agriculture & Food Climate Action Initiative, 2020.*

Figure 12: Map of Insect Infestation, Plant Disease, and Invasive Species Risk Areas

Table 8 lists and provides brief descriptions of risk mitigation strategies. Future stages of the MNAI process can address these strategies.

TABLE 8: RISK MITIGATION STRATEGIES

Condition Rating	Number of Assets
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, reducing risks for each partner
Transfer	Insurance, fixed price contracts, and other risk transfer tools

6 Recommendations

This section provides insights that can be gained from considering both the inventory — including the condition and risk assessments — and the asset management readiness assessment. It is divided into: (6.1) opportunities to strengthen natural asset management at an organization-wide level, (6.2) possible actions for the further development of the inventory, and (6.3) steps the RDN can consider to advance to a full natural asset management initiative.

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

The RDN is at a relatively early stage of adopting asset management, which creates opportunities for natural asset considerations to be incorporated as overall progress on asset management is made. For example, expanding the Strategic Asset Management Plan to include natural assets can provide a framework for incorporating the knowledge of programs such as the Drinking Water and Watershed Protection Program, and departments, including Parks.

Good asset management practice clearly defines roles and responsibilities. Therefore, the RDN could articulate who on the cross-departmental asset management working group is responsible for ensuring natural asset management considerations are incorporated into asset management planning across service areas. Related goals and objectives should be included in the terms of reference for the working group.

The RDN understands that, once the inventory is complete, it will be important to identify expenditures required to maintain the services that natural assets currently provide. An asset management plan for natural assets should be developed that includes cost, and short-term natural asset management actions to support water management objectives.

It will be important to build understanding and support for planning for natural asset management among the Regional Board to ensure the plan is adequately resourced. It is recommended that the results of the MNAI project are communicated to senior staff and the Regional Board as part of the process of building awareness of the role of natural assets in service delivery.

6.2. Possible actions for the further development of the inventory

Based on the inventory, the RDN could consider the following, regardless of whether a full natural asset management process is pursued. These are mostly incremental measures.

- Refine the inventory by adding in municipal data layers.
- Expand the inventory to incorporate ortho photo map layers, which are regularly updated and may be useful in refining the condition assessment.

- Obtain and incorporate data pertaining to the estuaries within the RDN, which are important assets for service provision.
- Incorporate data pertaining to the RDN's shoreline and beach assets, which is currently lacking.
- Incorporate data on forest and tree canopy, which is useful for assessing the condition of forests and trees, and relevant for service provision.
- Incorporate LiDAR data into the inventory to add attribute details to the inventory as well as condition data.
- Determine acceptable levels of risk to the District of Nanaimo's risk mitigation strategies (see Table 8).
- Expand the risk identification to include field verification of results.
- 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 with adjacent local governments to stimulate collaboration within the watershed.
- Schedule regular updates (e.g., every three to five years) of the inventory, condition assessment and risk identification to understand trends
- Maintain interest and momentum in natural asset management to move towards a full natural asset management project.

6.3. Steps to a full natural asset management project

If the RDN wishes to proceed with a full natural asset management project including implementation, it will need to consider the following steps:

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, and (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**. This step involves modelling the services provided by natural assets. The modelling can consider the current state of natural assets or the potential for natural assets to deliver services under different management (e.g. restoration) scenarios. The modelling can also consider the impact of climate change impacts on the natural assets and hence the services those assets deliver.

4/ **Economic assessment**. The economic assessment component provides a market-based indication of, for example (a) the current 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 for service delivery.

5/ **Planning**. This step allows local governments to explore different scenarios such as "what happens to the services provided by the wetland if there is significant building upstream?" or "what happens to the services if the forest is restored?" Using modelling, local governments can understand and quantify changes in service levels. They can also determine corresponding values through continued economic assessment. Based on the foregoing, local governments can begin to consider and prioritize actions ranging from status quo to planning, regulatory, financial operations, maintenance, acquisition, and monitoring interventions.

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

7/ **Ongoing monitoring**. It is essential to continue monitoring the project 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 three years through a monitoring arrangement to be established with the communities.

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Annex: Results of the RDN's risk identification process

This annex contains the results of the RDN's risk management workshops. Table 9 provides a summary of the workshop findings, including hazard impacts and mitigation actions and opportunities.

TABLE 9: SUMMARY OF RISK IDENTIFICATION WORKSHOP FINDINGS		
Hazard	**Impact**	**Mitigation Actions & Opportunities**
Fires (wildfire & urban interface)	**Natural asset affected:** forests, grasslands, soils, upland ecosystems **Services affected:** water supply, water quality, biodiversity, recreation, air quality, wildfire habitats, cultural and archaeological heritage/sites, economic opportunities (forest harvesting, eco-tourism, mineral extraction, fish and game)	■ Public education including: FireSmart Neighbourhood Champion Workshops, Home and Neighbourhood Assessments, RDN FireSmart & WaterSmart Landscape Guide ■ Community Wildfire Resiliency Plans (2022) ■ Fuels Management Prescriptions (2022 and ongoing) ■ FireSmart Program (vegetation management events, community outreach, FireSmart home assessments, Neighbourhood Champion Workshops and assessments)
Overland flooding	**Natural asset affected:** watercourses, wetlands, agricultural lands, aquifers **Services affected:** stable water supply, carbon sequestration, clean water, recreation, flood retention, biodiversity	■ Regional Rainwater Management Strategy ■ Green Infrastructure ■ Regional Rainwater Management Strategy (2022)
Rivers, Lakes, & Streams Flooding	**Natural asset affected:** water-courses (bank erosion), wetlands, agricultural lands, aquifers, parks **Services affected:** stable water supply, carbon sequestration, clean water, recreation, flood re-tention, biodiversity	■ Regional Growth Strategy (2011) ■ Parksville Development Permit Areas ■ Drinking Water and Watershed Protection Action Plan (2019) ■ Floodplain Management Bylaw ■ Development Permit Areas (DPA) in Area A, Marine Coast, and Freshwater DPAs

TABLE 9: SUMMARY OF RISK IDENTIFICATION WORKSHOP FINDINGS

Hazard	Impact	Mitigation Actions & Opportunities
Coastal flooding	**Natural asset affected:** natural assets within coastal zone **Services affected:** fire protection / stable water supply, recreation, fisheries (aquaculture), impacts river delta (plant & animal life), loss of estuaries, upland plant and animals, erosion mitigation	■ RDN Sea Level Rise Adaptation Program (underway) ■ Floodplain Management Bylaw No. 1469 ■ Qualicum Beach Waterfront Master Profile ■ Development Permit Areas (DPA) in Area A, Marine Coast, and Freshwater DPAs
Wind event	**Natural asset** affected: forests, streams, wetlands, parks **Services affected:** habitat for species, carbon sequestration, recreation (lose limbs & downed trees), recreation	■ Tree Management in Parks Policy ■ BC Hydro Electrical Awareness Training ■ Climate monitoring at Mt Arrowsmith and Upper Nanoose Creek
Non point source contaminants	**Natural asset affected:** streams, waterbodies, groundwater **Services affected:** clean water	■ Procedures within water treatment facility ■ MOTI & hazmat procedures ■ OCP updates in Area F address groundwater quality risk and nitrate pollution from existing livestock farms
Saltwater intrusion	**Natural asset affected:** groundwater **Services affected:** clean water/ freshwater provision	■ Water conservation
Drought	**Natural asset affected:** forests, streams, watercourses, vegetation, agricultural lands, groundwater, snowpack **Services affected:** stable water supply, recreation, biodiversity, local food supply, tourism	■ Drinking Water and Watershed Protection Program ■ Public Education (WaterSmart & FireSmart Landscape Guide) ■ Area A Development Permit Area (Rainwater harvesting required) ■ Region-wide watering restrictions framework ■ Water Conservation rebates and education ■ Water budget modelling ■ Nanoose water budget (phase 3 near completion) ■ Policy B1.21 ground water requirements ■ Water Services Emergency Plans *cont…*

TABLE 9: SUMMARY OF RISK IDENTIFICATION WORKSHOP FINDINGS

Hazard	Impact	Mitigation Actions & Opportunities
cont'd **Drought**		■ Liquid Waste Management Plan & Wastewater Emergency Plans ■ Water conservation / efficiency, watering restrictions, rainwater collection, dam pulse releases (Englishman, Nanaimo Rs) protection of natural assets including groundwater recharge areas
Insect infestation, plant disease, & invasive species	**Natural asset affected:** forest, wetlands, grasslands, regional and community parks **Services affected:** recreation, biodiversity, commercial operations, food production, indigenous plants	■ Flagged AG report - Vancouver island AG climate adaptation strategy (located report) ■ Sensitive Ecosystem DPA, designated conservation areas ■ Tree Management Policy ■ RDN Stewardship seed funding, ■ RDN Promotion of native plans via FireSmart, WaterSmart (FireSmart and WaterSmart Landscape Guide)
Air quality	**Natural asset affected:** forests, grasslands, soils, upland ecosystems **Services affected:** recreation, clean air, human health and safety, commercial operations	■ Provincial Open Burning Smoke Control Regulation ■ Policies in Official Community Plans, building codes, select area outdoor burning bylaws ■ Woodstove Exchange Rebates
Heat event	**Natural asset affected:** forest, wetlands, grasslands, coastal, streams **Services affected:** Human health & safety, water supply, commercial operations, recreation, biodiversity	
Dam failure	**Natural asset affected:** berms (breeches); biodiversity; water-courses, forest, wetlands, grass-lands **Services affected:** biodiversity, flood retention, recreation, water supply, water quality, human health and safety, commercial operations	■ Dam emergency plans (for dams that are being managed) ■ Dam risk assessments
Tsunami	**Natural asset affected:** soil salination **Services affected:**	
Development / land conversion	**Natural asset affected:** **Services affected:**	■ Growth containment boundary

Municipal Natural Assets Initiative