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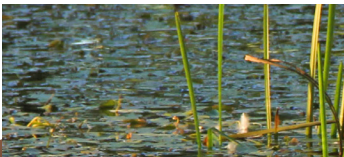


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# Toward natural asset management in the Halifax Regional Municipality Nova Scotia



Summary of inventory results and recommendations  
October 2021

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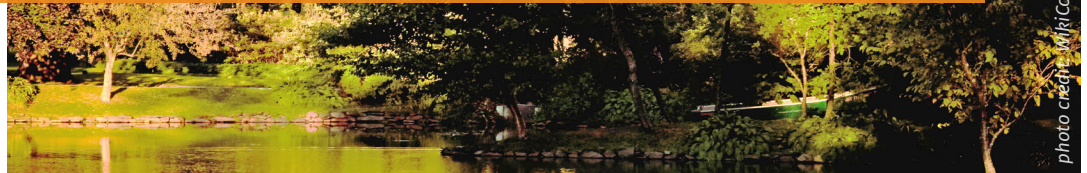
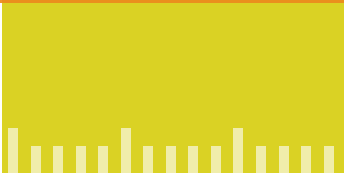


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## Municipal Natural Assets Initiative





## 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.

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# 1 Purpose

This report summarizes the results of a project to develop a natural asset inventory in the Halifax Regional Municipality, 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<sup>1</sup>.

### 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 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

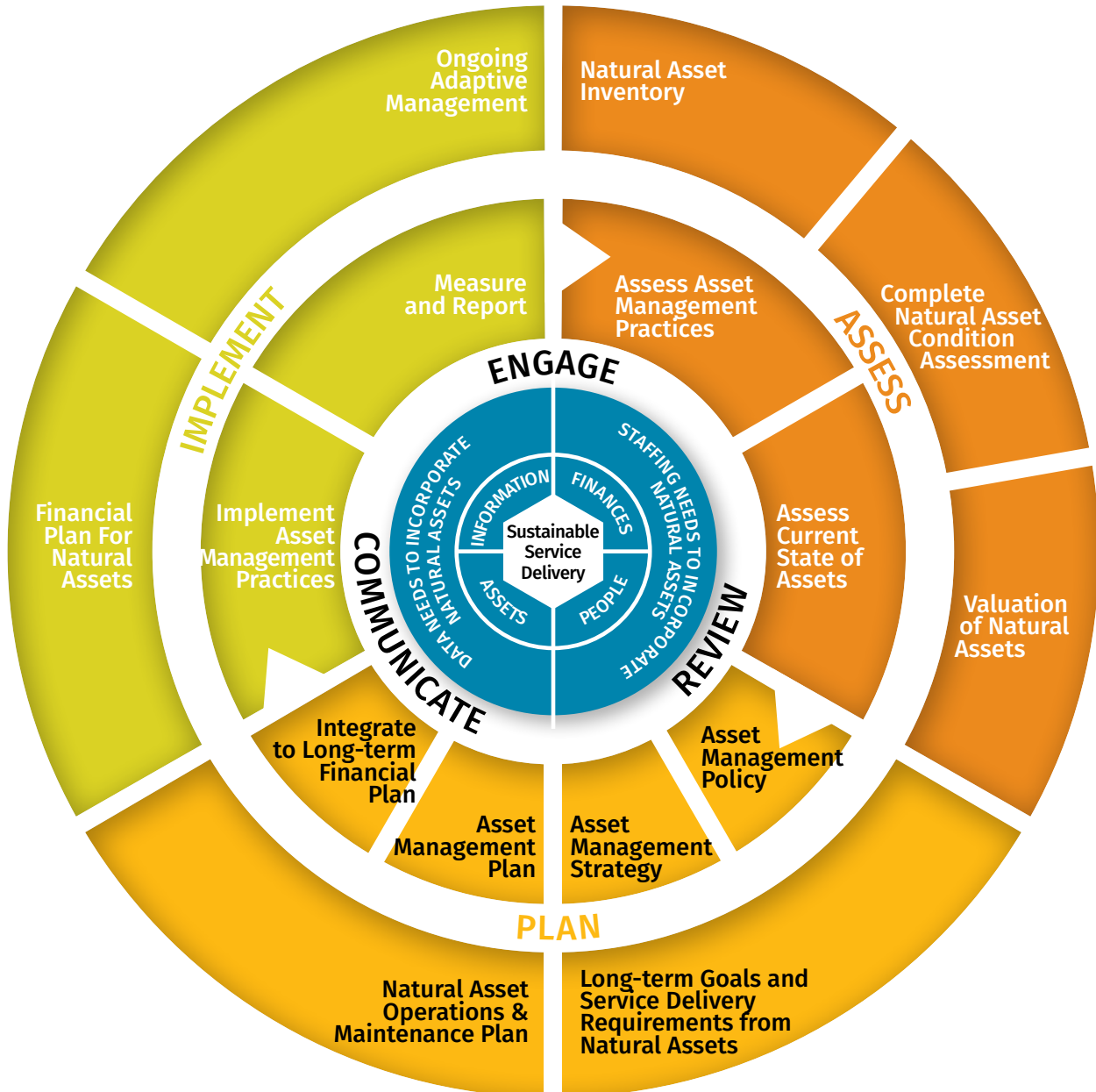
There are numerous ways for local governments to manage natural assets. The Municipal Natural Assets Initiative (MNAI) uses methodologies and tools rooted in standard asset management and provides a range of advisory services to help local governments implement them. MNAI has developed the methods and 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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<sup>1</sup> [mnai.ca/media/2018/02/finaldesignedsept18mnai.pdf](https://mnai.ca/media/2018/02/finaldesignedsept18mnai.pdf)

## What is a natural asset inventory?

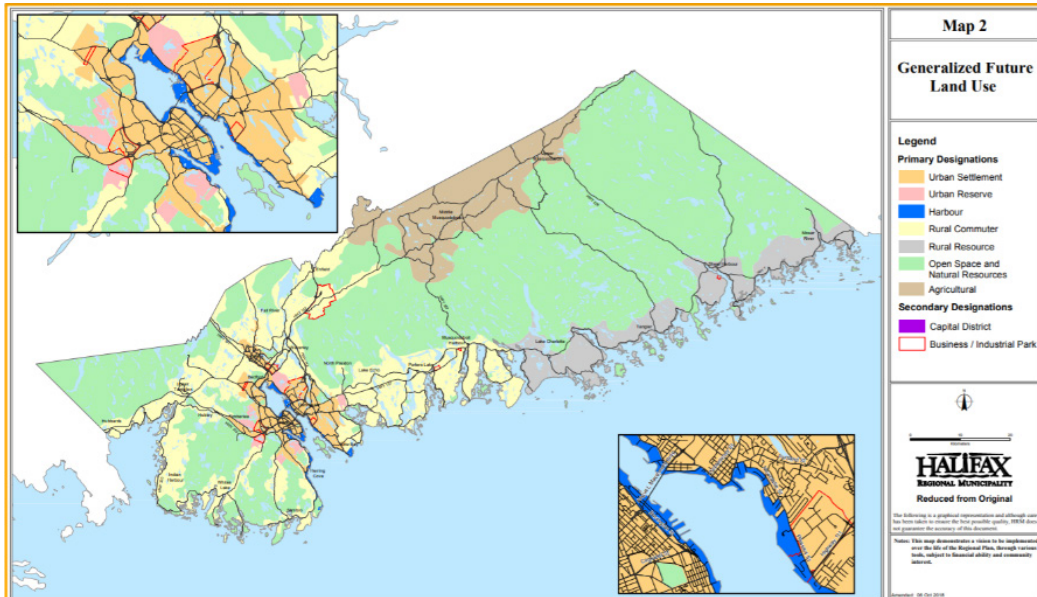
Natural asset inventories provide details on the types of natural assets a local government relies upon, their condition, and the risks they face. As depicted in Figure 1 and explained in detail in the Annex, a natural asset inventory is the first component of the Assessment phase. The Assessment phase, 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 value but 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.*

# 3 Local government context

## 3.1. General



**Figure 2:** The Halifax Regional Municipality<sup>2</sup>.

The Halifax Regional Municipality (population ~400,000) is the capital for the province of Nova Scotia and is located within the traditional ancestral lands of the Mi'kmaq people. It is a large municipality by area (nearly 6,000 sq km) with considerable Atlantic coast shoreline<sup>3</sup>.

The Halifax Regional Municipality has three main interests in natural asset management.

First, it wants to help meet a range of environmental, financial and community health goals by creating a sound evidence base for natural assets and elevating them in decision-making to be on par with the consideration given to engineered assets. As part of this, the Halifax Regional Municipality plans to ultimately make all natural asset classes the subject of long-term asset management plans.

Second, as the Halifax Regional Municipality reviews its regional plan, it will review the inventory results to inform decisions about where to appropriately locate future developments relative to flood-prone and wilderness areas.

Third, the Halifax Regional Municipality is vulnerable to climate change risks of sea level rise, hurricanes and other extreme weather events. The inventory will inform implementation of Halifax's response to these risks, including HalifACT, which is described as a climate action movement and a community response to the climate crisis<sup>4</sup>.

<sup>2</sup> *Regional Municipal Planning Strategy (2014, October).* Retrieved April 2021 from [www.halifax.ca/about-halifax/regional-community-planning/regional-plan](http://www.halifax.ca/about-halifax/regional-community-planning/regional-plan)

<sup>3</sup> *Wikipedia.* Retrieved April 2021 from [en.wikipedia.org/wiki/Halifax,\\_Nova\\_Scotia](https://en.wikipedia.org/wiki/Halifax,_Nova_Scotia)

<sup>4</sup> *HalifAct.* Retrieved May 2021 from [www.halifax.ca/about-halifax/energy-environment/halifact-2050-acting-climate-together](http://www.halifax.ca/about-halifax/energy-environment/halifact-2050-acting-climate-together)

Priority natural assets include wetlands, forests, wilderness area parks and urban lakes. Priority services from natural assets include ensuring water quality, moderating stormwater and flood damage, coastal erosion protection, habitat protection, and carbon sequestration.

### 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<sup>5</sup> 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 completed readiness assessment helps local governments prioritize actions that increase their effectiveness in managing all assets, including natural ones.

#### Competency 1: Policy & Governance

The Halifax Regional Municipality's completed readiness assessment indicates it is at a relatively early stage of adopting asset management as an organization-wide practice. It does not yet have an asset management policy but does have a draft asset management roadmap to guide short-term actions for the next 1-3 years. Senior management has also recognized the benefits that asset management can provide to the organization. The Halifax Regional Municipality also has a permanent cross-functional asset management team to guide and support the asset management function across the organization. Council has demonstrated support for asset management and has approved funding for priority improvements.

#### Competency 2: People & Leadership

While some senior managers have recognized the important role of natural assets in service delivery, the Halifax Regional Municipality as a whole has not defined the benefits that it would like natural assets to deliver to support organizational objectives, nor does it have a staff person responsible for incorporating natural asset management into asset management processes. That said, the Halifax Regional Municipality is working towards more integrated asset management and there is strong interest in and support by Council in forests, lakes, and rivers. Council has an interest in buying large tracts of wilderness areas adjacent to parks and expanding park boundaries, but this is not yet conceptualized or understood in terms of the concepts or language of natural asset management. The Halifax Regional Municipality has developed an urban forest strategy, which has helped build buy-in and support for priority initiatives that will improve natural asset management and incorporate it into core asset management business practices.

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5 See [fcm.ca/sites/default/files/documents/resources/tool/asset-management-readiness-scale-mamp.pdf](https://www.fcm.ca/sites/default/files/documents/resources/tool/asset-management-readiness-scale-mamp.pdf) for detail



## Competency 3: Data & Information

In terms of progress in building its data and information foundation to support asset management planning, the Halifax Regional Municipality has achieved Level 3 on the FCM readiness scale for engineered assets. This means it has basic inventory data for all engineered assets with some level of service information and standardized condition ratings. The Halifax Regional Municipality has defined life-cycle investment requirements for critical assets and has linked asset management and financial information for its critical assets.

This MNAI project has supported the Halifax Regional Municipality in completing a basic inventory for natural assets. Prior to undertaking the project, the Halifax Regional Municipality had some inventory on trees and was gaining insight on wetlands through a Wetland Ecosystem Services Protocol (WESP) analysis being undertaken through a partnership with Ducks Unlimited.

The Halifax Regional Municipality is at a very early stage of understanding the condition and performance of both its engineered and natural assets. Similarly, it is at an early stage in developing financial data for its engineered and natural assets and linking that data to its asset information. It does have operating and capital expenditure data for engineered assets. To-date, the Halifax Regional Municipality has not put a value on services from natural assets other than for urban trees and the urban forest, based on replacement costs.

## Competency 4: Planning & Decision-making

The Halifax Regional Municipality does not yet have asset management plans in place but it does have a structured approach to prioritizing asset investment which would be applicable to natural assets. In terms of budgeting and financial planning, it prepares an annual capital budget based on an annual reassessment of current needs. It has a four-year capital plan that addresses short-term issues and priorities and a ten-year capital outlook. Capital budgets include operating impacts for engineered and natural assets; however, to-date when projects have been brought forward, natural assets have been incorporated as one-off projects based on departmental priorities.

## 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 Halifax Regional Municipality in an Excel file and the dashboard as a website address. Information on the condition of 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 Halifax Regional Municipality (through a data license agreement), open sources and the Province of Nova Scotia. MNAI combined the spatial data layers to establish a comprehensive depiction of natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment.

**TABLE 1: SUMMARY OF DATA SOURCES**

DATASET NAME	SOURCE	PURPOSE
Forest Inventory	Province of Nova Scotia <a href="https://novascotia.ca/natr/forestry/gis/dl_forestry.asp">novascotia.ca/natr/forestry/gis/dl_forestry.asp</a>	Used as the base layer to construct the inventory for the Halifax Regional Municipality. The sections set on the county of West and East Halifax were used as the inventory proper, while surrounding counties were used to assess impact of adjacent lands on the boundary assets in the inventory. Surface permeability was determined from this data using the landcover types.
Hydrography - Streams	The Halifax Regional Municipality	Assess length of hydrographic features in each asset.
Hydrography - Lakes	The Halifax Regional Municipality	Originally used to assess area of hydrographic features in each asset, not used in version 2 with inclusion of update lake files.
Significant Wetland Data	The Halifax Regional Municipality	FORNON data was erased with areas of the wetlands, then this dataset was merged with it to superimpose areas of significant wetlands over FORNON data.
Updated Lakes	The Halifax Regional Municipality	Used to provide up-to-date information on the locations and extent of inland water body features and streams. Areas of these lakes were erased from the Forest Inventory base file.

**TABLE 1: SUMMARY OF DATA SOURCES**

DATASET NAME	SOURCE	PURPOSE
Updated Streams	The Halifax Regional Municipality	This file was identical to the Updated Lakes file (same polygons, but different attributes). Used to confirm locations covered by the Updated Lakes file.
Secondary Watersheds	The Halifax Regional Municipality	Used to split natural assets by the watershed they are located in.
Crown Land	The Halifax Regional Municipality	Used to subdivide natural assets after condition assessment.
Polling Districts	The Halifax Regional Municipality	Used to subdivide natural assets after condition assessment.
Protected Areas	The Halifax Regional Municipality	Used to subdivide natural assets after condition assessment.
HRM Parks	The Halifax Regional Municipality	Used to subdivide natural assets after condition assessment.
Street Centrelines	HRM Open Data <a href="https://catalogue-hrm.opendata.arcgis.com/">catalogue-hrm. opendata.arcgis. com/...</a>	Used to estimate road density in and around each natural asset.
Streams	The Halifax Regional Municipality	Used to estimate the length of streams (km) in each natural asset.
Land Ownership Parcels	The Halifax Regional Municipality	Can be used to identify ownership information for different areas.

The inventory project defined a total of 54,357 individual assets, covering 558,736 hectares (ha), as noted in Table 2.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE			
NATURAL ASSET TYPE	NUMBER OF ASSETS	TOTAL AREA (HA)	AVERAGE ASSET AREA (HA)
Agriculture	719	7,938	11.04
Beach	790	955	1.21
Natural Barren	2,120	4,647	2.19
Ocean Wetland	2,393	11,275	4.71
Shrubland	4,116	18,741	4.55
Forest	6,743	424,429	62.94
Inland Water	8,163	45,870	5.62
Lacustrine Transition Zone	11,123	6,535	0.59
Wetland	18,190	38,345	2.11
<b>Total</b>	<b>54,357</b>	<b>558,736</b>	<b>10.28</b>

Figure 3 shows the spatial distribution of the natural assets.

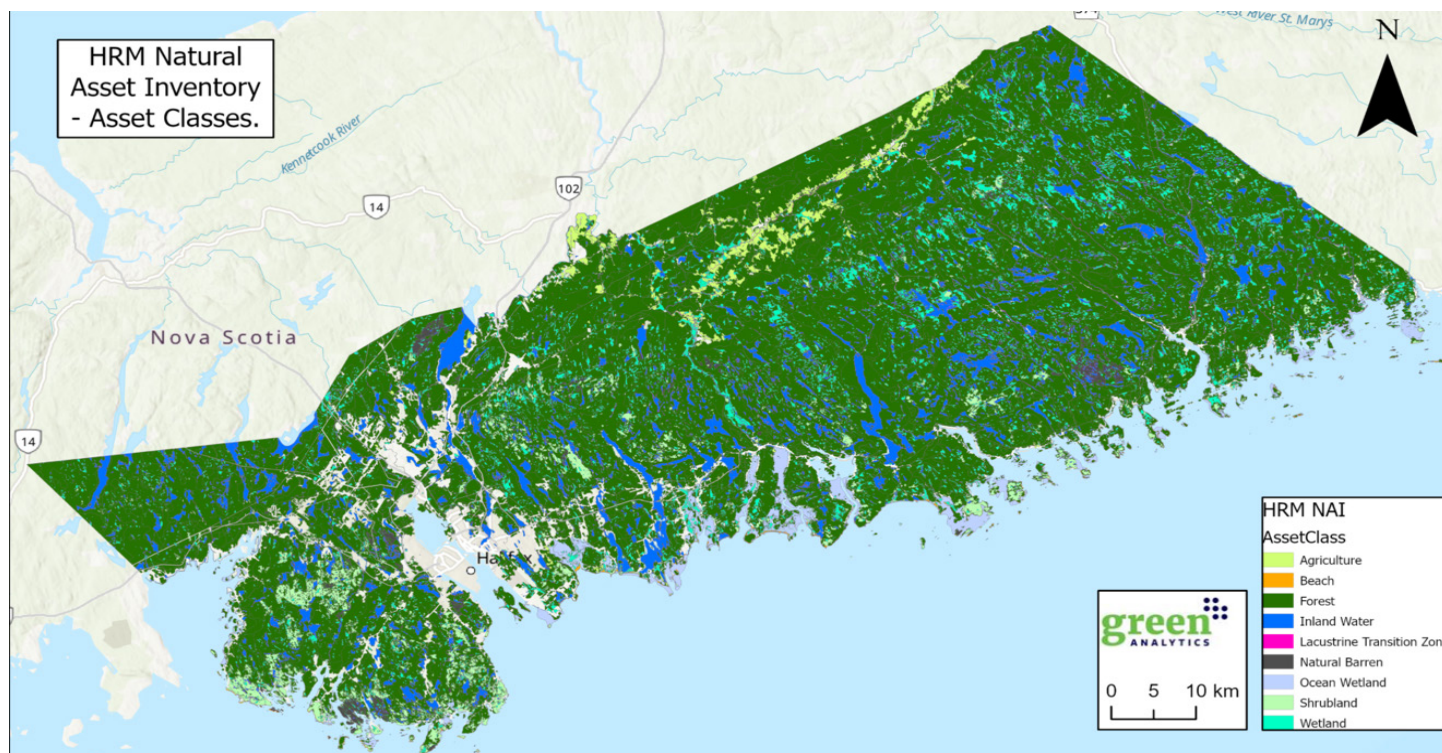


Figure 3: Spatial distribution of natural assets.

### 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 corresponding data as required. For example, changes in condition can be noted for individual assets. Information on each asset is housed in an asset registry. Table 3 is an excerpt from the Halifax Regional Municipality's registry showing natural asset characteristics and details.

**TABLE 3: EXCERPT FROM THE REGISTRY**

Natural Asset Inventory												
Asset ID	Asset Class	Area (ha)	Secondary Watershed	Interior Forest Area (ha)	Stream Length (km)	Permeability Score	Relative Size Score	Road Density (km/km <sup>2</sup> )	Road Density Score	Adjacent Land Score	Total Score	Asset Rating
AGR1	Agriculture	1.29	Shore Direct	0.00	0.00	5	1	0.00	10	8	24	2 - Fair
AGR10	Agriculture	0.00	Atlantic Ocean	0.00	0.00	5	1	0.00	10	9	25	2 - Fair
AGR100	Agriculture	2.42	Shore Direct	0.00	0.00	5	1	2.78	1	8	15	3 - Poor
AGR101	Agriculture	0.27	Shore Direct	0.00	0.00	5	1	0.00	10	9	25	2 - Fair
AGR102	Agriculture	0.51	Little R. (Petpeswick Inlet)	0.00	0.00	5	1	0.00	10	9	25	2 - Fair
AGR103	Agriculture	2.95	Shore Direct	0.00	0.00	5	1	2.10	1	8	15	3 - Poor
AGR104	Agriculture	1.11	Shore Direct	0.00	0.00	5	1	0.00	10	8	24	2 - Fair
AGR105	Agriculture	7.65	Musquodoboit R.	0.00	0.25	5	1	1.75	5	8	19	3 - Poor
AGR106	Agriculture	8.72	Shore Direct	0.00	0.23	5	1	0.97	10	8	24	2 - Fair
AGR107	Agriculture	0.01	Musquodoboit R.	0.00	0.00	5	1	0.00	10	10	26	2 - Fair
AGR108	Agriculture	0.02	Shore Direct	0.00	0.00	5	1	0.00	10	8	24	2 - Fair
AGR109	Agriculture	1.76	Shore Direct	0.00	0.00	5	1	2.33	1	7	14	3 - Poor
AGR11	Agriculture	0.00	Atlantic Ocean	0.00	0.00	5	1	0.00	10	9	25	2 - Fair
AGR110	Agriculture	3.15	Shore Direct	0.00	0.15	5	1	3.33	1	8	15	3 - Poor
AGR111	Agriculture	3.18	Shore Direct	0.00	0.01	5	1	0.00	10	9	25	2 - Fair
AGR112	Agriculture	3.39	Shubenacadie R.	0.00	0.00	5	1	4.57	1	7	14	3 - Poor
AGR113	Agriculture	0.35	Shubenacadie R.	0.00	0.00	5	1	6.85	1	6	13	3 - Poor
AGR114	Agriculture	7.45	Shubenacadie R.	0.00	0.00	5	1	3.64	1	8	15	3 - Poor
AGR115	Agriculture	2.82	Shubenacadie R.	0.00	0.00	5	1	3.33	1	8	15	3 - Poor
AGR116	Agriculture	6.35	Shubenacadie R.	0.00	0.16	5	1	5.45	1	6	13	3 - Poor
AGR117	Agriculture	24.29	Shubenacadie R.	0.00	0.47	5	1	2.63	1	7	14	3 - Poor
AGR118	Agriculture	0.05	Shubenacadie R.	0.00	0.00	5	1	0.00	10	8	24	2 - Fair
<b>Total</b>		<b>558,736.</b>		<b>237,796.69</b>	<b>5,192.42</b>							

### 4.4. Online dashboard

Inventories may provide more insights when characterized visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by 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 4 is a screenshot from the dashboard that MNAI provided to the Halifax Regional Municipality. The full version can be accessed at [go.greenanalytics.ca/HRM](https://go.greenanalytics.ca/HRM). The dashboard contains a summary of the natural asset inventory, the asset registry and the results of the condition assessment (the condition and decomposition tabs). The dashboard also contains an inventory of the urban forest area within the Halifax Regional Municipality.



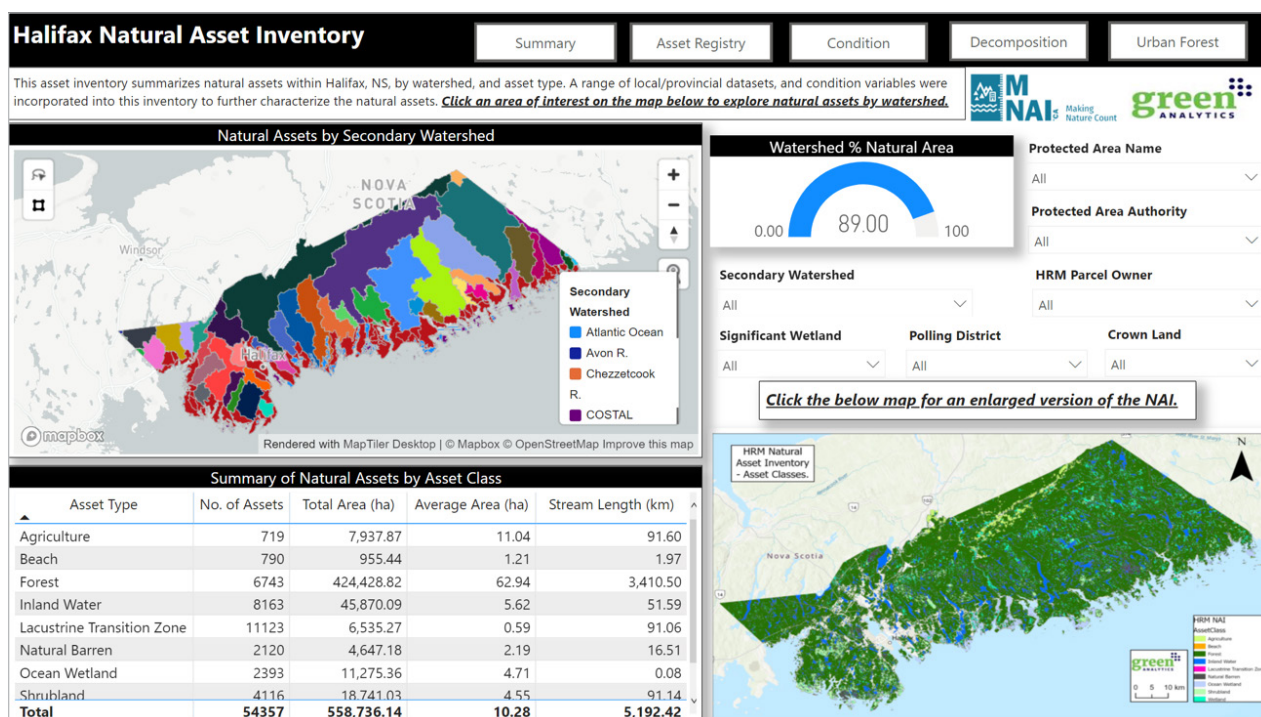


Figure 4: Screenshot of main inventory summary.

## 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, in turn, can support the effective management of natural assets, be reflected in the registry and the 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 Halifax Regional Municipality. Table 4 summarizes the condition assessment steps and indicators.

**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) received 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

**TABLE 4: CONDITION ASSESSMENT APPROACH AND INDICATORS**

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator*
<b>Road density</b>	Measures the density of the roads in and around the assets according to high density (assets with more than 2km of roads per km squared), medium density (assets with between 1km and 2km of roads per km squared) and low density (assets with less than 1km of road per km squared).	Natural asset inventory plus spatial representations of roads
<b>Surface permeability</b>	The permeability of surfaces is ranked on a scale of nil to high 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 <a href="https://data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3">data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3</a>
<b>Adjacent land use</b>	Considers the distance to, and the nature of, the area surrounding natural 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

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 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
- **No Rating**

Figure 5 summarizes the natural asset condition assessment results per the online dashboard.

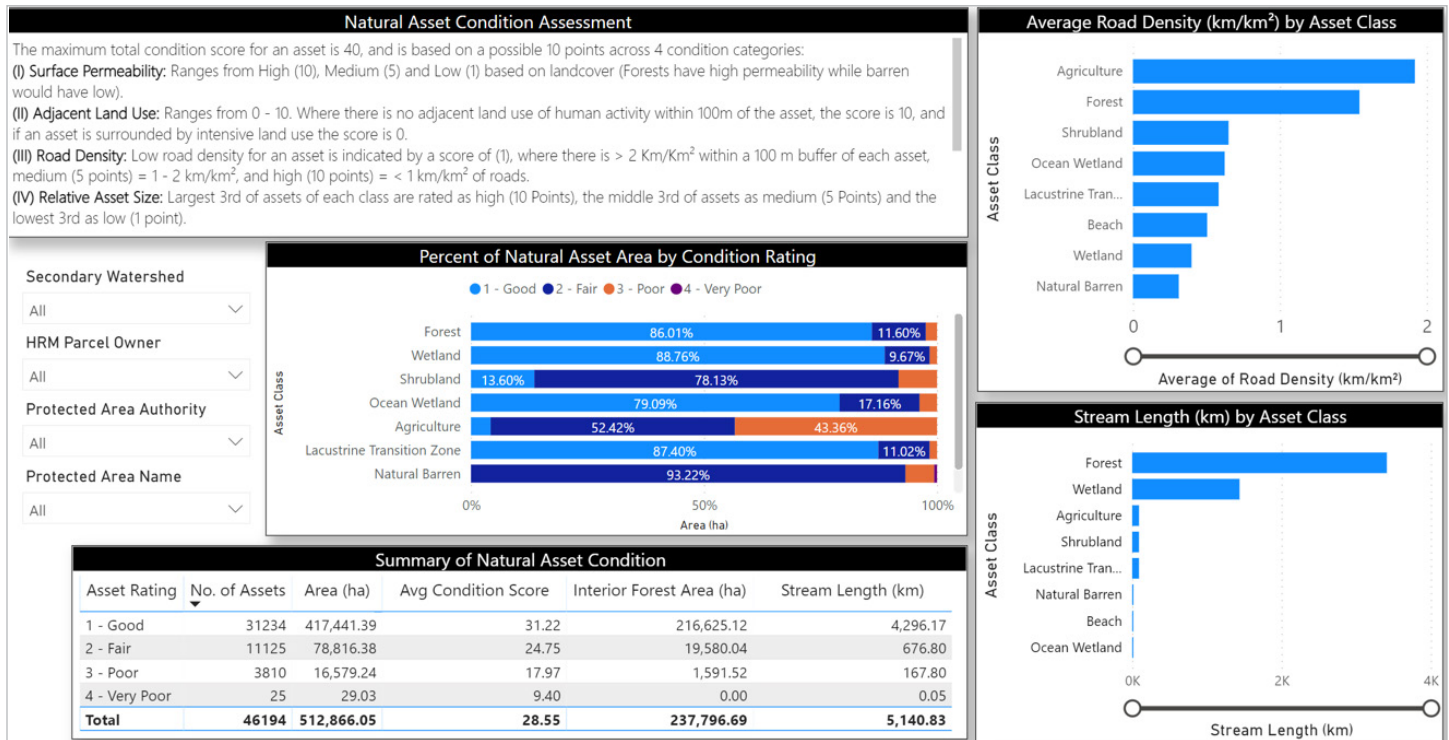


Figure 5: Screenshot of condition assessment details.

Overall, about 455,739 ha (or 82 per cent) of natural assets were assessed in good condition and 84,996 ha (or 15 per cent) were assessed in fair condition. Forest, wetland and shrubland assets all ranked largely good and fair.

Table 5 summarizes condition ratings and Figure 6 summarizes condition by natural asset type.

**TABLE 5: SUMMARY OF NATURAL ASSET CONDITION RATINGS**

Condition Rating	Number of Assets	Total Area (ha)	Average Condition Score
Good	36,819	455,739	31.19
Fair	12,637	84,996	24.91
Poor	4,876	17,971	17.97
Very Poor	25	29	9.40
<b>Total</b>	<b>54,357</b>	<b>558,736</b>	<b>28.53</b>

## Percent of Natural Asset Area by Condition Rating

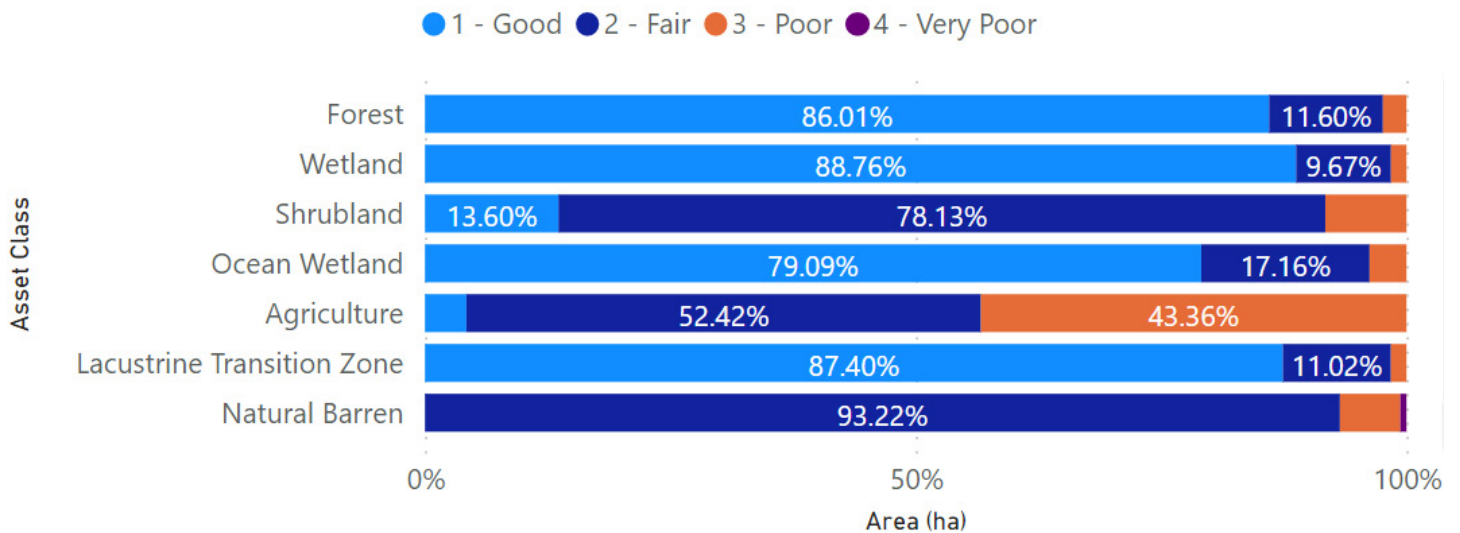


Figure 6: Summary of condition rating by natural asset type

### 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. 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 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* and guidance in self-administering it.

Risk management is a four-stage process that includes risk identification, analysis of probability and consequence, development of risk mitigation strategies, and control and documentation. The use of the risk identification tool informs the first and second stages of risk management through the identification of 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 Halifax Regional Municipality to maintain municipal services.
- **Political risk:** risks related to the nature of municipal politics.

## 5.2. Using the risk identification tool

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

- Flooding (coastal)
- Flooding (overland)
- Erosion
- Storm surge
- Lack of flood hazard mapping
- Construction activity
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources
- Lack of monitoring reports
- Overuse of trails/dumping
- Aquatic invasive species



- Forest invasive species
- Lack of land management plans
- Political policy change
- Forest fire
- Drought (current and future)
- Ice storms/freezing rain
- Wind (hurricanes, Nor'easters)
- Salt (road)
- Salt (coastal)
- Dams
- Lack of maintenance
- Sea level rise/coastal squeeze

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. To assess impact and consequence, the Halifax Regional Municipality considered four questions:

- 1/ what impact is likely to happen?
- 2/ what is the consequence of that impact happening?
- 3/ what can be done to mitigate the probability of impact and/or consequence?
- 4/ what cues will signal the need for mitigation?

### 5.3. Results of the risk identification process

The risk identification process revealed:

- 17 high-level risks: coastal flooding, overland flooding, erosion, storm surge, lack of flood hazard mapping, construction activity, development pressure, pollutant loading, lack of monitoring reports, forest invasive species, forest fire, drought (current and future), wind (hurricanes, Nor'easters), salt (road), salt (coastal), dams, and sea level rise/coastal squeeze
- 1 high-medium level risk: ice storms/freezing rain
- 6 medium-level risks: overuse of trails/dumping, invasive species, aquatic invasive species, lack of land management plans, political policy change, and lack of maintenance
- 0 low-level risks

In terms of scope, the identified risks affect natural assets across the Halifax Regional Municipality, particularly those in coastal and urban areas. The risks also have the potential to negatively impact engineered assets (both that the Halifax Regional Municipality owns and does not own), personal health and safety, and the local economy.

## Risk Matrix

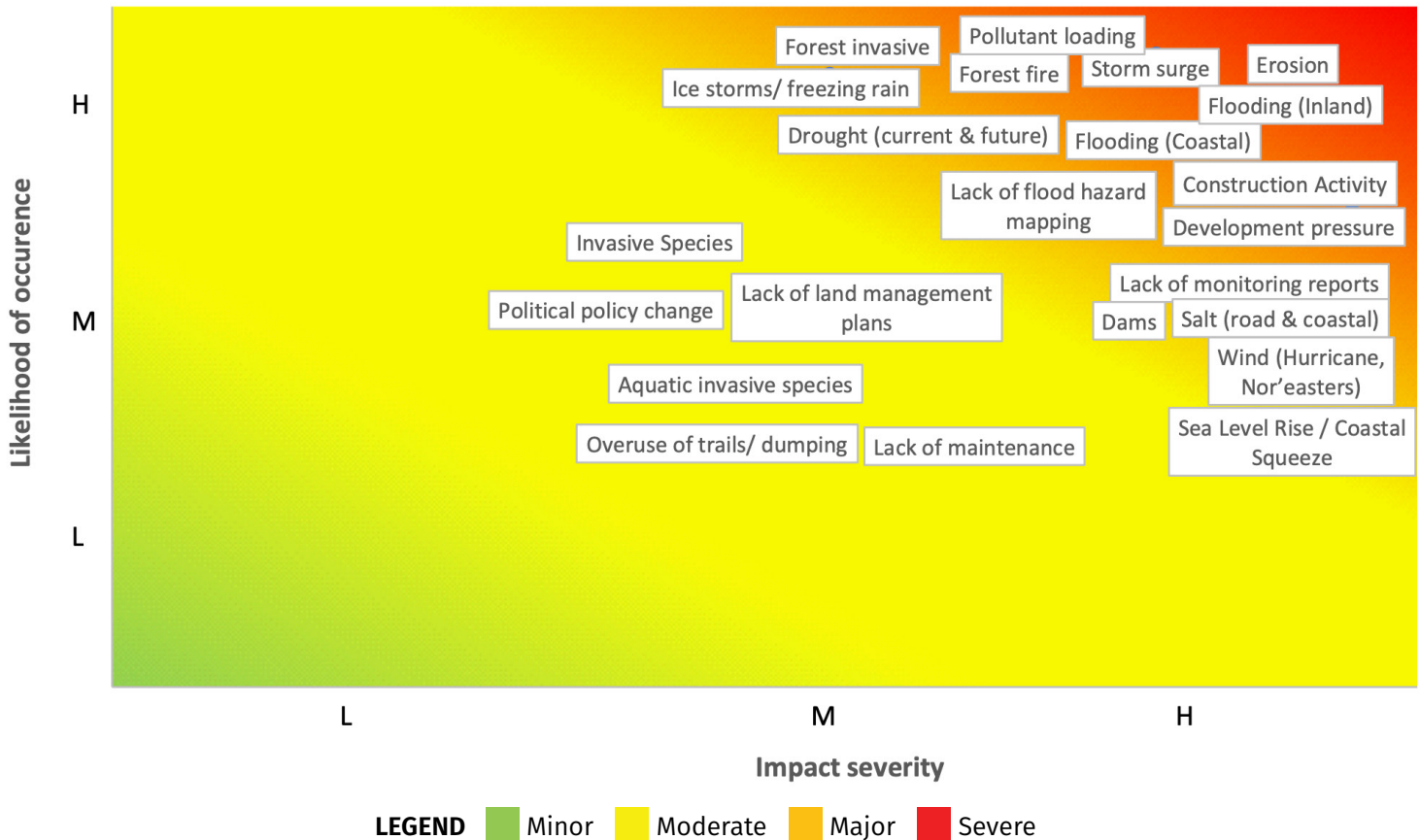


Figure 7: Results of risk identification process

## 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) potential priorities for the local government (6.2) possible actions for the further development of the inventory, and (6.3) steps the Halifax Regional Municipality can consider to advance to a full natural asset management initiative.

### 6.1. Potential priorities for the local government

Combining the results of the condition assessment with the outcomes of the risk identification highlights potential priorities on which the Halifax Regional Municipality could focus their natural asset management efforts. These are:

- **Flooding (coastal and overland):** Flooding, both coastal and overland, can negatively impact infrastructure, public safety, property, the local economy, and the environment. All natural assets in the Halifax Regional Municipality are at risk with heightened risk identified in coastal areas, Little Sackville River, and Shubenacadie. The condition assessment for this project largely confirms the secondary watersheds of Sackville River, Shubenacadie River, Costal Island, and the Shore District have below average ratings. In response to these risks, the Halifax Regional Municipality has implemented land use by-laws such as watercourse buffer requirements and coastal elevation requirements, both of which are under review for expansion. A flood risk assessment study has been completed for the Sackville River to prioritize mitigation projects.<sup>6</sup>
- **Erosion:** Erosion resulting from flooding, development, sea-level rise, storm surge and extreme events is a high-level risk to natural assets in the Halifax Regional Municipality, particularly within the Point Pleasant Park, Regatta Point Park, Silver Sands Parks, and Halifax Water's watersheds. The Halifax Regional Municipality has worked with Halifax Water on an Integrated Stormwater Management and Erosion Control By-Law that includes sediment and erosion control plans for a broad range of activities such as large site-specific developments, stand-alone site improvements, grade alterations and topsoil removal.<sup>7</sup>
- **Storm surge and sea level rise/coastal squeeze:** Storm surges in conjunction with sea level rise are expected to have severe impacts on Canada's East Coast, leading to erosion and posing new risks to water, power, and transportation infrastructure, as well as coastal ecosystems. The Halifax Regional Municipality has identified Peggy's Cove/Eastern Shoreline as an area of heightened risk. In response to this risk, coastal elevation requirements have been implemented, which are currently under review for updated elevation figures. HaliFACT<sup>8</sup> calls for a detailed risk and vulnerability analysis of coastal, waterfront and shoreline areas, as well as a coastal-specific adaptation strategy. MNAI recommends exploring the efficacy of shoreline and nearshore vegetation to mitigate storm surge and coastal erosion. This can serve a similar purpose as engineered infrastructure, but without negative impacts to surrounding ecosystems.
- **Flood hazard mapping:** The Halifax Regional Municipality has flood hazard mapping underway, which is anticipated to be completed in 2022. This will serve as valuable input for prioritizing the coastal and inland flood risk areas for further management and monitoring.

<sup>6</sup> Halifax Regional Municipality, 2018.

<sup>7</sup> This action was implemented through the introduction of By-Law G-200 and AO 2020-010-OP, which passed in September 2021.

<sup>8</sup> Halifax Regional Municipality, 2020.

- **Construction activity:** Construction activity impacts natural assets across the Halifax Regional Municipality, particularly those in the urban core and suburban growth areas. Construction can result in the infilling of wetlands and run-off into natural areas, particularly watercourses. The increase in impermeable surfaces and degradation of natural assets can exacerbate existing risks such as pollutant loading, flooding, and drought.
- **Development pressure:** Development in the Halifax Regional Municipality is focused in the urban core and suburban areas, particularly Sandy Lake, Kearney Lake, Birch Mountain/Blue Cove at Highway 102, Northwest Arm, and coastal areas. Run-off from development, shoreline hardening, and undersized coastal lots are putting all types of natural assets under increased pressure. While the majority of natural assets, by area, are in good or fair condition, increasing proximity to intensive land use can contribute to their declining health. Although development pressures are politically sensitive, proactive land use planning and policies that include identifying and managing natural assets and their associated services can limit urban sprawl and direct development to growth areas, reduce land use conflicts and pressure on existing infrastructure, and preserve natural areas. Furthermore, better information on natural assets can ensure that development decisions are fully evidence-based.
- **Pollutant loading (including salt on roads and coastal areas):** Pollutant loading from urban and suburban activities poses a high risk to natural assets, particularly beaches, the Lacustrine Transition Zone, ocean and inland wetlands, and inland waterways. Urban lakes and Sackville Rivers have declining water quality from road salt, trail use, and fecal matter. Coastal areas have experienced saltwater intrusion into groundwater and foliage impacts. In broad terms, MNAI recommends the Halifax Regional Municipality seeks out priority pollutant reduction opportunities, protect natural assets such as wetlands and riparian buffers that help control run-off, and begin ecological restoration and retrofit activities to clean up degraded water bodies.
- **Lack of monitoring reports:** The Halifax Regional Municipality lacks the capacity for monitoring natural assets, which is often piecemeal and fragmented where it does occur, and recognizes the need for more partnerships to address this. Collaborating with other levels of government (including Indigenous communities), residents, local schools, and non-government groups on initiatives such as forest and street tree monitoring could extend the utility of the street tree inventory, and the extent of water quality monitoring, which could start as early as 2022.

- **Forest invasive species:** Invasive species can reduce resiliency, increase climate-related risks, negatively impact biodiversity, lower property values, and increase municipal costs to maintain, control and eradicate target species. The Halifax Regional Municipality's forests are threatened by Emerald Ash Borer, Hemlock Woolly Adelgid, Dutch Elm Disease, Beech Leaf Weevil, Brown Spruce Longhorn Beetle, and Asian Longhorn Beetle. Educational materials are provided to residents. The Halifax Regional Municipality could also engage volunteers to conduct vegetation maintenance to remove invasive species from parks and natural areas.
- **Forest fire:** Forest fires or wildfires are more likely to occur as a result of global warming, which brings risk to undeveloped, inaccessible areas, including large forests surrounding residential areas. Forest fire was identified as a high-risk, high-probability hazard to forests and shrublands, mainly in rural areas with wildland fires, in Porters Lake, and within Halifax Water's watersheds. HaliFACT has identified the need to develop evacuation plans. Next steps could include the development of a Community Wildfire Protection Plan and collaborating with the Province of Nova Scotia on fire management on Crown land.
- **Drought (current and future):** Drought has been identified as a high-level risk to natural assets in all rural areas, surface water supplies, and groundwater water supplies. The Halifax Regional Municipality has noted increasing frequency of drought, dry wells, lower snowpack, and lower water levels. Warmer summers and dry soils can lower water levels in wetlands, creeks, and streams, and also contribute to the loss of trees and fish habitat, threaten species, and increase disease outbreaks. In response, HaliFACT identifies the need for a holistic, integrated, and climate-informed water supply strategy. The implementation of water quantity monitoring can also help identify trends serious enough to require drought plans.
- **Wind (hurricanes, Nor'easters):** Damaging winds from hurricanes and Nor'easters can result in storm surges, forest damage, fire, erosion, and flooding. Such events have the potential to impact all natural assets and can bring catastrophic loss to property, infrastructure, and community health and safety. Low-lying areas prone to flooding are at particular risk. In addition to current policies, including a vertical setback from the coast and the Nova Scotia Coastal Protection Act, HaliFACT calls for a detailed risk and vulnerability analysis of coastal, waterfront and shoreline areas, as well as a coastal-specific adaptation strategy.
- **Dams:** Dam failure has been identified as a low probability / high consequence risk. The Halifax Regional Municipality owns several dams (e.g., Otter Lake, Big Indian Lake, and Russell Lake). Halifax Water owns some others and some lack assigned ownership. Dam failure can impact natural assets and bring significant impacts to resident health and safety, business, and engineered infrastructure.



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

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

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

The Halifax Regional Municipality is at a relatively early stage of adopting asset management as an organization-wide process. This creates opportunities to incorporate natural asset management from the outset.

The Halifax Regional Municipality is interested in bringing the same level of rigour to natural assets such as the wetlands, parklands and waterways as they have put on urban forestry management. Accordingly, they will seek opportunities to incorporate natural asset management into policy and practice.

For example, staff from the Halifax Regional Municipality expressed interest in ensuring that natural assets are referred to in the asset management policy that is currently planned and will make use of templates that MNAI provided. Similarly, the Halifax Regional Municipality's draft asset management roadmap is at an early stage of development and staff expect they could integrate natural asset management based on the knowledge gained through this project.

Staff also noted the opportunity to leverage existing resources (e.g., their Ducks Unlimited partnership, new Lidar data, Urban Forest inventory) to make progress on natural asset management. They also saw opportunity to have staff as part of the cross-functional asset management team support the integration of natural asset management with all aspects of service delivery.

Finally, staff expressed interest in introducing and standardizing language around natural asset management, with the objective of mainstreaming it into organizational processes, practices and corporate culture. This would be another opportunity to incorporate natural assets from the outset as asset management plans are developed.

### 6.3. Possible actions for the further development of the inventory

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

- Expand the risk identification to include field verification of results.
- Determine acceptable levels of risk to the Halifax Regional Municipality's risk mitigation strategies (see Table 6).
- Further develop the condition assessment and risk assessment using local climate projections, land use modelling, and other data already at their disposal.
- Identify linkages between risks. For example, development in floodplains can increase flooding and erosion, and wildfire can exacerbate drought.
- Explore the potential of coastal natural assets (e.g., shoreline and nearshore vegetation, dunes, coastal wetlands) to mitigate storm surge and coastal erosion.
- Share the inventory with adjacent local governments to stimulate collaboration within the watershed.
- Schedule regular updates (e.g., every 3-5 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.

### 6.4. Steps to a full natural asset management project

If the Halifax Regional Municipality 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 (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 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 in terms of service delivery.
- 5/ Planning.** This step allows local governments to explore through modelling 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, changes in service levels can be understood and quantified. Corresponding service values can also be determined 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 these 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 Halifax Regional Municipality's risk identification process

This Annex contains the results of the Halifax Regional Municipality's use of MNAI's risk identification tool, which they self-administered with guidance from MNAI. Table 7 was the main product that the Halifax Regional Municipality's personnel developed from the exercise.

## Step 1: Identification of risks

Common Risks to Natural Assets:

- Overuse of trails/dumping
- Flooding (current and future)
- Forest fire
- 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
- Storm surge
- Lack of flood hazard mapping
- Lack of land management plans
- Lack of monitoring reports
- Construction activity
- Political policy change



## Step 2: Complete survey

**TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY**

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Flooding (Coastal)	H	Agriculture, Beach, Forest, Lacustrine Transition Zone, Ocean Wetland, Shrubland	Coastal areas	Watercourse buffer requirements under the LUB (20 m minimum); Coastal elevation requirements; under review to expand
Flooding (overland)	H	Agriculture, Inland water, Lacustrine Transition Zone, Natural Barren, Shrubland, Wetland	Little Sackville River; Shubenacadie	Watercourse buffer requirements under the LUB (20 m minimum); under review to expand overall CFAS planning
Erosion	H	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	Coastal; River erosion from flooding events; development; Park examples: Point Pleasant, Regatta Point, Silver Sands Parks, Halifax Water's watersheds	Substrate can play a factor
Storm Surge	H	Agriculture, Beach, Forest, Lacustrine Transition Zone, Ocean Wetland	Coastal, everywhere along coast in HRM, heavily in Peggy's Cove/Eastern Shore	Coastal elevation requirement under the LUB, numbers need to be updated as part of the Regional Plan Review
Lack of Flood Hazard Mapping	H	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	Coastal, inland flood risk areas (e.g. Little Sackville River)	Flood hazard mapping is currently underway with an anticipated completion date of early 2022 for all HRM
Construction Activity	H	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	Urban core, suburban growth, everywhere	Infilling of wetlands (coastal and inland); poorly management construction sites run-off into natural assets

**TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY**

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Development Pressure	H	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	Urban Core, within serviceable boundary, suburban growth, everywhere, especially Sandy Lake, Kearney Lake, Birch Mountain/ Blue Cove at Hwy #102, Northwest Arm, undersized coastal lots	Run-off from development; shoreline hardening can increase run-off; a lot of pressure and politically sensitive
Pollutant Loading	H	Beach, Lacustrine Transition Zone, Ocean Wetland, Wetland	Urban Lakes (e.g., Banook, MicMac, Long Lake, Sackville Rivers, Bedford-Sackville Connector Greenway Trail; First Lake, water supplies	Presence of feces may be impacting water quality, anecdotally on the rise with more people using trails during COVID; road salt
Lack of Monitoring Reports	H	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	Everywhere; don't have any; Street tree inventory (framework developed)	Don't have capacity to monitor; need more partnerships; monitoring is piecemeal and fragmented if it currently occurs; WQM was approved and may occur in 2022; street trees could be expanded
Overuse of trails/ dumping	M	Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	Reported dumping of concrete into wetlands located at PIDs 41437575 and 41459579; Bedford-Sackville Connector Greenway Trail	Increase in dog feces on trails, trail overuse and misuse, dumping in parks, particularly larger ones (wilderness parks)
Invasive Species	M	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	TPW reports instances of Giant Hogweed along some 100 series highways. Japanese knotweed often found in ROWs and parks	Dependent on the species; HRM to experience longer growing season and warmer weather which can increase habitat range for invasive species

**TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY**

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Turtles		Inland water		Issues with turtles and the dry hydrants in natural waterways
Aquatic Invasive Species	M	Beach, Lacustrine Transition Zone, Wetland, Inland water	Micmac & Banook Little Albro Lake	Yellow floating heart, goldfish
Forest Invasive	H	Agriculture, Forest, Lacustrine Transition Zone, Shrubland	DeWolf Park; ultimately everywhere; anywhere that is forested	Emerald Ash Borer, HWA, Dutch Elm Disease, Beech Leaf Weevil, Brown Spruce Longhorn Beetle, Asian Longhorn Beetle
Lack of Land Management plans	M	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	All areas	We have LUBs which have been identified for “Bylaw Simplification” program to simplify and update. Project to take several years but will replace outdated LUBs. Phase 1 (Urban Core, Centre Plan) targeting completion this year. We have some protections in place (watercourse buffers, coastal elevations), but needs to be updated. No buffers for wetlands currently (unless contiguous with a watercourse) but will be reviewed as part of the Regional Plan review to be completed in 2022. UFMP, GNP also factor in – need to be implemented. They are mitigating factors. No master plans for PPP and other parks. Park plans will help mitigate.

**TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY**

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Political Policy Change	M	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	Municipal/provincial	May be high support from Regional Council for protection of natural assets, Mitigation Strategy, Provincial (restrictions can make things harder to accomplish), council could change
Forest Fire	H	Forest, Shrubland	Mainly in rural areas with wildland fires; Porters Lake Halifax Water's watersheds	High risk, high probability
Drought (Current and Future)	H	Agriculture, Beach, Forest, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	All rural areas Surface water supplies Groundwater water supplies	Every year it's going up. Issues with dry wells (we are tracking); precipitation has been below average (snow pack is lower than average with lower water level)
Ice Storms/Freezing Rain	H/M	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Shrubland, Wetland	Everywhere	High probability, low/medium risk (infrastructure from a risk probability). Medium overall.
Wind (Hurricane, Nor'easters)	H	Agriculture, Beach, Forest, Lacustrine Transition Zone, Natural Barren, Ocean Wetland, Shrubland, Wetland	Everywhere, especially coastal	
Salt (road)	H	Beach, Lacustrine Transition Zone, Ocean Wetland, Wetland, Inland water	Some areas are salted where people are on wells; some are a mix of brine (highways); salt in urban; sand in rural with wells	Brine - Sodium Chloride and water, can affect branches Salt and brine doesn't seem as detrimental to trees, precipitation washes salt away quickly; Salt has huge impact on lakes;

**TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY**

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Salt (coastal)	H	Beach, Ocean Wetland	All rural areas	Issues with turtles and the dry hydrants in natural waterways
Dams	H	Agriculture, Beach, Forest, Inland water, Lacustrine Transition Zone, Natural Barren, Shrubland, Wetland	Several dams owned by HRM, others by Halifax Water, examples of HRM owned are Otter Lake, Big Indian Lake and Russell Lake	Low probability of dam failure but high risk; some dams may not have assigned ownership, that can cause damage
Lack of maintenance	M	Forest	Street trees	Prince Albert Road; Spring Garden future projects
Sea Level Rise / Coastal Squeeze	H	Agriculture, Beach, Forest, Lacustrine Transition Zone, Ocean Wetland	Coastal; Barrier beaches; Cow Bay saltwater lagoon; Lower East Chezzetcook; highly developed areas that don't allow retreat	



**Municipal Natural Assets Initiative**

