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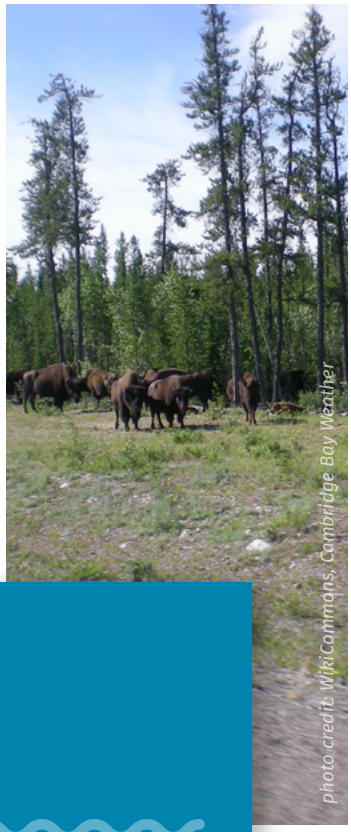

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Toward natural asset management in the

City of Yellowknife

Northwest Territories

Summary of inventory results and recommendations
November 2021

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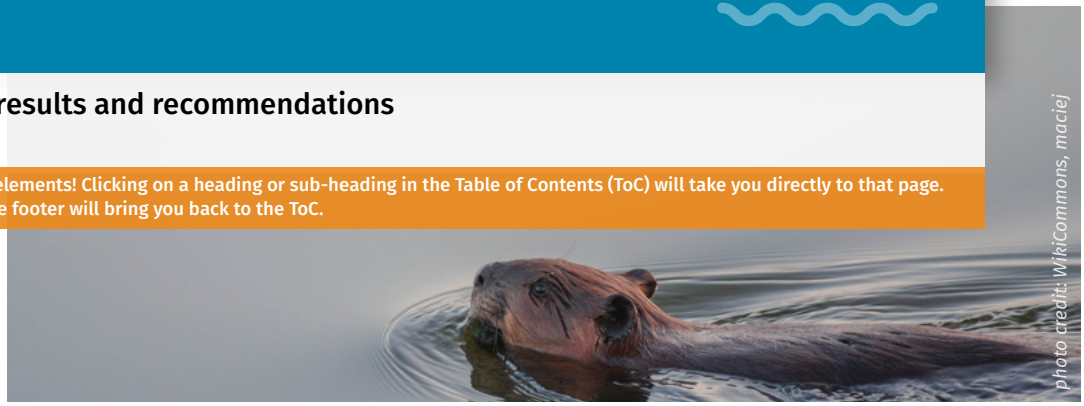

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Municipal Natural Assets Initiative

MNAI.CA
Making Nature Count

Making Nature Count

Invest in Nature

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

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1 Purpose

This document summarizes the results of a project to develop a natural asset inventory for the City of Yellowknife 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 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.

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 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.

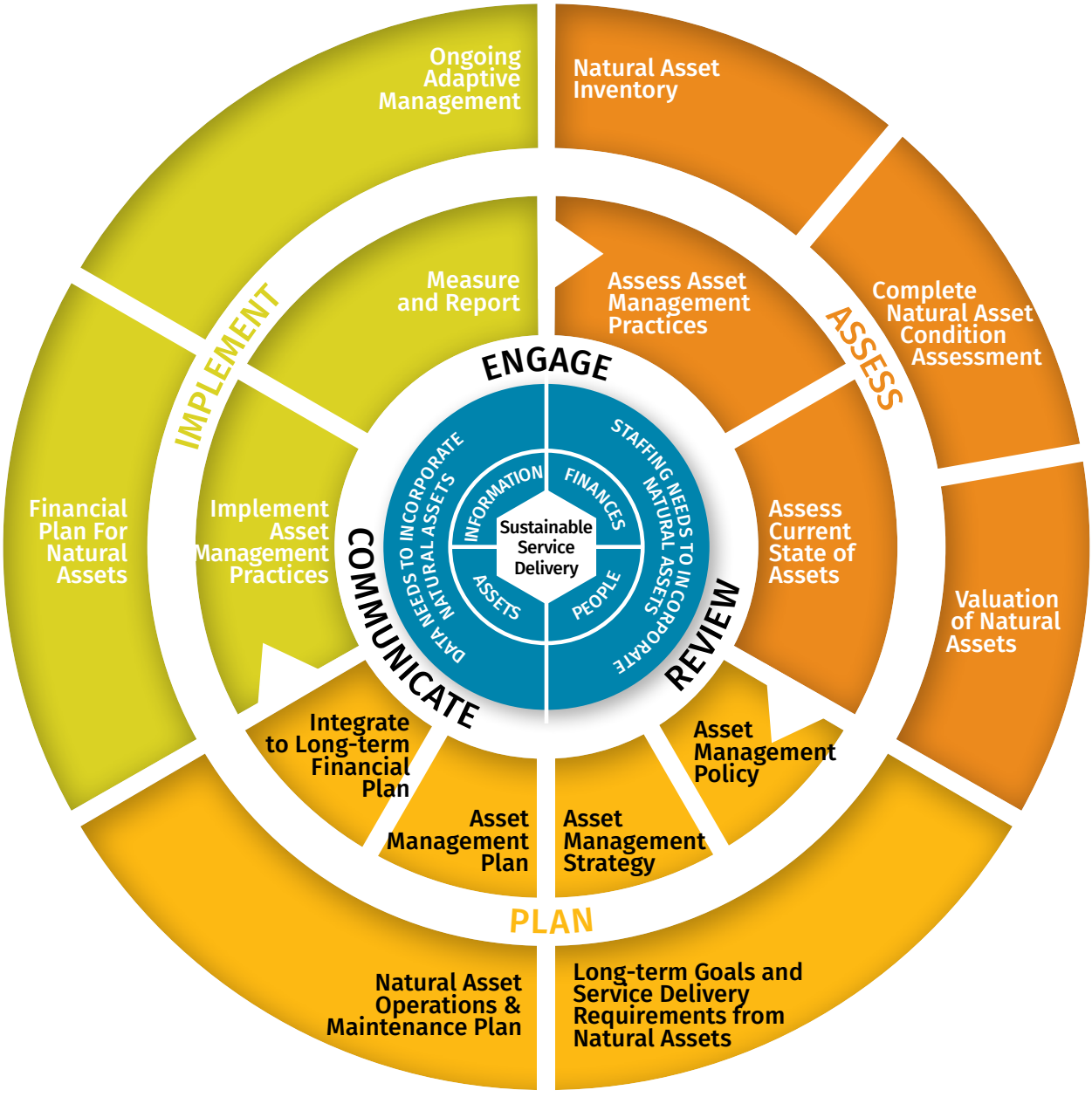

***Figure 1**: The Asset Management Process. MNAI has adapted this for use with natural assets.*

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: City of Yellowknife[3].

The City of Yellowknife (population ~19,500) is the capital city and the largest community in the Northwest Territories. It is situated on the northern shore of Great Slave Lake, about 400 kilometres south of the Arctic Circle, on the west side of Yellowknife Bay[4].

The City of Yellowknife places itself in the awareness stage of asset management and its focus areas are to develop an official asset management policy, an asset registry, and draft key levels of service.

The City of Yellowknife's interests in natural asset management relate to achieving an awareness of the natural assets they rely on, understanding the risks these are exposed to, and ultimately evaluating natural assets in terms of service delivery and measures to maintain them. This, in turn, is expected to lead to better decision-making.

3 *Northwest Territories. Retrieved August, 2021 from spectacularnwt.com/travel-info/maps.*

4 *Wikipedia. Retrieved August 2021 from en.wikipedia.org/wiki/Yellowknife*

The natural asset inventory links to two Council priorities: prioritizing adaptation and mitigation measures to climate change and enhancing long-term financial and asset management planning[5].

The City of Yellowknife identifies the sewage lagoon - a modified natural asset that connects to 13 kilometres of watercourses and wetlands before discharging into Great Slave Lake - as a priority asset as it replaces the need for a sewage treatment plant and its associated costs. Thus, priority services are sewage treatment, drainage services and water retention from surrounding wetlands.

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[6] 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 City of Yellowknife has begun to formally adopt asset management and there is senior-level buy-in for developing an asset management program. It has approved resources and a budget for asset management, as well as a Council-approved asset management policy. While the policy does not mention natural assets, it also does not explicitly exclude them from consideration in infrastructure decision-making.

The City of Yellowknife has developed a five-year asset management strategy with specific objectives, but none is related to natural asset management and Council has not yet approved it. No performance measures have been established to track progress on the strategy. The City of Yellowknife is currently using the Federation of Canadian Municipalities Asset Management Readiness Assessment tool to track progress.

Competency 2: People & Leadership

The City of Yellowknife has a cross-functional asset management team that leads, communicates and supports asset management improvement and organizational changes. There is currently no staff person specifically responsible for incorporating natural asset management-related needs into its asset management system.

5 *Council's Goals and Objectives 2019-2022. Retrieved August 2021 from www.yellowknife.ca/en/city-government/resources/City_Council_and_Mayor/Councils_Goals__Objectives/STRATEGIC-PRIORITIES-2019-2022-ACTION-PLAN.pdf*

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

Council supports and champions asset management as a core business function and has approved funding to continue activities supporting implementation of its strategy. It is not yet aware of the resourcing and funding needed to incorporate natural asset management into the asset management system requirements and strategy.

Competency 3: Data & Information

The City of Yellowknife has begun to formally document information about its assets. It has basic inventory data for all engineered assets, including information on general asset properties such as size, material, location, and installation date. The City of Yellowknife does not yet have standardized condition ratings and has not identified critical assets or levels of service for engineered assets. With respect to financial data on its assets, the City of Yellowknife has data to support the Public Sector Accounting Board Handbook section PS-3150 financial reporting on tangible capital assets. It is currently working on linking capital and operating financial data with asset data and migrating data to a centralized location.

The natural asset inventory being developed through this project is the City of Yellowknife's first formal documentation of natural asset data. As such, the City of Yellowknife does not yet have financial data that puts a value on services from natural assets.

Competency 4: Planning & Decision-making

The City of Yellowknife is moving towards a structured approach to asset investment planning across all service areas. Senior administration is using a prioritization matrix to make capital investment decisions, although it is a more qualitative assessment that is not yet supported with asset management data. Asset investment planning is still quite reactive and annual budgets are based on short-term priorities and known problems. The City of Yellowknife does not yet have specific asset management plans and uses a general 10-year capital outlook as its asset management plan.

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 City of Yellowknife in an Excel file and the dashboard as a website address. Information on the estimated 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 City of Yellowknife, the Northwest Territories government, and the Environmental Systems Research Institute (ESRI). 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 complete the condition assessment.

TABLE 1: SUMMARY OF DATA SOURCES

DATASET NAME	SOURCE	PURPOSE
Treecover.shp	City of Yellowknife	Used to estimate canopy coverage in hectares for natural assets.
Trails.shp	City of Yellowknife	Used to estimate the length of trails in km within natural assets.
yk_roads_gdb.gdb	Yellowknife Open Data website. *opendata.yellowknife.ca/*	Used in conjunction with the NRN road dataset to create polygons showing location and extent of roads as landcover in the study area. While the NRN file showed more roads that could be verified via satellite imagery, this file still accounted for some roads the NRN file did not. While not used for the road density condition assessment, a 7.5 m buffer was created around this file and the NRN road file, which were merged together to create polygons that accounted for road cover in the study area.
MunicipalBoundary.shp	City of Yellowknife	Used to define the boundary of the natural asset inventory (NAI) based on current extent of the municipality.
Proposed MunicipalBoundary.shp	City of Yellowknife	Used to limit extent of the second version of the NAI based on these proposed boundaries.
Streams.shp	City of Yellowknife	Used to estimate the length of streams (km) that fall within the boundaries of each natural asset.

TABLE 1: SUMMARY OF DATA SOURCES

DATASET NAME	SOURCE	PURPOSE
Intermittent_Lakes_ Foreshore_Flats.shp	City of Yellowknife	Used as a component of the base natural asset inventory, to serve as natural assets. Used polygons from this dataset for waterbody assets.
Parks.shp	City of Yellowknife	Used to estimate extent of parks in hectares for each asset.
Dog_Areas.shp	City of Yellowknife	Used to estimate extent of areas in hectares where dogs are allowed for each asset.
PropertyParcels.shp	City of Yellowknife	Used to identify type of land ownership and use for an area covered by a natural asset.
FMD_NWT_EcoRegions. shp	NWT Centre for Geomatics	Used to identify the ecological characteristics of the region the natural assets were located in.
11V_20200101-20210101.tif	ESRI *livingatlas.arcgis.com/landcover*	Used to serve as a component of the base landcover file. However, detail regarding Water and Forests were better reflected in the Wooded Areas and Intermittent water files; the areas of these files, along with the CanVEC wetland file, were erased from the ESRI data. Used the Bare Ground and Urban category polygons in this dataset to assess adjacent land impacts on natural assets.
MiningLeases.shp	City of Yellowknife	Used to estimate extent of mining leases in hectares present in each natural asset.
NRN_Roads	Government of Canada. *open.canada.ca/data/en/dataset/3d282116-e556-400c-9306-ca1a3cada77f*	Used this file for estimating the Road Density score as it accounted for more roads than the yk_roads dataset. Also used in conjunction with the yk_Roads datasets to create a 7.5 m buffer around the lines of both road datasets to create polygons accounting for the extent and prevalence of roads in the study area for condition assessment and land cover classification.
DrainageLine.shp	City of Yellowknife	Used to estimate extent of drainage lines in kilometres throughout each asset.
Saturated Soils	Government of Canada. *open.canada.ca/data/en/dataset/80aa8ec6-4947-48de-bc9c-7d09d48b4cad/resource/b311e6bc-fd35-4b0e-8237-8bf20bab47dd*	Used to identify and locate wetlands in the area of interest and was one of the files used as a component for the base landcover dataset. Areas of these wetlands were erased with the location of known waterbodies from the intermittent file due to the accuracy of the waterbodies compared to satellite imagery.

TABLE 1: SUMMARY OF DATA SOURCES		
DATASET NAME	**SOURCE**	**PURPOSE**
nWooded_Areas	City of Yellowknife, Government of NWT	Used to identify areas of forests for the base landcover dataset. Noted to be more accurate than the ESRI forest category. Area of the CanVEC wetlands and Intermittent Water files were erased from this file in creating the base landcover inventory.

The inventory project defined a total of 11,668 individual assets, covering 19,249 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 the asset area in the City of Yellowknife is forest, followed by bare scrub/trees. Note that in addition to the assets below, the City of Yellowknife is also home to a beach asset.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE			
NATURAL ASSET TYPE	**NUMBER OF ASSETS**	**TOTAL AREA (HA)**	**AVERAGE ASSET AREA (HA)**
Forest	3,269	8,482	**2.59**
Bare Scrub/Tree	5,177	4,593	**0.89**
Major Water Bodies	241	2,330	**9.67**
Open/Intermittent Water	1,392	1,968	**1.42**
Wetland	729	1,519	**2.08**
Vegetated Shoreline	851	303	**0.36**
Sand Pits	16	51	**3.18**
Beach	3	2	**0.67**
Total	**11,668**	**19,249**	**2.98**

Figure 3 shows the spatial distribution of the natural assets.

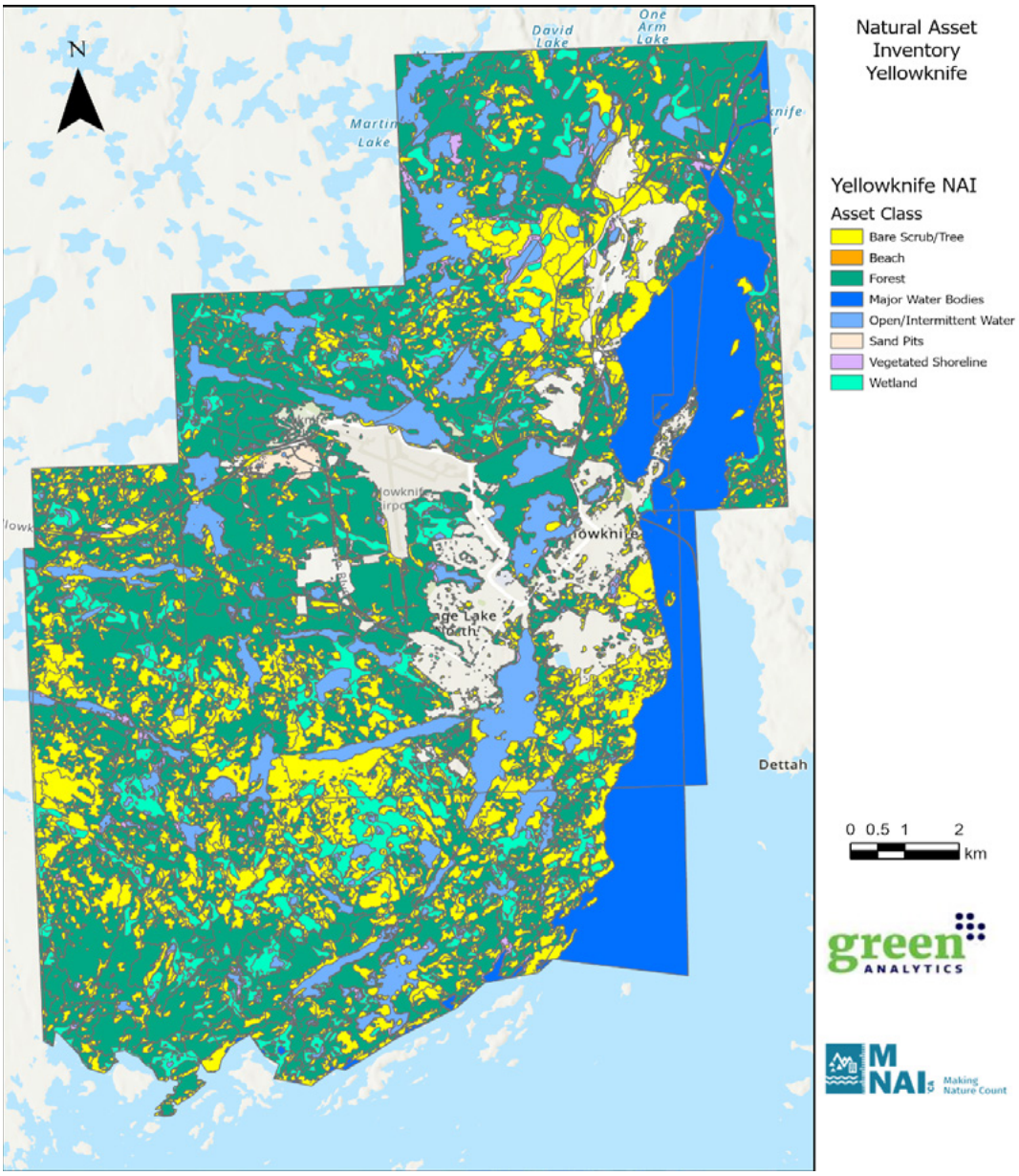

***Figure 3**: Spatial distribution of natural assets.*

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 City of Yellowknife's online registry showing natural asset characteristics and details. Additional detail is provided in the online dashboard.

TABLE 3: EXCERPT FROM THE REGISTRY

Asset Class Natural Asset Inventory

Asset ID	Asset Class	Asset Area (ha)	EcoRegion (Level 4)	HydroID	GridID	DrainID	Town Boundary	Interior Forest Area (ha)	Mining Lease Area (ha)	Dog Park Area (ha)	Park Area (ha)	Stream Length (km)	Road Density (km/km²)	Area of High Water Risk (ha)	Drainage Line Length (km)	Cara Area
BEA1-1	Beach	0.84	Great Slave Lowland High Boreal	0	0	0	Both Boundaries	0	0.84	0.82	0.59	0.00	7.06	0.00	0.02	
BEA2-1	Beach	0.52	Great Slave Lowland High Boreal	5999	1054	1054	Both Boundaries	0	0.52	0.13	0.00	0.00	3.39	0.39	0.00	
BEA3-1	Beach	0.38	Great Slave Lowland High Boreal	0	0	0	Both Boundaries	0	0.38	0.00	0.00	0.00	0.00	0.30	0.03	
BST1000-1	Bare Scrub/Tree	0.00	Great Slave Upland High Boreal	0	0	0	Both Boundaries	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BST100-1	Bare Scrub/Tree	0.00	Great Slave Lowland High Boreal	0	0	0	Both Boundaries	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BST1001-1	Bare Scrub/Tree	0.20	Great Slave Upland High Boreal	5914	617	617	Both Boundaries	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BST1002-1	Bare Scrub/Tree	0.00	Great Slave Upland High Boreal	6492	686	686	Both Boundaries	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BST1003-1	Bare Scrub/Tree	0.16	Great Slave Upland High Boreal	0	0	0	Both Boundaries	0	0.00	0.16	0.16	0.00	0.00	0.00	0.00	
BST1004-1	Bare Scrub/Tree	0.78	Great Slave Upland High Boreal	6484	546	546	Both Boundaries	0	0.00	0.78	0.78	0.00	0.00	0.00	0.12	
BST1005-1	Bare Scrub/Tree	0.45	Great Slave Upland High Boreal	5826	135	135	Both Boundaries	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BST1006-1	Bare Scrub/Tree	0.75	Great Slave Upland High Boreal	5826	135	135	Both Boundaries	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

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 City of Yellowknife. The full version can be accessed at *go.greenanalytics.ca/Yellowknife*.

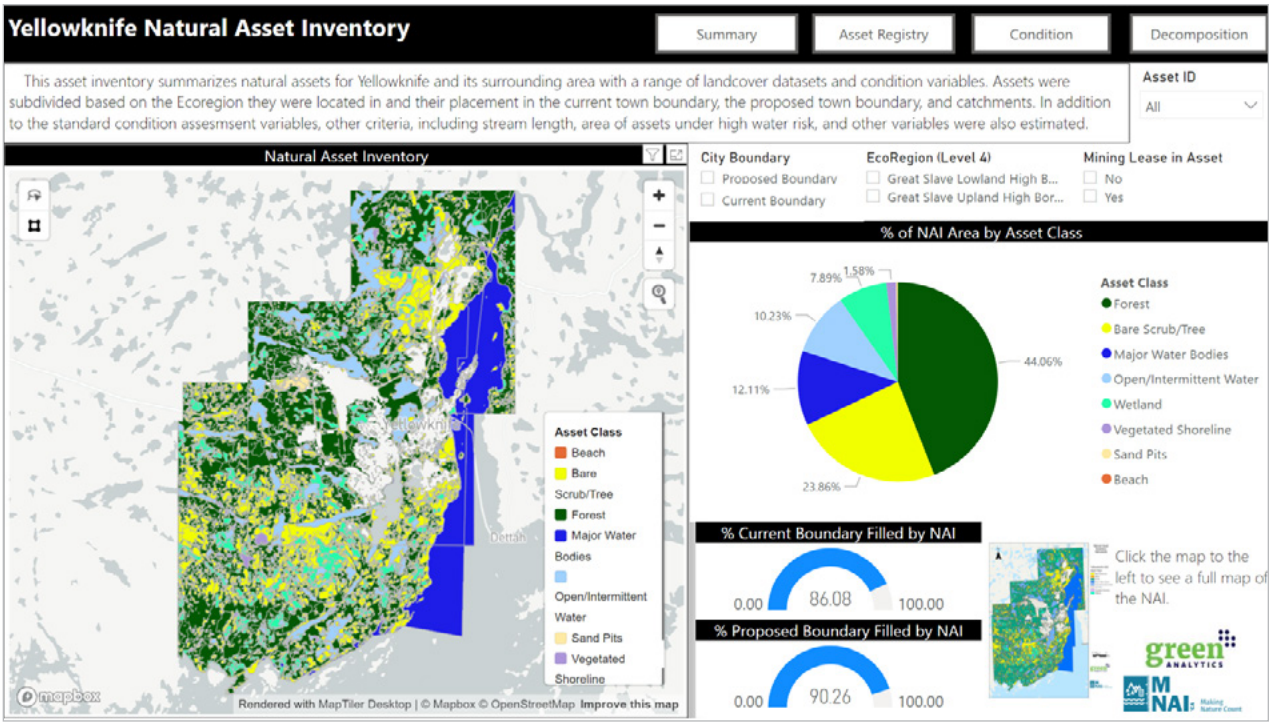

Figure 4: Screenshot of main inventory summary.

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 estimate of the status of the natural assets for the City of Yellowknife. 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 4 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 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 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. However, it is well-established 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) because 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. 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) 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
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 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
Surface permeability	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 *data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3*

TABLE 4: CONDITION ASSESSMENT APPROACH AND INDICATORS		
Indicator	**Description & Methods for Quantification**	**Data used to Quantify Indicator***
Adjacent land use	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

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

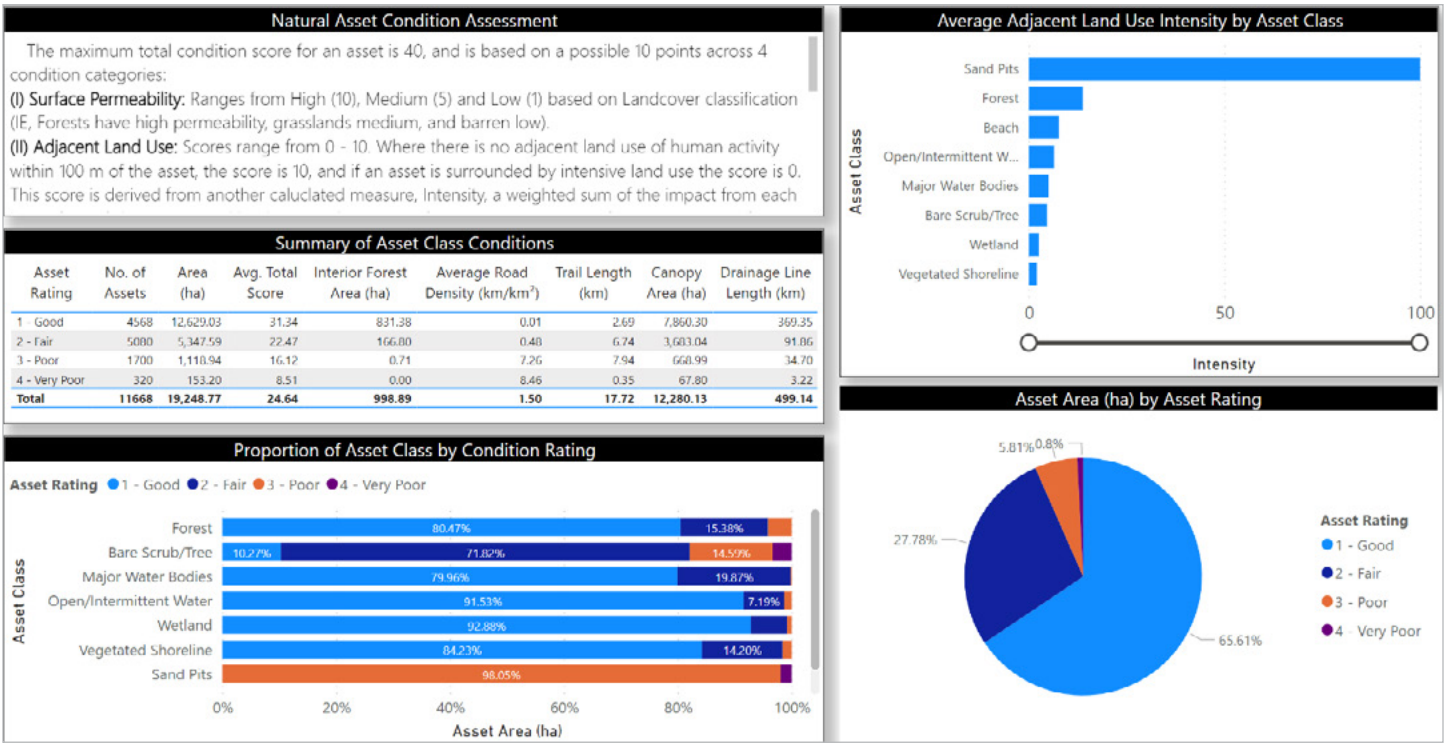

Figure 5: Screenshot of condition assessment details.

Overall, about 12,629 ha (or 66 per cent) of natural assets were assessed in good condition and 5,349 ha (or 28 per cent) were assessed in fair condition.

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	4,568	12,629	31
Fair	5,080	5,348	22
Poor	1,700	1,119	16
Very Poor	320	153	9
Total	**11,668**	**19,249**	**25**

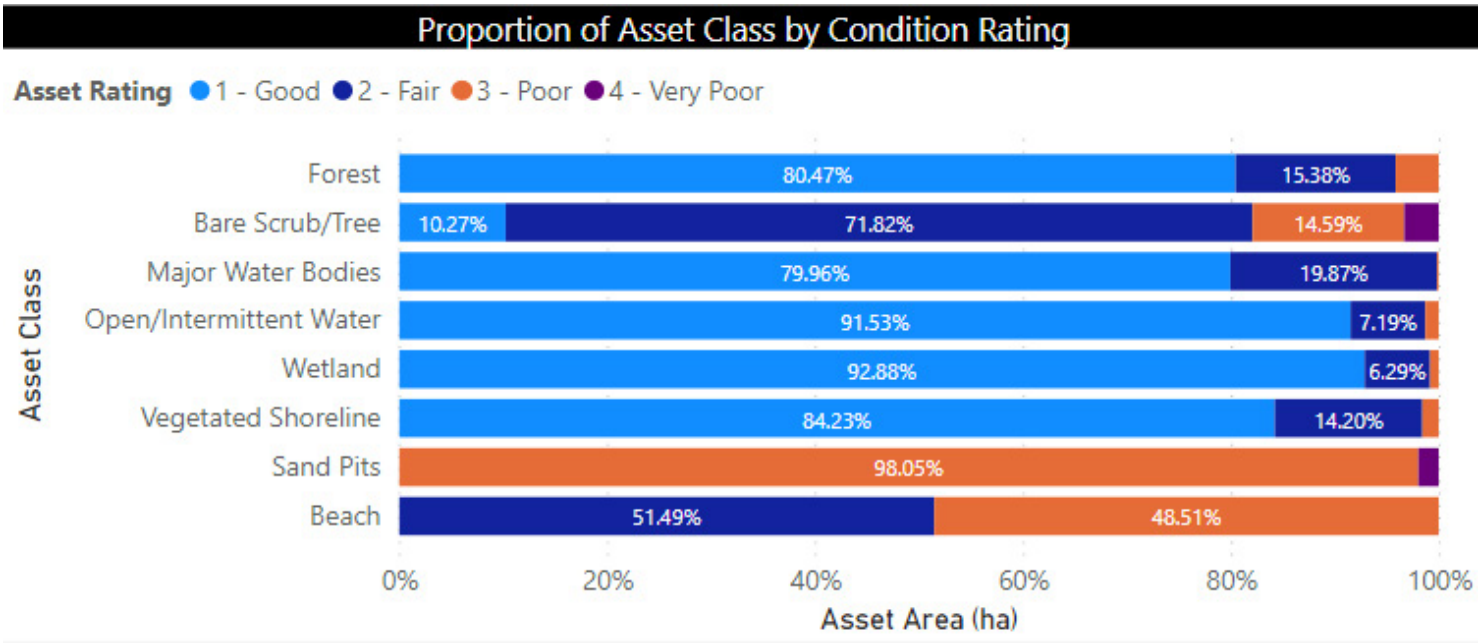

***Figure 6**: Summary of condition rating by natural asset type*

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 may 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 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* 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 by identifying the top risks to natural assets and their associated services, plus a high-level analysis of impacts and consequences.

Risk types relevant to natural asset management typically include:

- **Service risk:** the risk of an asset failure that directly affects service delivery.
- **Strategic risk:** the risk of an event occurring that impacts the ability to achieve organizational goals.
- **Operations and maintenance risk:** risks related to poor asset controls and oversight, which can lead to poor record-keeping and poor monitoring of asset.
- **Financial risk:** risks related to the financial capacity of the City of Yellowknife 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 City of Yellowknife considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including:

- Overuse of trails/ illegal dumping
- Flooding (due to high water)
- Flooding (due to rainstorm)
- Flooding (due to spring freeze/thaw)
- Urban interface forest fires
- Forest fire impacts to air quality
- Invasive species
- Development pressure on natural assets
- Pollutant loading from urban, agricultural, or industrial sources
- Permafrost melting
- Erosion
- Construction activity damage to natural assets

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 City of Yellowknife 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?

5.3. Results of the risk identification process

The risk identification process revealed:

- 4 high-level risks (flooding due to spring freeze/thaw, urban interface forest fires, and forest fire impacts to air quality, pollutant loading)
- 7 medium-level risks (overuse of trails/illegal dumping, flooding due to high water, flooding due to rainstorms, invasive species, permafrost melting, and construction activity)
- 2 low-level risks (development pressure on natural assets and erosion)

In terms of scope, the identified risks affect natural assets across the City of Yellowknife, with numerous risks potentially affecting trails and greenspaces. The identified risks also have the potential to negatively impact engineered assets (particularly roads, sewage, and drainage networks), property, and personal health and safety.

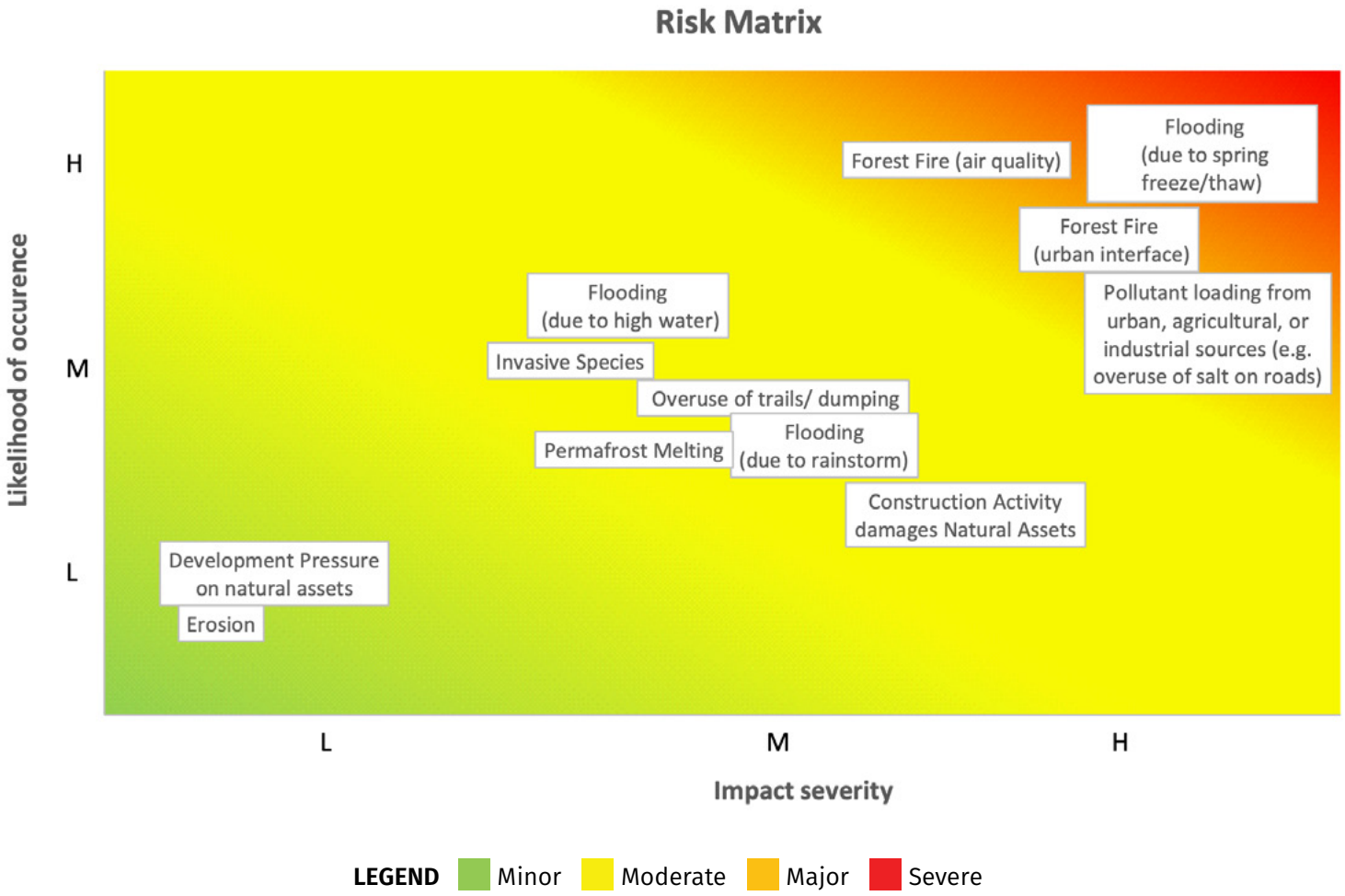

Figure 7: Results of risk identification process

5.4. Potential priorities for the local government

The outcomes of the risk identification process highlight potential priorities on which the City of Yellowknife could focus natural asset management efforts. Where possible, these are informed by the condition assessment. These are:

- **Flooding due to spring freeze/thaw:** The City of Yellowknife identified flooding due to spring freeze and thaw as a manageable, tolerable, high-level risk with potential impacts to streets and the drainage network in various locations, particularly the Franklin Hill area. In the spring, water freezes in underground infrastructure, which blocks pipes and reduces their capacity. This requires significant personnel time to address and can damage property. While spring flooding is a seasonal occurrence, its timing and extent will be more variable as the climate changes. Where possible, investments in increased monitoring of natural assets, restoration to increase natural drainage capacity, and identification of disaster risk reduction strategies to use natural assets to dampen and buffer extreme weather events should be pursued

- **Pollutant Loading:** The City of Yellowknife identified pollutant loading as a manageable, intolerable high-level risk that could impact both human health and city finances. Arsenic contamination from prior mining activity represents a potential risk to drinking water quality should it be released into Great Slave Lake. The City of Yellowknife received Disaster Mitigation and Adaptation funding of $25.8 million in 2019 to replace underwater pipes and invest in natural infrastructure to help manage this risk. The City of Yellowknife also uses a modified natural watercourse to treat sewage, which could be a source of pollutant loading. It is managing this latter risk through a monitoring program, control structure replacement, and desludging of Fiddler's Lagoon.
- **Urban interface forest fire:** The City of Yellowknife identified urban interface forest fires as a manageable and intolerable high-level risk that impacts residential structures in the southwest portion of the city. To address this, the City of Yellowknife has identified interface areas, completing Fire Smarting in highest risk areas, and initiated response planning. It is also exploring efforts to increase both Fire Department capabilities and dedicated sprinkler tools.
- **Forest fire impacts to air quality:** Forest fire impacts to air quality are a partially manageable and tolerable high-level risk to human health across the City of Yellowknife. For example, the 2015 forest fire season caused such severe air quality issues that the City of Yellowknife opened low-utilization facilities to the public as clean-air spaces.

Table 6 lists and provides brief descriptions of risk mitigation strategies. Future stages of the MNAI process can address these.

TABLE 6: RISK MITIGATION STRATEGIES

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

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 City of Yellowknife can consider to advance to a full natural asset management initiative.

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

Staff noted that a first priority following the completion of this inventory will be to strengthen information about natural assets to better support management actions. For example, they would like to identify what natural assets are most critical to service delivery and determine the monitoring and maintenance needed to sustain the services provided to the community.

In this context, a short-term opportunity is to develop objectives around natural assets into the City of Yellowknife's five-year asset management strategy, prior to Council approval. This could be aligned with the above-noted effort to strengthen information about natural assets and include defining anticipated or desired levels of service for the natural assets.

Another opportunity that staff identified is to ensure that a member of the Asset Management Steering Committee has clear responsibilities for natural asset considerations. Staff also noted the importance of continuing to build Council awareness of both the City of Yellowknife's progress, and of needs related to asset management, including natural asset management. In support of this, staff may wish to present the results of this natural asset inventory project to Council.

An opportunity to integrate natural asset management into overall asset management relates to the development of standardized condition rating assessments, and the assignation of criticality scores for engineered assets. It would be appropriate to ensure that considerations around critical natural assets are included in this process. Related to this, staff identified the need to improve its prioritization matrix for asset investment planning. This would be done by including quantitative measures based on asset data and information. As part of the improvement process, natural asset considerations could be added to the matrix.

As the City of Yellowknife develops formal asset management plans for different service areas, it is advisable to integrate natural asset management considerations. Natural assets are implicated in many service areas (e.g., water, recreation, public health); therefore, they should be considered as a cross-cutting theme in asset management planning. It is also possible to consider

developing an asset management plan specifically for natural assets as is currently being done in, for example, the Township of Langley, British Columbia.

Finally, a possible medium-term action to ensure integration of natural asset management is to make the role of natural assets in service delivery explicit in an amendment to the asset management policy; however, since natural assets are not explicitly excluded in the current policy, this is not urgent.

6.2. Possible actions for the further development of the inventory

Based on the inventory, the City of Yellowknife 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 process to include field verification of results.
- Determine acceptable levels of risk to the City of Yellowknife's risk mitigation strategies (see Table 6).
- Further develop the condition assessment and risk assessment for using local climate projections, land use modelling, and other data already at their disposal.
- Expand disaster risk reduction strategies by identifying where and how natural assets dampen and buffer extreme weather events.
- Share the inventory with adjacent local governments to stimulate collaboration within the watershed.
- Initiate and enhance monitoring - for example, using gauges, water level sensors, and data loggers to improve understanding of trends, feed into condition ratings of assets, and gather information for modelling.
- Schedule regular updates (e.g., every 3-5 years) of the inventory, condition 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 City of Yellowknife 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 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 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 efforts on their own.

1/ **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 City of Yellowknife's risk identification process

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

Step 1: Identification of risks

Common Risks to Natural Assets:

- Overuse of trails/dumping
- Flooding (due to high water)
- Flooding (due to rainstorms)
- Flooding (due to spring freeze/ thaw)
- Forest fire (air quality)
- Forest fire (urban interface)
- Invasive species
- Development pressure on natural assets
- Pollutant loading from urban, agricultural, or industrial sources (e.g., overuse of salt on roads)
- Permafrost melting
- Erosion
- Construction activity damages natural assets

Step 2: Complete survey

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Overuse of trails/ dumping	M	Trails	Central YK	• Dumping occurs in certain areas which are monitored • Trails are getting more use recreationally but less commuter with COVID • City advertising other trails to share use • Manageable/Tolerable
Flooding (due to high water)	M	Docks, Boat Launches, Boardwalks, Parks	Coastal Great Slave Lake	• Currently experiencing high water levels in GSL due to higher-than-normal precipitation in watershed • Work underway to identify impacted areas/assets and future risk • Manageable/Tolerable
Flooding (due to rainstorms)	M	Streets	Downtown YK	• Some flooding in high rain events • Manageable/Tolerable
Flooding (due to spring freeze/ thaw)	H	Streets, Drainage Network	Various, Franklin Hill a focus	• Water freezes in underground infrastructure, blocks pipes, reduces capacity. • Requires lots of personnel time to address • can lead to property damage • Unmanageable/Tolerable
Forest fire (urban interface)	H	Residential Structures	SW of Yellowknife	• Interface areas profiled, fire-smarting under way in highest risk areas • Looking into increased capabilities and dedicated sprinkler tools for FD • Some response planning initiated. • Manageable/Intolerable
Forest fire (air quality)	H	Recreation Facilities	All Areas	• 2015 forest fire season caused severe air quality issues • Low utilization facilities were opened and free to the public as clean-air spaces • Manageable/Tolerable

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Invasive species	M	Parks, Trails, Greenspaces, waterways	various	• Mountain Pine Beetle, Zebra Mussels, Wild Pigs noxious plants are future risks • Unmanageable/Tolerable
Development Pressure on natural assets	L		Kam Lake Area	• Community Plan is focussed on densification • Manageable/Tolerable
Pollutant loading from urban, agricultural, or industrial sources (e.g., overuse of salt on roads)	H	Sewage Infrastructure	Fiddler's lagoon, Great Slave Lake (GSL)	• low agricultural presence, low active industrial presence • Arsenic contamination from prior mining activity, • Impact of new developments assessed and approved by Land and Water Boards • Increasing Phosphorus levels in watercourse used for sewage treatment monitoring in place • Manageable/Intolerable (water license related)
Permafrost Melting	M	Roads	Franklin Hill, Deh Cho Blvd, MacDonald Drive	• Drilling programs prior to construction to determine permafrost presence. Try to protect (insulate) if present • Plan for more frequent replacement • Manageable/ Tolerable
Erosion	L	Water Treatment Plant, Roads, Trails, Drainage Network	Yellowknife River Banks, various roads and ditches	• Excess Capacity and Redundancy in water filtering to deal with turbidity • Vegetation encourages on ditch wall • More rain leads to more water in ditches and roadside erosion. Impacts some trails, fixed as found • Manageable/Tolerable
Construction activity damages natural assets	M	Greenspaces	Kam Lake	• Development focus is on densification, minimizing disturbance to new areas

Municipal Natural Assets Initiative