Municipal Natural Asset Management Monitoring Report

On behalf of
Municipal Natural Assets Initiative (MNAI)

Lucas Mollame and Dr. Michael Drescher
University of Waterloo
September 13, 2021

Disclaimer

While reasonable efforts have been made to ensure the accuracy of the report's content, any statements made are made only as of the date of the report and such information and data are subject to uncertainties, inaccuracies, limitations and to changes based on future events. Municipal Natural Assets Initiative makes no representations, warranties or guarantees (express, implied, statutory or otherwise) regarding the data on which the information is based or the information itself, including quality, accuracy, usefulness, fitness for any particular purpose, reliability, completeness or otherwise, and assumes no liability or responsibility for any inaccuracy, error or omission, or for any loss or damage arising in connection with or attributable to any action or decision taken as a result of using or relying on the information in the report.

Please cite as:

Mollame, L & Drescher, M. (2021). MNAI Monitoring Report. Municipal Natural Assets Initiative. Victoria, British Columbia, Canada. MNAI.ca

Welcome Letter

September 9, 2021

To: Cohort One Municipalities and the Municipal Natural Assets Initiative

Re: Monitoring Report for Municipal Natural Asset Management Program

I am pleased to present to the Municipal Natural Assets Initiative this monitoring report for Cohort One's Municipal Natural Asset Management (MNAM) program.

This newly created monitoring framework and report is the first step towards understanding changes in strategy/plans (e.g., financial, bylaw change), investment, operations and governance, and in service delivery and ecosystem health that result from municipal natural asset management.

Monitoring and evaluation are the gathering of evidence to understand and assess the extent to which programs are achieving goals and producing intended outcomes. Gathering this information on what is changing because of municipal natural asset management interventions can promote program functioning and support decision-making by local governments. Beyond the scope of this report, long-term monitoring will produce standardized, comparable results between projects and across time. This will help support the emergence of municipal natural asset management as a mainstream practice across Canada.

Through a review of monitoring literature and the adaptation of common monitoring tools to build a monitoring framework design relevant for MNAM programs, this monitoring report will share detailed findings on program outcomes. This report contributes evidence that will foster support for municipal natural asset management among elected officials and municipal staff. As well, this report will communicate a description of progress for each municipality's MNAM program.

We hope this monitoring report will aid each municipality in Cohort One, MNAI, and the future of this growing field. We would like to thank you for this opportunity and look forward to discussing our findings with you.

Lucas Mollame and Dr. Michael Drescher

Executive Summary

Municipalities are starting to incorporate municipal natural asset management into their environment and service delivery strategies. As momentum for municipal natural asset management continues to build, the Municipal Natural Assets Initiative (MNAI) required a standardized monitoring framework and data protocols to collect, manage, and analyze data on outcomes of municipal natural asset management. This report details the creation and application of that monitoring framework. The goal is to build towards applying this same monitoring framework for all future municipal natural asset management projects. This monitoring framework focuses on the implementation of asset management strategy /plans (e.g., financial, bylaw change), changes in investment (e.g., land acquisition), operational/governance changes, and ecosystem changes to the extent possible. This report will be useful for municipal staff working with natural assets, local elected officials, local governments looking to incorporate municipal natural asset management, and provincial governments preparing to support future municipal natural asset initiatives.

The monitoring framework will focus on what has changed in five municipalities (Cohort One) since the introduction of the municipal natural asset management program. These municipalities will be treated as case studies for the application of the monitoring framework. These case studies are the Town of Gibsons, the City of Grand Forks, the City of Nanaimo, the Town of Oakville, and the District of West Vancouver. A second report will be created for Cohort Two. After initial piloting of municipal natural asset management, each municipality continues to progress in integrating municipal natural asset management into their environmental restoration and service delivery strategies.

The monitoring framework will focus on answering the following question: *how are municipalities progressing in their municipal natural asset management programs compared to identified indicators?* Through a formative outcome monitoring framework design, a description of progress was created for each municipality. Data were collected following the initial program intervention and no comparison group is used. Thus, indicators were created for comparisons to be made with each municipality.

The design of this monitoring framework is rooted in academic research and literature on monitoring and evaluation, namely, RealWorld Evaluation practices. Thus, the monitoring team prepared tools to ground this framework, including a Program Logic Model (PLM) and an Evaluation Matrix. A PLM is a graphical depiction of the causal relationship of the program being evaluated. The most common template of a PLM has an explanation of the situation, inputs and program components, baseline activities/outputs, outcomes, and impacts. The PLM in this monitoring framework did not use “short-term” and “medium-term” outcomes that are common in traditional PLM designs and instead grouped different outcomes in program streams. These program streams are:

1/ Awareness, Capacity, and Education Outcomes – Outcomes related to the understanding of Municipal Natural Asset Management as a municipal program for city staff and the public.

2/ Implementation Outcomes - Outcomes related to the integration of Municipal Natural Asset Management as a realized municipal strategy.

3/ Ecosystem Rehabilitation/Restoration Outcomes - Outcomes related to the recovery of key ecosystems as a part of Municipal Natural Asset Management.

4/ Service Delivery Outcomes – Outcomes related to the provision of municipal services through Municipal Natural Asset Management.

Outcome streams were used to group a much larger list of anticipated program outcomes. The Evaluation Matrix is a table that links each evaluation question with the means for answering that question. In columns, it outlines the evaluation question, the corresponding indicators to answer said question, and the data sources, analysis methods and timing the evaluation will use. In addition, the evaluation matrix for this monitoring framework has an additional column for benchmarks which are comparison values for each evaluation question.

These tools integrate the four program streams to inform the selection of relevant indicators. The indicators selected use the following criteria:

- a clear relationship between the program and changes in said program,
- demonstrate an intent to measure,
- a variable of difference in the program, and
- ways to improve program operations.

For data collection methods, interviews were carried out with program managers/directors and key municipal documents were reviewed. These documents and transcripts from the interviews were placed and sorted into a database. Documents from each municipality were then coded based on outcome and indicator categories defined in the Program Logic Model and the Evaluation Matrix. Results were then scored by a five-point colour-coded scoring system.

Findings showed that most of the municipal case studies in this cohort are progressing well in Awareness, Capacity, and Education Outcomes as well as some Implementation Outcomes. However, these municipalities are progressing much slower towards Ecosystem Rehabilitation and Restoration Outcomes and Service Delivery Outcomes. Reasons for this include slow uptake of a municipal natural asset management approach from managerial staff in these municipalities, little-to-no new natural asset management policies in the municipality, and the lack of monitoring metrics for all types of ecosystem services. Moving forward, Canadian local governments should consider partnering with other organizations or individuals who can provide the necessary ecological expertise, explore new funding opportunities created by federal and provincial governments, and promote provincial regulations for municipal natural asset management.

Table of Contents

1.0 Introduction

The purpose of this monitoring report is to communicate the progress made since the introduction of a municipal natural asset management program by the Municipal Natural Assets Initiative (MNAI) through five case studies. The findings of this monitoring report focus on how these municipalities are progressing towards intended program outcomes. The findings also provide evidence of barriers and opportunities for municipal natural asset management that may provide valuable lessons for future work. This monitoring report will be of use for and should be considered by the following stakeholders: local government staff working with natural assets, local elected officials, local governments considering a municipal natural asset management program, and provincial governments supporting municipal-led natural asset initiatives.

The five municipalities that are part of this first national cohort (Cohort One) are the Town of Gibsons, the City of Grand Forks, the District of West Vancouver, the City of Nanaimo, all in British Columbia, and the Town of Oakville in Ontario. As more local governments start to consider the possibilities of municipal natural asset management, MNAI required a monitoring framework to strengthen the existing evidence they have collected. A monitoring framework is the means of measuring whether a program is on course to achieve its goals and objectives. As more local governments implement a municipal natural asset management approach, MNAI may not be able to provide direct assistance to every municipality. The development of this monitoring framework will create a standardized monitoring system for the 90+ local governments that are now working with MNAI. Standardization will help ensure that the data acquired from each municipality will map directly onto an evidence database. Standardized data will then allow for comparison between municipalities and a deduction of general patterns. The monitoring framework will include diverse approaches for the acquisition of a variety of data types that will allow documentation of modifications to municipal operations and management as well as short- and long-term outcomes of MNAM programs.

Staff and elected officials in other local governments can use this monitoring report to improve their municipal natural asset management. As well, all 90+ local governments partnered with MNAI can learn lessons, skills, and tools from Cohort One to progress towards program outcomes. Local governments interested in incorporating municipal natural asset management can also learn similar lessons, skills, and tools before they integrate such an approach. As the evidence database continues to grow, there will be multiple examples for local government staff and decisionmakers to pull from as it relates to intended program outcomes. Provincial governments can learn about the promotion of municipal natural asset management as an effective complement to asset management. Provincial governments could use the data provided in this report to encourage and promote municipal natural asset management as a part of significant regulation or legislation.

1.1. Monitoring Focus

The focus of this monitoring framework is on answering the following question: *how are municipalities progressing in their municipal natural asset management program compared to identified indicators?* The rationale for this focus comes from the need to know what has changed in municipal operations following the piloting of municipal natural asset management. This means observing the implementation of municipal natural asset management strategy/plans (e.g., financial, bylaw change), changes in investment (e.g., land acquisition), operational/governance changes, and ecosystem changes, to the extent possible. Therefore, monitoring results will contribute to a description of progress. A description of progress is an examination of what changes are happening and how they are happening. It is not an assessment of effectiveness or performance for each municipality nor is it an evaluation of the program. As municipal natural asset management is still in its early stages for each of the five municipalities, a focus on describing progress to-date is most needed for local government staff to understand outcomes since the program intervention.

The remainder of this report will present the results from applying this monitoring framework. Appendix 1 contains a table of the key stakeholders and their information needs. Appendix 2 presents the background of municipal natural asset management as well as the role of the Municipal Natural Assets Initiative. Appendix 3 describes the monitoring framework design and the two critical tools developed to ground this monitoring framework in best practices for monitoring and evaluation. Appendix 4 describes the data collection and analysis methods used to provide the information for the monitoring results. Appendices 5 and 6 contain the evaluation tools described in Appendix 3. Finally, Appendix 7 contains the interview guide used as one of the primary data collection methods.

2.0 Findings

The next sections of the report will present the monitoring results. These sections will go in-depth on how well the five municipalities are progressing in each outcome stream based on a Balanced Scored. In this report, the same 11 evaluation questions were used for each case study. Section 2.0 is divided into five subsections for each case study. Each case study is further subdivided into the four outcome streams. Each of the outcome stream subsections includes the evaluation questions, indicators, and benchmarks. Section 3.0 will discuss general recommendations and next steps for this monitoring framework and each of the five municipalities.

2.1. Town of Gibsons

2.1.1. Background

The Town of Gibsons is a small coastal community with a population of 4,605 in southwestern British Columbia, approximately 46 kilometres northwest of Vancouver. The Town of Gibsons is a member municipality of the Sunshine Coast Regional District (Fig. 1). According to the last two censuses, the Town of Gibsons' population grew from 4,437 people to 4,605 people – a 3.8% change. In 2009, the United Nations-recognized International Awards for Liveable Communities recognized the Town of Gibsons as one of the most livable communities under 20,000.

Figure 1: *Map of the Town of Gibsons and the Sunshine Coast Regional District.*

The Town of Gibsons was North America's first community to integrate natural assets into their asset management, infrastructure services, and planning policies. In 2014, the Town of Gibsons became the first municipality in North America to pass a municipal asset management policy that defines and recognizes natural assets as a separate asset class and creates specific obligations for their operation, maintenance, and replacement. In 2016, the Town of Gibsons became a founding member of MNAI which has worked to refine, replicate and upscale the Town of Gibsons' municipal natural asset management approach.

While the Town of Gibsons has integrated many natural assets into its municipal natural asset management program, it is most well-known for its work on the Town of Gibsons' Aquifer, which started in 2009 (Fig. 2). While the Town of Gibsons' experience advantage can make it more difficult to compare it with the other municipalities in this cohort, the Town of Gibsons has been included to provide data specific to ecosystem rehabilitation and restoration outcomes and service delivery outcomes. As the latter two outcome streams, timing is still a significant factor in creating a description of progress. In addition, the results from the Town of Gibsons could be useful for other local governments considering a municipal natural asset management program. The lessons they have learned are invaluable for a robust municipal natural asset management program.

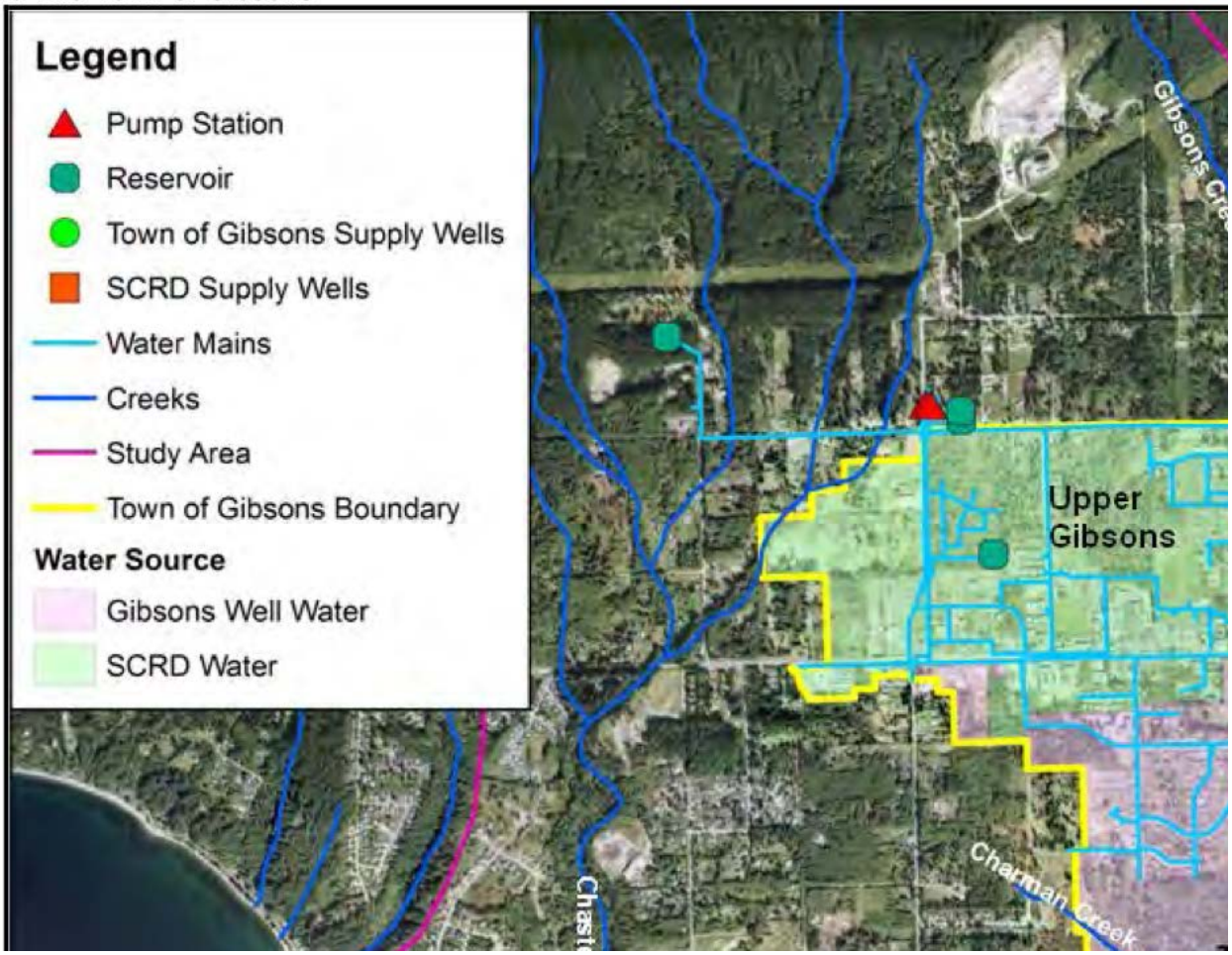


Figure 2: *Map of the Water Distribution and Supply System as it relates to the area of the Gibsons' Aquifer.*

INDICATOR Benchmark, **TOWN OF GIBSONS**	**SITE SCORE**
Awareness, Capacity and Education Indicators	
Number of general consultation efforts for NAM *Benchmark 1:* More than 50% of NAM Consultation events have a high attendance rate *Benchmark 2:* All [100%] of information materials describe one reason for conducting MNAM	
Number of formal and informal partnerships with academic institutions, relevant local nongovernmental institutions, or private landowners At least 1 formal or informal partnership	
Implementation Indicators	
Number of barriers or opportunities identified in MNAM delivery within the project community *Benchmark 1:* 100% of relevant documents identify barriers and opportunities *Benchmark 2:* All [100%] of managers provide at least one barrier	
Number of changes made to OP, ZBL, Secondary Plans, etc. All [100%] of relevant municipal planning policy changed to integrate MNAM	
Amount of funding and financing received for projects All [100%] of projects and programs have available funds to ensure a full lifecycle	
Number of new NAM policy, strategies, and plans All [100%] of NAM policy, strategies, and plans created to support MNAM	
Ecosystem Rehabilitation and Restoration Indicators	
Number of ecosystem service quality measurements or metrics within project community area kept in the natural asset inventory All [100%] of the major municipal ecosystem services have measurements/metrics available in NA inventory	
Number of sites selected as potential rehabilitation or restoration projects Community has identified a possible site for the creation of a NAM project that fits with larger NAM goals	
Number of relevant indicators identified for monitoring and evaluation Municipality has identified at least one key indicator for the lifecycle of NAM projects	
Service Deliver Indicators	
Percentage increase in co-benefit metrics monitored by project community Increase in co-benefits from natural asset management	
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure	

Figure 3*: Balanced Scorecard for the Town of Gibsons*

2.1.2. Awareness, Capacity and Education Outcomes

EVALUATION QUESTION
Have municipalities made the general public aware of natural asset management occurring?

Indicator	Benchmark 1	Benchmark 2
Number of townhalls, information sessions, and other general consultation events on municipal natural asset management.	More than 50% of natural asset management consultation events have a high attendance rate from local citizens.	All (100%) of information materials describe one reason for conducting municipal natural asset management.

The Town of Gibsons does not collect or publicize data on attendance rates for natural asset management consultation events; however, the Town of Gibsons has held consultation events where municipal natural asset management projects are one of the topics. This includes two public information meetings held on Wednesday, Sept 4, 2019, and Wednesday, Sept 18, 2019, for expanding service from the Town of Gibsons' Aquifer to Water Zone 3, which covers Upper Gibsons. However, there is no data available on the number of attendees for both public information meetings. On Monday, Sept 14, 2020, the Town of Gibsons held a virtual public hearing to introduce the new Tree Preservation Bylaw for its urban forest. The urban forest was recognized as a significant natural asset. This public hearing received 22 written comments.

In terms of the content of information materials, the Town of Gibsons does publicize information on what natural assets are, how they are managed, and management objectives. The Town of Gibsons' website also supports a large archive of previous interviews, news articles, radio appearances, and other forms of media for its residents and visitors to view. These materials define natural assets and explain how they are working in the community. For example, the Town of Gibsons' website links to a YouTube video explaining how White Tower Park's stormwater ponds are storing, treating, and filtering most of the town's rainfall throughout the year. Finally, the Town of Gibsons also co-hosts other educational events, such as a community clean-up event for its Harbour. This community clean-up educated residents on the importance of natural asset health and environmental stewardship.

For the first indicator, there are no available attendance rates for a score to be calculated. Therefore, a Grey score was awarded (Fig. 3). The Town of Gibsons is encouraged to collect and publicize data on the attendance rates for natural asset management consultation events. This data will ensure that future monitoring can calculate a more accurate score. For the second indicator, all information materials that the Town of Gibsons produced accurately describe at least one reason for conducting municipal natural asset management. Therefore, a Dark Green score was awarded for the second indicator (Fig. 3). The Town of Gibsons is encouraged to continue sharing information on their municipal natural asset management program and to consider interactive consultation events as a way of building awareness.

EVALUATION QUESTION	
Have municipal staff partnered with academic institutions, relevant local non-government institutions, or private landowners??	
Indicator	**Benchmark**
Number of formal and informal partnerships with academic institutions, relevant local non-governmental institutions, or private landowners.	At least one (1) formal or informal partnership is with an academic institution, a relevant local non-governmental organization, or a private landowner.

As part of their early work with natural assets and municipal natural asset management, the Town of Gibsons started partnerships with environmental non-government organizations (eNGOs) and a consulting firm that led to the creation of MNAI. These organizations are the Smart Prosperity Institute, the David Suzuki Foundation, and Brooke & Associates who worked together and also started MNAI. This partnership continues to be supported through resource sharing, technical support, communication channels, and professional development.

In addition to the formation of MNAI, the Town of Gibsons has partnered with the Sunshine Coast Regional District (SCRD), the Nicholas Sonntag Marine Education Centre, and the Sunshine Coast Streamkeepers Society for various natural asset projects. Starting with the SCRD, this regional government has fostered asset stewardship for all electoral areas and member municipalities. Through this partnership, the Town of Gibsons is creating a regional water governance model for the co-management of the region's natural water assets. Next, the Nicholas Sonntag Marine Education Centre is a local aquarium that hosts education programs and events for the Howe Sound marine region. Through the Healthy Harbour Project, the Centre partnered with the Town of Gibsons under a four-year agreement for the management of natural assets within the Town of Gibsons' Harbour. Finally, the Sunshine Coast Streamkeepers Society is a local volunteer-run environmental organization that does regular creek assessments and yearly salmon spawning surveys for a few of the Town of Gibsons' creeks. While not under a formal partnership agreement, the Streamkeepers Society has done some restoration and monitoring work in the Charman Creek Riparian Zone, within the Town boundary.

As well, the Town of Gibsons is interested in partnering with the Squamish Nation for a few projects. During interviews, staff shared that the Town of Gibsons and the Squamish Nation have agreed on the importance of natural asset management for the protection of cultural assets. This agreement was formalized in a few project requirements. For example, as part of the Healthy Watershed Initiative Grant for the Town of Gibsons' Source to Sea project, the Town must provide plans to support meaningful engagement, employment opportunities, and outcomes that serve First Nations and Indigenous partners in project implementation and learning.

Due to the many partnerships related to municipal natural asset management, the Town of Gibsons was awarded a Dark Green score (Fig. 3). The Town of Gibsons is encouraged to continue starting, fostering, and nurturing more partnerships that are conducive to municipal natural asset management. As well, the Town of Gibsons should look to build partnerships with local academic institutions and continue to encourage provincial and federal governments to partner with local governments for the management of large natural asset areas.

2.1.3. Implementation

EVALUATION QUESTION
Have the municipality and relevant stakeholders identified any barriers or opportunities to municipal natural asset management within the project community?

Indicator	Benchmark 1	Benchmark 2
Number of barriers or opportunities identified for municipal natural asset management delivery within the project community.	All (100%) of topically relevant government documents and reviews identify barriers and opportunities and provide specific examples.	All (100%) of managers provide at least one barrier or opportunity encountered and acted upon.

The first barrier that the Town of Gibsons staff identified was organizational structure. According to interviewed staff and the Town of Gibsons' Eco-asset Strategy, municipal natural asset management requires team-based, collaborative approaches across departments and disciplines. A piecemeal approach risks departmental siloing which can negatively affect program outcomes. However, these departments may have little-to-no experience working with staff from other departments. To act on this barrier, the Town of Gibsons staff created education and training courses to prepare for inter-department collaboration. As well, staff management increased the number of projects each department is working on so they must produce practical solutions together. A practical example of the Town of Gibsons working through this barrier is the crafting of their Tree Preservation Bylaw in late 2020. Staff from the Planning and Development Services Department and the Infrastructure Services Department worked to write the bylaw, present it to council and the public, and get it approved.

Town of Gibsons staff also mentioned lacking provincial policies and tools to enable municipal natural asset management. The Province of British Columbia could provide a clearer directive on the rules and regulations around municipal natural asset management. This could then lead to a roadmap for municipalities to work through. To address this governance issue, interviewed staff described a predictive model they are building to help other municipal governments understand the opportunities that municipal natural asset management provides. Finally, for opportunities or other enabling conditions, interviewed staff shared that they believe a municipality must do the following three things to enable municipal natural asset management:

1/ formally recognize natural assets as fundamental to infrastructure,

2/ change the financial plan to recognize the value of natural assets, and

3/ change the definition of infrastructure in the Official Community Plan to include "our engineered infrastructure is interconnected and interdependent on nature to function."

For both indicators used for this evaluation question, the Town of Gibsons has provided ample evidence on identified barriers and opportunities. Thus, for both indicators, the Town of Gibsons was awarded Dark Green scores (Fig. 3). The Town of Gibsons is encouraged to continue identifying possible opportunities and barriers, especially regarding ecosystem rehabilitation and restoration outcomes and service delivery outcomes. As well, the Town of Gibsons should continue sharing their experiences so other municipalities can more effectively act on these opportunities and barriers.

EVALUATION QUESTION

Have the municipalities made changes to their Official Plan, Zoning Bylaw, Secondary Plans, etc.?

Indicator	Benchmark
Number of changes made to Official Plan, Zoning Bylaw, Secondary Plans, etc.	All (100%) of relevant municipal planning policy documents changed to integrate municipal natural asset management practices.

The Town of Gibsons has changed several key policies to account for municipal natural asset management. For example, it has incorporated several policies in the Official Community Plan to integrate municipal natural asset management practices. This includes policy 6.2.6 which aims to grow the Town of Gibsons' environmental assets "by pursuing opportunities for reclamation of habitat, greening of streets and other projects that benefit both environment and community." The Official Community Plan also includes policies for the growth of the Town of Gibsons' parks, trails, and outdoor recreation access by creating "a system of linked parks and trails to provide opportunities for both active and passive outdoor uses." There are also policies for new natural asset signs, provincial and federal advocacy, water asset management policies for the Town of Gibsons' Aquifer, parkland access, and infrastructure and servicing for natural assets. The Town of Gibsons has also worked with provincial officials to encourage the creation and interpretation of provincial policies for facilitating municipal natural asset management. For example, the Town of Gibsons found that Development Cost Charges, which are charges levied by municipalities on development to help pay for capital infrastructure requirements, can be collected for improvements to natural assets. Therefore, "on July 19th, 2016, the Town of Gibsons adopted a revision to the Development Cost Charges Bylaw 1218 which included a $3.2 million valuation for an increase in the White Tower storm retention pond volumes."

In 2014, the Town of Gibsons created a municipal asset management policy manual that defined and recognized natural assets as an asset class or category. This policy manual includes objectives and principles to ensure that natural assets can be operated, maintained, and/or replaced. Also in 2014, the Town of Gibsons changed their Significant Accounting Policies to include a Tangible Capital Asset Note in their financial statements that acknowledges the importance of natural assets and the need to manage them in conjunction with engineered assets. In the Town of Gibsons' 2020-2024 Financial Plan Bylaw, environmental protection should include "preserving natural assets and other environmentally-sensitive areas of the Town." However, there are some outstanding changes that the Town of Gibsons has yet to implement. For example, following a review and update to the Town of Gibsons' Integrated Stormwater Management Plan, recommendations were made to update the Subdivision Bylaw; currently, those changes have yet to be made.

Since the Town of Gibsons started to consider the value of their natural assets, they made changes to every key piece of relevant planning policy, with more changes expected. Therefore, the Town of Gibsons was awarded a Dark Green score for this indicator (Fig. 3). The Town of Gibsons is encouraged to continue updating existing policies to account for a multitude of key natural assets and to implement recommendations from the Integrated Stormwater Management Plan.

EVALUATION QUESTION

Have new projects received funding or financing?

Indicator	Benchmark
Amount of funding and financing received for projects.	All (100%) of projects and programs have available funds to ensure a full lifecycle.

In 2018, the Town of Gibsons received approximately $249,000 through the federal-provincial Clean Water and Wastewater Fund to update their Integrated Stormwater Management Plan which has made several recommendations to the Town of Gibsons related to municipal natural asset management. In July 2020, the Rural and Northern Communities Infrastructure Stream from the Investing in Canada Plan awarded the Town of Gibsons $955,000 to construct an additional stormwater pond at the Whitetower Park site. On July 8, 2021, the Town of Gibsons' council approved the award of the Whitetower Pond Tender to Pirate Excavating Ltd. for $814,963.96; this budgeted cost falls within the $955,000 funding award. In terms of planned projects, the Town of Gibsons is working with MNAI for the Source to Sea project. This project will install surface water monitoring in all the creeks located in the Town of Gibsons' Aquifer watershed through hydrometric stations on the waterways to determine seasonal discharge values. The Town of Gibsons' council has authorized the budget reallocation of $45,000 from Drainage Development Cost Charges and $20,000 from the Groundwater Management Zone project to fund the Source to Sea project. $39,367 was spent in 2020 for the Source to Sea Project and current estimates have the 2021 Budget for the project set at $85,000. In addition, council supported an application to the Provincial Infrastructure Planning Grant Program for $10,000 to fund the Source to Sea Project.

Following changes to infrastructure funding programs, the Town of Gibsons has been able to successfully secure some form of external funding that either covers or contributes to the costs for an entire project lifecycle. As well, the Town of Gibsons has invested a significant source of internal revenue for municipal natural asset management. Therefore, the Town of Gibsons was awarded a Dark Green score for this indicator (Fig. 3). The Town of Gibsons is encouraged to continue applying to infrastructure grants and programs and to continue committing internal funds for municipal natural asset management.

EVALUATION QUESTION

Have staff created new natural asset management policies, strategies, and plans?

Indicator	Benchmark
Number of new natural asset management policies, strategies, and plans.	All (100%) of natural asset management policy, strategies, and plans created to support municipal natural asset management within project community.

The Town of Gibsons continues to create new municipal natural asset management policies, plans, and procedures. On Sept 18, 2020, the Town of Gibsons adopted a Tree Preservation Bylaw to protect the local tree cover. This bylaw is recognized as the first step towards building an Urban Forest Plan. This Tree Preservation Bylaw has three key objectives:

1/ to identify tree species that are to be protected within the Town of Gibsons,

2/ recognize the importance of the tree canopy and the many benefits of Urban Forests, trees on private property, Town road dedications, or green spaces, and

3/ establish procedures to preserve the Town of Gibsons' tree canopy by minimizing tree removal, preventing damage or destruction of trees, establishing mandatory conditions for the replacement of trees, and optimizing planting provisions and tree health within the Town.

The Town of Gibsons' 2020 Budget Supporting Document shows that the Town has committed to developing a Reforestation Strategy. This strategy will give priority to reforesting areas that provide the best opportunity to reduce risk and increase resilience. The Town of Gibsons has stated that an Urban Forest Plan will provide a complete tree inventory, determine the percentage of tree canopy in the Town, enable council to establish a target tree density, develop a Tree Management Plan, and address the role that trees play in a natural asset system. At this time, the Town of Gibsons has compiled an Urban Forest Canopy layer through LiDAR data. This layer will then go towards establishing a Tree Density Target.

In addition to this Urban Forest Plan and Reforestation Strategy, the Town of Gibsons' 2020 Budget Supporting Document has listed several other natural asset management plans. This includes a Fringe Area Plan with the Sunshine Coast Regional District that would include the co-management of natural assets. Council has also identified this Fringe Area Plan as a priority in the 2019-2022 Strategic Plan. As of Dec 31, 2020, preliminary discussions with the Sunshine Coast Regional District have resulted in the following action item planned: "lead the development of a Fringe Area Plan with Sunshine Coast Regional District at a watershed scale, including Aquifer protection, flood protection, transportation routes, asset management, and land-use planning."

Finally, the Town of Gibsons has begun assembling a long-term master plan for its marine foreshore area. Several ongoing projects will contribute to this master plan. These projects include a completed foreshore condition assessment, the Source to Sea project, the Healthy Harbour project, and a Coastal Resilience project. As part of their Official Community Plan, the Town of Gibsons already has a Harbour Area Plan which acknowledges that the Town of Gibsons' harbour area has many natural assets. This Harbour Area Plan has created several policies to protect marine natural assets. For example, Policy 5.3.3 states that the "Town of Gibsons must maintain and enhance the natural shoreline and aquatic zone through plating, by avoiding 'hard' infrastructure in the foreshore, and by creating wetlands and marsh areas for habitat and to protect shorelines against erosion from currents, fetches, and wakes." The Harbour Area Plan also states that staff will prepare a report card every two years to assess the Harbour Area through several sustainability indicators and include benchmarks and milestones.

In conclusion, all new municipal natural asset management policies, strategies, and plans created in the Town of Gibsons fully encompass natural assets into a single service delivery framework. Therefore, the Town of Gibsons was awarded a Dark Green score (Fig. 3). The Town of Gibsons is encouraged to continue working through planned projects and provide updates when available.

2.1.4. Ecosystem Rehabilitation and Restoration

EVALUATION QUESTION
Are measurements or metrics being used for assessing ecosystem service quality?

Indicator	Benchmark
Number of ecosystem service quality measurements or metrics within a municipal project area kept in the natural asset inventory.	All (100%) of the major ecosystem services within a municipal area have measurements or metrics stored in the natural asset inventory.

The Town of Gibsons is monitoring several ecosystem service quality metrics across three of the four main ecosystem service types. The Town of Gibsons collects quantitative data on water quality, air quality, aquifer recharge levels, stormwater service provision, flood mitigation services, and habitat provision. While it also collects qualitative data on user well-being, it does not monitor any other qualitative or quantitative cultural ecosystem service quality metrics. For example, staff report that the White Tower Park space is "extremely popular with Gibsons' citizens and visitors" but there is a lack of survey data on why citizens and visitors enjoy the parks and for what they use the parks. The Town of Gibsons' Aquifer, the Healthy Harbour Project, and the White Tower Park Stormwater Ponds are the three major natural asset areas where ecosystem service monitoring occurs in the Town of Gibsons. To start with the Town of Gibsons' Aquifer, the Town of Gibsons monitors water quality, water storage, aquifer recharge level, recharge temperature, and service stability.

For the Healthy Harbour Project, the ecosystem services that the Town of Gibsons monitors are the biota and benthic elements of the marine ecosystems, including but not limited to eelgrass, herring, crabs, salmon and clams. Cultural and aesthetic values of the harbour area are mentioned, but reviewed documents do not provide more information on how these ecosystem services are monitored. The Healthy Harbour Project recognizes that eelgrass beds provide the infrastructure service of attenuating wave activity during storm surge events, help prevent coastal erosion, and maintain the foreshore's integrity. As well, these services protect upland public and private properties and essential municipal infrastructure, including sewer services. Restoration activities are ongoing to protect eelgrass beds and accurately measure their services.

Finally, for the White Tower Park Stormwater Ponds, the major ecosystem services that the Town of Gibsons monitors are services for stormwater management. In its Official Community Plan, alternative drainage systems, such as stormwater ponds, are noted for their infiltration abilities, their ability to treat stormwater as part of the hydrologic cycle, and for enhancing aquatic and terrestrial habitats. As well, in a valuation study of the stormwater management ponds, the Town of Gibsons found that the location of the ponds is ideal for attenuating peak flows and for providing more flood mitigation through peak flow reduction than engineered alternatives. The Town of Gibsons continues to monitor these services and makes upgrades when needed.

Therefore, the Town of Gibsons was awarded a Light Green score (Fig. 3). Most of the major ecosystem service categories in identified natural asset areas have an ecosystem service quality metric. However, the Town of Gibsons has not identified an appropriate cultural ecosystem service quality metric and is encouraged to include cultural ecosystem service quality metrics in their natural asset inventory.

EVALUATION QUESTION

Has the municipality created a rehabilitation or restoration project?

Indicator	Benchmark
Number of sites selected as potential rehabilitation or restoration project(s).	Community has identified a (one) possible site for the creation of a natural asset management project that fits with larger natural asset management goals.

The Town of Gibsons continues to identify key natural asset areas for potential rehabilitation and restoration projects. For example, the Town of Gibsons identified White Tower Park as the site to construct an additional stormwater pond to settle out sediments and remove pollutants from the stormwater before it enters the adjoining Charman Creek. According to the Town of Gibsons, the expansion will enable the stormwater ponds to service 47.7 hectares of land and help address long-term erosion and water quality impacts of past development on Charman Creek. There have also been previous citizen-led initiatives to protect a 13-hectare parcel of Charman Creek lands. In October 2018, the Town of Gibsons' council was presented with a petition with 200 signatories requesting that the Charman Creek Lands be kept in a natural state as a park. In September 2020, a second petition with 1,450 signatories was presented requesting that the lands be protected in perpetuity.

As part of their work on the foreshore and harbour area, both the Healthy Harbour Project and the Source to Sea Project have stipulations that if the restoration or rehabilitation of a specific area is needed, it can be completed under the scope of work. A virtual report was presented to council on Dec 15, 2020, that showed there is a vibrant and healthy eelgrass habitat in the east Armours Beach region, but there is more debris closer to the Town of Gibsons' Landing marine facility. Restoration activities have now targeted the Town of Gibsons' Landing area for marine clean-up. The 2020 Healthy Harbour Report also states that the Nicholas Sonntag Marine Education Centre will monitor the impacts of the restoration work over the coming years and that through further restoration, the coverage of eelgrass may increase. For the Source to Sea project, results can inform staff on where future restoration work could occur through a baseline inventory and a condition assessment for the entirety of the Town of Gibsons' Aquifer watershed.

Therefore, the Town of Gibsons continues to identify potential sites for rehabilitation and restoration projects both on land and in the sea. The Town of Gibsons was awarded a Dark Green score (Fig. 3) and is encouraged to identify more sites for rehabilitation and restoration work, especially those that may be shared across municipal boundaries.

EVALUATION QUESTION

Has the monitoring of natural asset and ecosystem services occurred?

Indicator	Benchmark
Number of relevant indicators identified for monitoring and evaluation.	Municipality has identified at least one (1) key indicator for the lifecycle of the natural asset management project(s).

The Town of Gibsons identified several indicators for each natural asset management project. For example, in the Healthy Harbour Project, the Town of Gibsons has included the following indicators as a part of their ongoing Level 3 Eelgrass Assessment: (i) plant density, (ii) level of biodiversity, (iii) shoot length, (iv) identifiable species, (v) leaf area index, and (vi) location and the number of mooring buoys. These indicators were chosen based on best practices for mapping and monitoring of eelgrass habitat in British Columbia from Environment Canada & Precision Identification Biological Consultants. As a part of their aquifer monitoring work, Town of Gibsons staff in consultation with Waterline Resources Inc. identified several water-related indicators and benchmarks in the Proposed Groundwater Monitoring Plan. These indicators were first identified in 2013 and have been refined through an adaptive management process. These indicators include (i) renewable groundwater resources per capita, (ii) total groundwater abstraction/recharge, (iii) number of contaminated sites, (iv) groundwater contribution to base flow, and (v) public outreach on groundwater sustainability. These indicators have been monitored on an annual basis with reports submitted to the Town of Gibsons. Finally, for the Urban Forest Plan and Tree Management Plan, staff have already noted that the creation of a target tree density will be a primary indicator for both plans.

In conclusion, the Town of Gibsons identified more than one key indicator for natural asset management projects. Therefore, the Town of Gibsons was awarded a Dark Green score for this indicator (Fig. 3) and is encouraged to also develop specific benchmark values or targets. It should also develop indicators for other natural asset management projects and address all four categories of ecosystem service delivery.

2.1.5. Service Delivery

EVALUATION QUESTION
Is there a record of increased co-benefits?

Indicator	Benchmark
Percentage increase in co-benefits metrics monitored by project community.	Increase in co-benefits from natural asset management.

The Town of Gibsons has identified and continues to assess a few co-benefits changes. Under the Natural Asset Management section in the Town of Gibsons' 2020 Budget Supporting Document, listed co-benefits include (i) improvements to biodiversity and habitat creation, (ii) improvements to water quality, retention and absorption, (iii) improvements to livability, (iv) cost savings, (v) human health, (vi) wellbeing, (vii) carbon storage, (viii) greenspace, and (ix) recreation. As well, other co-benefits listed are "a reduction in risks to property values" and "a reduction in the burden to grey infrastructure." In the Town of Gibsons' Official Community Plan, there are several co-benefits contained in key objectives. For example, under the Plan's Parks & Outdoor Recreation section, a trail network should be promoted throughout the community and region to highlight "recreational opportunities that will have a positive effect on the local economy." However, at this time, the Town of Gibsons does not monitor changes in co-benefit metrics.

The Town of Gibsons does list health-related metrics for the Gibsons' Aquifer. In interviews and key documents, the Town of Gibsons continues to monitor its Aquifer for Escherichia Coli levels, Total Coliform levels, the absence of contaminates, amount of water pumped, colour, pH,

and other public health metrics. In addition, the Healthy Harbour Project documents describe that the restoration of eelgrass could lead to the stabilization of sediment, the provision of habitat for forage fish that support healthy salmon populations, supporting the biodiversity of species, carbon sequestration, socio-economic values around natural beauty, and eco-tourism. However, there is still a lack of specific data on a percentage increase in co-benefits as restoration is ongoing. The Town of Gibsons is encouraged to start measuring co-benefit metrics. Thus, the Town of Gibsons was awarded an Orange score for this indicator (Fig. 3).

EVALUATION QUESTION

Has pressure been reduced on traditional municipal infrastructure that would have been impacted by climate change?

Indicator	Benchmark
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change.	Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure.

According to interviewed staff, by restoring and improving stormwater ponds in a natural area, the Town of Gibsons did not have to construct a $4,500,000 engineered alternative for its drainage system. Thus, the Town can save 25% on a total upfront construction cost of $955,000 to expand the stormwater ponds. In addition, maintenance and operation costs for the engineered alternative were expected to be between $75,000-$100,000 a year compared to the maintenance cost for the natural asset which is expected to cost between $20,000-30,000 annually. As progress in service delivery outcomes continues, the Town of Gibsons is working on calculating an overall return on investment valuation for all infrastructure improvements needed per square kilometre. Interviewed staff then explained that the Town of Gibsons would be able to calculate the returns from the replanting of the forest, restoring the integrity of three major creeks, and redesigning the foreshore, as necessary. In interviews, Town of Gibsons' staff were able to show that a decrease in the infrastructure retrofitting and renewing budget can be expected due to municipal natural asset management. The Town of Gibsons is encouraged to continue valuing natural asset management projects in comparison with engineered alternatives and to produce documents that show these comparisons across the municipality. For this indicator, the Town of Gibsons was awarded a Yellow score (Fig. 3).

2.2. City of Grand Forks

2.2.1. Background

The City of Grand Forks is a small city in southeastern British Columbia just north of the Canada-U.S. border. The 2016 census measured the population at 4,049 people. The City of Grand Forks is a member municipality of the Regional District of Kootenay Boundary and is located at the junction of the Kettle and Granby Rivers. The City of Grand Forks has shown a keen sense of the values of its natural assets and is advanced in asset management planning. Due to massive river floods in 2017 and 2018, the City of Grand Forks and MNAI decided to assess flood mitigation benefits from the Kettle River Floodplain under different development scenarios. The results from this pilot study demonstrated that the Kettle River floodplain provides – at a minimum – between $500 and $3,500/hectare in flood damage reduction for downtown buildings in the City of Grand Forks during high flow events.

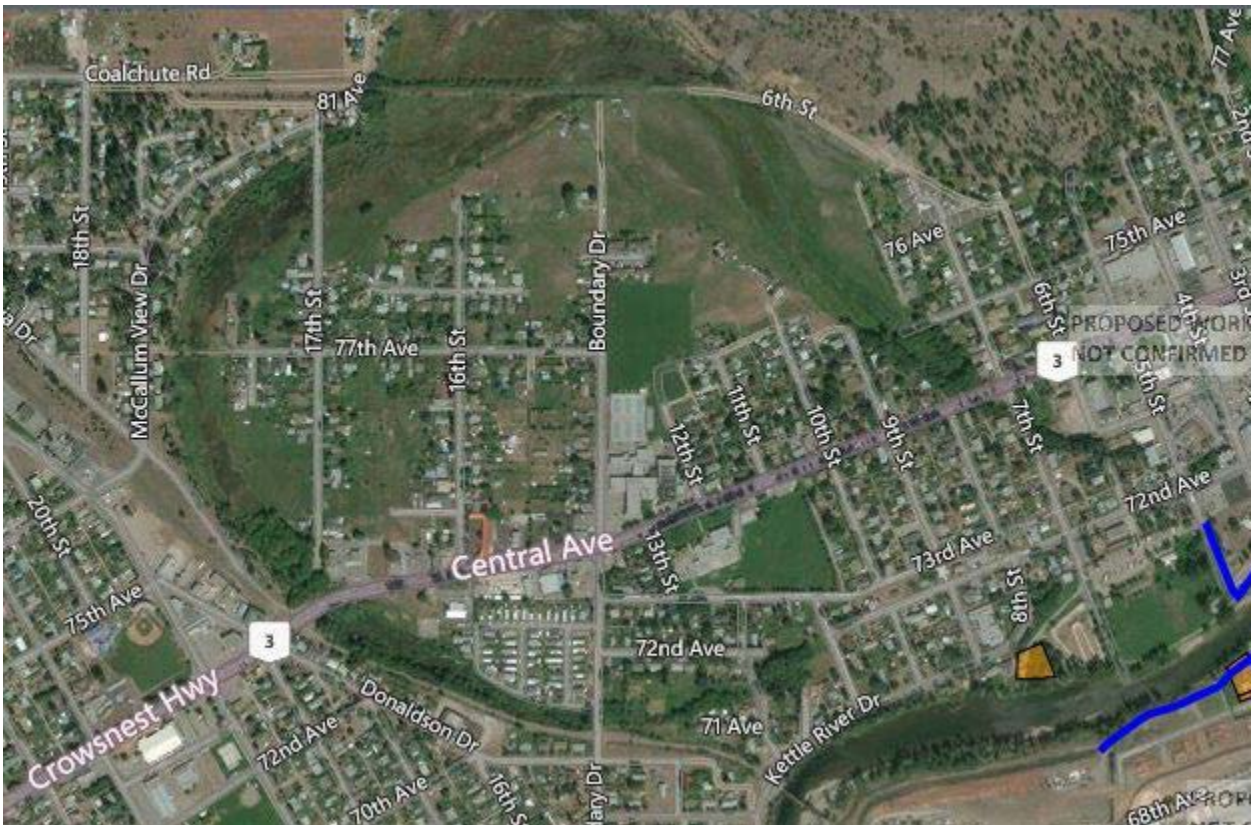


Figure 4: *A Map of the Grand Forks area purchased for the Federal Disaster Mitigation and Adaptation Fund program.*

In May 2018, the City of Grand Forks and the outlying communities along the Kettle and Granby Rivers experienced a 1-in-200-year flood event that significantly damaged substantial portions of the community's infrastructure, dwellings, and economic base (Fig. 4). In January 2019, the City of Grand Forks applied for $49.9 million in funding for flood protection infrastructure and a buyback program from the Federal Disaster Mitigation and Adaptation Fund (DMAF) program. The City of Grand Forks also applied for a $3-million grant from the National Disaster Mitigation Program (NDMP) for flood protection and stormwater improvements on the east side of the downtown. In June 2019, the City of Grand Forks received confirmation of a total of $51.6 million for flood response efforts, including provincial funding for the work sent under the NDMP program.

INDICATOR Benchmark CITY OF GRAND FORKS	SITE SCORE
Awareness, Capacity and Education Indicators	
Number of general consultation efforts for NAM *Benchmark 1:* More than 50% of NAM Consultation events have a high attendance rate *Benchmark 2:* All [100%] of information materials describe one reason for conducting MNAM	
Number of formal and informal partnerships with academic institutions, relevant local nongovernmental institutions, or private landowners At least 1 formal or informal partnership	
Implementation Indicators	
Number of barriers or opportunities identified in MNAM delivery within the project community *Benchmark 1:* 100% of relevant documents identify barriers and opportunities *Benchmark 2:* All [100%] of managers provide at least one barrier	
Number of changes made to OP, ZBL, Secondary Plans, etc. All [100%] of relevant municipal planning policy changed to integrate MNAM	
Amount of funding and financing received for projects All [100%] of projects and programs have available funds to ensure a full lifecycle	
Number of new NAM policy, strategies, and plans All [100%] of NAM policy, strategies, and plans created to support MNAM	
Ecosystem Rehabilitation and Restoration Indicators	
Number of ecosystem service quality measurements or metrics within project community area kept in the natural asset inventory All [100%] of the major municipal ecosystem services have measurements/metrics available in NA inventory	
Number of sites selected as potential rehabilitation or restoration projects Community has identified a possible site for the creation of a NAM project that fits with larger NAM goals	
Number of relevant indicators identified for monitoring and evaluation Municipality has identified at least one key indicator for the lifecycle of NAM projects	
Service Deliver Indicators	
Percentage increase in co-benefit metrics monitored by project community Increase in co-benefits from natural asset management	
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure	

Figure 5: Balanced Scorecard for the City of Grand Forks

2.2.2. Awareness, Capacity, and Education

EVALUATION QUESTION
Have the municipalities made the general public aware of natural asset management occurring?

Indicator	Benchmark 1	Benchmark 2
Number of townhalls, information sessions, and other general consultation events on municipal natural asset management.	More than 50% of natural asset management consultation events have a high attendance rate from local citizens.	All (100%) of information materials describe one reason for conducting municipal natural asset management.

Most of the City of Grand Forks consultation events and information materials were created in response to the May 2018 flood recovery. On June 13, 2018, a public meeting was held to update attendees on hydrological and flood-protection planning and financial, insurance, and housing issues. A public flood recovery meeting was held on July 9, 2018, and July 11, 2018, to follow up on affected citizens' concerns and questions. The major topics of this meeting were infrastructure upgrades and future flood potential. On September 19, 2018, and October 3, 2018, the City of Grand Forks announced at public meetings that they would re-establish the floodplain and riparian areas in the North Ruckle, South Ruckle, and Johnson Flats neighbourhoods. During a September 2019 meeting with the "Owners of Properties the City wants to Repurpose for Future Flood Infrastructure," this group requested regular information in writing on all flood recovery efforts, including (i) appraisal processes and outcomes, (ii) buy-out processes and timelines, (iii) project milestones and public events, (iv) grant agreements, requirements and outcomes, and (v) flood mitigation infrastructure planning and upgrades.

During the September 19, 2019 general meeting, the City of Grand Forks committed to improving communication and engagement with project and community stakeholders. Following this, the City of Grand Forks implemented a Project Communications Plan developed by the consultancy firm Alliance Communications. This Communications Plan developed key messages for internal and external audiences to ensure common project understanding and prompt messaging on land acquisition and restoration processes and timelines. A part of this Communications Plan was the development of the Recovery to Resilience campaign in October 2019 to optimize communication and collaboration among key stakeholders during floodplain restoration and infrastructure upgrades from 2019-2023. The City of Grand Forks has not publicized the number of attendees at any of the 13 public meetings from June 2018 to November 2019.

Regarding the content of information materials, many of these were created as a part of the Recovery to Resilience campaign. These materials describe a few of the reasons for managing the floodplain and riparian areas as natural assets. Specifically, benefits of floodplain and wetland restoration are increased recharge of groundwater, the reduction of sediment pollution, and the provision of habitat for fish, birds and pollinators. As well, these materials use the language of municipal natural asset management by stating that "restoration of the floodplain and riparian areas provides a durable, regenerating 'natural asset' that costs far less over time than hard infrastructure." The interviewed staff mentioned that as a part of their restoration work, a map and kiosk sign were installed that described these benefits and basic functionality to recreational users.

While the City of Grand Forks' website does not have a dedicated section for municipal natural asset management, the Recovery to Resilience campaign contains most of the project documents and outreach materials. Visitors to the website have the option to sign up for emailed project updates and a newsletter. This newsletter contains project updates, an FAQ section, and contact information for the City Resilience team. The City of Grand Forks has also been part of extensive media coverage on their flood recovery efforts, including a series of Global News video stories on flood mitigation and land acquisition issues.

For the first indicator, the City of Grand Forks has not collected information on the number of residents or property owners who attended consultation events. While the City of Grand Forks has held many consultation events, municipal staff are encouraged to prepare attendance rates for municipal meetings. This will help the City of Grand Forks determine how effective current consultation strategies are at building awareness across the municipal population. Therefore, the City of Grand Forks receives a Grey score (Fig. 5). For the second indicator, the City of Grand Forks has made a concerted effort to describe the benefits of municipal natural asset management through floodplain and wetland restoration. As well, the Recovery to Resilience campaign developed external messaging to clearly describe these benefits in a way that is understandable and approachable. Therefore, the City of Grand Forks receives a Dark Green score (Fig. 5) and is encouraged to continue using the Recovery to Resilience campaign to share messages on municipal natural asset management.

EVALUATION QUESTION

Have municipal staff partnered with academic institutions, relevant local non-government institutions, or private landowners?

Indicator	Benchmark
Number of formal and informal partnerships with academic institutions, relevant local non-governmental institutions, or private landowners.	At least one (1) formal or informal partnership is with an academic institution, a relevant local non-governmental organization, or a private landowner.

The City of Grand Forks has started a few informal partnerships with local non-governmental organizations (NGOs). These organizations are focused on protecting and conserving the local environment in the Regional District of Kootenay Boundary. For example, the Granby Wilderness Society is a local eNGO that was founded to create a new wilderness park at the North End of the Granby River in the City of Grand Forks. Most of the work done by the Granby Wilderness Society focuses on the restoration and conservation of riparian areas and species-at-risk. For example, in 2010, the Granby Wilderness Society's lead biologist wrote a Conservation Action Plan for Species at Risk in the Grand Forks Area.

In 2012, the Granby Wilderness Society, the Grand Forks Wilderness Association, the Boundary Weeds Committee, the Christina Lake Stewardship Society, and a habitat biologist from the Ministry of Forests, Lands and Natural Resources (now the Ministry of Forests, Lands, Natural Resource Operations and Development) formed the Boundary Habitat Stewards group. This group investigates the protection of species-at-risk and black cottonwood riparian planning. In 2019, the Regional

District of Kootenay Boundary gave $10,000 to the Granby Wilderness Society and the Boundary Habitat Stewards for restoration projects. The Granby Wilderness Society has worked to protect Lewis's Woodpecker, a provincially threatened species, by compiling known locations of nest sites, inventorying potential habitats, identifying threats and mitigation efforts, and applying for funding through the Habitat Stewardship program provided by the Government of Canada.

Both the Granby Wilderness Society and the Boundary Habitat Stewards have worked extensively with the City of Grand Forks. For instance, interviewed staff shared that their lead biologist has spoken to city council several times, provided input on the City of Grand Forks' tree management policy, and presented a work plan for the restoration of riparian area sites. Currently, the partnership between the City of Grand Forks, the Granby Wilderness Society, and the Boundary Habitat Stewards group has not been formalized. According to municipal staff, there was an effort to formalize a partnership between these organizations in 2018. The partnership agreement would be based on a commitment to conserve natural areas and manage wildlife. However, this process stalled with a change in staff management.

Due to these informal partnerships for ecosystem rehabilitation and restoration, the City of Grand Forks receives a Dark Green score (Fig. 5). The City of Grand Forks is encouraged to create a partnership agreement with the Granby Wilderness Society and the Boundary Habitat Stewards group based on the commitment to conserve natural areas and manage wildlife. This agreement could also stipulate the sharing of resources and materials for ecosystem rehabilitation and restoration projects.

2.2.3. Implementation

EVALUATION QUESTION

Have the municipality and relevant stakeholders identified any barriers or opportunities to municipal natural asset management within the project community?

Indicator	Benchmark 1	Benchmark 2
Number of barriers or opportunities identified for municipal natural asset management delivery within the project community	All (100%) of the topically relevant government documents and reviews identify barriers and opportunities and provide specific examples.	All (100%) of the managers provide at least one barrier or opportunity encountered and acted upon.

Regarding the number of barriers and opportunities identified and acted upon in the City of Grand Forks, the primary barrier identified was the public reception and confusion with the property buy-out program. Property owners were expecting pre-flood values as these values were used in a similar flooding situation in Manitoba. However, the value of land in the City of Grand Forks was taken post-flood which led to significant pushback from property owners. To address this barrier, city council considered what in-kind contributions it could offer property owners instead of pre-flood land values. However, when these in-kind contributions did not receive public support, the City of Grand Forks adjusted their proposed capital project budgeting and invested more than originally planned. This changed the cost from $51,000,000 to $55,000,000 for the Land Acquisition Program.

Residents also raised concerns about the lack of consultation during critical times in the

development of the mitigation and land acquisition programs. To address this barrier for the flood protection programs, the City of Grand Forks implemented the Communications Plan to develop clear internal and external messaging. Internal messages ensured a common project understanding, a commitment to speak with a unified voice, and compassionate approaches to affected property owners. External messages ensured that affected property owners would receive clear, concise, and timely messaging on land acquisition and restoration processes and timelines. Interviewed staff also mentioned that the City of Grand Forks is looking for support on developing public education strategies for natural assets that could be tailored for the community.

The DMAF Program Charter compiled cost-related, scheduling, and scope-related constraints. These constraints also act as barriers for the City of Grand Forks. In terms of cost-related constraints, the City of Grand Forks acknowledged that the funding approved for the program is limited and the possibility of future funding from DMAF funding partners is low. To compound this, the higher spending due to the Land Acquisition Program has constrained available funding for the Flood Mitigation Program. Another cost-related constraint is macro and micro construction cost trends. Project costs associated with labour, equipment, and material scarcity must be considered, and as such could pose a significant budgetary constraint to the program.

In terms of scheduling constraints, the Province of British Columbia has regulatory requirements to working in and near the river. Therefore, a substantial part of the flood mitigation work will need to be scheduled around fish windows. As well, snow melt events known as freshet can be a scheduling constraint as its timing, duration and size are not known until only a few days before an event. Thus, higher water levels can make construction unsafe and cause water infiltration issues during excavation and sub-surface work. Another scheduling constraint is the speed of land acquisition. To mitigate future floods, the higher priority restoration projects are situated in higher flood risk areas. However, if there is a significant delay with acquiring those areas, flood mitigation work cannot start, causing significant delays and risks to the entire project. The last scheduling constraint is the length of time it can take to achieve permits and approvals. The Program Charter estimated that these approvals may take between 90 to 140 days from the time that the application is submitted to final permit approval. Thus, if timings of approval and the timings of fish windows do not align, construction work may be missed by a year.

The next constraint category is scope-related constraints. While some of these projects could be worked on simultaneously, there is a risk that the scheduling or cost-related constraints could compound upon one another. As well, these projects could cause significant disruptions to the City of Grand Forks and resident activities, risking the viability of the tourism industry. Finally, interviewed staff noted that the City of Grand Forks already has a limited staff capacity, so the coordination of multiple projects would pose significant challenges and risks.

The DMAF Program Charter also identified two synergies or opportunities. The first opportunity is scope overlap. The City of Grand Forks could overlap program activities with other non-DMAF planned public works. Thus, DMAF work and non-DMAF work can occur in conjunction with one another to leverage economies of scale, optimize timings, reduce disruption, and/or decrease costs associated with set-up, access, material purchase and mobilization. The second opportunity is the leveraging of retained assets. Once the purchase of properties has been completed, improvements made to the property may hold value for the City of Grand Forks. These improvements or additions can be repaired, sold, or moved. Some of these assets could then lead to the development of an affordable housing strategy, or the City of Grand Forks could pursue for-profit development opportunities with the private sector to increase the housing supply.

Throughout the City of Grand Forks' flood recovery and mitigation program, staff consistently identified and acted upon numerous barriers and opportunities. As well, reviewed documents also describe barriers and opportunities identified and acted upon throughout the DMAF program lifecycle. Therefore, the City of Grand Forks has been awarded a Dark Green score for both indicators (Fig. 5). The City of Grand Forks is encouraged to continue identifying barriers and opportunities, especially as the focus of the DMAF program shifts towards floodplain and wetland restoration.

EVALUATION QUESTION

Have the municipalities made changes to their Official Plan, Zoning Bylaw, Secondary Plans, etc.?

Indicator	Benchmark
Number of changes made to Official Plan, Zoning Bylaw, Secondary Plans, etc.	All (100%) of relevant municipal planning policy documents changed to integrate municipal natural asset management practices.

The City of Grand Forks has made many changes to planning policy documents to integrate municipal natural asset management practices. For example, the Grand Forks City Council adopted a policy for its urban forest, with a guiding principle that states that "a healthy urban forest provides habitat, ecosystem function and amenity values to the City." This policy does recognize several ecosystem services and co-benefits provided by an urban forest including a reduction in air pollution, dust control, noise control, shade, habitat improvement, biodiversity, and soil stabilization. This policy also outlines risk management practices, tree selection procedures, and tree removal procedures. The City of Grand Forks' Asset Management Financial policy states that the City of Grand Forks' asset management principles is founded on the concept of sustainable service delivery. This policy has not been changed to include natural assets or ecosystem service valuation. However, under the City of Grand Forks' Strategic Plan 2015-2019 Fiscal Accountability theme, the City of Grand Forks is committed to never selling its natural assets and infrastructure. The City of Grand Forks commits to several strategic projects and actions under this Fiscal Accountability theme. These projects and actions include protecting the aquifer and related infrastructure from any external interests, developing policies and guiding principles to protect valuable assets, and continuing conservation education for the public.

The City of Grand Forks is also changing its Official Community Plan. On January 18, 2021, the City of Grand Forks released a form notice on a Request for Proposals (RFP) for the Official Community Plan and Related Planning Initiatives. Project Area #4 of this RFP is for the creation of a floodplain designation, zoning amendment(s), and park dedication. The interviewed staff mentioned that the City of Grand Forks also has a 2021 work plan to overhaul the Floodplain Management Bylaw and the Zoning Bylaw in three areas to help protect natural assets and support the conservation and restoration of these assets. Under the current Zoning Bylaw, there are already several protections for the preservation of significant natural features, including provisions for parks, natural areas, and trail improvements based on community requirements. According to interviewed staff, the City of Grand Forks wants to create a limitation on how far out into the floodplain development can occur. This would prevent the filling and loss of wetlands and floodplain areas.

The City of Grand Forks has made multiple changes to key policy documents to align municipal natural asset management with current policy mandates; however, it has not explicitly recognized

natural assets and ecosystem services as a part of these changes. In addition, changes to the Official Community Plan are still pending. Therefore, the score awarded for this indicator is Yellow (Fig. 5). The City of Grand Forks is encouraged to share this Plan and zoning bylaw changes once it is completed.

EVALUATION QUESTION	
Have new projects received funding or financing?	
Indicator	**Benchmark**
Amount of funding and financing received for projects.	All (100%) of projects and programs have available funds in order to ensure a full lifecycle.

The City of Grand Forks has maintained strong financial accounting records as part of the Disaster Mitigation and Adaptation Fund (DMAF) program requirements. In 2020, the City of Grand Forks completed agreements for funding of $51.7 million, with contributions of $20 million from the federal government and $31.7 million from the Province of British Columbia. Since developing the DMAF Program Charter, the estimated budget, including contingencies, is listed at just under $56.9 million. Budgeting for natural infrastructure costs was set at $11,875,535.

In 2020 financial statements, the City of Grand Forks incurred $15,298,107 of expenditures under the DMAF program, including $3,595,000 of land acquisition costs, $4,756,485 for residential improvements, $2,169,981 for added buy-out compensation and $2,394,641 for program design and support, construction, and management costs. Expenditures also included cash payments of $2,382,000 for deferred property purchase agreements which will be completed in 2021. To offset these costs, the City of Grand Forks received a cash advance of $23,194,000 from the Province of British Columbia. The City of Grand Forks recognized $8,981,017 of this cash advance as revenue in 2020, with the remaining $14,096,136 of the advance recorded as deferred revenue. $5,987,345 was recorded as federally eligible grant revenue in 2020, with $6,065,243 listed as a total federal contribution to date included in accounts receivable. This accounting report shows that the City of Grand Forks has enough funds for the entirety of the DMAF program.

For restoration-specific projects, these are funded through a combination of private funding from property owners and British Columbia's Habitat Conservation Trust Fund. The Habitat Conservation Trust Fund awarded the Granby Wilderness Society $50,000 for a black cottonwood reforestation project in 2019. In 2012, the Boundary Habitat Stewards received $4,000 to examine the potential for ecosystem restoration in a nearby grasslands habitat. According to interviewed staff, the City of Grand Forks may seek additional funding for the full extent of planned restoration activities. As a part of the Official Community Plan and Related Planning Initiatives RFP, the City of Grand Forks has budgeted $25,000 for the Official Community Plan, the Zoning amendments, and Park Dedication for floodplain lands.

In conclusion, the City of Grand Forks can fully fund the DMAF program and restoration activities as currently designed. Therefore, the City of Grand Forks was awarded a Dark Green score (Fig. 5). However, if the City of Grand Forks expands restoration activities, it may need to find additional sources of funding. The City of Grand Forks is encouraged to explore more funding sources, specifically to expand its municipal natural asset management approach.

EVALUATION QUESTION
Have staff created new natural asset management policies, strategies, and plans?

Indicator	Benchmark
Number of new natural asset management policies, strategies, and plans.	All (100%) of natural asset management policies, strategies, and plans created to support municipal natural asset management within project community.

According to interviewed staff, the City of Grand Forks is not at the point where they are considering new municipal natural asset management policies, plans, or procedures. However, staff are aware of the need to create plans, policies, or strategies for municipal natural asset management, but senior management have not prioritized this planning. However, the City of Grand Forks has completed a sensitive ecosystem mapping and inventory compiled through LiDAR data. This sensitive ecosystem mapping and inventory has Habitat Suitability Mapping for two locally occurring rare species, along with recommendations for future conservation actions. According to interviewed staff, since completing the sensitive ecosystem mapping and inventory, the City of Grand Forks has dedicated three hectares of wetland and twelve hectares of grassland and aspen parkland as protected natural areas.

For this indicator, the City of Grand Forks receives a Red score (Fig. 5). The City of Grand Forks has completed some foundational work in preparing for the creation of new natural asset management policies, procedures, and plans. With proposed changes in the Official Community Plan, there is a pathway to the creation of new policies, strategies, and plans. In addition, the dedication does not specifically mention municipal natural asset management nor does it include reasons for why this land should be protected and conserved. The City of Grand Forks is encouraged to create new natural asset management policies, procedures, and plans once the DMAF program is completed.

2.2.4. Ecosystem Rehabilitation and Restoration

EVALUATION QUESTION
Are measurements or metrics being used for assessing ecosystem service quality?

Indicator	Benchmark
Number of ecosystem service quality measurements or metrics within a municipal project area kept in the natural asset inventory.	All (100%) of the major ecosystem services within a municipal area have measurements or metrics stored in the natural asset inventory.

In 2018, the City of Grand Forks completed a mapping and inventory study for their sensitive ecosystem areas. Phase one of this study was completed through air photo interpretation supported

by LiDAR. This resulted in a canopy model; however, interviewed staff noted that the City of Grand Forks has not re-run the canopy model with new LiDAR data as their LiDAR acquisition had data quality issues. However, the available data have resulted in some operations changes such as leaving tree debris in nearby wetland areas for decomposition as opposed to removing debris. The City of Grand Forks has brought in arborists and biologists to assess the wildlife attributes municipal staff want to conserve.

One ecosystem service quality metric that the City of Grand Forks has identified is habitat suitability. Habitat suitability is measured through a ranking system for two specific species, Western Rattlesnakes and Lewis's Woodpeckers. These rankings will aid the City of Grand Forks' future conservation project planning. Each sensitive ecosystem inventory class and subclass was assessed using a four-rank system (nil, low, medium, and high) for its suitability to provide features selected by the species for living (feeding, travel) and breeding (large cottonwood snags) or denning (rock and talus caves and crevasses). However, this ranking system does not take actual species occurrence data into account, and as part of the report recommendations, the City of Grand Forks is encouraged to conduct other field verification and a full ecosystem classification. These recommendations can help guide future conservation projects in the municipal area and provide the data necessary for determining development locations.

Therefore, the City of Grand Forks is awarded an Orange score for this indicator (Fig. 5). While the sensitive ecosystem mapping and inventory study is a strong step towards monitoring ecosystem services, habitat suitability is only one major ecosystem service quality metric. The City of Grand Forks is encouraged to create or identify metrics for all ecosystem service types in their natural asset inventory.

EVALUATION QUESTION

Has the municipality created a rehabilitation or restoration project?

Indicator	Benchmark
Number of sites selected as potential rehabilitation or restoration project(s).	Community has identified a (one) possible site for the creation of a natural asset management project that fits with larger natural asset management goals.

The City of Grand Forks has identified the neighbourhoods of North Ruckle, South Ruckle, and Johnson Flats as sites for floodplain and wetland restoration. In addition to restoring the floodplain and wetland areas, the City of Grand Forks will also construct dikes and earth berms on property acquired through the buyout program. This flood mitigation infrastructure will provide more room for higher water level flows during flood events and protect critical sites from erosion. The City of Grand Forks can also incorporate community access trails and greenspaces into or on top of newly constructed flood mitigation infrastructure.

In addition, through their sensitive ecosystem inventory and mapping study, the City of Grand Forks has recognized their old forest, broadleaf woodland, woodland, grassland, sparsely vegetated, riparian, wetland, and freshwater ecosystems as sensitive. This study briefly describes and defines these sensitive ecosystem areas. Some of these descriptions mention the ecosystem services these areas provide. For example, under the Woodland Sensitive Ecosystem Area description, the report describes woodlands as having "the potential to provide important ecological niches that other forest stands lack, are often inhabited by uncommon or rare species, and are generally sensitive

to disturbances." According to interviewed staff, the City of Grand Forks will use the available data in the sensitive ecosystem inventory and mapping to select sites for future rehabilitation and restoration projects.

Interviewed staff also mentioned that the City of Grand Forks is working with two different project scales for ecosystem rehabilitation and restoration. The first scale of projects is in partnership with local eNGOs for the restoration of riparian cottonwood ecosystems along the banks of the Kettle and Granby rivers. These areas have been dominated by agronomic grasses and invasive plant species that have a low riparian habitat quality compared to the potential of the area. This restoration project has led to approximately 450 to 500 linear metres of restored riverbank through planting and bioengineering to build some plant cover and habitat quality back into the area. The second scale of projects is the large-scale restoration projects that are a part of the DMAF Program Charter. Through the DMAF program, eight hectares of floodable open space will be increased to 23 hectares of open floodable land of which half will be restored to Oxbow wetlands, re-contoured wetland areas, floodways that are using natural infrastructure approaches, and restored riparian areas where there is a dike.

The City of Grand Forks has identified multiple sites for restoration projects, both as a part of the DMAF Program Charter and in partnership with local eNGOs. Therefore, the City of Grand Forks has been awarded a Dark Green score for this indicator (Fig. 5). The City of Grand Forks is encouraged to continue identifying additional sites for restoration and rehabilitation, especially for other sensitive ecosystem areas that are outside of the DMAF program scope.

EVALUATION QUESTION

Has the monitoring of natural assets and ecosystem services occurred?

Indicator	Benchmark
Number of relevant indicators identified for monitoring and evaluation.	Municipality has identified at least one (1) key indicator for the lifecycle of the natural asset management project(s).

As a part of the City of Grand Forks' DMAF Program Charter, the Program Priority Matrix identified a few indicators that will receive a score throughout the lifecycle of the program. This program priority matrix also includes the work packages, structural projects, priority rankings, weighting, and indicators as part of the DMAF program reporting requirements. The indicators are (i) property acquisition required, (ii) protection of critical infrastructure, (iii) protection of public safety, and (iv) public opinion. Data were not available on whether these indicators have been monitored. According to interviewed staff, the most important indicator for the City of Grand Forks is the area of floodable land. This indicator takes a natural asset management approach for the monitoring of the conveyance capacity of the land. The City of Grand Forks has already modelled predicted benefits of floodplain and wetland restoration. Following the actual restoration of land, building removal, and recontouring of land, the City of Grand Forks will run another LiDAR evaluation to provide data for this indicator. In addition, interviewed staff mentioned incorporating a flood management cost indicator. This indicator would encompass the private and public costs of continued flooding and flood responses in comparison to a natural asset management approach.

The City of Grand Forks was awarded a Dark Green score for this indicator as municipal staff have identified multiple indicators for monitoring and evaluation of municipal natural asset management

projects (Fig. 5). The City of Grand Forks is encouraged to identify or create specific targets for these indicators based on a feasible timeline. As well, other indicators could address ecosystem service categories not included and encompass indicators for other sensitive ecosystem areas.

2.2.5. Service Delivery

EVALUATION QUESTION
Is there a record of increased co-benefits?

Indicator	Benchmark
Percentage increase in co-benefit metrics monitored by project community.	Increase in co-benefits from natural asset management.

The City of Grand Forks has not started monitoring co-benefits metrics for natural assets. Therefore, with no data available, the City of Grand Forks was awarded a Grey score (Fig. 5). However, program documents do describe potential co-benefits that fully restored floodplain and wetland areas could provide. These potential co-benefits include sites for recreation, species habitat, and the stabilization of downtown economic development. According to interviewed staff, the City of Grand Forks is conscious of the benefits provided by its tree canopy, and they are aiming to monitor changes in this canopy using LiDAR tools. The City of Grand Forks is encouraged to incorporate co-benefit indicators into a monitoring framework for their restoration and rehabilitation projects.

EVALUATION QUESTION
Has pressure been reduced on traditional municipal infrastructure that would have been impacted by climate change?

Indicator	Benchmark
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change.	Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure.

The 2020 Financial Statement does show some data on the municipal budget set for renewing grey infrastructure. The net book value of Tangible Capital Assets for the City of Grand Forks increased from 2019 to 2020 by $6,260,516. The net book value of general capital fund assets under construction rose from 2019 to 2020 from $945,156 to $2,455,815. The net book value of electrical utility assets under construction also rose from 2019 to 2020 from $177,267 to $216,937. The net book value of wastewater utility assets under construction decreased from 2019 to 2020 from $4,064,196 to $711,275. The net book value of water utility assets under construction remained the same from 2019 to 2020 at $42,526. In total, the net book value of Tangible Capital Assets under construction decreased by $1,802,592 across Tangible Capital Asset categories. The City of Grand Forks' long-term debt obligations for purchased assets in 2020 stands at $3,220,135. With restoration work ongoing as part of the DMAF Program, the City of Grand Forks has been unable to conduct a comprehensive

valuation study for a fully restored Kettle River floodplain. Therefore, the net book value of a natural asset area cannot be compared to changes in net book values for assets under construction or the construction costs of new assets. The City of Grand Forks is unable to provide conclusive data on whether the municipal budgeting for grey infrastructure renewal will decrease due to services provided by the restored floodplain. Therefore, a Red score was given for this indicator (Fig. 5). The City of Grand Forks is encouraged to differentiate whether assets under construction are due to climate change or expected service changes.

2.3. District of West Vancouver

2.3.1. Background

The District of West Vancouver (DWV) is a district municipality northwest of the City of Vancouver, British Columbia (Fig. 6). It is one of three municipalities that make up the North Shore along with the District of North Vancouver and the City of North Vancouver. The 2016 census showed that the District of West Vancouver has a population of 42,473, a slight drop from 42,694 from the 2011 census. Despite the rapid population growth of the City of Vancouver and the wider region, the DWV is only projected to see the population increased to 60,000 residents by 2041.

Figure 6: *A map of the District of West Vancouver's regional land use from West Vancouver's 2018 Official Community Plan.*

DWV has committed to an asset management approach that incorporates climate resiliency. An infrastructure management study was completed for the District of West Vancouver in 2010 that outlined sustainable infrastructure replacement funding levels over the next 100 years. This study formed the basis for expanding the current asset management program to include condition assessments for drainage infrastructure, coordinated capital planning between infrastructure renewal projects, and the development of integrated stormwater master plans.

As part of this study, DWV was interested in understanding the financial case for stream daylighting as it relates to a 90-metre stretch of Brothers Creek and potentially applying that methodology to

other streams. Stream daylighting is the opening of buried watercourses and restoring them to their natural conditions. This pilot study revealed that daylighted parts of the Brothers Creek could provide stormwater management benefits equal to the upgraded engineered infrastructure required to meet current stormwater standards (i.e., a 1-in-200-year event) and that the capital costs of restoring the creek are similar to those of upgrading culverts to meet stormwater requirements. However, due to unforeseen regulatory and conceptual challenges, the stream daylighting project has stalled. This is due to regulations that make it easier to keep a stream buried underground in cement pipes than to restore it to a natural state. The District of West Vancouver completed an inventory of its natural assets and delivered a presentation and report to council in June 2019.

INDICATOR Benchmark **DISTRICT OF WEST VANCOUVER**	**SITE SCORE**
Awareness, Capacity and Education Indicators	
Number of general consultation efforts for NAM *Benchmark 1:* More than 50% of NAM Consultation events have a high attendance rate *Benchmark 2:* All [100%] of information materials describe one reason for conducting MNAM	
Number of formal and informal partnerships with academic institutions, relevant local nongovernmental institutions, or private landowners At least 1 formal or informal partnership	
Implementation Indicators	
Number of barriers or opportunities identified in MNAM delivery within the project community *Benchmark 1:* 100% of relevant documents identify barriers and opportunities *Benchmark 2:* All [100%] of managers provide at least one barrier	
Number of changes made to OP, ZBL, Secondary Plans, etc. All [100%] of relevant municipal planning policy changed to integrate MNAM	
Amount of funding and financing received for projects AIl [100%] of projects and programs have available funds to ensure a full lifecycle	
Number of new NAM policy, strategies, and plans All [100%] of NAM policy, strategies, and plans created to support MNAM	

INDICATOR Benchmark DISTRICT OF WEST VANCOUVER	SITE SCORE
Ecosystem Rehabilitation and Restoration Indicators	
Number of ecosystem service quality measurements or metrics within project community area kept in the natural asset inventory All [100%] of the major municipal ecosystem services have measurements/metrics available in NA inventory	
Number of sites selected as potential rehabilitation or restoration projects Community has identified a possible site for the creation of a NAM project that fits with larger NAM goals	
Number of relevant indicators identified for monitoring and evaluation Municipality has identified at least one key indicator for the lifecycle of NAM projects	
Service Deliver Indicators	
Percentage increase in co-benefit metrics monitored by project community Increase in co-benefits from natural asset management	
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure	

Figure 7: Balanced Scorecard for the District of West Vancouver.

2.3.2. Awareness, Capacity, and Education

EVALUATION QUESTION		
Have the municipalities made the general public aware of natural asset management occurring?		
Indicator	**Benchmark 1**	**Benchmark 2**
Number of townhalls, information sessions, and other general consultation events on natural asset management.	More than 50% of natural asset management consultation events have a high attendance rate from local citizens.	All (100%) of information materials describe one reason for conducting municipal natural asset management.

The District of West Vancouver has held some interactive consultation events for natural asset areas. For example, in 2018 and 2019 the District of West Vancouver held a Clean Shoreline Community cleanup event on Earth Day. The purpose of this event is to build community awareness on the importance of keeping beaches clean. The District of West Vancouver and local stewardship groups have also held information sessions through guided tours, summer camps, workshops, and guest lectures. Interviewed staff also mentioned that before the COVID-19 pandemic, staff were presenting on the importance of municipal natural asset management. The purpose of these presentations was

to encourage other local governments or eNGOs to build a natural asset inventory that would inform future decision-making.

However, the most significant form of natural asset management engagement and consultation came through the 2020 and 2021 budgeting processes. Staff held a few consultation events for the 2020 budget, including three budget information meetings on January 28, 29, and 30. Each of these Budget Information Meetings touched on various aspects of the budget, although the primary focus for attendees was on tax increases. Twenty-40 residents attended these three meetings. However, with the COVID-19 pandemic, District council withdrew Budget 1 and work started on Budget 2. The primary method of engagement for Budget 2 was an online forum that was opened for public feedback. This forum received 62 written responses.

For the 2021 Budget, the District of West Vancouver held two Virtual Budget Information Sessions on January 28 and 29, 2021. As well, a public forum was created on the District of West Vancouver website. Finally, staff fielded email inquiries, created presentations, documents, and recordings. As part of an Engagement Summary Report, the District of West Vancouver recorded a total of 727 public and stakeholder interactions during the 2021 Budget engagement period from January 26 – February 9, 2021. Similar to Budget 1 and 2 in 2020, the most common theme identified in interactions was "do not support tax increase and feel that taxes are already high." But responses also indicated that active transportation and climate change initiatives should remain priorities.

For the first indicator, the District of West Vancouver received a Grey score for this indicator (Fig. 7). While the District of West Vancouver has held some consultation events for projects that describe aspects of the municipal natural asset management program, there is not enough attendance data for an attendance rate to be calculated. The District of West Vancouver is encouraged to hold consultation events specific to natural asset management or to record the number of responses for natural asset management components.

Before the COVID-19 pandemic, the District of West Vancouver created a Natural Asset Booklet that staff were planning to distribute in the school district. According to interviewed staff, some distribution of the booklet has now begun, and the booklet is available on the DWV's website. This booklet explains that natural assets supply ecosystem services that are needed but often go unnoticed. These services include stormwater management, climate regulation, natural habitat, recreation, flood control, erosion protection, and public health co-benefits. The Natural Asset Booklet then describes the different natural assets in the District of West Vancouver. In conclusion, the District of West Vancouver received a Light Green score for the second indicator (Fig. 7). The District of West Vancouver is encouraged to continue providing information materials that share reasons for conducting municipal natural asset management and include those reasons as progress continues in their municipal natural asset management program.

EVALUATION QUESTION	
Have municipal staff partnered with academic institutions, relevant local non-government institutions, or private landowners?	
Indicator	**Benchmark**
Number of formal and informal partnerships with academic institutions, relevant local non-governmental institutions, or private landowners.	At least one (1) formal or informal partnership is with academic institutions, relevant local non-governmental organizations, or private landowners.

The District of West Vancouver has a history of working with several local stewardship groups based in the West Vancouver area. These stewardship groups protect key ecosystem areas, plan for changes in ecosystem areas, and educate the public on the importance of sustainability, climate change, and environmental protection. These groups include the Friends of Cypress Provincial Park Society, the Lighthouse Park Preservation Society, Nature Vancouver, North Shore Black Bear Society, the North Shore Wetland Partners, Ocean Ambassadors Canada, Old Growth Conservancy Society, West Vancouver Shoreline Preservation Society, West Vancouver Streamkeeper Society, and West Vancouver Nature House.

Many of these stewardship groups focus their work on a particular species or ecosystem area, such as the North Shore Black Bear Society and the Lighthouse Park Preservation Society. In addition, most of these stewardship groups also do some form of monitoring and evaluation. For example, the West Vancouver Streamkeeper Society monitors the number of salmon in local streams, whether salmon are returning to the streams, and what kind of habitat encroachment and degradation is occurring. This monitoring data has led to partnered projects with the District of West Vancouver, such as an estuary enhancement for Rodgers Creek, a fish ladder and debris rack for Nelson Creek, and a fish ladder and culvert for Lawson Creek. The West Vancouver Shoreline Preservation Society and the District of West Vancouver spearheaded the creation of the 2012-2015 Shoreline Protection Plan and other recent foreshore habitat restoration work. The West Vancouver Shoreline Preservation Society also conducted public outreach efforts on the shoreline area. Finally, some of the stewardship groups collaborated on a few projects. For example, the Lighthouse Park Preservation Society, the North Shore Wetland Partners Society, the Old Growth Conservancy Society, the West Vancouver Shoreline Preservation Society, and the West Vancouver Streamkeeper Society approached the District of West Vancouver council to form the West Vancouver Nature House in 2014.

According to interviewed staff, the District of West Vancouver also built a partnership with the British Pacific Properties (BPP). BPP is a real estate firm in the West Vancouver area responsible for a significant number of development and infrastructure projects. BPP and the District of West Vancouver partnered on a stormwater protection project that would redirect excess runoff during extreme rainfall events. As part of their partnership, BPP provided a significant amount of funding for this project. The District of West Vancouver and BPP are also working on an Area Development Plan for the Cypress Village area. Interviewed staff mentioned that in exchange for the protection of a large, forested area, BPP would be able to increase the density of the development. Finally, working with the local First Nations group is an area of focus for the District of West Vancouver. The

particular groups consulted are the Coastal Salish Nation and the Squamish Nation. The Coastal Salish Nation in particular has expressed concern over the loss of traditional food sources and has begun monitoring the health of the ocean. The District of West Vancouver and the Coastal Salish Nation have exchanged information on an informal basis.

In conclusion, the District of West Vancouver has formed several formal and informal partnerships with a variety of concerned stakeholder groups and organizations. These organizations have a history of working with the District of West Vancouver, whether on a formal or informal basis and have supported the District of West Vancouver to act on environmental protection and conservation. Therefore, the District of West Vancouver received a Dark Green score for this indicator (Fig. 7 and is encouraged to continue fostering these partnerships and to include local stewardship group perspectives.

2.3.3. Implementation

EVALUATION QUESTION

Have the municipality and relevant stakeholders identified any barriers or opportunities to municipal natural asset management within the municipality?

Indicator	Benchmark 1	Benchmark 2
Number of barriers or opportunities identified for municipal natural asset management delivery within the municipality.	All (100%) of the topically relevant government documents and reviews identify barriers and opportunities and provide specific examples.	All (100%) the managers provide at least one barrier or opportunity encountered and acted upon.

The most significant barrier impeding progress for the District of West Vancouver continues to be the COVID-19 pandemic. According to the documents reviewed, the District of West Vancouver has made considerable progress in achieving asset management goals since 2015. However, the COVID-19 pandemic has created several setbacks that will affect future progress. In general, due to the COVID-19 pandemic, support for capital projects had to be reduced to an $8 million asset levy. With funding for capital projects reduced by more than 50%, many important and worthwhile projects had to be postponed. This has worsened what staff have described as a "deferred maintenance" problem, where work is postponed or stretched due to under-investment in asset maintenance. This has caused more assets to fall under a high use, poor condition category. Therefore, in some cases, disposal with or without replacement may be the only reasonable option, while in others, retention, restoration and re-use may be preferred. In any case, significant funds and significant effort will be required.

Due to this barrier, staff have had to significantly scale back expected investments into their municipal natural asset management program. This includes the complete removal of a 0.5% Natural Capital and Climate Response levy from the 2020 Budget. For the 2021 Budget, staff recommended a joint asset management levy of 3.0% at a minimum to ensure optimal service delivery. However, council approved a 2.5% levy as future revenues remain uncertain. Therefore, even with funds available from prior years' projects that were completed under budget, these funds will not be sufficient to meet all requirements, so some proposed projects will need to be postponed.

However, despite the COVID-19 pandemic, the District of West Vancouver has integrated their asset management database so information about each asset can be held in one place.

In conclusion, both documents and staff identified the COVID-19 pandemic as the most significant barrier that continues to impact the District of West Vancouver's natural asset management program. Therefore, the District of West Vancouver received a Light Green score for both indicators (Fig. 7). As interview responses and key documents indicate, this barrier will have some serious long-term implications for the District of West Vancouver. Currently, it is difficult to estimate when setbacks may be corrected. The District of West Vancouver is encouraged to continue to identify and share barriers, especially those related to the economic fallout of the COVID-19 pandemic.

EVALUATION QUESTION

Have the municipalities made changes to their Official Plan, Zoning Bylaw, Secondary Plans, etc.?

Indicator	Benchmark
Number of changes made to Official Plan, Zoning Bylaw, Secondary Plans, etc.	All (100%) of relevant municipal planning policy documents changed to integrated municipal natural asset management practices.

The District of West Vancouver has several existing policy mandates that align with municipal natural asset management practices. On June 10, 2019, District of West Vancouver staff presented a Natural Capital Asset Inventory with the recommendation that the inventory be incorporated into the District of West Vancouver's financial planning, asset management, financial reporting, and capital budgeting processes and decisions. In this Natural Capital Inventory report, District of West Vancouver staff acknowledges that there are no bylaws or policies directly related to natural capital and ecosystem services. However, there are a few bylaws that contain provisions for the preservation of features in the natural environment. These bylaws are the Creeks Bylaw, the Interim Tree Bylaw, the Parks Regulation Bylaw, and the Watercourse Protection Bylaw. The Creeks Bylaw prevents the fouling, obstructing or impeding of the flow of any creek in the municipality. The Tree Bylaw sets out regulations on the cutting and damaging of trees. The Parks Regulation Bylaw regulates the use of parks and specifically restricts the environmental degradation of park areas. Finally, the Watercourse Protection Bylaw sets requirements for construction work, mandates the creation of a sediment control plan, and sets general protections for watercourse areas.

In addition, the District of West Vancouver has an Environmental Strategy and a Parks Master Plan which include statements, actions, and guidance that supports municipal natural asset management and environmental protection. The Environmental Strategy describes actions to be taken for the management of creek habitats, the urban forest, and the foreshore area. For instance, to protect creek habitats and corridors, recommended actions are to develop, update, and implement revised bylaws to protect the creeks, including designating creek corridors as mandatory Development Permit Areas. Thus, subdivisions, developments, or alterations to property will require a development permit. Another example is an action item for the foreshore area. This action is to develop and implement a Foreshore Policy based on environmental protection. In the Parks Master Plan, there are a few recommendations that support municipal natural asset management practices in parks areas. For example, under the management of natural areas section, recommendation 4.3.1 is to identify ecosystems in parks that may require special treatment to ensure their protection.

The Parks Master Plan also contains an inventory of parks in the area including Regional Parks, Provincial Parks, leased parks, parks created by a bylaw, and parks without a bylaw.

Finally, the District of West Vancouver's Official Community Plan specifically supports the valuation of natural capital through (i) restrictions on development to protect environmentally sensitive lands, (ii) policies that provide the community-wide framework and intent for ongoing protection and restoration of these assets and (iii) direction for future reviews to address emerging issues such as climate change. Included policies are the use of low-impact storm and rainwater management to mimic natural conditions, using green infrastructure to manage increases in frequent storm events, managing land uses to protect the value of watercourse and riparian corridors, providing opportunities to vary development form and density, and protecting the shoreline and its significant environmental and cultural features.

Therefore, there are existing policies, plans, and strategies in the District of West Vancouver that align with municipal natural asset management practices. However, amendments to these policies should include municipal natural asset management and ecosystem services. Therefore, the District of West Vancouver received a Yellow score for this indicator (Fig. 7). The District of West Vancouver is encouraged to change policies as necessary to fully integrate a municipal natural asset management approach, including updates to an asset management policy that highlights the importance of natural assets.

EVALUATION QUESTION

Have new projects received funding or financing?

Indicator	Benchmark
Amount of funding and financing received for projects.	All (100%) of the projects and programs have available funds to ensure a full lifecycle.

The District of West Vancouver has had to make some changes to funding for natural asset management projects and programs due to the COVID-19 pandemic. On Feb 4, 2020, a natural capital or climate response levy of 0.5% was approved by District Council after a previous motion for a 1.0% levy was defeated. In the District of West Vancouver's 2020-2024 Five Year Financial Plan, also known as Budget 1, this 0.5% levy would fund Natural Capital and Climate Response projects. However, once a public health emergency was declared and Budget 1 was withdrawn, Budget 2 removed the proposed Natural Capital and Climate Response levy. Due to this removal, the District of West Vancouver expected to lose $1.7 million in expected revenue. However, under information published for the 2021 Budget, the withdrawal of the general asset levy and the natural capital and climate response levy actually resulted in a total of more than $12 million of lost revenue. An additional $7 million needed to be diverted to support continued public safety maintenance measures and a COVID-19 response.

In 2015, the Fiscal Sustainability Review of General Fund Capital Assets showed that an investment of at least $13.9 million is required every year to maintain assets at an optimal level. This amount does not include the incremental costs of climate response or natural capital projects. This amount was used as justification to propose a combined asset levy of 3.0%, at a minimum, for the 2021 Budget. This levy was needed to keep all assets functioning optimally. However, on March 8, 2021, District Council approved a 2.5% Asset levy. There are still a few natural asset management projects listed in the 2021 budget, including the Coastal Marine Management Plan Implementation

($55,000) and the implementation of Shoreline Protection projects ($210,000). As well, a funding proposal for the completed parks asset inventory was submitted to the COVID-19 Safe Restart Grant from the Government of British Columbia. As part of an asset management update, the District of West Vancouver is planning to create an integrated environmental strategy that would include investment in the maintenance of natural capital assets.

Based on the statement that a 3.0% asset levy is the minimum required to replenish the function of all assets in the District of West Vancouver and a 0.5% natural capital and climate response levy was removed from 2020 Budget 2, the District of West Vancouver received an Orange score for this indicator (Fig. 7). There is a lack of support to fund the necessary projects to fully integrate municipal natural asset management as a sustainable service delivery method. The District of West Vancouver is encouraged to fully fund its municipal natural asset management program so degraded natural assets can be restored. In addition, the District of West Vancouver should look to external funding opportunities from the Provincial Government of British Columbia and the Federal Government of Canada as a possible funding source.

EVALUATION QUESTION

Have staff created new natural asset management policies, strategies, and plans?

Indicator	Benchmark
Number of new natural asset management policies, strategies, and plans.	All (100%) of the projects and programs have available funds to All (100%) of natural asset management policies, strategies, and plans created to support municipal natural asset management within project community.

The District of West Vancouver has created a few new policies, strategies, and plans that apply municipal natural asset management principles. Specifically, the District of West Vancouver has concentrated the bulk of their work on the foreshore and shoreline area. In 2012, the District of West Vancouver created the Shoreline Protection Plan 2012-2015 to protect and enhance "one of the community's greatest natural assets." This plan listed 12 short-term and long-term priority projects to build on earlier success and enhance the shoreline area. To support these priority projects, the District of West Vancouver is creating a Foreshore Development Permit Area which would control where development is allowed within the coastal floodplain. These permit areas are based on the calculation of interim flood construction levels for the District of West Vancouver coastline.

The District of West Vancouver has also been working with North Shore partners to create a North Shore Sea Level Rise Risk Assessment and Adaptation Management Strategy to scope the risk of sea-level rise for the District of West Vancouver and to create a coordinated set of action areas to manage that risk. One of the recommended actions in this strategy is to incorporate findings and adaptation measures into asset management and/or natural asset management plans. These adaptation measures include planning and governance measures, building and site measures, community-scale structural flood protection measures, and community-scale nature-based measures. Specifically, community-scale nature-based measures use landscape features to reduce flood risk, primarily through attenuating wave effects, while providing environmental or social co-benefits. One of the measures included in the accompanying toolkit is to restore naturally resilient environments.

In May 2019, the District of West Vancouver announced they are implementing a stormwater diversion system for a creek system below Highway 1. This project will protect 800 properties in the Westmount and Altamont neighbourhoods. Funding for this project was provided by the District of West Vancouver and British Pacific Properties. Work for this project began after the Vinson, Brothers, and Hadden Creeks report was submitted. The focus of the report was on the health and condition of the creeks and creek infrastructure, including the connections between the conditions and activities in the watersheds and their impacts and benefits on the creeks. This report does include municipal natural asset management practices, such as documenting the condition of the creek conveyance system, identifying enhancement opportunities for wildlife habitats, and identifying required remedial and new capital work items for the creek conveyance system.

Finally, the District of West Vancouver completed a LiDAR Tree Canopy Study in 2020 to produce evidence of the efficacy of the Interim Tree Bylaw. Findings from this study showed that the total tree canopy in the District of West Vancouver increased from 2013 to 2018 for the entire District of West Vancouver and within the area of existing neighbourhoods. Based on the results of the study and to support the existing tree canopy, staff proposed no change to the bylaw to protect tree size, no increased flexibility to remove trees, additional protected tree species, and tree protection on neighbouring lots during construction activities. Staff also recommended that a funding request is included in the 2021 budget to develop an Urban Forest Management Plan. However, funding for an Urban Forest Management Plan has not been included in the Proposed 2021-2025 Five-Year Financial Plan. According to interviewed staff, the District of West Vancouver is interested in expanding its LiDAR study to include other vegetation, such as hedges.

Therefore, the District of West Vancouver received a Yellow score for this indicator (Fig. 7). The District of West Vancouver has completed some foundational work through their natural asset inventory and they have started to use that inventory to create new plans, policies, and strategies. However, some of the recommended actions from these plans have not been implemented. The District of West Vancouver is encouraged to implement these recommended actions and measures and to create specific municipal natural asset management policies, practices, and plans.

2.3.4. Ecosystem Rehabilitation and Restoration

EVALUATION QUESTION
Are measurements or metrics being used for assessing ecosystem service quality?

Indicator	Benchmark
Number of ecosystem quality measurements or metrics within a municipal project area kept in the natural asset inventory.	All (100%) of the major ecosystem services within a municipal area have measurements or metrics stored in the natural asset inventory.

The District of West Vancouver has identified measurements and metrics for ecosystem service quality through a valuation estimation of services. In the District of West Vancouver's natural asset inventory, ecosystem service valuations were prepared for their forests, waterways, foreshore, and parks assets. For the forest area, ecosystem services were valued for clean water supply, filtration,

stormwater management, clean air, carbon sequestration, habitat, and recreation. For waterways, ecosystem services valued included clean water supply, water regulation, water filtration, habitat, and recreation. For the foreshore area, the ecosystem services valued were storm surge protection, erosion regulation, recreation, and habitat. Finally, for parks areas, the only ecosystem service valued was recreation. However, while each ecosystem service has a specific valuation method, the inventory makes it clear that these are conceptual estimates and not an actual ledger of asset values. The District of West Vancouver has yet to create specific measurements or metrics of ecosystem service provision levels for the natural assets in this inventory.

In other plans, strategies, and policies that the District of West Vancouver is involved with, some ecosystem service measurements and metrics have been identified. For example, in the Integrated Stormwater Management Plan, Kerr Wood Leidal Associates consulting firm collected, analyzed, and reported on baseline water quality data, presence of benthic invertebrates, and flow monitoring data for three creeks across a few watershed sites. In addition, for the District of West Vancouver's drinking water quality program, water from Eagle Lake and Montizambert Creek are analyzed for bacteriological, physical and chemical metrics. 589 samples were analyzed in 2020.

In conclusion, the District of West Vancouver received an Orange score for this indicator (Fig. 7). While there is some baseline data collection, the District of West Vancouver has not identified metrics and measurements for changes in ecosystem service categories. As well, where ecosystem service monitoring is occurring, this monitoring framework is not aligned with a municipal natural asset management program or framework. The District of West Vancouver is encouraged to align existing measurements and metrics with their municipal natural asset management program and to create more robust measurements and metrics for cultural ecosystem services.

EVALUATION QUESTION

Has the municipality created a rehabilitation or restoration project?

Indicator	Benchmark
Number of sites selected as potential rehabilitation or restoration project(s).	Community has identified a (one) possible site for the creation of a natural asset management project that fits with larger natural asset management goals.

According to interviewed staff, the District of West Vancouver is not working on any ecosystem rehabilitation and restoration projects that fit into set natural asset management goals. However, staff did mention there are a few areas under consideration for a potential restoration project, such as the foreshore area. Additionally, some sites have been identified as part of other policy initiatives. For example, as part of the North Shore Sea Level Rise Risk Assessment and Adaptive Management Strategy, several Comprehensive Adaptation Planning Zones (CAPZs) were identified. These zones are areas of the North Shore where flooding could extend beyond the first row of development. For each of these zones, the planning context, the probability of flooding, and initial integrated adaptation concepts are presented. These adaptation concepts include ecosystem restoration and adaptation, such as re-establishing natural shoreline materials to prevent erosion.

The District of West Vancouver also identified several sites for an ecosystem rehabilitation and restoration project as part of the Integrated Stormwater Management Plan. However, this Plan does not explicitly state that these identified sites align with natural asset management goals. These sites were identified before the introduction of the District of West Vancouver's municipal natural asset

management program. For example, as part of the Vinson, Brothers, and Hadden Creek Integrated Stormwater Management Plan submitted in 2017, 15 projects were identified for improvement. Reasons for their inclusion include invasive species management, riparian protection, restoration and planting, stream daylighting, and in-stream habitat enhancement. The rationale, benefits, estimated cost, and priority of each project is also included in the report.

While the District of West Vancouver has not specifically identified a site for the creation of a natural asset restoration or rehabilitation project, as part of existing policy and strategy initiatives, some site identification has occurred. Therefore, the District of West Vancouver receives a Dark Green score for this indicator (Fig. 7). The District of West Vancouver is encouraged to restore and rehabilitate key ecosystem areas as part of existing strategies, policies, and plans and to align these projects with natural asset management goals.

EVALUATION QUESTION

Has the monitoring of natural assets and ecosystem services occurred?

Indicator	Benchmark
Number of relevant indicators identified for monitoring and evaluation.	Municipality has identified at least one (1) key indicator for the lifecycle of the natural asset management project(s).

While a specific natural asset management indicator has yet to be identified, interviewed staff mentioned several indicators are under consideration. This includes examining the interactions between constructed infrastructure and natural infrastructure, sea-level rise, and flood risk. In addition, some existing policies, strategies, and plans have identified potential indicators. For example, as part of the North Shore Sea Level Rise Risk Assessment and Adaptive Management Strategy, indicators and targets were created to monitor and evaluate the progress and outcomes of the strategy. For example, one of the progress indicators is the percentage of the Strategy's specific actions that have been initiated or completed with a target of 100% by 2030. However, these indicators are specific to tracking the progress of implementing this Strategy and expected outcomes of sea-level rise adaptation. There is no mention in reviewed documents of these indicators fitting into a larger framework for monitoring and evaluating a municipal natural asset management program.

In addition to this Strategy, several performance indicators were identified for a monitoring framework of the Integrated Stormwater Management Plan. These indicators include water quality performance indicators such as dissolved oxygen and temperature, flow monitoring performance indicators such as pulse count and duration, a benthic invertebrate biomonitoring performance indicator and recommended supplemental performance indicators such as the number of erosion sites. In addition to these performance indicators, several long-term targets were paired with each of these indicators to act as benchmark values. These benchmark values are required under Metro Vancouver's Monitoring and Adaptive Management Framework for Stormwater. As well, this framework requires that these parameters are monitored at a minimum every five years, although more frequent monitoring may occur.

While the District of West Vancouver has not specifically identified indicators for natural asset management projects, several indicators have been identified in other strategies and plans that align with natural asset management practices. In addition, the sites identified in these strategies and plans have been included in the District of West Vancouver's natural asset inventory. Therefore,

the District of West Vancouver received a Dark Green score for this indicator (Fig. 7). The District of West Vancouver is encouraged to align these identified indicators with the monitoring of their municipal natural asset management program.

2.3.5. Service Delivery

EVALUATION QUESTION
Is there a record of increased co-benefits?

Indicator	Benchmark
Percentage increase in co-benefits metrics monitored by the project community.	Increase in co-benefits from natural asset management.

The District of West Vancouver has not yet created or identified a co-benefit metric for municipal natural asset management. Therefore, the District of West Vancouver received a Grey score for this indicator (Fig. 7). However, the District of West Vancouver has described potential co-benefits in the natural asset inventory. For example, under the urban forest section in the natural asset inventory, listed co-benefits include aesthetic appreciation, public health, increased property values, education, tourism, and culture. The inventory report explains that trees are especially helpful in reducing what is called the "heat island effect" in which built-up areas have higher temperatures than green spaces. The District of West Vancouver natural asset inventory included preliminary valuations for co-benefits gained from natural asset areas. For example, potential educational benefits for an elementary school located near Brothers Creek were valued at $192,000 in 2017. The District of West Vancouver is encouraged to create a co-benefit metric, with a specific focus on co-benefit valuation changes.

EVALUATION QUESTION
Has pressure been reduced on traditional municipal infrastructure that would have been impacted by climate change?

Indicator	Benchmark
Amount of municipal budget forecast to be spent on renewing grey infrastructure has climatic change.	Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure.

According to interviewed staff, the District of West Vancouver has not seen specific instances of a decrease in the municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure. Staff also mentioned that funding for grey infrastructure renewal still comes before natural asset and natural capital work. Therefore, the District of West Vancouver received a Red score for this indicator (Fig. 7). The District of West Vancouver is encouraged to continue searching for funding opportunities for municipal natural asset management so that services delivered by natural assets can complement grey infrastructure.

2.4. City of Nanaimo

2.4.1. Background

The City of Nanaimo is a city on the southeast coast of Vancouver Island just west of mainland British Columbia (Fig. 8). It is approximately 110 kilometres northwest of Victoria, the capital of British Columbia, and 55 kilometres west of British Columbia's largest city, Vancouver. The Strait of Georgia separates the City of Nanaimo and the City of Vancouver. The City of Nanaimo is B.C.'s sixth-largest city and by 2019 was supporting a population close to 100,000 according to the City's best estimates. The population is expected to grow to 106,000 by 2024. The City of Nanaimo is a member municipality of the Regional District of Nanaimo which is British Columbia's fifth-most populous Regional District.

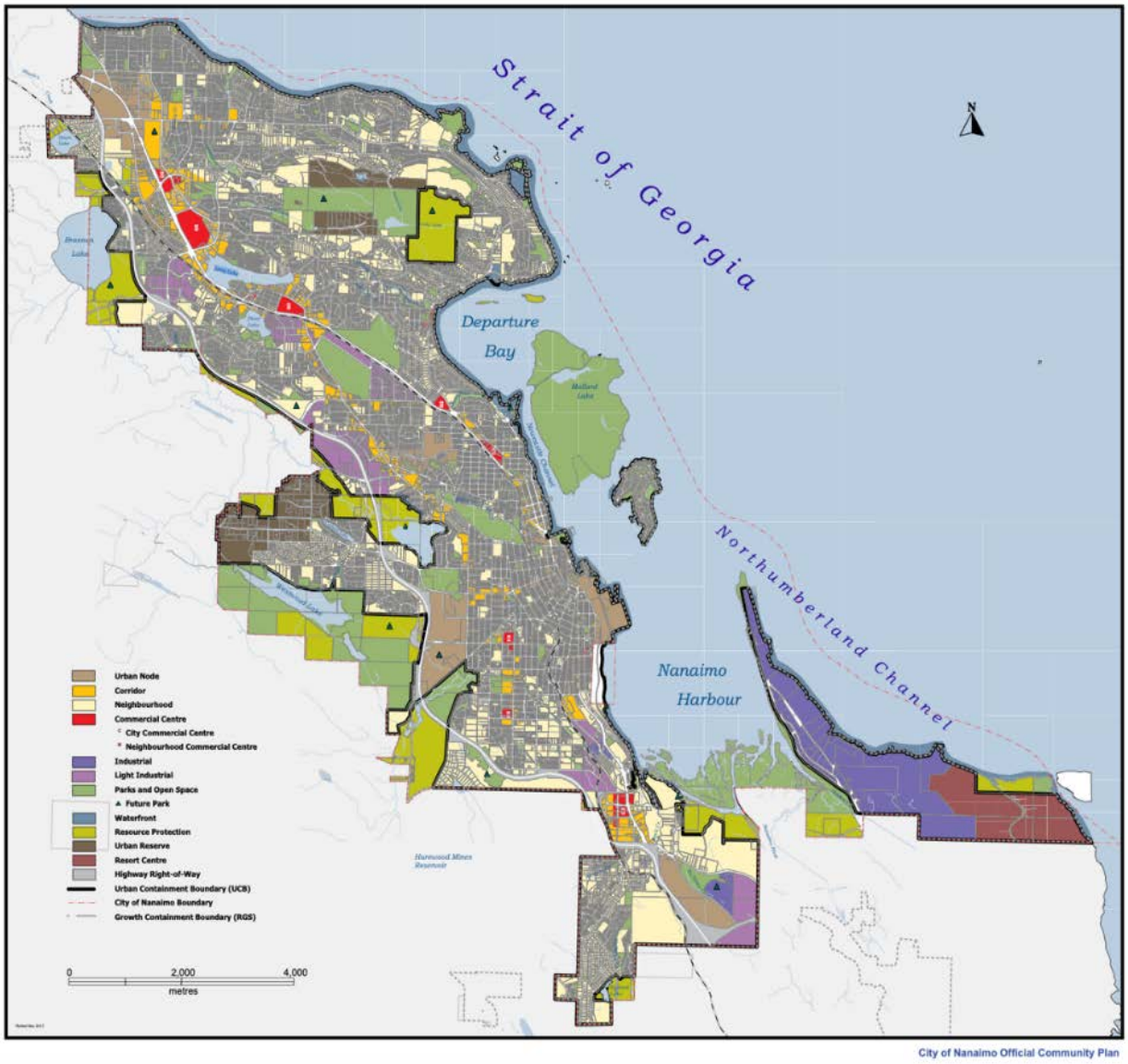


Figure 8: *Future Land Use from the City of Nanaimo's 2008 Official Community Plan Nanaimo.*

The City of Nanaimo has an experienced background in asset management, with a formal asset management approach for its infrastructure in place for almost 15 years. In 2018, the City of Nanaimo owned and maintained more than $3 billion in engineered infrastructure assets. This includes roads,

water mains, facilities, drainage systems, parks, and the sewer system. Through their involvement in MNAI's pilot program, the City of Nanaimo started to expand their asset management framework to consider the role of natural assets. The primary natural asset of interest during piloting was the Buttertubs Marsh Conservation Area, a 55-hectare reclaimed wetland and floodplain habitat in the City of Nanaimo (Fig. 9). The City of Nanaimo selected the Buttertubs Marsh Conservation Area as a study site because of its stormwater retention and flood mitigation capabilities, its importance as a local natural landscape, the availability of data, and ongoing partnerships with Ducks Unlimited, the Nature Trust of BC, and local stewardship groups, such as the Friends of Buttertubs.

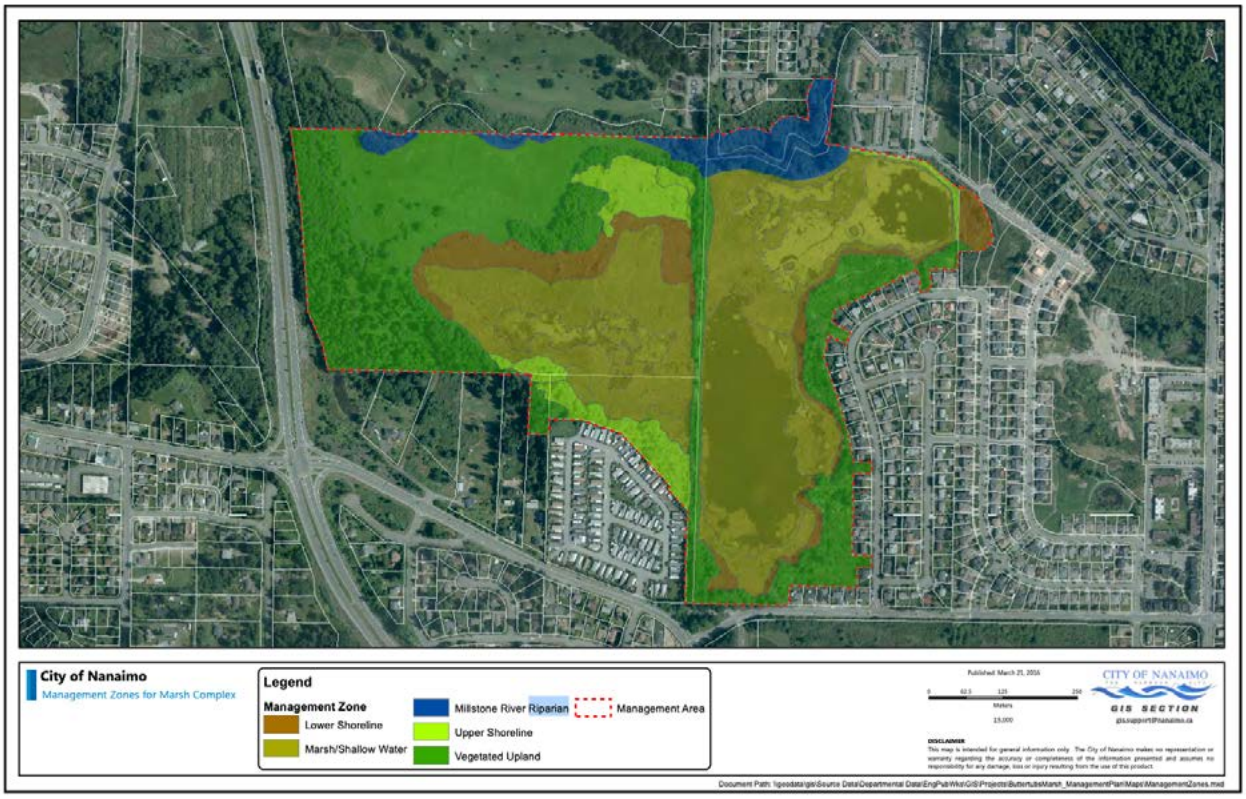


Figure 9*: A Map of the Buttertubs Marsh Management Zones*

The pilot project showed that the Buttertubs Marsh Conservation Area provides a very significant peak flow attenuation function and an overall water volume retention function. Applying a replacement cost approach and using the cost of constructing a stormwater management pond or wetland for the required storage volume of $150 per cubic metre as a benchmark, the storage benefit of the Buttertubs Marsh Conservation Area was valued at $4,694,295. Under various climate change scenarios, this value increased to between $6,559,676 and $8,207,305.

INDICATOR Benchmark CITY OF NANAIMO	SITE SCORE
Awareness, Capacity and Education Indicators	
Number of general consultation efforts for NAM *Benchmark 1:* More than 50% of NAM Consultation events have a high attendance rate *Benchmark 2:* All [100%] of information materials describe one reason for conducting MNAM	 
Number of formal and informal partnerships with academic institutions, relevant local nongovernmental institutions, or private landowners At least 1 formal or informal partnership	
Implementation Indicators	
Number of barriers or opportunities identified in MNAM delivery within the project community *Benchmark 1:* 100% of relevant documents identify barriers and opportunities *Benchmark 2*: All [100%] of managers provide at least one barrier	 
Number of changes made to OP, ZBL, Secondary Plans, etc. All [100%] of relevant municipal planning policy changed to integrate MNAM	
Amount of funding and financing received for projects All [100%] of projects and programs have available funds to ensure a full lifecycle	
Number of new NAM policy, strategies, and plans All [100%] of NAM policy, strategies, and plans created to support MNAM	
Ecosystem Rehabilitation and Restoration Indicators	
Number of ecosystem service quality measurements or metrics within project community area kept in the natural asset inventory All [100%] of the major municipal ecosystem services have measurements/metrics available in NA inventory	
Number of sites selected as potential rehabilitation or restoration project(s) Community has identified a possible site for the creation of a NAM project that fits with larger NAM goals	
Number of relevant indicators identified for monitoring and evaluation Municipality has identified at least one key indicator for the lifecycle of NAM projects	
Service Deliver Indicators	
Percentage increase in co-benefit metrics monitored by project community Increase in co-benefits from natural asset management	
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure	

2.4.2. Awareness, Capacity, and Education

EVALUATION QUESTION
Have the municipalities made the general public aware of natural asset management occurring?

Indicator	Benchmark 1	Benchmark 2
Number of townhalls, information sessions, and other general consultation events on natural asset management.	More than 50% of natural asset management consultation events have a high attendance rate from local citizens.	All (100%) of information materials describe one reason for conducting municipal natural asset management.

Most of the municipal natural asset management consultation events were integrated into the City of Nanaimo's Official Community Plan Update. As part of the City of Nanaimo's engagement process for the Official Community Plan Update, staff launched the Reimagine Nanaimo campaign in July 2020 to gather data on the future of the City of Nanaimo. As part of the feedback summary report, the City of Nanaimo collected participation data. In total, for Phase 1 of the Reimagine Nanaimo campaign, the City of Nanaimo received more than 9,000 separate inputs ranging from website comments to online discussion groups, statistical surveys, and public idea questionnaires. The City of Nanaimo also tracked digital outreach, traditional media, published announcements, and city advertising. However, the City of Nanaimo has not currently held a consultation event that is specific to its municipal natural asset management program.

The City of Nanaimo has a variety of digital and hard-copy information materials that describe a few reasons for integrating municipal natural asset management. For instance, as part of the Reimagine Nanaimo background report, the City of Nanaimo described its current climate adaptation measures and how it could expand upon these measures. These procedures include the protection of watersheds and riparian areas through stewardship efforts, urban forest protection regulations, and implementing low-impact development for stormwater management. The background report then lists the reasons why these measures are needed. For example, the forest areas in the City of Nanaimo support rainwater management and healthy streams. Another information material published by the City of Nanaimo is the Natural Connections newsletter. This newsletter describes the restoration work the City of Nanaimo completed over the past few months and how these projects are beneficial to the community. For example, the Spring 2020 newsletter explains that riparian planting helps filter water absorbed through the soil and into streams, helps prevent erosion of the stream banks, provides shelter, shading, and other benefits to our aquatic ecosystem, and improves the health of these water systems.

The City of Nanaimo and the Regional District of Nanaimo also developed a few fact sheets for creek areas that have ongoing projects. These fact sheets describe current project work, why the work is important, and the challenges faced by the creek. For example, in the Beck Creek fact sheet, ongoing project work includes water quality monitoring and riparian restoration. The listed benefits of this riparian area are shade, erosion control, fish habitat, and water filtration. These fact sheets also advertise upcoming River Days. These events highlight the many values of the City of Nanaimo's waterways and aim to increase public awareness and encourage the stewardship of rivers in the community. On the City of Nanaimo's website, an entire section of the site is dedicated to ongoing

green initiatives. These initiatives include the ongoing municipal natural asset management in the Buttertubs Marsh Conservation Area as well as other restoration sites and projects. One particular way that the City of Nanaimo is displaying restoration changes is through a "chronology." A chronolog is a crowd-sourced time-lapse of restoration sites.

For the first indicator, the City of Nanaimo received a Grey score (Fig. 10). While the City of Nanaimo has engaged residents through its Official Community Plan Update, it has not held municipal natural asset management consultation events. Therefore, there is no data to determine whether natural asset management consultation events had a high rate of attendance. The City of Nanaimo is encouraged to hold natural asset management consultation events and gather attendance data. For the second indicator, in all reviewed information materials, the City of Nanaimo accurately includes and explains various reasons for incorporating municipal natural asset management. Therefore, the City of Nanaimo received a Dark Green score (Fig. 10). The City of Nanaimo is encouraged to continue to develop appropriate information materials and to engage residents, especially as additional program outcomes are achieved.

EVALUATION QUESTION

Have municipal staff partnered with academic institutions, relevant local non-government institutions, or private landowners?

Indicator	Benchmark
Number of formal and informal partnerships with academic institutions, relevant local non-governmental institutions, or private landowners	At least one (1) formal or informal partnership is with academic institutions, relevant local non-governmental organizations, or private landowners.

The City of Nanaimo partnered with several organizations for the management of the Buttertubs Marsh Conservation Area. These organizations are Ducks Unlimited Canada, the Regional District of Nanaimo, the University of Vancouver Island, and the Partnership for Water Sustainability in BC. Ducks Unlimited Canada (DUC) is a national eNGO whose purpose is to conserve, restore, and manage wetlands and associated habitats for the benefit of North America's waterfowl. DUC offers scientific expertise, education, policy, and partnerships across several impact areas in Canada. DUC has been the primary facilitator for on-the-ground conservation work and management in Canada since 1986 under the North American Waterfowl Management Plan.

DUC has worked with the City of Nanaimo since the 1980s. Much of their partnership has centred on the enhancement and management of the Buttertubs Marsh Area. In 2012, DUC and the City of Nanaimo strengthened their partnership through the joint purchase of the West Marsh – adjacent to the Buttertubs area. The Buttertubs Marsh West property is now held in partnership with DUC and the City of Nanaimo as tenants in common. One of the goals of the purchase was to provide recreational amenities to the public that are consistent with conservation purposes. In addition to the ongoing management of the Buttertubs Marsh Area, DUC has produced several monitoring reports. These monitoring reports are a requirement under the ecogift designation from the Government of Canada's Ecological Gift Program. This program offers significant tax benefits to landowners who donate land or a partial interest in land to a qualified recipient. The recipient must ensure that the land's biodiversity and environmental heritage are conserved in perpetuity.

The next partnered organization is Vancouver Island University (VIU). Along with the management of the Buttertubs Marsh Conservation Area, VIU and the City of Nanaimo have worked together on a Bird Banding Project. VIU operates a bird banding station at Buttertubs West Marsh and has published monitoring reports on the bird banding process. On April 19, 2021, Nanaimo City Council and VIU announced the signing of a non-binding Memorandum of Understanding (MOU). Under the terms of the MOU, the City of Nanaimo and VIU will (i) establish a framework for collaboration between the two organizations; (ii) adopt a cooperative approach to working together for the mutual benefit of the City and VIU, the students and broader community; (iii) pursue areas of common strategic interest; (iv) actively participate in joint initiatives, projects, and activities; and (v) identify and address common areas of concern that may emerge during the life of the MOU. An Executive Committee will be created with senior leaders from the City of Nanaimo and VIU.

The final key partnership is with the Partnership for Water Sustainability in BC. This organization is a non-profit society that was originally formed to deliver the Water Sustainability Action Plan for British Columbia. The vision of the Partnership for Water Sustainability in BC is that water sustainability will be achieved through the implementation of green infrastructure policies and practices. They were also a significant contributor to the Millstone River Ecological Accounting Process. This report provides local government staff with a methodology and metrics for operationalizing maintenance and management of stream corridor systems. Two senior members of the Partnership served on the Project Committee. In addition, the Partnership for Water Sustainability contributed to an asset management framework for sustainable service delivery. This framework continues to be a guiding pillar in the creation of a municipal natural asset management approach.

The City of Nanaimo has also worked to build a collaborative relationship with local First Nations communities, especially the Snuneymuxw First Nation. In 2005, the City of Nanaimo and the Snuneymuxw signed a Memorandum of Understanding (MOU). This MOU prioritized mutual respect and cooperation and created a commitment for a set of principles to guide a government-to-government relationship. This MOU was followed by the signing of a government-to-government Protocol Agreement in 2009 that was then renewed on May 27, 2019. The Protocol Agreement re-established regular meetings of the Protocol Working Agreement Group to coordinate economic opportunities, service provision, land use planning, and to establish a joint decision-making process. The City of Nanaimo and the Snuneymuxw have also hosted community-wide engagement events. Finally, the City of Nanaimo and the Snuneymuxw have partnered on a few restoration projects such as the restoration work ongoing in Departure Creek.

For this indicator, the City of Nanaimo received a Dark Green score (Fig. 10). The City of Nanaimo has several formal and informal partnerships that it has utilized for municipal natural asset management. The City of Nanaimo is encouraged to continue to facilitate active and responsive dialogue between partners.

2.4.3. Implementation

EVALUATION QUESTION

Have the municipality and relevant stakeholders identified any barriers or opportunities to municipal natural asset management within the municipality?

Indicator	Benchmark 1	Benchmark 2
Number of barriers or opportunities identified for municipal natural asset management delivery within the municipality	All (100%) of the topically relevant government documents and reviews identify barriers and opportunities and provide specific examples.	All (100%) of the managers provide at least one barrier or opportunity encountered and acted upon.

One barrier to municipal natural asset management encountered by interviewed staff is staff resources and funding. Unfortunately, interviewed staff stated the City of Nanaimo staff do not have enough time to fully integrate a municipal natural asset management program and there are other priorities that the City of Nanaimo is working on. Similar to this barrier, staff mentioned they have experienced silos between the Planning Department and the Engineering Department. There are questions on which one of these departments should lead the municipal natural asset management program. To address this barrier, interviewed staff stated that the City of Nanaimo is creating an asset management committee and hiring an asset management manager. One of the main responsibilities of this position will be to integrate natural assets and engineered assets into a single process. This integrated process will move the City of Nanaimo away from a piecemeal, project-based approach towards a holistic, program-based approach.

For the first indicator, the documents reviewed do not identify municipal natural asset management barriers and opportunities. Therefore, the City of Nanaimo received a Red score for this indicator (Fig. 10). The City of Nanaimo is encouraged to include barriers to implementing municipal natural asset management in the City of Nanaimo in key documents. As progress continues in the City of Nanaimo's municipal natural asset management program, more barriers and opportunities should be identified. For the second indicator, the City of Nanaimo received a Dark Green score (Fig. 10). Interviewed staff accurately identified and described a staff capacity barrier. The City of Nanaimo staff is encouraged to include these barriers in future reports.

EVALUATION QUESTION

Have the municipalities made changes to their Official Plan, Zoning Bylaw, Secondary Plans, etc.?

Indicator	Benchmark
Number of changes made to Official Plan, Zoning Bylaw, Secondary Plans, etc.	All (100%) of relevant municipal planning policy documents changed to integrated municipal natural asset management practices.

The City of Nanaimo is also working on an update to its Official Community Plan. Two of the goals identified in the scoping and background work for the Official Community Plan are the importance of a green approach and access to nature and outdoor recreation. In general, residents have shared that they are concerned about the loss of natural areas in the City of Nanaimo. Residents also want to see more access to nature, parks, and open space. According to interviewed staff, municipal natural asset management has been an emerging theme from consultations for the Official Community Plan Update. This has resulted in a healthy discussion on what a municipal natural asset management approach might mean for the community.

One natural asset area that the City of Nanaimo has included in their plan and policymaking is their urban forest. In 2010, the City of Nanaimo created their Urban Forestry Management Strategy (UFMS). The purpose of this strategy is to give context and a framework for the sustainable management of the City of Nanaimo's existing and future urban forest. The Strategy recognizes the urban forest as a living utility or asset. This Strategy also describes the benefits of a sustainable urban forest, which include rainwater capture, air quality improvements, energy savings, food, public safety and health, wildlife habitat, economic benefits, property values and aesthetics. Finally, the Strategy has a series of modules that identify goals, objectives, and procedures that the City of Nanaimo is either pursuing or will commit to over the next five years. For example, under the Parks and Natural Areas Management module, the City of Nanaimo commits to developing forest management/natural areas plans for each of their urban park areas. Finally, according to interviewed staff, the UFMS gives direction at the subdivision level on what trees need to be protected and how to create tree protection areas.

To achieve the objectives and goals in the Urban Forestry Management Strategy, the City of Nanaimo implemented a Tree Management and Protection Bylaw. This bylaw regulates the permits for the pruning or removal of trees on private property. If residents petition the City of Nanaimo to prune or remove trees, they must submit a Tree Removal Permit. The Tree Removal Permit is based on seven tree removal criteria. In addition, the Tree Management and Protection Bylaw defines and classifies significant trees that must be preserved in all circumstances. Significant trees are any tree that is of particular significance to the City of Nanaimo based on size, age, landmark value, overall cultural and ecological heritage or social impact, scientific value, and any tree that is protected as wildlife habitat for an egg or nest as defined in the Wildlife Act. Fees collected throughout this process are then submitted to a funding mechanism that compensates for the loss of any significant trees by planting additional trees within the City of Nanaimo.

Finally, the City of Nanaimo has several watercourse protection regulations that mandate setbacks for riparian areas. Since 1997, land use activities next to the watercourse and riparian areas in the City of Nanaimo have been regulated through the City Watercourse Development Permit Area (DPA) and the City of Nanaimo's Zoning Bylaw. The current zoning bylaw for the City of Nanaimo states that no new structures, buildings, additions, driveways, parking lots, fences, etc., can be built within a watercourse setback area. Setback areas can vary, based on the size of the watercourse, condition of the riparian area, and its connectivity to other watercourses. Rivers and streams with significant riparian areas have 30-metre setbacks. Streams and creeks have a 15-metre setback and minor streams that are isolated or only indirectly flow into fish-bearing watercourses have a 7.5-metre setback. Lakes, wetlands, and marine foreshore areas all have 15-metre setbacks.

In conclusion, the City of Nanaimo received a Yellow score for this indicator (Fig. 10). The City of Nanaimo has made several changes to key planning policy documents over the years to align policies with municipal natural asset management practices. However, the Official Community Plan Update has not been completed. This update could change the current municipal natural asset management approach in the City of Nanaimo. The City of Nanaimo is encouraged to use the terminology of municipal natural asset management as a key framework in their Official Community Plan.

EVALUATION QUESTION

Have new projects received funding or financing?

Indicator	Benchmark
Amount of funding and financing received for projects.	All (100%) of projects and programs have available funds to ensure a full lifecycle.

In available financial statements, the City of Nanaimo does not track expenses for the maintenance and operations of the BMCA. The City of Nanaimo does budget for some of the ongoing projects in the BMCA. For example, in the 2019 Budget, $1,777 was budgeted for a Buttertubs Marsh Hydrology Study, $108,253 was budgeted for the Climate Change Resiliency Strategy, and $1,000 was budgeted for the Jingle Pot Marsh Restoration. In the 2020 Budget, $31,923 was budgeted for the Climate Change Resiliency Strategy a total of $111,000 was budgeted from 2020-2024 for the Natural Parks Areas Assessment Program, and a total of $69,130 was budgeted from 2020-2022 for the Water Course Restoration and Enhancement Program. Finally, in the 2021-2025 Financial Plan adopted by Council on May 10, 2021, $104,060 was budgeted for the Natural Parks Areas Assessment Program from 2021-2024 and $51,750 was budgeted for the Water Course Restoration & Enhancement Program. In the 2019, 2020, and 2021 budgets, there is no explicit information on funding for the operations and maintenance of the BMCA.

According to interviewed staff, funding is sufficient to complete ecosystem restoration and rehabilitation projects as planned. Depending on the scale of the project, these funds might come from a capital budget, in-kind contributions, or external funding applications and grants. Interviewed staff noted that a scope of work exercise is needed to determine what the City of Nanaimo can afford and what the City of Nanaimo's priorities are. Finally, staff mentioned that there are a few instances where staff must spread work out over a few years.

Therefore, the City of Nanaimo received a Yellow score for this indicator (Fig. 10). According to interviewed staff, there are sufficient funds to complete restoration and rehabilitation work on a project basis. However, there is no specific inclusion of a municipal natural asset management program in the 2019, 2020, and 2021 budgets. The City of Nanaimo is encouraged to create a separate municipal natural asset management program in the City of Nanaimo's financial statements. This will lead to a program-based approach for ecosystem restoration and rehabilitation work.

EVALUATION QUESTION

Have staff created new natural asset management policies, strategies, and plans?

Indicator	Benchmark
Number of new natural asset management policies, strategies, and plans.	All (100%) of natural asset management policies, strategies, and plans created to support municipal natural asset management within project community.

Regarding new natural asset management or ecosystem service management policies, strategies, and plans, the City of Nanaimo collaborated with their partners to create the Buttertubs Marsh

Conservation Area Management (BMCA) Plan. This plan has had several iterations and started with the consolidation of the East and West Marsh Plan into the 2004 Management Plan. Since the implementation of the 2004 Management Plan, a 2015 strategic review found that partners completed 58% of the tasks with another 18% underway. To account for the remaining tasks and address current issues, several management goals have been included in the latest update of the BMCA Plan. The goals are to (i) monitor, maintain and, where possible, enhance the Natural Ecosystems of the BMCA; (ii) provide for compatible public recreational and educational use of the area; and (iii) cooperative management. Also included in the plan is a description of all ecosystems in the BMCA through five distinct management zones. These management zones are based on the ecological features of the ecosystem and an updated Terrestrial Ecosystem Mapping. For each of the management zones, a description of the vegetation and wildlife or habitat values is provided. In addition, the plan explains the land use activity, the management direction, the priority management actions, and five-year management targets for each of the management zones.

Another Conservation Strategy that the City of Nanaimo is partnered with is the Coastal Douglas-Fir and Associated Ecosystems Conservation Partnership Conservation Strategy (CDFCP Conservation Strategy). This Strategy supports municipal natural asset management in the City of Nanaimo. The CDFCP Conservation Strategy was implemented in 2015 to create a 30-year vision and goals for the CDFCP along with 5-year objectives and actions. These short-term objectives are (i) providing sound science to support land securement and stewardship; (ii) conducting education and outreach; (iii) cultivating effective partnerships; (iv) facilitating securement of protected ecosystems and (v) supporting active ecosystem management. Along with these larger-scope Management Plans and Conservation Strategies, the City of Nanaimo has also conducted smaller collaborative restoration projects for streams and riparian areas. These projects replant native species and improve instream fish habitats in the creeks. These projects involved multiple partners such as the Departure Bay Neighbourhood Association, Nanaimo Streamkeepers, Department of Fisheries and Oceans and Snuneymuxw First Nation.

The City of Nanaimo has also been involved in the creation of management plans for other natural asset areas. In 2006, the Nanaimo Estuary Management Plan (NEMP) was implemented throughout the Regional District of Nanaimo. The purpose of this plan is to restore the productivity and diversity of the natural resources in the estuary with consideration for social and economic returns and benefits to the community. This plan describes management strategies for the fish and wildlife, water quantity and quality, and human activities in and around the Nanaimo Estuary. For example, in the water quantity and quality section, one of the management strategies is to use bacterial source tracking and other methods to investigate the sources of fecal coliform bacteria within the smaller watercourses of the Nanaimo and Chase Rivers. Although this plan was created before the implementation of the City of Nanaimo's municipal natural asset management program, NEMP recognizes the Nanaimo Estuary as one of the greatest natural assets in the region.

Finally, the City of Nanaimo has a Climate Change Resilience Strategy. This Strategy has six themes for climate adaptation action. These themes are (i) Water Supply, (ii) Flooding and Drainage, (iii) Environment, Parks and Recreation, (iv) Well-being and Preparedness, (v) Land use and Buildings, and (vi) Corporate Governance and Mainstreaming. Along with these themes, there are several objectives and priority actions. An example priority action is to inventory the City of Nanaimo's natural assets and incorporate these natural assets into the City of Nanaimo's asset management program to protect and maintain their function. The City of Nanaimo has committed to completing a natural asset inventory and strategy by 2022. Work on this natural asset inventory and strategy is scheduled to start in 2021.

While the City of Nanaimo has several policies, strategies, and plans that support municipal natural asset management, only the Buttertubs Marsh Conservation Area Management Plan directly incorporates a municipal natural asset management approach. Therefore, the City of Nanaimo was awarded a Yellow score for this indicator (Fig. 10). The City of Nanaimo is encouraged to create additional policies, strategies, and plans that are specifically directed to municipal natural asset management as a municipal-wide service delivery strategy.

2.4.4. Ecosystem Rehabilitation and Restoration

EVALUATION QUESTION
Are measurements or metrics being used for assessing ecosystem service quality?

Indicator	Benchmark
Number of ecosystem quality measurements or metrics within a municipal project area kept in the natural asset inventory.	All (100%) of the major ecosystem services within a municipal area have measurements or metrics stored in the natural asset inventory.

The City of Nanaimo has started to monitor some ecosystem service quality metrics and measurements for key natural asset areas. For the Buttertubs Marsh Conservation Area (BMCA), the City of Nanaimo has not collected an extensive amount of ecosystem service quality data; however, there are some indications that future monitoring will occur. For example, as part of the Conservation Agreement between Ducks Unlimited Canada and the Province of British Columbia for the BMCA, bio-inventory monitoring will be conducted every five years. As well, Ducks Unlimited Canada monitors wildlife and vegetation through a Species at Risk inventory. Finally, one of the priority management actions included in the Management Plan is to establish permanent baseline monitoring plots/transects. This baseline monitoring will be done in partnership with Vancouver Island University's biology department.

According to interviewed staff, the Province of British Columbia completed a sensitive ecosystem inventory that was incorporated into development permit area guidelines. Interviewed staff mentioned that the City of Nanaimo uses this inventory as a metric to determine what ecological features are recognized by the Province of British Columbia to help them identify additional parkland. The Sensitive Ecosystems Inventory (SEI) Project was published by the Ministry of Environment and Climate Change Strategy in 2011 and was last modified in 2020. However, the SEI does not describe the ecosystem services produced in these areas. Staff also recognize the SEI as a coarse metric. According to interviewed staff, park restoration plans are prepared with a specific focus on monitoring for the presence of endangered species. Finally, the City of Nanaimo and the Regional District of Nanaimo work with residents through a citizen-science approach to monitor water quality for urban streams. Currently, this monitoring consists of a few basic tests including water temperature, dissolved oxygen, presence of benthic invertebrates, and sediment levels. The Province of British Columbia then confirms the monitoring results and the Regional District of Nanaimo makes them available to the public.

In addition, the British Columbia Drinking Water Protection Act mandates the City of Nanaimo to provide the public with an annual report on the quality of their drinking water. The City of Nanaimo's water system originates in a large, protected watershed area at the headwaters of the south fork of the Nanaimo River. The City of Nanaimo and Mosaic Forest Management co-manage this watershed with policies and regulations to protect water quality. The raw water is taken, treated, and tested for the removal/inactivation of viruses and bacteria. The City of Nanaimo staff takes water samples at fixed locations to test the water for fecal coliform bacteria, Escherichia coli, and total coliform bacteria.

Therefore, the City of Nanaimo received a Yellow score for this indicator (Fig. 10). While the City of Nanaimo has started to include some ecosystem service quality metrics and measurements for natural asset areas, most of these metrics have not been monitored over several years. In addition, the City of Nanaimo has not identified an ecosystem service quality metric for cultural ecosystem services. The City of Nanaimo is encouraged to select measurements and metrics for the ecosystem services in multiple natural asset sites and to monitor these metrics over many years.

EVALUATION QUESTION

Has the municipality created a rehabilitation or restoration project?

Indicator	Benchmark
Number of sites selected as potential rehabilitation or restoration project(s).	Community has identified a (1) possible site for the creation of a natural asset management project that fits with larger natural asset management goals.

On the City of Nanaimo's website under the "Green Initiatives" section, the City of Nanaimo maintains a large inventory of sites identified for monitoring and restoration work. These sites are Departure Bay Centennial, East Wellington Park, Harewood Centennial Park, Linley Point Gyro Park, Nanaimo Estuary, Robin's Park, Third Street Park, and Woodstream Park. As mentioned in the Awareness, Education and Capacity section for the City of Nanaimo, municipal staff installed several "Chronolog" photo monitoring in these sites so staff and residents can observe progress over time. The site that is the centrepiece of the City of Nanaimo's natural asset management program is the BMCA. This site was the study area of the MNAI pilot study. The City of Nanaimo has purchased additional parcels of land in the BCMA with partnered organizations.

In conclusion, the City of Nanaimo received a Dark Green score for this indicator (Fig. 10). While the City of Nanaimo has not explicitly aligned ongoing restoration work as part of a municipal natural asset management framework, several sites have been identified as part of ongoing restoration work. The City of Nanaimo is encouraged to align sites identified for ecosystem restoration and rehabilitation with municipal-wide natural asset management goals.

EVALUATION QUESTION	
Has the monitoring of natural assets and ecosystem services occurred?	
Indicator	**Benchmark**
Number of relevant indicators identified for monitoring and evaluation.	Municipality has identified at least one (1) key indicator for the lifecycle of the natural asset management project(s).

The City of Nanaimo also has significant experience with identifying indicators for the monitoring and evaluation of conservation projects and programs. Starting with the management of the BMCA, the City of Nanaimo has created indicators and targets for land management in the West and East Marsh areas. These indicators and targets are Land Management Directions. These Land Management Directions describe the land use activity, the management direction, priority management actions, and five-year management targets. Under the restoration land use activity, the priority management actions are the mapping of invasive species, the removal of invasive species, planting native species, and boundary management in the south of the area. The targets for these actions are (i) by Year 2 all invasive species are mapped (ii) by Year 5 there is a 50% reduction in invasive species cover, and (iii) by the end of Year 5 all boundary issues are resolved. The inclusion of management targets will prioritize the next steps.

In addition to the management targets in the BMCA Management Plan, the City of Nanaimo created several draft indicators for monitoring progress for the upcoming Official Community Plan. The purpose of these indicators is to monitor the City of Nanaimo's progress as they set goals for implementing the Official Community Plan framework. The framework for the Official Community Plan is made up of five draft goals. The goal that aligns with municipal natural asset management practices is "A Green Nanaimo: Resilient & Regenerative Ecosystems." For this goal, the draft indicators are (i) the community's greenhouse gas emissions, (ii) the area of lands dedicated for natural area protection, (iii) water samples meeting British Columbia's water quality guidelines, (iv) the amount of household waste sent to the landfill, and (v) water consumption by residents. Along with these indicators the City of Nanaimo has created at least one draft target or benchmark for each of these indicators. For example, the draft targets for the "household waste sent to the landfill" indicator are 150 kg/household/yr by 2030, 120 kg/household/yr by 2040, 100 kg/household/yr by 2050. For the "area of lands dedicated for natural area protection," the current draft target is an increase in area, with a specific target area yet to be determined.

As well, the City of Nanaimo's Climate Change Resilience Strategy created several climate adaptation indicators. The Strategy does acknowledge that measuring adaptation to climate change is challenging. However, the criteria for these indicators are (i) linked to goals and objectives, (ii) allow adaptive and flexible planning, (iii) are inclusive of both process and outcome, and (iv) are easy to measure and relatively accurate. There are multiple indicators for the six themes included in the Climate Change Resilience Strategy. These indicators include growth in the volume of water stored, value of assets in the unprotected future floodplain, canopy cover, and capital infrastructure projects assessed for climate risk. The Climate Change Resilience Strategy also describes and explains why these indicators are included. For example, the description for the "value of assets in unprotected future floodplain" indicator is "calculation of the value of assets in the floodplain for the year 2100."

In conclusion, the City of Nanaimo created several indicators for the lifecycle of natural asset management projects and other restoration projects that align with natural asset management practices. Therefore, the City of Nanaimo received a Dark Green score for this indicator (Fig. 10). The City of Nanaimo is encouraged to finalize the indicators in the Official Community Plan Update and align existing indicators in the natural asset management framework for the City of Nanaimo.

2.4.5. Service Delivery

EVALUATION QUESTION
Is there a record of increased co-benefits?

Indicator	Benchmark
Percentage increase in co-benefits metrics monitored by the project community.	Increase in co-benefits from natural asset management.

The City of Nanaimo has yet to create or identify co-benefit metrics; however, it has considered the potential of co-benefits in a few of its policies, plans, and strategies. For example, the Climate Change Resilience Strategy has six themes. These six themes mention some of the co-benefit potentials for climate adaptation action. Under the Corporate Governance and Mainstreaming theme, one of the climate adaptation actions is to assess the potential economic benefit to the City of Nanaimo from climate change adaptation to help offset costs. Another example is the Urban Forestry Management Strategy. In this Strategy, several potential co-benefits are listed. These benefits include economic benefits, aesthetic benefits, and safety benefits. However, the monitoring of these listed co-benefits is not mentioned in the Strategy.

Therefore, the City of Nanaimo receives a Grey score for this indicator (Fig. 10). Until the monitoring of co-benefits ensues, a score cannot be given on whether an increase in co-benefits has occurred due to municipal natural asset management. The City of Nanaimo should include co-benefit metrics in a future natural asset inventory. The City of Nanaimo is encouraged to include co-benefit monitoring so a more accurate score can be given.

EVALUATION QUESTION
Has pressure been reduced on traditional municipal infrastructure that would have been impacted by climate change?

Indicator	Benchmark
Amount of municipal budget forecast to be spent on renewing grey infrastructure has climatic change.	Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure.

On April 5, 2017, the 20 Year Infrastructure Investment Plan was implemented for the City of Nanaimo. The purpose of this Plan is to show the projected investment required over the next 20 years for current infrastructure renewal, for new and upgraded infrastructure required due to

growth, and for specific projects. The Plan's analysis is separated into the three funds that make up the City of Nanaimo's infrastructure funding. For the General Fund, the projected funding shortfall is $124 million which includes $43 million for Development Cost Charges (DCC) contributions. For the Sewer Fund, the projected DCC contributions shortfall is $24 million. For the Water Fund, the projected shortfall is $121 million which includes $50 million for DCC contributions. The strategies for reducing the funding gap in the plan include increasing property taxes, decommissioning under-utilized or inefficient infrastructure, and implementing improvements to the City of Nanaimo's Asset Management System. Currently, municipal natural asset management is not included in the Plan as a potential strategy to reduce the funding gap. It is important to note that the 20 Year Infrastructure Investment Plan was completed before the MNAI piloting study.

In the 2020-2024 Financial Plan, natural asset management projects that supplement or complement hard infrastructure are not included in the infrastructure program breakdown. Currently, natural asset management work or projects are not mentioned in the 2020-2024 Financial Plan. In the 2021-2025 Draft Financial Plan, there are no asset management projects included that supplement or complement hard infrastructure. In both Financial Plans, a Municipal Natural Asset Management Program section was not included.

While the City of Nanaimo has a significant funding shortfall for its traditional assets that will require various strategies, natural asset management is not included. As well, a municipal natural asset management program has not been included in Financial Plans for the City of Nanaimo. Therefore, the City of Nanaimo received a Red score for this indicator (Fig. 10). The City of Nanaimo is encouraged to incorporate a holistic program-based approach to municipal natural asset management. This approach should be reflected in Financial Plans and future updates to the Infrastructure Investment Plan.

2.5. Town of Oakville

2.5.1. Background

The Town of Oakville is in Ontario's Golden Horseshoe region, halfway between Toronto and Hamilton, in the Halton Region on Lake Ontario. The 2016 Census reported a population of 193,832. This figure is expected to rise rapidly as the Town of Oakville is a part of the Greater Toronto Area, one of the most densely populated areas in Ontario and Canada. The entire Halton Region is one of the fastest-growing regional municipalities in Canada and is home to the City of Burlington, the Town of Halton Hills, the Town of Milton, and the Town of Oakville (Fig. 11).

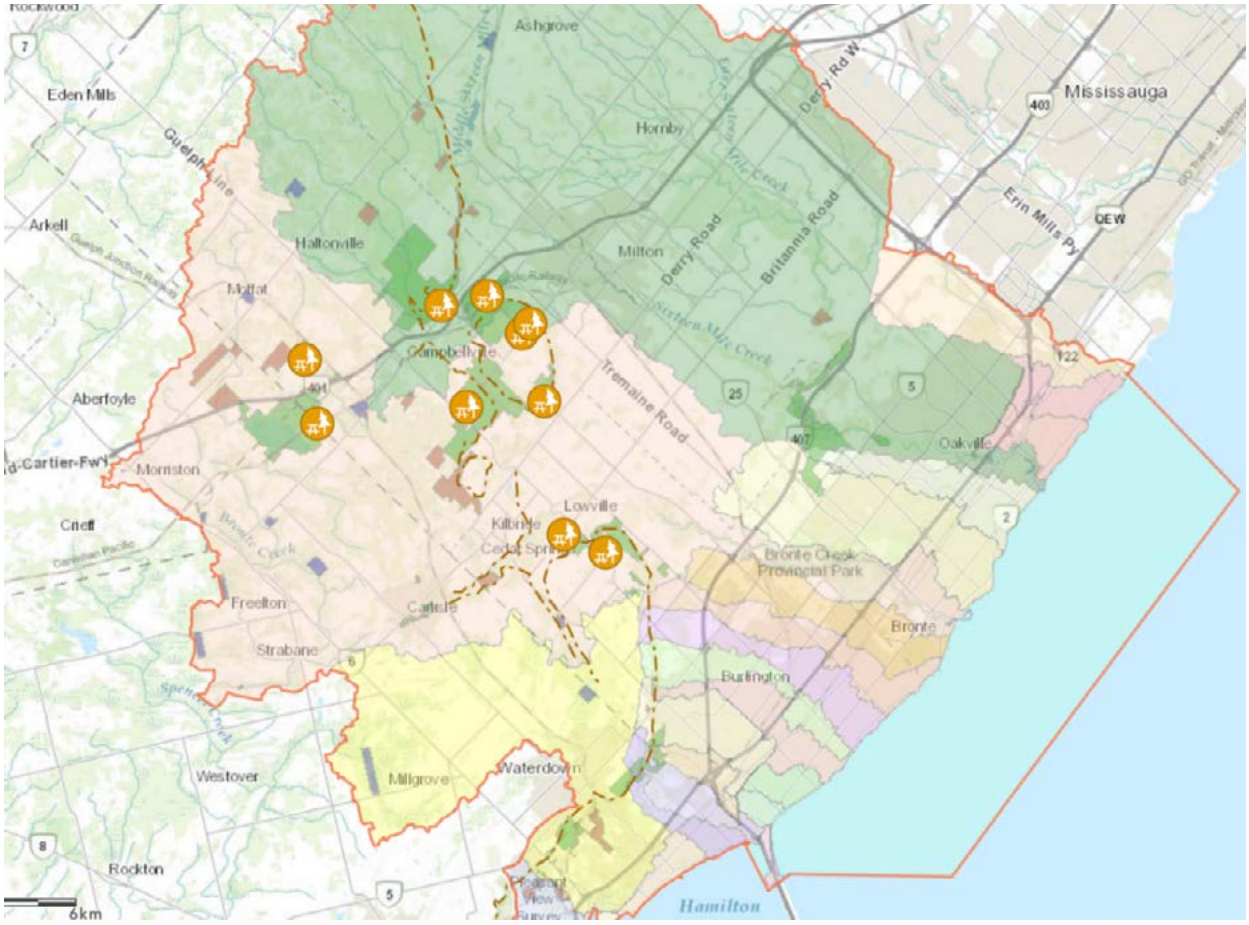


Figure 11: *A watershed base map from Conservation Halton.*

The Town of Oakville has a significant climate change and asset management background. Following the Public Sector Account Board (PSAB) 3150 Initiative, the Town of Oakville has maintained a complete inventory of its engineered assets since 2008. In addition, the Town of Oakville joined the national Partners for Climate Protection (PCP) program in 2005 and joined the Local Governments for Sustainability's (ICLEI) Building Adaptive and Resilient Communities (BARC) framework in 2011 as one of the first 12 signatories. For the MNAI pilot study, the natural asset selected was the Maplehurst Remnant Channel site, situated in an older part of the Town of Oakville. The site was chosen as it has a remnant stream, drainage ditches, and both public and private natural assets. Using a replacement cost method for valuing the services (conveyance and attenuation) provided by the remnant channel under existing and intensified development scenarios, it was demonstrated that it would cost the Town of Oakville between $1.24 million and $1.44 million to replace approximately a 240-metre channel with engineered infrastructure.

INDICATOR Benchmark TOWN OF OAKVILLE	SITE SCORE
Awareness, Capacity and Education Indicators	
Number of general consultation efforts for NAM *Benchmark 1:* More than 50% of NAM Consultation events have a high attendance rate *Benchmark 2:* All [100%] of information materials describe one reason for conducting MNAM	
Number of formal and informal partnerships with academic institutions, relevant local nongovernmental institutions, or private landowners At least 1 formal or informal partnership	
Implementation Indicators	
Number of barriers or opportunities identified in MNAM delivery within the project community *Benchmark 1:* 100% of relevant documents identify barriers and opportunities *Benchmark 2*: All [100%] of managers provide at least one barrier	
Number of changes made to OP, ZBL, Secondary Plans, etc. All [100%] of relevant municipal planning policy changed to integrate MNAM	
Amount of funding and financing received for projects All [100%] of projects and programs have available funds to ensure a full lifecycle	
Number of new NAM policy, strategies, and plans All [100%] of NAM policy, strategies, and plans created to support MNAM	
Ecosystem Rehabilitation and Restoration Indicators	
Number of ecosystem service quality measurements or metrics within project community area kept in the natural asset inventory All [100%] of the major municipal ecosystem services have measurements/metrics available in NA inventory	
Number of sites selected as potential rehabilitation or restoration project(s) Community has identified a possible site for the creation of a NAM project that fits with larger NAM goals	
Number of relevant indicators identified for monitoring and evaluation Municipality has identified at least one key indicator for the lifecycle of NAM projects	
Service Deliver Indicators	
Percentage increase in co-benefit metrics monitored by project community Increase in co-benefits from natural asset management	
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure	

Figure 12: *Balanced Scorecard for the Town of Oakville.*

2.5.2. Awareness, Capacity, and Education

EVALUATION QUESTION
Have municipalities made the general public aware of natural asset management occurring?

Indicator	Benchmark 1	Benchmark 2
Number of townhalls, information sessions, and other general consultation events for natural asset management.	More than 50% of natural asset management consultation events have a high attendance rate from local citizens.	All (100%) of information materials describe one reason for conducting municipal natural asset management.

The Town of Oakville has held a few consultation events for policies, strategies, or plans that align with municipal natural asset management. These consultation events are known as public information centres (PICs). For example, the Town of Oakville held PICs at strategic points throughout the development of the Stormwater Management Master Plan. The first PIC was held on June 23, 2016, at the Town Hall. Notifications of the PIC were sent to stakeholders, residents, agencies and municipal staff by mail and email, as well as notices within the local newspaper. In addition, the Town of Oakville created comment forms for members of the public so they could comment on the site or via mail, fax, or email. A second PIC was held at the Town Hall on June 25, 2019 to present the preliminary preferred solutions to the public. The Stormwater Management Master Plan now incorporates municipal natural asset management piloting as a strategy to improve stormwater management under different climate change scenarios. However, there is no available attendance data for any of the Stormwater Management Master Plan PICs.

The Town of Oakville has collected some attendance data for some PICs. For example, the Munn's Creek Erosion Mitigation EA Study held two PICs – one on April 30, 2019 and the other on March 12, 2020. Both PICs engaged 25 Town of Oakville residents. The first PIC presented the study background, environmental assessment process, existing conditions, and alternative concepts. The second PIC presented the evaluation of the alternatives, preliminary design drawings, and considerations for implementation and construction. The study team provided public feedback during and after the PICs on preferences for balancing erosion mitigation measures versus construction disturbances in the creek corridor.

The Town of Oakville has published information materials that describe a few reasons for a climate adaptation approach. For example, the Town of Oakville's Climate Change Primer gives residents a general education in climate change. This Primer also describes the climate change goals for the Town of Oakville. However, the Primer does not identify municipal natural asset management as an adaptation action. According to interviewed staff, the Town of Oakville developed flyers that explain the services delivered by natural areas, channels and stormwater ponds. These flyers have been distributed at some of the engagement events described above. Town of Oakville staff have noticed a mixed response to these education efforts for stormwater ponds. Residents feel that there is an increased rodent and algae presence in natural areas which has resulted in an increased number of complaints. However, staff also noted that Town residents love and appreciate recreational amenities offered by natural areas.

In 2011, the Town of Oakville published an Eco-Letter for educators that contains curriculum resources, in-class activities, and free presentations so students can become better environmental stewards. The Town of Oakville published two versions of the Eco-Letter: an Elementary School Edition and a High School Edition. The Town of Oakville's website has two separate web pages for stormwater ponds and natural areas and streams. Each of these web pages describes the importance of each of these areas, why the Town of Oakville maintains these areas, and actions that residents can take to protect these areas. The Town of Oakville also published a few informational videos on the ongoing work to clean stormwater ponds. These videos also describe the services delivered by stormwater ponds such as water storage and sediment sequestration. This video has been viewed 252 times.

For the first indicator, the Town of Oakville received a Red score (Fig. 12). The Town of Oakville has some data on attendance for PICs; however, the rate of attendance is low compared to its population. The Town of Oakville is encouraged to raise attendance rates for municipal natural asset management consultation events. For the second indicator, the Town of Oakville received a Yellow score (Fig. 12). The Town of Oakville has developed several information materials that teach some basic municipal natural asset management principles. This includes traditional media, digital media, and a municipal Primer to educate residents on climate change. However, the Town of Oakville has not developed any information materials specific to municipal natural asset management or ecosystem services.

EVALUATION QUESTION

Have municipal staff partnered with academic institutions, relevant local non-government institutions, or private landowners?

Indicator	Benchmark
Number of formal and informal partnerships with academic institutions, relevant local non-governmental institutions, or private landowners.	At least one (1) formal or informal partnership is with academic institutions, relevant local non-governmental organizations, or private landowners.

The Town of Oakville has maintained several environmental-oriented partnerships. These partnerships are with the Global Covenant of Mayors for Climate and Energy, Local Governments for Sustainability (ICLEI), Credit Valley Conservation Authority, Conservation Halton, the University of Waterloo's Partners for Action, Oakvillegreen Conservation Association, the Halton Environmental Network, the Institute of Catastrophic Loss Reduction, and the GTA Clean Air Council. Each of these partnerships works with various aspects of the Town of Oakville's environmental policies and initiatives.

Some of the organizations are programs in and of themselves. For example, the Global Covenant of Mayors for Climate and Energy is a global alliance that supports solutions in cities that will have the most impact on climate change by reducing emissions and fostering local climate resilience. Through this alliance, the Town of Oakville completed an intensive pilot study with the Global Covenant of Mayors and the Local Governments for Sustainability (ICLEI). The Town of Oakville was selected as a showcase city where they would participate in two of ICLEI's local programs. These programs are the Partners for Climate Protection and Building Adaptive and Resilient Programs.

The Town of Oakville is the only municipality out of 25 that started the pilot study to be awarded a Mitigation Badge.

As well, the Town of Oakville is located within two of the watershed-based Conservation Authorities in Ontario. These conservation authorities are the Credit Valley Conservation Authority (CVCA) and Conservation Halton. Conservation Authorities protect, restore, and manage the impacts on Ontario's water resources through an integrated watershed management approach. CVCA and Conservation Halton work on several ecosystem protection, rehabilitation, and restoration projects with the Town of Oakville. For example, Conservation Halton focuses their work on the Town of Oakville's Natural Heritage System. The land was privately owned but is being conveyed into public stewardship.

Oakvillegreen Conservation Association is a community organization that protects the Natural Heritage System through advocacy, environmental awareness and urban forest stewardship. Oakvillegreen Conservation Association runs several programs such as native tree and shrub planting, hosting Corporate Greening Days, and leading Urban Forest Tours. According to interviewed staff, Oakvillegreen and Conservation Halton worked with the Town of Oakville on a Low Impact Development (LID). As well, Oakvillegreen has reached out to Town of Oakville staff to plant trees in the Natural Heritage System. The Halton Environmental Network (HEN) is an organization that educates and builds awareness for the importance of climate action and environmental sustainability across the Halton Region. HEN created several programs and activities to achieve this goal, including film screenings, virtual conferences, and urban gardening. According to interviewed staff, HEN has an interest in installing permeable pavements in driveways which the Town of Oakville could support.

The Town of Oakville also works with several university-affiliated organizations. These organizations help the Town of Oakville to update policies, plans, and the public on flood preparedness. For example, the Town of Oakville and the University of Waterloo's Partners for Action held the "Keep Calm and Adapt – Emergency and Extreme Weather Preparedness Event" in May 2018 with flood experts from Halton Region, Conservation Halton, and the Halton Environmental Network. Event attendees were encouraged to view resources as education pieces for household and municipal flood preparedness.

Finally, the Town of Oakville is also a member of the Greater Toronto Area (GTA) Clean Air Council. This is a council of more than 30 municipalities in the GTA that focuses on combating air pollution and climate change by reducing energy use and minimizing greenhouse gas emissions. The GTA Clean Air Council does this by identifying common priority areas for collaborative actions through annual Declarations that serve as work plans for the members of council. For each of the Declaration goals, targets are set, and results are presented annually to show progress in achieving Declaration goals. For example, in the 2019-2023 Intergovernmental Declaration on Clean Air and Climate Change, one of the commitments is to strengthen municipal capacity to consider and develop Value Propositions and Business Cases for Green Infrastructure.

In conclusion, the Town of Oakville received a Dark Green score for this indicator (Fig. 12). The Town of Oakville continues to participate in several programs and partnerships that are leading to beneficial environmental outcomes. Some of these partnerships have been directly involved in the green infrastructure and natural asset work in the Town of Oakville. The Town of Oakville is encouraged to continue building partnerships that focus on green infrastructure and natural assets.

2.5.3. Implementation

EVALUATION QUESTION
Have the municipality and relevant stakeholders identified any barriers or opportunities to municipal natural asset management within the municipality?

Indicator	Benchmark 1	Benchmark 2
Number of barriers or opportunities identified for municipal natural asset management delivery within the municipality.	All (100%) of the topically relevant government documents and reviews identify barriers and opportunities and provide specific examples.	All (100%) of the managers provide at least one barrier or opportunity encountered and acted upon.

Interviewed staff identified barriers that include issues with planning, financing, education, and capacity. The maintenance and operations of natural assets were not well established in the Town of Oakville. This lack of knowledge contributed to a reluctance to take on projects or change policies when the benefits were not understood and there were competing interests. To address this barrier, staff have incorporated pilot studies and training courses to educate staff on the potential services natural assets can provide. Interviewed staff also noted that they are just starting to incorporate natural assets in the general asset registry. This means that staff are currently managing natural assets like a traditional asset as they continue to gather more information on these areas. In terms of capacity and financing barriers, interviewed staff mentioned that they struggle with finding the time to complete funding applications for green infrastructure and natural asset work. To address this barrier, the Finance department created a new position in December 2020 dedicated to handling funding and grant applications.

In reviewed documents, some of the creek erosion mitigation projects describe barriers and opportunities with implementing proposed solutions. In the Creek Inventory and Assessment Study, barriers and opportunities were identified for each of the inventoried creeks. For example, one of the barriers to providing flood storage for the Joshua's Creek Flood Mitigation Study is that a significant area of land would be required to handle downstream flooding, especially during extreme weather events. As well, the Inventory and Study list the advantages and disadvantages of rehabilitation techniques. For the Munn's Creek Erosion Mitigation Environmental Assessment Study, identified opportunities include the ability to address erosion and flooding issues, restoring, or enhancing riparian and aquatic habitats, and educating the public and landowners about stream corridor management and encroachment issues.

For the first indicator, the Town of Oakville received a Dark Green score (Fig. 12). In the reviewed documents, the Town of Oakville lists and describes both general and specific barriers and opportunities for creek restoration work. The Town of Oakville is encouraged to include natural asset management barriers and opportunities in project documents. For the second indicator, the Town of Oakville also received a Dark Green score (Fig. 12). Interviewed staff described several barriers the Town of Oakville is working through for their municipal natural asset management program.

EVALUATION QUESTION
Have the municipalities made changes to their Official Plan, Zoning Bylaw, Secondary Plans, etc.?

Indicator	Benchmark
Number of changes made to Official Plan, Zoning Bylaw, Secondary Plans, etc.	All (100%) of relevant municipal planning policy documents changed to integrate municipal natural asset management practices.

Many of the Town of Oakville's municipal planning policy documents align with municipal natural asset management practices. Starting with the 2019-2022 Strategic Plan, one of the key focus areas is the environment. The goal of this key focus area is to protect greenspace and promote environmentally sustainable practices. To achieve this goal, the Strategic Plan sets out several objectives to ensure effective stewardship of the Town's natural environment, to create a climate change resilient community, and to transition to a low carbon future.

The Livable Oakville Plan, which is the Town of Oakville's Official Plan, was adopted in 2009 and applies to all lands within the Town of Oakville except the North Oakville area. The Livable Oakville Plan creates key land use designations. One of these land use designations is the Natural Area designation. The Natural Area designation identifies and ensures the long-term preservation of the existing natural heritage system, which includes natural features such as wetlands, woodlands, and valleylands. The Town of Oakville uses this designation to map natural areas in the Town of Oakville for development regulations or restrictions. The Livable Oakville Plan protects Significant Wildlife Habitats, Environmentally Sensitive Areas, Areas of Natural and Scientific Interest, Fish Habitats, and Natural Corridors.

Another section of the Livable Oakville Plan that aligns with a municipal natural asset management approach is the Achieving Sustainability section. The Achieving Sustainability objectives include the preservation, enhancement, and protection of the Town's environmental features, natural heritage systems and waterfronts as well as the maintenance and growth of the urban forest. The Livable Oakville Plan specifically sets a 40% canopy cover as the goal.

For Stormwater Management policies, the Livable Oakville Plan states that where existing watercourses are sufficiently wide to carry storm flows, there shall be no modification of these areas, except for erosion control and water quality maintenance measures to the satisfaction of the Town of Oakville, the Conservation Authority, and the Province of Ontario. These requirements include stipulations for erosion control, stabilization techniques, and all other alterations. The Town of Oakville requires that for watersheds that extend beyond the municipal boundary, stormwater management plans will be developed in conjunction with the adjacent municipality. Finally, existing groundwater recharge rates will be kept in all developments, where possible. Municipal natural asset management as a stormwater management service delivery strategy is not mentioned in the Livable Oakville Plan.

Next, the Livable Oakville Plan also has a land designation of the Urban Forest and Hazard Lands. This land designation recognizes the municipal-owned urban forest as green infrastructure that can deliver multiple services. To protect the urban forest, the Town of Oakville mandates that for every square metre of leaf area that is removed from Town property or Town road rights-of-way, sufficient trees will be replanted to replace the lost square metres of leaf area. The Livable Oakville Plan also specifies that the Town of Oakville shall develop standards for the protection

and planting of trees. The Town of Oakville regulates tree removal on private property through the private tree protection bylaw. This bylaw will be discussed in more detail below. Finally, the Town of Oakville's Conservation Authorities administer the Hazard Land designation. The Livable Oakville Plan reinforces this by stating that no new development or site alteration is permitted within Hazard Lands without the approval of the Conservation Authority.

The Town of Oakville also adopted Secondary Plans for the North Oakville East and West areas respectively under the New Communities of Oakville policy. Known together as the North Oakville Secondary Plans, these plans are amendments to the Town of Oakville's 2006 Official Plan. The objective of both Secondary Plans is to establish a Natural Heritage and Open Space System in North Oakville East and West. The purpose of the Natural Heritage and Open Space is the establishment of a system, the majority of which is to be in public ownership, and the focal point of which is a linked natural heritage system enhanced by a range of open space facilities. Both plans include land designations such as core preserve areas, linkage preserve areas, stream corridor areas, and boundaries. These plans also recognize the ecological services that natural areas provide, and they contribute to goals of environmental protection and enhancement. A review of these plans, known as the North Oakville Secondary Plans Review, was initiated in May 2017. This review was started in conjunction with the Official Plan Review so the Official Plan and the Secondary Plans can be made into one official plan document. The North Oakville Secondary Plans' natural heritage system is scheduled to be revised.

Lastly, the Town of Oakville implemented several bylaws to protect natural asset areas. One of these bylaws is the Private Tree Bylaw which helps protect and grow the Urban Forest canopy cover. This bylaw applies to all private property in the Town of Oakville and prohibits the injury, destruction, or removal of any tree with a diameter equal to or greater than fifteen (15) centimetres on a lot, or any tree required to be retained or planted as a condition of an approved site plan, without first obtaining a permit according to this bylaw. As well, the Private Tree Bylaw aligns with existing provincial and federal legislation to protect endangered tree species. If these regulations are not followed, the Town of Oakville may fine a person between $400-$100,000.

With these data presented, the Town of Oakville received a Light Green score (Fig. 12). Although the Town of Oakville does not include municipal natural asset management as an approach or strategy in key planning policy documents reviewed, existing policy aligns with municipal natural asset management practices. As the Town of Oakville continues to review its Official Plan and subsequent planning policy documents, the Town of Oakville is encouraged to adopt a municipal natural asset management approach that specifically recognizes natural asset areas as a land use designation.

EVALUATION QUESTION	
Have new projects received funding or financing?	
Indicator	**Benchmark**
Amount of funding and financing received for projects.	All (100%) of projects and programs have available funds in order to ensure a full lifecycle.

The Town of Oakville makes use of a variety of funding sources. For example, the Town of Oakville and Oakvillegreen Conservation Association received partial funding from the Province of Ontario for a bioswale project completed collaboratively. In addition, the Town of Oakville received funding from the Great Lakes Guardian Community Fund for the Bronte Bluffs Restoration and Water Quality Improvement project completed in 2015. The budget set for this project was $25,000 which included funds for new plantings, slope stabilization, and the purchase and installation of a lookout.

From the 2020 and 2021 key budget documents in the Town of Oakville, natural asset management work and projects are shifting from a variety of programs and departments to be concentrated in one or a few departments. For example, in the 2020 Approved Operating Capital Budget, projects that align with municipal natural asset management are kept under the Development Engineering program budget, the Planning Services program budget, and the Parks and Open Space program budget. For example, under the Parks and Open Space program, one of the listed capital projects is to update the Urban Forest Strategic Management Plan. This Plan recognizes the Town of Oakville's urban forest as green infrastructure and sets a canopy cover target. The 2020 Budget sets the cost of this update at $30,000. Under the Development Engineering program, the budget for the Munn's Creek erosion restoration was set at $2,110,000.

In the 2021 Budget, municipal natural asset management projects were moved to the Development Services program. This program was not included in the Approved 2020 Operating and Capital Budget. However, some projects align with municipal natural asset management that is part of other programs. In the 2021 Budget and Business Plan, one of the key initiatives of the Development Services program is to develop new policies and procedures that complement and protect new natural assets which serve to enhance natural areas and complement the Biodiversity Strategy. The projects included in the recommended capital budget for 2021 include erosion work for Munn's Creek ($1,213,000), storm pond maintenance ($105,000) and Environmental Studies and Monitoring ($70,000). In addition, a key initiative for the Parks and Open Space program is to implement an invasive species strategy and continue updating the Urban Forest Strategic Management Plan.

Therefore, the Town of Oakville does demonstrate that proposed projects and programs have available funds to ensure a full lifecycle and received a Dark Green score (Fig. 12). However, municipal natural asset management is not included as a recognized program in financial documents. The Town of Oakville is encouraged to include municipal natural asset management as a program-based budget so municipal natural asset management does not risk becoming a piece-meal project-based approach in the Town of Oakville.

EVALUATION QUESTION

Have staff created new natural asset management policies, strategies, and plans?

Indicator	Benchmark
Number of new natural asset management policies, strategies, and plans.	(All 100%) of natural asset management policy, strategies, and plans created to support municipal natural asset management within project community.

The Town of Oakville has developed several climate-focused policies, strategies, and plans that can support municipal natural asset management. The Town of Oakville has a Climate Change Strategy and an Urban Forest Strategic Management Plan that were implemented before municipal natural asset management piloting. This strategy and plan contain several policies that align with municipal natural asset management practices. The Climate Change Strategy aims to increase the Town of Oakville's capacity to protect against and respond to climate change impacts. The Strategy does this by presenting climate data from Environment and Climate Change Canada and projecting how climatic change will impact the Town of Oakville. The Climate Change Strategy uses pictogram symbols for climatic change which include temperature, precipitation, high wind, thunder and lightning, winter precipitation events, and temperature and air quality. Each of these pictogram symbols is assigned to climate impact statements along with vulnerability levels. Finally, the Town of Oakville presents several adaptation actions for each of the forecasted climate impact statements.

For example, one of the climate impact statements in the Climate Change Strategy is that increased water use in the summer months will occur due to an increase in average and extreme temperatures. To prepare for this climate impact, the Climate Change Strategy describes existing policies, plans, and strategies that the Town of Oakville has adopted that will then lead to increased adaptation outcomes. One of these plans is the 2014 Water Sustainability Plan (WSP). The WSP will integrate planning and management strategies to conserve and strategically manage water and minimize the discharge of pollutants to area waterways and Lake Ontario. The Climate Change Strategy also includes action items to address this climate impact and to monitor the results of environmental performance in water conservation and identify opportunities for cost savings through water conservation, efficiency and re-use. The Climate Change Strategy uses two themed impacts for creeks and channels and urban forestry, trails, and natural areas.

Next, the Urban Forest Strategic Management Plan recognizes the Town of Oakville's urban forest as green infrastructure. The Plan describes the extensive benefits that the urban forest provides to urban communities, including a reduction in air pollution, cooling, windbreaking, shading, water quality, habitat, and aesthetic appreciation. The Urban Forest Strategic Management Plan values the total environmental benefits of the ecological services at $2.1 million per year. The Urban Forest Strategic Management Plan sets performance indicators to monitor the progress in protecting the Town of Oakville's urban forest. The main indicator is a 40% tree canopy coverage in 50 years (2058). The Urban Forest Strategic Management Plan sets implementation tools, such as a tree inventory, to ensure the Urban Forest Strategic Management Plan objectives are achieved. According to interviewed staff, the Forestry Department completes a physical tree count every 10 years and currently is completing the 2021 inventory.

The Town of Oakville also adopted the Oakville Strategy for Biodiversity in 2018. The goal of the Strategy is to secure the long-term future of the Town of Oakville's native plants and animals. To achieve this goal, the Strategy presents management opportunities, targets, and indicators. Through studies on Environmental Sensitive Areas, Areas of Natural and Scientific Interest, and the Halton Natural Areas Inventory, the Strategy recognizes the natural areas and watercourses in the ravines of Bronte Creek, 14 Mile Creek, 16 Mile Creek, and the woodlands of North Oakville and Iroquois Shoreline Woods as the most important and best quality natural habitats to support native species biodiversity. The Strategy presents a total of 28 management opportunities. Each management opportunity names the problem, addresses options for management, describes potential stakeholders and sites, and includes measures to determine success.

Also in 2018, the Town of Oakville implemented the 2018-2022 Environmental Sustainability Strategy (ESS). This Strategy has an extensive history in the Town of Oakville, starting with the first Environmental Strategic Plan in December 2005 and an update in 2011. From 2011-2018, 97% of the actions in the Environmental Strategic Plan were either underway or completed, along with the adoption of several new plans and programs, and the hosting of engagement events. The ESS provides an overarching environmental sustainability vision, aligning deliverables with other plans and strategies, and setting new actions where there are gaps in implementation. In addition, the ESS included an updated set of environmental sustainability indicators for the State of the Environment Reporting. The ESS is organized into four themes: (i) Sustainable Environment, (ii) Sustainable Households, (iii) Sustainable Community, and (iv) Sustainable Government. Under the Sustainable Environment theme, actions related to municipal natural asset management include the development and implementation of the Biodiversity Strategy, improvements to air regulations and airshed air quality, completing and implementing the Stormwater Master Plan, and accounting for natural capital and ecosystem services in financial planning. However, the current ESS does not include actions for pursuing a municipal natural asset management program or approach for identified natural asset areas.

In conclusion, the Town of Oakville received a Light Green score for this indicator (Fig. 12). The Town of Oakville has several climate adaptation policies, strategies, and plans that can support municipal natural asset management practices. However, these policies, strategies, and plans do not specifically describe municipal natural asset management as a climate adaptation approach. The Town of Oakville is encouraged to update and review policies so that a municipal natural asset management approach is implemented as a service delivery strategy and a climate adaptation strategy.

2.5.4. Ecosystem Rehabilitation and Restoration

EVALUATION QUESTION
Are measurements or metrics being used for assessing ecosystem service quality?

Indicator	Benchmark
Number of ecosystem service quality measurements or metrics within a municipal project area kept in the natural asset inventory.	All (100%) of the major ecosystem services within a municipal area have measurements or metrics stored in the natural asset inventory.

The Town of Oakville monitors several ecosystem service quality measurements and metrics for their natural areas. In interviews, staff stated that for the North Oakville area, the Town of Oakville does a full suite of water quality monitoring. Most of the water quality monitoring that the Town of Oakville focuses on is total suspended solids (TSS). TSS data is then shared through the State of the Environment Report. The State of the Environment Reporting Program is the accompanying monitoring program for the Environmental Sustainability Strategy. In 2015, the Town of Oakville reported that the maximum levels of TSS decreased in all creeks, with the most significant drop appearing in Fourteen Mile. For most of the sites monitored in the State of the Environment Report, TSS levels were below the Provincial Water Quality Objective. In addition, interviewed staff mentioned that the Town of Oakville is starting to incorporate the impact that development has on flow in stream areas.

The Town of Oakville also monitors the amount of greenspace area and biodiversity quality in greenspaces. In 2015, the Town of Oakville had a total of 2,501 ha of publicly held open space, 1,522 ha of which was town-owned. In 2016, the Town of Oakville reported there was a total of 2,519 hectares of publicly owned greenspace. While the State of the Environment Report recognizes quantity as an important measurement, the report also states that quality is critical to supporting a rich variety of species necessary for a healthy ecosystem. Therefore, when the Town of Oakville adopted the Oakville Strategy for Biodiversity (OSB), targets and indicators were created to monitor biodiversity improvements. These Strategy targets are both direct and indirect measures of biodiversity protection. Direct measures of biodiversity protection are measurements that monitor species groups such as Species at Risk or Invasive Species, habitats that support biodiversity, and the quality of aquatic habitats. Indirect measures of biodiversity protection are measurements that assess the success of programs and policies that identify, protect, enhance, and restore biodiversity.

The OSB also sets specific targets to meet the Strategy's goals. For example, one of these targets is that "the Town of Oakville will protect at least 17% of terrestrial and inland water areas in a natural state to support biodiversity." All data gathered for these indicators and targets will be presented in a report card that provides feedback to all stakeholders, acknowledges the progress made and provides encouragement to continue working to attain future targets. Finally, the Town of Oakville has developed a Forest Health Report Card. This report card has several ecosystem service quality metrics for urban forest health while monitoring biodiversity quality. Specifically, the Forest Health Report Card includes measurements for general health, invasive plant presence, and the presence of invasive species.

Therefore, the Town of Oakville receives a Light Green score for this indicator (Fig. 12). The Town of Oakville monitors several ecosystem service quality measurements and metrics for a variety of natural asset areas. In addition, the Town of Oakville has added several metrics that reflect the complex nature of ecosystem service quality. However, the Town of Oakville does not monitor for cultural ecosystem services. The Town of Oakville is encouraged to incorporate additional ecosystem service quality metrics and measurements for all natural asset areas, specifically cultural ecosystem service metrics and measurements.

EVALUATION QUESTION

Has the municipality created a rehabilitation or restoration project?

Indicator	Benchmark
Number of sites selected as potential rehabilitation or restoration project(s).	Community has identified a (one) possible site for the creation of a natural asset management project that fits with larger natural asset management goals.

The Town of Oakville has identified a few sites for the creation of an ecosystem rehabilitation or restoration project. The goals of these projects align with municipal natural asset management practices. For example, in the Creek Inventory and Assessment Study, each of the creeks in the Town of Oakville has been assessed. This assessment described the erosion concerns for each of the Town of Oakville's creeks. For example, for Munn's Creek, bank protection measures are failing, and eroding banks are putting recreational trails and private property at risk. The Town of Oakville and a consulting firm then used the information from the Assessment Study to prepare a Mitigation Environmental Assessment Study for Munn's Creek. The Munn's Creek Assessment Study describes potential solutions for addressing erosion concerns. These solutions include the construction of an armour stone retaining wall and restoration of the slope on the east side of the stream.

In addition, the Town of Oakville has worked to develop a Shoreline Inventory and Assessment Report. In this report, sites for restoration work are assigned both a structure and safety score on two separate evaluation scales. Each of these scales has several different criteria and weighting for each of the criteria. Finally, the report identifies the top 10 priority sites that receive the lowest overall score. In 2018, Town Council approved $3,789,000 to fund several high-priority restoration projects. These projects were identified after higher-than-expected water levels in Lake Ontario which resulted in overland flooding. Therefore, several sites assessed in the Shoreline Inventory and Assessment Report were prioritized due to changes in their condition. These project sites include Dingle Park, Lakeside Park, and Sixteen Mile Creek. In conclusion, the Town of Oakville received a Dark Green score for this indicator (Fig. 12). The Town of Oakville has identified several sites that align with municipal natural asset management practices. The Town of Oakville is encouraged to incorporate these recommended projects into a municipal natural asset management program.

EVALUATION QUESTION	
Has the monitoring of natural assets and ecosystem services occurred?	
Indicator	**Benchmark**
Number of relevant indicators identified for monitoring and evaluation.	Municipality has identified at least one (1) key indicator for the lifecycle of the natural asset management project(s).

The Town of Oakville has a strong history of tracking and monitoring several environmental indicators. As part of the Town of Oakville's Environmental Sustainability Plan, municipal staff developed a State of the Environment reporting program to supply information on key indicators. The Town of Oakville monitors 15 indicators that are organized under four themes. As a part of the Sustainable Environment theme, the Town of Oakville tracks water quality, permeable surface area, air quality, and area of greenspace. The most recent monitoring report shows that the Town of Oakville is making progress in its air quality and greenspace indicators while progress has stalled in the water quality and permeable surface area indicators. For the greenspace indicator, the Town of Oakville states that greenspace contributes to important ecological services such as better air quality, water quality, flood protection, climate stability and biodiversity protection.

The Town of Oakville's State of the Environment reporting program also monitors the amount of education and outreach programs that increase community awareness on environmental sustainability issues. Specifically, the Town of Oakville states that by monitoring the number of events that it hosts and/or participates in each year, it can assess its efforts in raising the profile of the environment and support households and businesses in its sustainability efforts. However, the Town of Oakville's State of the Environment reporting program acknowledges it is difficult to compare across years. Therefore, the Town of Oakville wants to trend towards hosting fewer but larger events so staff resources are more effectively used. Finally, the Town of Oakville has an Urban Forest Health Monitoring Program. This monitoring program assesses the Town of Oakville's woodland areas on a three-year rotation for invasive plant and animal species. A report card is then developed for the woodlands surveyed each year to evaluate the overall health of the forest. In the 2020 Report Card, the Town of Oakville uses a colour-coded rating legend to monitor invasive plant presence and ash tree mortality. For example, in Colborne Park, nine trees were given a red rating for ash tree mortality. Both garlic mustard and euonymus were given a yellow rating for invasive plant presence.

In conclusion, the Town of Oakville received a Dark Green score for this indicator (Fig. 12). The Town of Oakville's State of the Environment reporting program has identified several indicators that align with municipal natural asset management practices. As well, indicators are also variable and address multiple aspects of a municipal natural asset management program. The Town of Oakville is encouraged to continue identifying and monitoring indicators for their environmental areas.

2.5.5. Service Delivery

EVALUATION QUESTION

Is there a record of increased co-benefits?

Indicator	Benchmark
Percentage increase in co-benefits metrics monitored by the project community.	Increase in co-benefits from natural asset management.

Currently, the Town of Oakville does not have a co-benefit metric for natural asset areas. For example, under the air quality health index indicator in the 2017 State of the Environment Highlights Report, the Town of Oakville reported 91% of days as low health risk and 0% of days as high health risk. However, in the 2018-2022 Environmental Sustainability Strategy, which describes the identified indicators, this indicator is not linked with an increase in urban tree canopy cover or other natural asset areas. Therefore, the Town of Oakville received a Grey score for this indicator (Fig. 12). The Town of Oakville is encouraged to create co-benefit metrics for natural asset areas.

EVALUATION QUESTION

Has pressure been reduced on traditional municipal infrastructure that would have been impacted by climate change?

Indicator	Benchmark
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change.	Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure.

Interviewed staff sees the Town of Oakville's municipal natural asset management, green infrastructure, and low-impact developments as a complement to grey infrastructure. However, this does not negate the need for grey infrastructure renewal. Interviewed staff also mentioned that some areas of the Town of Oakville were developed before implementing traditional asset management practices and will require a considerable number of grey infrastructure retrofits and upgrades. Town of Oakville staff closed by saying they would expect more progress for this indicator in 10 years.

The Town of Oakville's Financial Statements do not recognize natural resources as assets. As well, these Financial Statements do not specify the amount spent on retrofitting and renewing tangible capital assets. The 2021 Budget does provide some data on the operating and capital budgets in 2021. In addition, budget forecasts are presented for 2022 and 2023. In the 2020 Budget, the Town of Oakville spent $746,000 on their Asset Management Program with an expected expense increase to $1,096,000 in the 2021 Budget. The 2022 forecasted budget rises to $1,113,100, a 1.6% increase. The 2023 forecasted budget increases again to $1,129,500, a 1.5% increase. In the Town of Oakville, natural asset management work falls under the Development Services Program where new natural asset management policies and procedures are scheduled to be developed. The requested 2021 budget for

the Development Services program is $5,186,800. In total, $5,143,000 is the expected expense for several projects which include the maintenance of storm ponds and flood protection. However, not all projects are for the management of natural areas. The 2022 budget forecast for the Development Services Program expects a 2.3% increase to $5,308,300 and a 2.0% in 2023 to $5,413,400.

Based on the way that the Town of Oakville currently organizes its financial statements, it is difficult to say whether there will be a decrease in the Town of Oakville's budget spent on retrofitting and renewing grey infrastructure. Therefore, the Town of Oakville received a Red score for this indicator (Fig. 12). The Town of Oakville is encouraged to recognize natural assets as a separate asset category in financial statements and to recognize municipal natural asset management as a separate program.

3.0 Discussion, Lessons Learned, and Next Steps

3.1. Comparing Monitoring Results

The scorecards for each municipality have been merged into the comparison scorecard below (Fig. 13). By creating this comparison scorecard, the monitoring results become easier to compare across the five municipalities and the patterns in indicator scores become more noticeable. This section of the report will discuss these patterns, with support from other research in program evaluation and monitoring, green infrastructure, ecosystem services, and municipal natural asset management.

INDICATOR Benchmark	GIBSON	GRAND FORKS	WEST VAN	NANAIMO	OAKVILLE
Awareness, Capacity and Education Indicators					
Number of general consultation efforts for NAM *Benchmark 1:* More than 50% of NAM Consultation events have a high attendance rate *Benchmark 2:* All [100%] of information materials describe one reason for conducting MNAM					
Number of formal and informal partnerships with academic institutions, relevant local nongovernmental institutions, or private landowners At least 1 formal or informal partnership					
Implementation Indicators					
Number of barriers or opportunities identified in MNAM delivery within the project community *Benchmark 1:* 100% of relevant documents identify barriers and opportunities *Benchmark 2*: All [100%] of managers provide at least one barrier					
Number of changes made to OP, ZBL, Secondary Plans, etc. All [100%] of relevant municipal planning policy changed to integrate MNAM					

INDICATOR Benchmark	GIBSON	GRAND FORKS	WEST VAN	NANAIMO	OAKVILLE
Amount of funding and financing received for projects All [100%] of projects and programs have available funds to ensure a full lifecycle					
Number of new NAM policy, strategies, and plans All [100%] of NAM policy, strategies, and plans created to support MNAM					
Ecosystem Rehabilitation and Restoration Indicators					
Number of ecosystem service quality measurements or metrics within project community area kept in the natural asset inventory All [100%] of the major municipal ecosystem services have measurements/ metrics available in NA inventory					
Number of sites selected as potential rehabilitation or restoration project(s) Community has identified a possible site for the creation of a NAM project that fits with larger NAM goals					
Number of relevant indicators identified for monitoring and evaluation Municipality has identified at least one key indicator for the lifecycle of NAM projects					
Service Deliver Indicators					
Percentage increase in co-benefit metrics monitored by project community Increase in co-benefits from natural asset management					
Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure					

Figure 13: *Cohort One Comparison Scorecard.*

3.1.1. Awareness, Capacity and Education Outcomes

Each municipality has created at least one formal or informal partnership with an academic institution, non-governmental organization, and/or a private landowner. Therefore, all the municipal case studies received a Dark Green score. In this cohort, most of the partnerships are with a local, community-based eNGO. These organizations are concerned about environmental degradation, can offer expertise, and can engage the community through a variety of awareness events. These data show that local governments are interested and capable of partnering with other environmentally conscious organizations. Second, there is a multitude of organizations at the provincial, regional, and local levels that local governments can partner with. Third, staff were appreciative of these partnerships and the added capacity they brought to the local government. Local governments also partnered with multiple organizations and formed networks for regional collaboration.

Most municipalities do not record attendance data for municipal natural asset management consultation events. Therefore, each municipality received a Grey score for this indicator as attendance rates could not be calculated. Even when attendance rates are available, such as with the Town of Oakville, attendance rates are not specific to a municipal natural asset management program. This is because municipal natural asset management is embedded in other environmental initiatives that the local government had already committed to before this program intervention. Most municipalities have low attendance rates for engagement events despite high resource inputs (Coningsby & Behan 2019). Barriers to participating in consultation and awareness events include lack of communication, availability of consultation and awareness events, and the feeling that contributions will not have an impact on decision-making. Regarding the content of information materials developed, local governments made primary use of digital resources. Local governments and their partners focused on explaining the service delivery potential, the benefits of ecosystem rehabilitation and restoration, and ecosystem service valuation for incorporating municipal natural asset management.

3.1.2. Implementation Outcomes

Each municipality identified at least one barrier or opportunity for municipal natural asset management. Barriers varied widely and often depended on the local context. However, there are some similarities in these barriers. For example, most local governments are constrained by staff capacity. In smaller municipalities, such as the City of Grand Forks, staff are stretched across multiple projects making it difficult to develop one consistent and clear municipal service delivery strategy. In large municipalities, such as the Town of Oakville, staff need to be trained or educated on municipal natural asset management which can drain resources and capacity. Regarding opportunities, the most consistent opportunities were alignment with existing asset management policy and leveraging of existing climate change adaptation work to include municipal natural asset management. Finally, the COVID-19 pandemic continues to present barriers and opportunities for municipalities. For example, the District of West Vancouver delayed capital projects in response to revenue changes and new spending needs.

Most local governments in this cohort are making changes to planning policy documents to integrate municipal natural asset management. As well, many local governments already have policies, plans, or strategies that align with municipal natural asset management. This includes strengthening bylaws, requiring setbacks for key natural asset areas, and changing land-use policies in Official Plans to integrate municipal natural asset management practices. For financing and funding, local governments will be cautious in applying internal revenue for projects or programs

where outcomes are uncertain. However, local governments continue to explore external funding opportunities, such as grants. For example, the Town of Gibsons was awarded $955,000 from the Province of British Columbia and the Government of Canada through the Rural and Northern Communities Infrastructure Stream of the Investing in Canada Plan.

Finally, most municipalities are not recording progress for this outcome, which is the creation of new natural asset management policies, strategies, and plans. As described above, most local government decision-makers are focusing on aligning municipal natural asset management practices with existing policies, strategies, and plans rather than creating new plans where municipal natural asset management is the focus. Local government staff are aware of the need to create new policies, strategies, and plans that are specific to municipal natural asset management; however, projects may be planned years in advance so that work occurs sequentially. For example, the City of Grand Forks is focused on completing the Disaster Mitigation and Adaptation Fund Program Charter which does not include the creation of new municipal natural asset management policies, strategies, and plans. It is unlikely that staff will be directed to develop new policies, strategies, and plans until the Disaster Mitigation and Adaptation Fund Program is officially completed.

3.1.3. Ecosystem Rehabilitation and Restoration Outcomes

Measuring ecosystem service quality metrics and measurements had the lowest scores for this cohort. While most municipalities do measure some ecosystem service quality metrics or measurements such as water quality, they have not identified metrics or measurements specific to a natural asset area of interest nor have they created metrics or measurements for all ecosystem service types. For example, none of the municipalities created or identified a cultural ecosystem service quality metric or measurement. If local government staff and officials have poor climate literacy, this can be a barrier to incorporating climate-related information into decision making, such as ecosystem service quality metrics and measurements (Coningsby & Behan 2019). As well, if staff turnover rates are high, it can make it difficult for municipal climate programs to mature and reach later stages, such as measuring, reporting, and monitoring. However, some local governments do have monitoring programs that include ecosystem service quality metrics and measurements. For example, the Town of Oakville's Strategy for Biodiversity includes specific biodiversity targets and indicators that address ecosystem service provision.

In addition, most Canadian local governments are prioritizing monitoring for climate change mitigation over climate change adaptation (Guyadeen et al. 2019). While there can be some synergistic opportunities between climate mitigation actions and climate adaptation actions, adaptation actions are complex and require long-term strategies, commitments, measures, and specific biophysical indicators (Basset & Shandas 2010; Betsill & Bulkeley 2006; Heidrich et al. 2013; Donatti et al. 2019). Second, all municipalities in this cohort identified at least one site for an ecosystem rehabilitation and restoration project and at least one indicator for internal monitoring and evaluation purposes. Both sites and indicators were identified through previous policy initiatives, strategies or plans. For example, the District of West Vancouver's Integrated Stormwater Management Plan identified several urban creek sites and indicators to measure ecosystem rehabilitation and restoration outcomes. This shows that municipalities are aware of sites that require restoration and/or rehabilitation, have data backing site selection, and have developed indicators to monitor restoration and/or rehabilitation outcomes.

3.1.4. Service Delivery Outcomes

Most of the municipalities did not produce meaningful data for intended program outcomes in this outcome stream. However, based on the timings described in the Evaluation Matrix (Appendix 6), this lack of data was anticipated given the current program lifecycle. However, some local government documents have recognized the co-benefit potential from natural assets. For example, the District of West Vancouver and the Town of Gibsons identified co-benefits from natural asset areas. For a "decrease in municipal budget spent on retrofitting and renewing grey infrastructure," most local government documents forecasted an increase which resulted in Red scores. Asset management is still primarily focused on 'grey' or built infrastructure renewal. As well, municipalities are anticipating funding shortfalls due to the COVID-19 pandemic and reduced municipal revenue generation.

The next few sections will present a few critical lessons learned throughout this monitoring process. Municipalities should be aware of these lessons when considering a municipal natural asset management program. While these lessons may not be universal for the experience of all municipalities, they can also be treated as potential opportunities to enable municipal natural asset management and to better use local resources.

3.2. Lesson 1: Activating and Enabling Local Partnerships and Champions

The results from this monitoring process show that partnerships and champions are key external and internal drivers for municipal natural asset management in local governments. All municipalities in this cohort continue to manage at least one partnership for climate action, sustainability, and/or environmental degradation. The organizations that local governments have partnered with include local utilities, non-governmental organizations (NGOs), and conservation authorities. Both the private and public sectors increasingly rely on NGOs and community-based groups to meet current challenges, especially due to labour and skills shortages (Giguere 2003). Partnerships can reduce municipal risk and resources by leveraging staff and community partner skills and experiences. In this cohort, municipalities used partnerships for community outreach, scientific expertise, and major ecosystem monitoring.

Champions can also advocate for municipal natural asset management through local policymaking channels. Community champions are people in the community who take on a particular issue or project and then raise effective awareness and support for it (Lindsay et al. 2019). These community champions do not require a specific level of expertise or skill but can play a crucial role in leading change by offering insightful suggestions, challenging potential groupthink of professionals, and setting clear expectations for future cooperation. Community champions can address community concerns, especially around pressures to continue urban development, while ensuring that the process is transparent and open.

Community champions can also emerge from local government staff. When building policy capacity, personal motivation is one of the strongest predictors of increasing biodiversity efforts in municipal land-use planning (Allred et al. 2021, pg. 14). Influential champions from local government staff can act as catalysts to create a large coalition, energize other staff, and progress towards intended program outcomes. Therefore, community champions and partnerships should be activated and enabled during the earliest stages of municipal natural asset management. Strong champions and partnerships can drive the process, overcome challenges, and push program implementation throughout the local government.

3.3. Lesson 2: Building a Program-based Approach for Municipal Natural Asset Management

Local governments must build capacity to integrate a program-based approach for municipal natural asset management. This includes securing support from senior managers, city councillors, and other key decision-makers to properly incorporate municipal natural asset management work under a single program umbrella. Currently, most of the local governments in this cohort are working on municipal natural asset management through a piecemeal, project-based approach where long-term planning is limited. To start to change this approach, integrating climate change into the Official Plan provides a direct mandate for the implementation of climate actions related to land use planning and development (Coningsby & Behan 2019). Therefore, one way to build the capacity needed for a program-based approach is to share data on local ecosystem degradation and biodiversity loss with vocal stakeholders and local government leaders (Allred et al. 2021).

Few municipalities in this cohort account for and track a municipal natural asset management program in their local financial documents. Current financial asset management standards in North America are ill-equipped to fit natural assets into existing asset management practices (Matsler 2019). One reason for this is some of the individual components of a natural asset area, such as trees, soils, and bodies of water, cannot be recorded into local financial documents. While there is a need for changes at the provincial and federal levels to build these accounting standards, local governments can shift their financial reporting to account for ecosystem service provision. In this cohort, the Town of Gibsons added a Tangible Capital Asset Notes to their financial statements that acknowledge the importance of natural assets and the need to manage them in conjunction with engineered assets. Another barrier to building a program-based approach for municipal natural asset management is the tension over valuation methods. Most asset management programs place a value on assets by using replacement costs and not service value because their goal is to assess all physical assets in a consistent way across all sectors that is comparable to all other businesses and municipalities (Matsler 2019). Replacement costs for physical assets are much more available than replacement costs for natural assets.

3.4. Lesson 3: Use Existing Tools for Municipal Natural Asset Management Site Identification

All municipalities in this cohort identified sites that required ecosystem rehabilitation and restoration. Municipalities used a variety of existing tools and strategies to identify these sites. This includes using existing resources from partnered organizations for site identification. Municipalities can also use data from ecosystem service quality metrics to identify sites for ecosystem rehabilitation and restoration through analyzing ecosystem service stress (Allan et al. 2013). There have also been several tools and models developed that analyze ecosystems and divide sites for ecosystem restoration. This includes the Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) model (Zhang & Fang 2021) and the Relative Aggregated Value of Ecosystem Services (RAVES) index (Comín et al. 2018). Some municipalities in this cohort conducted LiDAR studies to create a better understanding of their urban forest canopy.

Canadian municipalities can also incorporate provincial and federal resources to guide site identification. For example, the Government of British Columbia developed Ecological Restoration Guidelines. These guidelines include setting restoration goals, restoration priorities, planning, implementation, maintenance, monitoring, resources, and a restoration plan. These guidelines are linked to the Terrestrial Ecosystem Restoration Program which designated restoration

priorities based on the Biogeoclimatic Ecosystem Classification subzones of the Province of British Columbia. Mapping for ecosystem service supply and demand can pair with valuation studies for site identification. This mapping should address the four types of ecosystem services which are regulating services, supporting services, provisioning services, and cultural services. Mapping beyond municipal jurisdictions can lead to regional partnerships so that resources can be shared.

3.5. Next Steps

There are several steps available to expand upon this monitoring framework and the results presented in the monitoring report. The most immediate research step is to monitor a second cohort of municipalities across Canada. These municipalities are the City of Courtenay, the District of Sparwood, the City of Oshawa, the Town of Florenceville-Bristol, the Town of Riverview, and the Village of Riverside-Albert. As well, the Region of Peel will be included in this second cohort. Monitoring a second national cohort will add more evidence on changes municipalities are making to their operations and management to incorporate municipal natural asset management. As well, more applications of the monitoring framework will strengthen tools like the Program Logic Model and the evaluation matrix. Finally, the monitoring framework can be modified in future applications so that suggested improvements can be implemented and other indicators can be measured.

The second step is to change the monitoring framework so that a larger number of case studies can be monitored simultaneously. This will mean automating the monitoring methodology and framework through an algorithm or data processing unit. While this report provided a detailed description of progress for the five municipal case studies, it is not feasible to replicate this process in similar reports for hundreds of projects and programs. An automated algorithm or data processing unit will produce dashboard-level monitoring results on program outcomes. As well, an automated process can monitor several municipalities over many years and can re-visit this cohort through an expedited process.

The monitoring framework should also change to incorporate specifications for geographic context and ecological context. Within this cohort, there are geographical and ecological differences between the five municipalities. For example, there are differences in climate, population, municipal history, ecosystems, species, and natural assets which in turn affect municipal operations, management, and service delivery. For this cohort, the monitoring framework was not modified to account for these differences. However, when the monitoring framework is automated, geographic and ecological contexts should be incorporated so that a more accurate representation of patterns can be examined. As well, research is needed on the development of biophysical indicators for natural assets. These indicators can target changes in ecosystems and should be based on ecological research for determining the health of natural assets. These indicators could include measurements for mineral presence in freshwater, leaf cover for urban forests, or shoreline erosion for coastal municipalities. Finally, monitoring methods and indicators are needed for assessing the performance of natural assets for natural hazards, city scales, and costs.

In professional practice, local government staff should aim to increase public support, engagement, and consultation for municipal natural asset management, especially for the municipalities that are struggling to achieve high attendance rates for consultation events. Local government staff can diversify community engagement approaches through targeting pre-existing community events, creating pop-up community outreach workgroups, and ensuring flexibility so residents can attend community events. Local government staff should also produce clear internal and external messaging on natural assets, management strategies, and ecosystem service provision. This messaging should focus on how the effects of climate change will impact the community and how natural assets can help communities adapt to those effects and build resilience.

Local government staff and municipal champions must work collaboratively with the Accounting Sector, the Engineering Sector, the Planning Sector, the Financial Sector, and the Insurance Sector to establish norms and standards for municipal natural asset management. These norms and standards could include the level of service natural assets would be expected to provide in comparison to grey infrastructure. The Province of British Columbia created the first professional asset management standards for engineers and geoscientists, with natural asset management as a core component of those standards. These standards are the Capital Asset Management Framework Guidelines which outline governance and oversight, risk management, planning, processes and approvals, public communications, project personnel, capital procurement, budgeting, reporting, monitoring, performance measurement, financing, and accounting. The Province of British Columbia released a primer for integrating natural assets into municipal asset management through the province's sustainable service delivery framework.

Another professional step needed is to expand the number of municipalities incorporating municipal natural asset management. Through collaborative efforts with MNAI, many local governments are starting to build natural asset inventories or make some modifications to municipal operations and management. Federal, provincial, and local governments could use initiatives to drive other local governments to build full municipal natural asset management programs or related projects. There are some examples of similar initiatives that could be copied. For example, the Public Sector Accounting Board (PSAB) 3150 Initiative required Canadian municipalities to record and report on their tangible capital assets on or after January 1, 2009. In response, the Province of Ontario, the Municipal Finance Officers' Association (MFOA) and the Association of Municipal Managers, Clerks and Treasurers of Ontario (AMCTO) created a partnership to provide information and training for the PSAB 3150 Initiative. In the Province of Alberta, a Liaison Committee was created with representatives from the Alberta Urban Municipalities Association, the Alberta Association of Municipal Districts and Counties, the Local Government Administration Association, the Alberta Rural Municipal Administrators Association, the Government Finance Officers Association and Alberta Municipal Affairs to provide updates on the PSAB 3150 Initiative and ensure consistent communication. Similar partnerships, strategies, and initiatives could be created with the professional sectors listed above. If feasible, the local government staff in this cohort and the second cohort could take a leading role in sharing their expertise.

Future municipal natural asset management professional practice should also be implemented in provincial planning frameworks. Unfortunately, provincial planning policies, regulations, and legislation such as the Planning Act and the Provincial Policy Statement in Ontario make minimal reference to ecological services and their functions. When provincial policies and regulations are scheduled for changes, updates, or revisions, municipal champions, eNGOs and local governments should work with their respective provincial governments to integrate policies, regulations and definitions on ecosystem services, natural assets, municipal natural asset management, and ecosystem rehabilitation and restoration.

Finally, Canadian local governments can incorporate municipal natural asset management through newly announced federal funding opportunities. In the 2021 Federal Budget "A Recovery Plan for Jobs, Growth, and Resilience" the Government of Canada proposed $200 million over three years, starting in 2021-2022, to Infrastructure Canada to establish a Natural Infrastructure Fund to support natural and hybrid infrastructure projects. Budget 2021 also proposed $1.4 billion over 12 years to top up the Disaster Mitigation and Adaptation Fund. The City of Grand Forks used this fund to fund their floodplain restoration program and other municipalities experiencing natural disasters could also use it.

4.0 Conclusions

Municipal natural asset management is an ecosystem-based adaptation approach for addressing declining municipal infrastructure service delivery and increasing urban ecosystem degradation. Through the creation and application of a monitoring framework, a description of progress was created for five municipalities. These case studies produced findings, patterns, lessons, and recommendations for future changes to municipal operations and management for municipal natural asset management. Municipal natural asset management can enhance service provision, improve municipal financial and asset risk, and increase climate resilience.

By accounting for and protecting natural assets, Canadian municipalities can increase climate adaptation and complement existing municipal service delivery. However, a monitoring framework is needed to better understand changes local governments have made to their operations and management to incorporate municipal natural asset management. Therefore, a monitoring framework was created using two common tools in program evaluations: a Program Logic Model and an evaluation matrix. This research changed the common template of a Program Logic Model to group program outcomes based on specific typologies. This Program Logic Model used a nested design to present four distinct outcome streams: Awareness, Education and Capacity, Implementation, Ecosystem Rehabilitation and Restoration, and Service Delivery. The evaluation matrix created evaluation questions with indicators, data sources, analysis methods, timings, and benchmarks. By applying the monitoring framework, this monitoring report shows that municipalities are receiving high scores for Awareness, Education and Capacity indicators and some Implementation indicators. However, progress is much slower and scores are lower for Ecosystem Rehabilitation and Restoration indicators and Service Delivery indicators.

Canadian municipalities are facing an increasing array of pressure from the effects of climate change, including the degradation of natural assets and built infrastructure. Ecosystem-based adaptation approaches like municipal natural asset management can be an adaptive, resilient, and cost-effective nature-based solution to these pressures. With changes to engineering and accounting standards for ecosystem services, green infrastructure, and nature-based solutions, local governments should seize this opportunity to integrate municipal natural asset management and make evidence-based decisions on the management of their natural assets now and into the future.

References

Allred, S., Stedman, R., Heady, L., & Strong, K. (2021). Incorporating biodiversity in municipal land-use planning: An assessment of technical assistance, policy capacity, and conservation outcomes in New York's Hudson Valley. *Land Use Policy, 104*, 105344–. *doi.org/10.1016/j.landusepol.2021.105344*

Bamberger, M., Rugh, J., & Mabry, L. (2012). *RealWorld evaluation: working under budget, time, data, and political constraints* (2nd ed.). Thousand Oaks, CA: SAGE Publications.

Bassett, E., & Shandas, V. (2010). Innovation and Climate Action Planning: Perspectives From Municipal Plans. *Journal of the American Planning Association*, 76(4), 435–450. *doi.org/10.1080/01944363.2010.509703*

Betsill, M. M., & Bulkeley, H. (2006). Cities and the Multilevel Governance of Global Climate Change. *Global Governance*, 12(2), 141–160. *doi.org/10.1163/19426720-01202004*

Cairns, S., O'Neill, S.J., and Wilson, S. (2019). Opportunities to Fund Municipal Natural Assets Management Projects: An Overview of Six Federal Infrastructure Funding Programs. *The Municipal Natural Assets Initiative*. Retrieved from: *mnai.ca/media/2019/05/SP_MNAI_Report_Full.pdf*

Comín, F. A., Miranda, B., Sorando, R., Felipe- Lucia, M. R., Jiménez, J. J., Navarro, E., & Macinnis-Ng, C. (2018). Prioritizing sites for ecological restoration based on ecosystem services. *The Journal of Applied Ecology*, 55(3), 1155–1163. *doi.org/10.1111/1365-2664.13061*

Coningsby, L. & Behan, K. (2019). Assessing the state of climate action in Ontario

municipalities: the drivers and barriers to implementation. *Clean Air Partnership*. Retrieved from: *www.cleanairpartnership.org/wp-content/uploads/2019/04/Drivers-and-Barriers-to-Implementation-Report-V4.pdf*

Donatti, C. I., Harvey, C. A., Hole, D., Panfil, S. N., & Schurman, H. (2020). Indicators to measure the climate change adaptation outcomes of ecosystem-based adaptation. *Climatic Change*, 158(3-4), 413–433. *doi.org/10.1007/s10584-019-02565-9*

Giguere, S. (2003). Local Governance and Partnerships – A Summary of the Findings of the OECD Study on Local Partnerships. OECD LEED Programme.
Retrieved from: *www.oecd.org/cfe/leed/1962067.pdf*

Guyadeen, D., Thistlethwaite, J. & Henstra, D. (2019). Evaluating the Quality of Municipal Climate Change Planning in Canada. *Climatic Change*. 152: 121-143.
doi.org/10.1007/s10584-018-2312-1

Heidrich, O., Dawson, R. J., Reckien, D., & Walsh, C. L. (2013). Assessment of the climate preparedness of 30 urban areas in the UK. *Climatic Change*, 120(4), 771–784.
doi.org/10.1007/s10584-013-0846-9

Lindsay, J., Rogers, B., Church, E., Gunn, A., Hammer, K., Dean, A., & Fielding, K. (2019). The Role of Community Champions in Long-Term Sustainable Urban Water Planning. *Water (Basel), 11*(3), 476–. *doi.org/10.3390/w11030476*

Matsler, M. (2019). Making "green" fit in a "grey" accounting system: The institutional knowledge system challenges of valuing urban nature as infrastructural assets. *Environmental Science & Policy, 99*, 160–168. *doi.org/10.1016/j.envsci.2019.05.023*

Zhang, C. & Fang, S. (2021). Identifying and Zoning Key Areas of Ecological Restoration for Territory in Resource-Based Cities: A Case Study of Huangshi City, China. *Sustainability (Basel, Switzerland), 13*(3931), 3931–. *doi.org/10.3390/su13073931*

Appendix 1 – List of Key Stakeholders and Anticipated Information Needs

Keeping stakeholders informed and ensuring their information needs are met throughout monitoring efforts is a key component of a well-structured monitoring framework. As well, by identifying the information needs of stakeholders it can ensure that expectations of the monitoring report match the level of results presented. Through discussions with MNAI, key stakeholders and their information needs have been identified. Engaging stakeholders ensures transparency. Furthermore, stakeholders offer insights that increase the quality, scope, and depth of evaluation questions (Preskill & Jones, 2009). In an ideal situation, all stakeholders would be involved, but due to limited time and funding stakeholder engagement strategies were selected based on their cost and time efficiency.

	Stakeholder Group	Information Needs
Primary	Participating Staff and Elected Officials	• How can we improve the management of our municipal natural assets? • What skills, tools, and strategies are necessary to progress towards desired outcomes?
	The Municipal Natural Assets Initiative (MNAI)	• How can we better prepare municipalities to start to manage their natural assets? • Are municipalities that are implementing municipal natural asset management progressing towards intended outcomes?
	Interested Local Governments	• What lessons can we learn from other local governments to effectively prepare for municipal natural asset management?
Secondary	Provincial Governments	• Can we promote municipal natural asset management as an effective asset management strategy? • How can we be included in program delivery?
Tertiary	Monitoring and Evaluation Researchers	• Is this an effective monitoring framework for municipal natural asset management?

Appendix 2 – Program Background

Natural assets are defined as the stock of natural resources or ecosystems that a municipality, regional district, or another form of local government could rely upon or manage for the sustainable provision of one or more local government services. Natural assets include areas such as healthy forests, wetlands, lakes, rivers, or coastlines (Wilson 2019). A growing number of local governments recognize it as important to understand, measure, manage and account for natural assets as it is for engineered ones. Doing so can enable municipalities to provide core services such as stormwater management, water filtration, and protection from flooding and erosion, as well as additional services such as those related to recreation, biodiversity, health, and culture. Outcomes of what is becoming known as municipal natural asset management can include cost-effective and reliable delivery of services, support for climate change adaptation and mitigation, and enhanced biodiversity. Unfortunately, many local governments only understand, measure, and manage their natural assets for a narrow range of aesthetic or social amenities and not for the wide range of essential services natural assets provide (Cairns 2019).

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

Five municipalities are a part of the first national cohort of local governments that worked with MNAI. These municipalities are the City of Nanaimo, the City of Grand Forks, the Town of Oakville, the District of West Vancouver, and the Region of Peel. Each local government selected a natural asset of interest within their municipal jurisdiction with which to pilot municipal natural asset management, and the MNAI team worked closely with municipal staff to guide them through the methodology. These municipalities are the case studies that were monitored using the monitoring framework. Unfortunately, after sending repeated requests to take part in monitoring, the Region of Peel did not participate; however, the Town of Gibsons was included to provide another case study. In addition, the Town of Gibsons was the first municipality to work in the field now known as natural asset management. Therefore, they were included to provide data on the later outcomes. Their data could then be used to create lessons for the municipalities that are still in the initial stages of a natural asset management program lifecycle. The Region of Peel will be included in the second cohort monitored. Staff from the five municipalities agreed to co-operate for monitoring purposes and provided key documents to support the monitoring team.

Appendix 3 – Framework Design

The approach for this monitoring framework is a *formative outcome monitoring approach* (Bamberger et al. 2012, pg. 211 & 214). This approach helps managers and program staff improve the design and implementation of the ongoing intervention and to learn lessons that can improve future interventions. A formative outcome monitoring approach was selected as municipal natural asset management is ongoing and will continue after the publication of this monitoring report. The results from this report should aid managers and planners in improving the design and implementation of municipal natural asset management in their local governments. This monitoring framework uses qualitative methods. Interviews and document reviews were the primary methods for data collection. Text analysis was the primary method for data analysis. Qualitative methods were chosen as most of the outcomes selected for monitoring were qualitative. Currently, this monitoring framework does not include the monitoring of biophysical indicators such as changes in ecosystems, as these changes may take several years until they are detectable. However, when the monitoring framework is changed to include biophysical indicators, there may be more of a shift towards incorporating both qualitative and quantitative methods of data collection and analysis.

This monitoring framework was used to collect, analyze, and present data in this monitoring report. The creation of this monitoring framework was commissioned post-test, or at the end of the initial intervention and contains no baseline data and no comparison group. Thus, the report data will be presented through case studies. This monitoring framework examines how municipalities are progressing in several outcome streams compared to indicators. Indicators were created as variables for the grounding of benchmark values. In monitoring and evaluation literature, benchmarks are points of reference for evaluated programs to be compared. Benchmarks are foundational to monitoring work as they will be the main source of determining scores for each outcome monitored.

When designing a monitoring framework, one must consider what kind of comparison will reveal the most meaningful information. For this monitoring framework, the comparisons were to benchmarks. This is beneficial because if results show that certain program milestones are not being reached, MNAI or the local government may want to modify its strategy. This monitoring framework is rooted in monitoring and evaluation theory and practice. The use of a monitoring framework (i.e., the conceptual links between evaluation questions, indicators, measurements, program outputs and program outcomes) will be important to produce rigorous monitoring results. Logically linking each stage of the development of this framework will ensure that data collected from the evaluation questions will match with the program outcomes. By not including such a monitoring framework, data collection and analysis would become too scattered or irreplicable.

In program monitoring and evaluation, there are two tools used to enhance the quality of a monitoring framework. These tools are Program Logic Models and Evaluation Matrixes. Definitions and descriptions of these tools are provided in the following sections, along with how these tools were adapted for this monitoring framework.

3.1. Program Logic Models

Program Logic Models (PLMs) are graphical depictions of the chain of causes and effects leading to the outcomes of the program. The focus of PLMs is on the causal relationship between the various elements leading to the outcome. The most common PLM template contains an explanation of the situation, inputs and program components, baseline activities/outputs, outcomes, and impacts. The PLM also describes the external factors of the program and the assumptions that the program is making for the causal relationships. External factors are the factors beyond the control of the program. This can include economic factors, political factors, organizational and institutional factors, environmental factors, and socioeconomic and cultural factors. Assumptions are the logical conclusions the monitoring team draws to describe the cause-and-effect links between the situation and the intended outcomes. The relationships between PLM components are always logical.

A PLM can be used by both the monitoring team and the program managers to create relevant indicators at each stage of the program. The PLM can also be used to identify where the data sources in the program are located. Logical links in the PLM can illustrate how the program was designed to work and help evaluators pinpoint where each program is as it is reaching specific outcomes. This adds support to the indicators assessed and the evaluation questions answered during monitoring. The PLM in this monitoring framework was created through an iterative process. It underwent multiple revisions after consultation with the monitoring team and staff from MNAI. As a part of the revisions, the PLM design and layout were modified to include "outcome streams." Outcome streaming is the displaying of linkages between outcomes of the same category. Streaming the expected outcome programs enables the demonstration of different outcome types as well as the unfolding of their causal relationship through time. Each outcome within the streams is a clear stage of progress which then feeds into the progress of the entire program. These outcome streams are:

1/ Awareness, Capacity, and Education Outcomes – Outcomes that relate to the understanding of Municipal Natural Asset Management as a municipal program for city staff and the public.

2/ Implementation Outcomes – Outcomes that relate to the carrying out of Municipal Natural Asset Management as a realized municipal strategy.

3/ Ecosystem Rehabilitation/Restoration Outcomes – Outcomes that relate to the recovery of key ecosystems as a part of Municipal Natural Asset Management.

4/ Service Delivery Outcomes – Outcomes that relate to the provision of municipal services through Municipal Natural Asset Management.

Without streaming the outcomes in this PLM, it would be too cluttered and difficult to follow. Through a collaborative effort with MNAI, this monitoring framework did not use short-term and medium-term outcomes that are common in traditional PLM design, and instead grouped different outcomes based on categories. To create the outcome streams, the monitoring team and MNAI produced a large list of outcomes that were then categorized and grouped into a typology. For example, the Awareness, Capacity, and Education Outcome Stream was made by combining an "education and awareness" outcome category with an "engagement and partnerships" category. The Implementation Outcome Stream combined the remaining short-term outcome categories which included strategy, policy and bylaw, programs, financing, investments and operations, and finally, third-party support for natural asset management. The Ecosystem Rehabilitation and Restoration Outcome Stream was created by combining outcomes related to the health of a natural asset area such as the commencement of a rehabilitation or restoration project, quality of ecosystem services, and improvements of natural asset health condition. The Service Delivery Outcome Stream combined

the remaining medium-term outcomes and focuses entirely on service provision from natural assets. Some outcomes were teased out of this list to make the distinctions clearer.

However, these design changes still include the temporal aspects common in short-, medium- and long-term outcome displays. Through a cascading design, the staggered timing of different outcomes, enabling functions, and the connections between outcomes are displayed. The Program Logic Model has been included in Appendix 5.

3.2. Evaluation Matrix

The second tool is the evaluation matrix. The evaluation matrix is a table that links each evaluation question with the means for answering that question. In columns, it outlines the evaluation question, the corresponding indicators to answer said question, and the data sources, analysis methods and timing this monitoring framework will use. To create these evaluation questions, each outcome box from the PLM was marked with a code. Then, evaluation questions were developed for each of the coded outcomes in the PLM so that each intended outcome could be covered by an evaluation question in the monitoring framework. The indicators, data sources, analysis methods and timings were created through a combination of best practices and stakeholder consultation with MNAI. This entire evaluation matrix was then reviewed by the MNAI team and through discussions and revisions, the final evaluation matrix was agreed upon.

As previously mentioned, indicators are qualitative or quantitative variables that describe the status or trend in a program. Data sources are where information or data can be found to address the indicator variable. Analysis methods are how that particular data can be best analyzed. Timings are when that data is likely to be available in the lifecycle of the program. And finally, benchmarks are the key points of reference or values against which progress will be measured against. Each evaluation question may have multiple data sources and analysis methods to ensure that data is not only coming from as many reliable sources as possible, but that analysis is presenting the data in a way that fully addresses the evaluation question. There may also be multiple benchmarks for one indicator variable. Multiple benchmarks can more accurately capture the entirety of the indicator variable.

While there are a total of 26 evaluation questions, approximately 11 evaluation questions were included in this application of the monitoring framework for this report. While all 26 evaluation questions are important, through input from stakeholders, these 11 were chosen for their pertinence to the current stage of the program for each of the five municipalities and to measure a progress baseline for each outcome stream. As well, not all evaluation questions during a limited monitoring timeframe. Future monitoring reports can use the monitoring framework and the multitude of evaluation questions to investigate progress in different indicators variables. Lastly, the language of “project community” is used within the evaluation matrix to encompass future municipal natural asset management programs that may not originate solely from a single-tier or two-tiered municipality. The evaluation matrix can be found in Appendix 6.

3.3. Key Indicators

The indicator variables address modifications in municipal operations and management after the implementation of municipal natural asset management piloting. These indicators include, but are not limited to, the number of relevant staff participating in natural asset education activities, the number of changes made to Official Plans, Zoning By-laws, Secondary Plans, and other planning policy documents, and the creation of monitoring indicators for current and future municipal natural asset management projects. Best monitoring and evaluation practices emphasize the use of indicators that are relevant, accurate, important, and useful. The indicators in the evaluation matrix meet the criteria of relevance, accuracy, importance, and usefulness in the following ways:

1/ By showing a clear relationship between the introduction of the program and value changes of the indicators – Municipal natural asset management is being introduced to change municipal operations and management regarding service delivery.

2/ The indicators measure what they purport to measure – Municipal operations and management can be varied but by creating indicators for intended program outcomes, this monitoring framework captures data for all program outcome streams.

3/ The indicators capture something that makes a difference in program effectiveness –Municipal natural asset management is the program intervention. This program intervention changes municipal operations and management to lessen the burden on conventional infrastructure and support mitigation and adaptation to climate change.

4/ The results from indicator analysis point to areas for improvement that actually can be improved – By reviewing individual municipalities and comparing them, barriers and facilitators for municipal natural asset management can be identified. The goal of this monitoring report is to support municipal natural asset management and point towards options for future program delivery.

Appendix 4 – Data Collection and Analysis Methods

As part of MNAI's involvement in the piloting of municipal natural asset management, each municipality agreed to take part in monitoring. Therefore, staff from the five local governments were aware that this research was occurring, were aware that their contact information would be shared, and did not have to be directly recruited for interviews. Instead, MNAI provided the monitoring team with a list of key contacts for follow-up. As well, local government staff agreed to provide additional documents such as internal reports that may not have been easily accessible through the document review process. More detail on each method is provided below.

4.1. Data Collection Methods

Interviews: Interviewing key program staff is a critical data collection method for monitoring and evaluation. It allows the monitoring team to gather added nuance from the documents reviewed as well as hear directly from staff on how the program may or may not be reaching outcomes. Semi-structured interviews were chosen over unstructured or structured interviews because semi-structured allowed for the creation of an interview guide based on the evaluation questions in the evaluation matrix while also allowing nuance to emerge through open-ended questions. As each municipality has an entirely different context in which they are implementing municipal natural asset management, interviewees need to detail and describe that context.

The interview guide was created using the evaluation matrix. Some of the data sources in the evaluation matrix already described preliminary interview questions which were modified or revised. Members of the David Suzuki Foundation and the MNAI team reviewed the interview guide for clarity. As well, interview questions were also prioritized given the limited interview time. In total, 11 questions were asked per interview.

Willing senior managers and directors were then contacted for interviews. The interviews were conducted remotely via teleconferencing to accommodate COVID-19 health and safety measures. The interviews were conducted over the teleconferencing application Microsoft Teams and lasted about 45 minutes each. Interview questions spoke to but were not limited to the following topics: (1) natural asset service delivery before and after natural asset management occurred; (2) barriers and opportunities that pilot communities met when attempting to integrate municipal natural asset management; (3) changes made to implement municipal natural asset management into a municipalities OP, ZBL, Secondary Plans, etc.; (4) community responses to municipal natural asset management. The interview guide with prioritized interview questions can be found in Appendix 7.

Document Review: A document review is a way of collecting data by examining existing documents. Specifically, it is useful in gathering background information, determining if the implementation of the program reflects program plans, and helping the development of other data collection tools. Document reviews examined existing program records (e.g., technical reports from piloting, strategies, and backgrounds), policies and procedures, council and committee meeting notes, lessons and learnings from stakeholders, external research, informational materials, and program materials offered by local government staff. Documents were also requested from program

managers after the completion of interviews. Document reviews were conducted to gain the necessary background understanding and to extract quantitative and qualitative information. Furthermore, document reviews also considered how communication materials were presented in terms of the language used, visuals for information accessibility, etc. This was done to determine how coherent lines of communication between the organization, municipality, and relevant stakeholders were maintained.

Most documents were in the public domain and available through each municipality's website. To find these documents, each of the participating municipalities' websites had a dedicated section to their municipal natural asset management projects or had a searchable database. As well, documents were retrieved through snowballing whereby additional documents were identified for review by scanning through the citations or referenced documents.

4.2. Analysis Methods

Through the creation of a database using the MAXQDA Analytics Pro software (Version 2020.4), both the selected documents and interview transcripts were placed in corresponding folders for each municipality. Then, each document was coded using the evaluation questions and subsequent indicators, data sources, analysis methods, timings, and benchmarks from the evaluation matrix through text analysis. The basis of this approach is to break text, whether this text is reviewed documents or interview transcripts, into smaller units, then group them into coding categories and themes to derive meaning. More specifically, the documents retrieved through the review process underwent manifest content analysis for use of keywords that were a part of the specific evaluation question row in the evaluation matrix. Manifest content analysis was also used for interview responses. This form of analysis was more intuitive as the interview responses were already divided by interview questions that correspond with an evaluation question.

Two rounds of coding were conducted, with a third round to ensure reliability and accuracy. Coding categories did not have to be created as each evaluation question and corresponding indicator, data source, analysis method, timing, and benchmark were used as coding categories. This is known as a closed coding system. As well, the outcome streams described in Section 2.2 were used as the basis for thematic clusters used in this monitoring report.

4.3. Scoring System

To present results and best communicate monitoring findings, a balanced scorecard was used. A balanced scorecard is a strategic management performance table used to present results from monitoring studies. There are four steps to creating a balanced scorecard: identifying the measures, assigning weights, balancing the measures, and setting specific targets. For the identification of measures, measures have been identified through the benchmarks. This monitoring framework did not include weighting which means that all indicators and benchmarks are evaluated and weighted equally. However, there is a possibility to consider weighting in future iterations of this monitoring framework. Measures or benchmarks were balanced between lagging, leading, efficient, and effective. To best describe progress in each municipality, this monitoring framework is using a five-point colour-coded scoring system to share data for each indicator monitored as well as each outcome stream identified in the Program Logic Model (Fig. 14). A colour-coded scoring system was chosen since colour makes the reporting more user-friendly and accessible to non-technical users of the information and those who may not have a background in program monitoring. As well, a five-point scoring system presents reliable results while being easily interpretable by municipal staff.

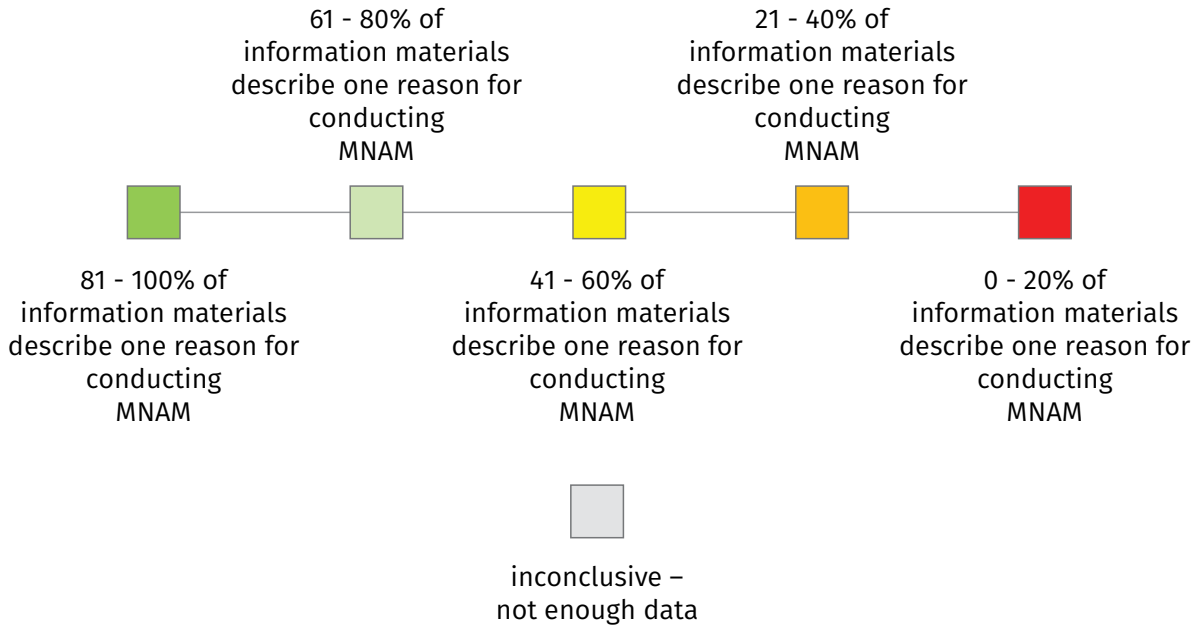
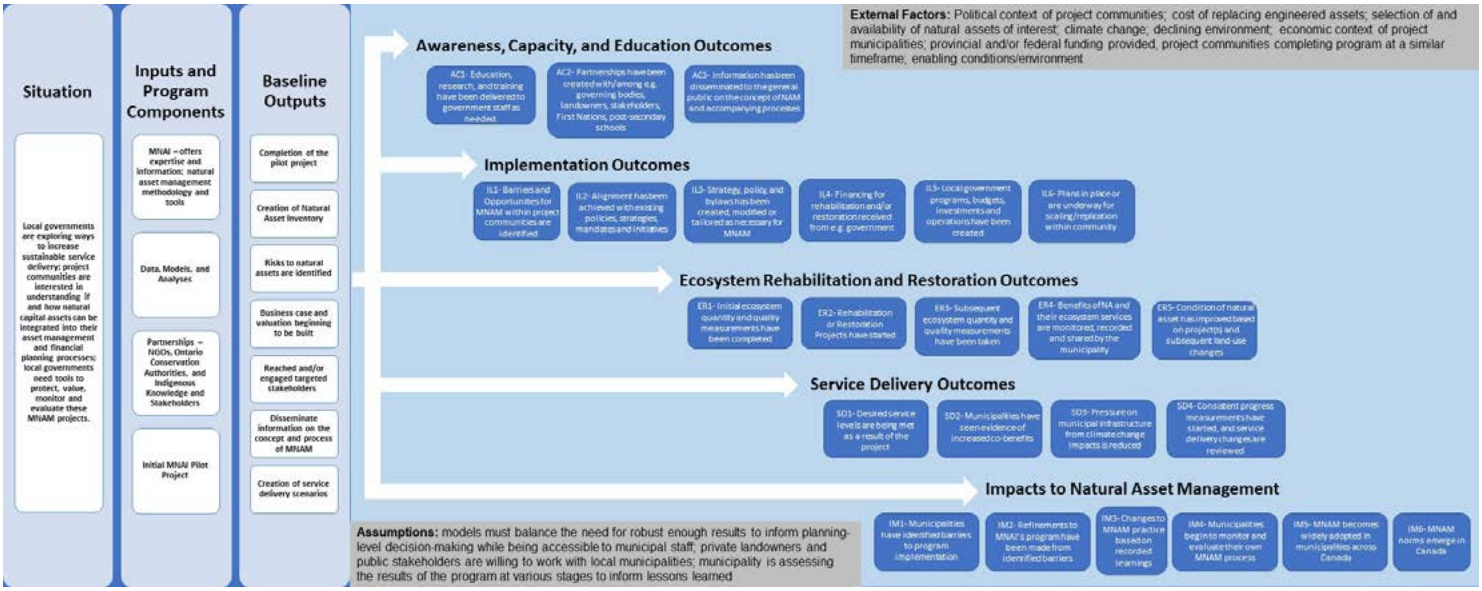


Figure 14*: A visual depiction of the five-point scoring system.*

Every colour in the scoring system signifies a specific range for the aggregate benchmarks. If a municipality reached the benchmark for the indicator, they were automatically awarded a Dark Green score. However, if the benchmark was not met, other colours were awarded based on the proportion reached compared to the set benchmark. In the evaluation matrix, these benchmarks come in the form of a percentage. For example, consider the above scoring depiction for the following indicator: "number of townhalls, information sessions, and other general consultation events for natural asset management." This indicator has two separate benchmarks. If 50% of the information materials include one reason for conducting municipal natural asset management, then the municipality was awarded a Yellow score for that indicator variable. If a municipality does not have the data necessary for a score to be given (i.e., no available attendance data when the benchmark specifically states an increase in attendance), then a Grey score was awarded. For the individual benchmarks, or benchmarks that are looking for a numbered minimum (i.e., one partnership or one site identified for ecosystem rehabilitation and restoration), only Dark Green, Red, or Grey was used.

This scoring system does rely on some subjective interpretation for awarding scores. However, subjectivity in qualitative monitoring and evaluation frameworks is common. It can be effective in identifying what should be counted or measured, how data should be categorized or recorded, what the data sources are, and what features of a program contribute to its outcomes (Bamberger et al. 2012). For this version of the monitoring framework, scores were assigned at the discretion of the monitoring team based on their interpretation of the indicator, the indicator variable, and the benchmark in the evaluation matrix. Section 3.5 of this report discussed the next steps of this research, which included changing the monitoring framework towards an automated or systematic process, thereby removing subjective interpretation.

Appendix 5 – Program Logic Model



Appendix 6 – Evaluation Matrix

Evaluation Question/ Problem	Indicator	Data Source	Analysis Method	Timing	Benchmarks
Are the municipalities meeting the awareness, capacity, and education outcomes? **Goals:** To ensure staff are operating with the appropriate awareness and education when beginning to implement municipal natural asset management (MNAM). Further, they have established the appropriate capacity to integrate natural asset management (NAM).					
AC1 **Question 1 – Have relevant municipal staff been trained in NAM?**	Number of relevant staff having participated in NAM training	Human resources records on staff training received	Percentage of staff who participated in NAM training	After municipality has started with NAM training	All (100%) of relevant staff have received NAM training
		Interviews with managers asking about staff training received	Percentage of staff who participated in NAM educational activities		
AC1 **Question 2 – Have levels of education on natural assets increased among relevant municipal staff?**	Staff rated education level with natural asset concepts after NAM training	Human resource training records and responses to training	Percentage of staff who participated in NAM training	After municipality finished MNAM training and educational activities	All (100%) of relevant staff have received NAM training
		Example survey item: "Rate your education level regarding NAM" – verbal indicators (very good, good, somewhat, etc.)	Percentage of staff who give a high rating in NAM education		At least half (50%) of all relevant staff are (self-)rated as having high NAM education
		Interviews with managers asking about staff NAM education levels	Percentage of staff who are rated as having high rating in NAM education		
AC1 **Question 3 – Have relevant municipal staff understood how the program can change their service delivery?**	Number of staff who understand natural assets can deliver municipal services	Example survey item: "Please state your agreement or disagreement with the following statement: Natural wetlands can store rainwater during major downpours."	Percentage of correct responses	After municipality finished MNAM training and educational activities	All (100%) of responses are correct
		Interviews with staff asking, e.g.: "Can you provide an example of how a natural area delivers a public service in your community?"	Coded segments of interview transcripts provide credible examples of service delivery by NAs		All (100%) of relevant staff provide at least one example of a public service provided by NAs

Evaluation Question/ Problem	Indicator	Data Source	Analysis Method	Timing	Benchmarks
AC2 **Question 1 – Have municipal staff incorporated relevant local knowledge and concerns?**	Number of engagements with local sources of knowledge	Government records regarding engagements with local sources of knowledge (e.g., open houses, interviews, door-to-door campaigns)	Number of engagements that incorporate local sources of knowledge	After municipalities have established engagements	At least one (1) engagement with local sources of knowledge for each major program phase
AC2 **Question 2 – Have municipal staff partnered with academic institutions, relevant local non-government institutions, or private landowners?**	Number of formal and informal partnerships with academic institutions, relevant local non-governmental institutions, or private landowners	Municipal records on formal and informal partnerships with academic institutions, relevant local NGOs, or private landowners	Number of formal and informal partnerships that involve academic institutions, relevant local non-governmental organizations, or private landowners	After municipalities have established said formal and informal partnerships	At least one (1) formal or informal partnership is with academic institutions, relevant local non-governmental organizations, or private landowners
AC3 **Question 1 – Have municipalities made the general public aware of natural asset management occurring?**	Number of townhalls, information sessions, and other general consultation events for NAM	Municipal records and meeting minutes on public consultation efforts	Percentage of NAM consultation events with high attendance in comparison to other consultation events	After initial public consultation efforts and the dissemination of informational materials	More than 50% of NAM consultation events have a high attendance rate from local citizens
		Information materials disseminated to the public	Coded segments of information materials list importance of conducting MNAM		All (100%) of information materials describe one reason for conducting MNAM
To what extent is the program meeting implementation outcomes? **Goals:** To ensure appropriate changes and steps in planning and municipal development process to reflect the importance of MNAM in municipal service delivery					
IL1 **Question 1 – Have the municipality and relevant stakeholders identified any barriers or opportunities to MNAM within the municipality?**	Number of barriers or opportunities identified for MNAM delivery within the municipality	Municipal planning documents and stakeholder responses to MNAM e.g.: • White papers • Technical reports • Financial summaries • Investigative journalism	Percentage of municipal documents that identify the issue of barriers and opportunities with specific examples	After awareness, capacity, and education outcomes	All (100%) of relevant municipal documents identify barriers and opportunities and provide specific examples
		Interviews with managers asking: "Are there any barriers or opportunities that your community encountered when attempting to integrate MNAM? Did you act upon these? How?"	Coded segments of interview transcripts on barriers or opportunities faced by the municipality		All (100%) of managers provide at least one barrier or opportunity encountered & acted uponkj

Evaluation Question/ Problem	Indicator	Data Source	Analysis Method	Timing	Benchmarks
IL1 **Question 2 – Have the municipality and relevant stakeholders acted upon identified barriers or opportunities to MNAM within the project community?**	Number of identified barriers or opportunities acted upon for MNAM delivery within the project community	Municipal planning documents and stakeholder communications, e.g.: • White papers • Technical reports • Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis	Coded segments of municipal planning documents and stakeholder responses that detail actions taken for barriers or opportunities	After awareness, capacity, and education outcomes	At least one (1) high priority barrier or opportunity within the organization's control is acted upon
IL2 **Question 1 – Can the municipality draw any alignment with existing policy and initiatives?**	Number of similarities between MNAM practice and existing policies and initiatives	Municipal planning documents e.g.: • Asset Management Plan • Technical Reports • Official Plan • Strategic Plan • Briefing notes to Council • Climate adaptation plan/ strategy	Coded segments of municipal planning documents with existing similarities to MNAM practice	After awareness, capacity, and education outcomes and during early implementation stages	MNAM is aligned with at least one existing policy or initiative
IL3 **Question 1 – Have the municipalities made changes to their OP, ZBL, Secondary Plans, etc.?**	Number of changes made to OP, ZBL, Secondary Plans, etc.	Municipal planning documents: • Asset Management Plan • Official Plan • Zoning By-law • Secondary Plans	Percentage of changes to municipal planning documents to implement MNAM	After initial implementation outcomes	All (100%) of relevant municipal planning policy documents changed to integrate MNAM practices
		Interviews with municipal planners asking: "What changes, if any, has your municipality made to implement NAM into your municipal planning policy documents?"	Coded segments of interview transcripts show changes made to planning policy documents before and after MNAM		
IL4 **Question 1 – Have new projects received funding or financing?**	Amount of funding and financing received for MNAM projects	Project funding and financing documents from e.g.: • Insurance Sector • Banking Sector • Federal and Provincial Grant Applications	Calculation of funding available per project within the municipality	After changes made to relevant municipal planning policy documents	All (100%) of MNAM projects have available funds in order to ensure a full lifecycle

Evaluation Question/ Problem	Indicator	Data Source	Analysis Method	Timing	Benchmarks
		Interviews with managers asking: "Have natural asset management projects received funding or financing? How much? From where?"	Coded segments of interview transcripts describing funding or financing received for MNAM projects		
IL5 **Question 1 – Has funding or financing been applied to the creation of new NAM programs?**	Amount of funding budgeted for a municipal natural asset management program	Program and project funding allocated to NAM projects in: • Technical reports • Budgeting documents	Calculation of funding allocated per program and project within the community	After the creation of new MNAM programs and projects	100% of MNAM programs and projects are appropriately budgeted for year-over-year operations and management
IL6 **Question 1 – Have staff created new NAM policy, strategies, and plans?**	Number of new NAM policies, strategies, and plans	Municipal planning documents e.g.: • NAM plans, policies, strategies	Percentage of NAM policies, strategies and plans created to integrate NAM within project communities	After the creation of MNAM programs and projects	All (100%) of NAM-relevant policies, strategies, and plans created to support MNAM within project community
Are municipalities on track to meet Ecosystem rehabilitation and Restoration outcomes? **Goals:** Once implementation has occurred, monitor natural assets and ecosystems to see increases in rehabilitation, restoration, or management metrics for natural asset health					
ER1 and ER3 **Question 1 – Are measurements or metrics being used for assessing ecosystem service quality?**	Number of ecosystem service quality measurements or metrics within a municipal project area kept in the natural asset inventory	Records of ecosystem service measurements or metrics in a natural asset inventory	Percentage of major ecosystem services that are assessed with a measurement or metric	After the establishment of NAM policy, strategies, and plans	All (100%) of the major ecosystem services within a municipal area have measurements or metrics stored in a natural asset inventory
ER1 and ER3 **Question 2 – How many natural assets areas have measurements been taken from?**	Number of natural asset areas with measurements identified in the natural asset inventory	Records of measurements or metrics for natural asset sites within the municipality kept in the natural asset inventory	Percentage of identified natural asset areas with measurements	After the creation of the natural asset inventory and the establishment of NAM policy, strategies, and plans	All (100%) of major natural asset areas within the municipality have measurements taken
ER2 **Question 1 – Has the municipality created a rehabilitation or restoration project?**	Number of sites selected as potential rehabilitation or restoration project(s)	Municipal Planning Documents including, but not limited to: • Rehabilitation or Restoration Project Technical Report(s) • Environment and Lifecycle Assessments	Number of potential sites identified within the municipality	After initial measurements of ecosystem quantity and quality within the project community	Community has identified a (one) possible site for the creation of a NAM project that fits with larger NAM goals

Evaluation Question/ Problem	Indicator	Data Source	Analysis Method	Timing	Benchmarks
			Coded segments of NAM planning policy documents that describe potential sites and reasoning for a rehabilitation or restoration project		
Question 2 – Where natural assets are intact and healthy, has the municipality created an operations and maintenance plan?	Creation of an operations and maintenance plan	Municipal Planning Documents including, but not limited to: • NA Operations and Maintenance Plan	Coded segments of NAM planning documents that describe maintenance and operations	After initial measurements of ecosystem quantity and quality within the municipality	Local government has outlined a maintenance plan for the next 10 years
ER3 **Question 1 – Is the quality of ecosystem service improving?**	Number of target ecosystem services that have seen improvement due to NA rehabilitation and restoration	Records of improvement in ecosystem service measurements or metrics in a natural asset inventory	Percentage of targeted ecosystem services that have seen improvement over a given time-period (e.g., 5-year, 10-year)	After the creation of rehabilitation and restoration project(s) or an operations and maintenance plan (e.g., 1-year, 5-year, 10-year)	All (100%) of target ecosystem services show improvement– e.g., RTE Abundance, RTE Diversity, Buffer Suitability of Surrounding Land, Area of Protected Zone
ER4 **Question 1 – Has the monitoring of NA and ecosystem services occurred?**	Number of relevant indicators identified for monitoring and evaluation	Municipal documents of a monitoring framework including e.g.: • evaluation plan • program logic model • evaluation matrix	Coded segments of municipal documents that detail indicator, data source, analysis method, timing, and benchmark	1 year after the creation of the NAM project	Municipality has identified at least one (1) key indicator for the lifecycle of the NAM project(s)
		Interviews with managers asking: "Has your team selected any relevant indicators for the creation of a monitoring framework? What are those indicators?"	Coded segments of interview responses which detail the selection of relevant indicators		
ER4 **Question 2 – Have the relevant indicators been measured and evaluated?**	Percentage change in relevant indicators identified for monitoring and evaluation	Municipal documents of completed evaluations	Coded segments of municipal documents that detail changes in relevant indicators	After the completion of the first evaluation	All (100%) of relevant indicators have been measured and evaluated

Evaluation Question/ Problem	Indicator	Data Source	Analysis Method	Timing	Benchmarks
ER5 **Question 1 – Has the condition of natural assets improved based on projects and subsequent land-use changes?**	Improvement of natural assets in the scoring of key tracking metrics as selected by the municipality	Records of natural asset condition and relevant metrics stored within natural asset inventory	Percentage of improvement in key tracking metric since the commencement of MNAM and the rehabilitation and restoration project	After the implementation of the NAM project	Higher natural asset condition performance as indicated by key tracking metric
		Municipal planning documents: • Technical Reports • Lifecycle and Environmental Assessments			
Are municipalities on track to meet service delivery outcomes? **Goals:** Once MNAM projects have matured in their lifecycle, service delivery levels are met and benefits not possible with grey infrastructure are recorded.					
SD1 **Question 1 – Due to the rehabilitation and restoration project, are desired sustainable service levels being reached?**	Number of municipal services now supplemented by natural asset management projects and policies	Municipal planning documents: • Lifecycle Assessment • Asset Management Reports regarding service level delivery	Number of services now supplemented by natural asset management	After the implementation of the NAM project	Municipal services are supplied through natural assets that supplement grey infrastructure
SD2 **Question 1 – Is there record of increased co-benefits?**	Percentage increase in co-benefits metrics monitored by the municipality e.g., importance of CES as recreation	Records of increased use of natural areas e.g., for leisure, recreation after management or restoration	Calculation of the increase of co-benefits from natural asset management project(s)	After the implementation of MNAM	Increase in co-benefits from natural asset management
SD2 **Question 2 – Is there record of decreased negative effects?**	Percentage decrease of negative effect metrics monitored by municipality e.g., number of urban heat stroke cases	Urban temperature measurements for UHI, general public and municipal staff, hospital records	Calculation of the decrease of negative effects from natural asset management project(s)	After the implementation of MNAM	Decrease in negative effects of dense grey infrastructure and built environment
SD3 **Question 1 – Has pressure been reduced on traditional municipal infrastructure that would have been impacted by climate change?**	Amount of municipal budget forecast to be spent on renewing grey infrastructure for climatic change	Interviews with managers asking: "Do you expect less spending on municipal services because of the services provided by natural assets?"	Coded segments of interview responses which detail an expectation that spending will decrease due to municipal natural asset management	After the implementation of MNAM policies and plans	Decrease in municipal budget forecasted to be spent on retrofitting and renewing grey infrastructure
SD4 **Question 1 – Are municipalities measuring and reviewing progress to their service delivery?**	Number of service delivery progress reports and updates delivered to key stakeholders	Record of municipal documents: • Service Delivery Reports	Coded segments of municipal documents that explain changes to service delivery due to MNAM	After the creation of an initial monitoring framework and internal evaluation plan	At least 1 service delivery progress measurement report written after first 5 years of MNAM

Appendix 7 – Interview Guide

As described in Appendix 3 and Appendix 4, this monitoring report applied 11 evaluation questions from the evaluation matrix (Appendix 6). However, this interview guide created interview questions for almost all 26 evaluation questions in the matrix. The interview questions used for this report and the corresponding evaluation questions are surrounded by asterisks (e.g., *example *).

AC1 QUESTION 1 – HAVE RELEVANT MUNICIPAL STAFF BEEN TRAINED IN NATURAL ASSET MANAGEMENT?

Interview Question: How much training or education have municipal staff received on natural asset management and related concepts such as ecosystem services management?

Who is this addressed to: Managers

Reasoning: Our evaluation needs to know what training has prepared municipal staff to implement natural asset management. If the training was successful or has received positive feedback from managers and staff, then other municipalities should look to adopt similar training. Furthermore, we also want to compare training received with education levels of staff before implementing natural asset management to ensure that the project has a greater chance of success.

Interview, Survey or Both: Interview

AC1 QUESTION 2 – HAVE LEVELS OF EDUCATION ON NATURAL ASSETS INCREASED AMONG RELEVANT MUNICIPAL STAFF?

Interview Question: What would you rate your staff's education level of natural asset management or related issues such as ecosystem services management? Why would you give this rating? Would you say there has been an increase in your staff's education level from when you first started this project?

Who is this addressed to: Interview for managers, Survey for staff

Reasoning: As stated in the question above, we want to be able to compare responses from the training question to levels of education to see where staff are being trained in natural asset management, and how effective that training is in delivering an increased education of key natural asset management concepts. As well, we also want to see if high education levels in natural assets lead to ease of implementation of natural asset management.

Interview, Survey or Both: Both – survey question could be a self-rating from staff while interview question for managers would be more generic and take an overview of the entire team/department.

AC1 QUESTION 3 – HAVE RELEVANT MUNICIPAL STAFF UNDERSTOOD HOW THE PROGRAM CAN CHANGE THEIR SERVICE DELIVERY?

Interview Question: Can you provide an example of how a natural area delivers a public service in your community?

Who is this addressed to: Municipal staff

Reasoning: This is a question to see if municipal staff understand the connection between municipal services and protecting natural assets. As well, this question may give insights on staff understanding of how municipal natural asset management operates in their municipality. Lastly, the details in their response may give some insights into their level of education on key concepts.

Interview, Survey or Both: Interview

AC2 QUESTION 1 – HAVE MUNICIPAL STAFF INCORPORATED RELEVANT LOCAL KNOWLEDGE AND CONCERNS?

Interview Question: Are there specific local stakeholders with knowledge of your natural assets or ecosystem services? Have you engaged with them? Have they provided any input and how has this been addressed?

Who is this addressed to: Managers

Reasoning: Participatory approaches to environmental planning have proven to be highly effective, as shown in the literature. Therefore, project communities should look at engaging with local stakeholders who know their natural assets that municipalities have either not considered or have not been aware of. This could include private landowners, local climate scientists, activists, etc. As well, these stakeholders could be a potential barrier if their concerns go unheard in the education and capacity outcome stream.

Interview, Survey or Both: Interview

*AC2 QUESTION 2 – HAVE MUNICIPAL STAFF PARTNERED WITH ACADEMIC INSTITUTIONS, RELEVANT LOCAL NON-GOVERNMENT INSTITUTIONS, OR PRIVATE LANDOWNERS? *

***Interview Question:** Are you aware of any partnerships or collaborations with other organizations to implement natural asset or ecosystem services management in your municipality? What kind of partnerships are these, who participates, and what are the benefits for the partners? **

Who is this addressed to: Managers

Reasoning: Although these partnerships may not be formal, it is important to be aware of who municipalities are working with, no matter the capacity. For example, some municipalities in Ontario may have partnerships with conservation authorities that are not available to municipalities in other provinces. If these partnerships are effective, they could be recommended for other municipalities in their relevant contexts.

Interview, Survey or Both: Interview

*AC3 QUESTION 1 – HAVE THE MUNICIPALITIES MADE THE GENERAL PUBLIC AWARE OF NATURAL ASSET MANAGEMENT OCCURRING? *

***Interview Question:** What public engagement efforts have you made to make the general public aware of natural asset or ecosystem services management? *

Who is this addressed to: Managers

Reasoning: Although we are not speaking to the general public on natural asset management occurring in their community, it is important to understand how the municipality is engaging with the public regarding changes and the reasoning for this. As well, knowing which engagement activities worked well may be useful for other municipalities.

Interview, Survey or Both: Both – Survey question could be "Select the kinds of public consultation efforts your municipality has made for making the public aware of natural asset management – open house, pamphlets, informational packets, etc."

*IL1 QUESTION 1 – HAVE THE MUNICIPALITY AND RELEVANT STAKEHOLDERS IDENTIFIED ANY BARRIERS OR OPPORTUNITIES TO MNAM WITHIN THE PROJECT COMMUNITY? *

***Interview Question:** Are there any barriers or opportunities that the municipality or your partners have encountered when attempting to implement municipal natural asset or ecosystem services management? Did you act upon these? How did you do that? *

Who is this addressed to: Managers

Reasoning: We have previous research completed on this very subject, but it is important to compare that research to the experiences of project communities and whether there is any new information on this subject. We should also acknowledge that our prior work might not have covered all barriers and opportunities. As well, insights on this topic should be shared with other municipalities that encounter similar barriers or opportunities.

Interview, Survey or Both: Interview

IL1 QUESTION 2 – HAVE THE MUNICIPALITY AND RELEVANT STAKEHOLDERS ACTED UPON IDENTIFIED BARRIERS OR OPPORTUNITIES TO MNAM WITHIN THE PROJECT COMMUNITY?

Interview Question: Not needed as a separate interview question – potential answers are covered in interview question IL1 Q1.

Who is this addressed to: N/A

Reasoning: N/A

Interview, Survey or Both: N/A

IL2 QUESTION 1 – CAN THE MUNICIPALITY DRAW ON ANY ALIGNMENT OF NATURAL ASSETS MANAGEMENT WITH EXISTING POLICY AND INITIATIVES?

Interview Question: Can you name and explain at least one existing municipal policy initiative or planning goal that natural asset or ecosystem services management aligns with in your community?

Who is this addressed to: Managers

Reasoning: This question not only looks to see if there is alignment for implementing natural asset management but if project communities are already thinking of climate resilience in their municipal planning. If climate resilience is already a serious policy issue

for the municipality, there may be more instances of alignment, and therefore, ease of implementation.

Interview, Survey or Both: Interview

*IL3 QUESTION 1 – HAS THE MUNICIPALITY MADE CHANGES TO THEIR OFFICIAL PLAN, ZONING BY-LAW, SECONDARY PLANS, ETC.TO ACCOMMODATE NATURAL ASSET OR ECOSYSTEM SERVICES MANAGEMENT? *

***Interview Question:** What changes, if any, has your municipality made to implement natural asset or ecosystem services management into your municipal planning policy, such as your Official Plan, By-laws, etc.? *

Who is this addressed to: Managers

Reasoning: For implementation to occur on a comprehensive level, measured changes need to be made to appropriate policies. While each municipality's official plan or zoning by-law will be different, similar changes could be adopted by other municipalities. Furthermore, responses to these changes from the public could provide additional insights.

Interview, Survey or Both: Interview

*IL4 QUESTION 1 – HAVE NEW PROJECTS RECEIVED FUNDING OR FINANCING? *

***Interview Question:** Have natural asset or ecosystem services management projects received funding or financing? Was this funding or financing sufficient to complete the project as planned? From where did the funding or financing come? *

Who is this addressed to: Managers

Reasoning: Although specifics may be difficult to provide, how much funding projects have to work with and where this funding was provided from will not only aid other municipalities looking to start municipal natural asset management but can also lead to other research opportunities. These research opportunities include investment patterns, investment structures, and willingness-to-pay studies. As well, exploring available funding opportunities can show potential financiers where there are existing gaps. Finally, the level of funding relative to the required funds could contribute to an understanding of project success.

Interview, Survey or Both: Interview

IL5 QUESTION 1 – HAS FUNDING OR FINANCING BEEN APPLIED TO THE CREATION OF NEW NATURAL ASSET MANAGEMENT PROGRAMS OR PLANS?

Interview Question: Has the municipality funding budgeted to implement a new natural asset or ecosystem services management program or plan? What kinds of programs or plans are these and what aspects of these programs or plans are funded?

Who is this addressed to: Managers

Reasoning: Although much of this question may be covered by internal municipal planning documents, the second part of the interview question could be critical. Determining where the most amount of funding is needed and how municipalities are approaching budgeting for natural asset management could yield insights on where investments are needed on a program-level. This question goes beyond IL5 Q1 as budgeting should extend beyond individual project implementation to the larger program level.

Interview, Survey or Both: Interview

*IL6 QUESTION 1 – HAVE STAFF IMPLEMENTED NEW NAM PROGRAMS OR PLANS? *

***Interview Question:** Has the municipality implemented, or is currently implementing, natural asset or ecosystem services management programs or plans? *

Who is this addressed to: Managers

Reasoning: This question goes beyond IL6 Q1 is addressing whether natural asset or ecosystem services management programs or plans actually are being carried out. Answers to this question might already be provided during IL6 Q1 or the answer to IL6 Q1 might have been 'no' in which case this question could be skipped.

Interview, Survey or Both: Interview

*ER1 AND ER3 QUESTION 1 – ARE MEASUREMENTS OR METRICS BEING USED FOR ASSESSING ECOSYSTEM SERVICE QUALITY CHANGES FROM BEFORE TO AFTER ECOSYSTEM REHABILITATION OR RESTORATION? *

***Interview Question:** Can you name and describe a metric the municipality is using to monitor ecosystem service quality improvements achieved through an ecosystem rehabilitation or restoration project? *

Who is this addressed to: Managers

Reasoning: This interview question tries to gain insight on several key areas in ecosystem rehabilitation and restoration. The first area is what qualitative or quantitative metrics municipalities are using. The second, which is much more subtle, is what metrics are most important to the municipality, and thus, the first to come to mind during an interview. A ranking of metrics could provide information on what ecosystem services municipalities are focusing on and why. The third area is whether municipalities are assessing ecosystem rehabilitation and restoration outcomes at all to establish whether the project was successful.

Interview, Survey or Both: Both – this same question could be included on a survey as a fill-in-the-blank or as a choice amongst several.

ER1 AND ER3 QUESTION 2 – HOW MANY NATURAL ASSET AREAS THAT HAVE BEEN REHABILITATED OR RESTORED HAVE MEASUREMENTS BEEN TAKEN FROM?

Interview Question: How many and which natural asset areas or ecosystems that have been rehabilitated or restored is your municipality monitoring?

Who is this addressed to: Managers

Reasoning: Ultimately, one of the goals of MNAI is to protect and conserve as many natural areas as possible from degradation. Therefore, MNAI will want to know how many natural assets municipalities are protecting, restoring, or rehabilitating. However, this answer could also be contingent on an existing green infrastructure network, the urban density of the project community, and the availability of natural assets within municipal boundaries. All these considerations will be a part of the answers here and lead to additional insights for the evaluation.

Interview, Survey or Both: Both – could work as a survey question for managers as well, same question, given a range for a number of areas (1-5, 5-10, 10-15, etc.)

*ER2 QUESTION 1 – HAS THE MUNICIPALITY CREATED REHABILITATION OR RESTORATION PROJECTS? *

***Interview Question:** Did the municipality conduct natural asset or ecosystem

rehabilitation or restoration projects? Why did the municipality select these areas for rehabilitation or restoration? *

Who is this addressed to: Managers

Reasoning: As we address in the next evaluation and interview question, not all natural assets require restoration or rehabilitation. However, understanding the reasoning behind why a site was selected for rehabilitation or restoration is important as it could demonstrate the kinds of decisions municipalities make in these areas. This could include service delivery, ease of restoration or rehabilitation, cost, etc.

Interview, Survey or Both: Interview

ER2 QUESTION 2 – WHERE NATURAL ASSETS ARE INTACT AND HEALTHY, HAS THE MUNICIPALITY CREATED AN OPERATIONS AND MAINTENANCE PLAN?

Interview Question: Does the municipality have in place monitoring and maintenance plans for healthy natural assets or ecosystems?

Who is this addressed to: Managers

Reasoning: This question would be for project communities who already have healthy natural assets and inquires whether they have created an operations and maintenance plan. This question aims at covering the whole natural asset portfolio of the municipality, not just the assets that require restoration or rehabilitation as in ER2 Q1.

Interview, Survey or Both: Interview

ER3 QUESTION 1 – IS THE QUALITY OF ECOSYSTEM SERVICES IMPROVING?

Interview Question: Have you seen an improvement in the metrics your team or municipality is using to monitor ecosystem service quality?

Who is this addressed to: Managers

Reasoning: This question complements question ER1 & ER3 Q1. It focuses on whether the ecosystem rehabilitation and restoration projects were successful in improving natural asset health and ecosystem services delivery. As well, this question also addresses the metrics selected for measurement. What we would be looking for is not only an improvement in key metrics but what metrics are improving and by how much. This could provide critical information for other municipalities looking to start their natural asset management journey.

Interview, Survey or Both: Interview

ER4 QUESTION 1 – HAS THE MONITORING OF NATURAL ASSETS AND ECOSYSTEM SERVICES OCCURRED?

Interview Question: Has the municipality monitoring plans in place for the services produced by its natural assets or ecosystems?

Who is this addressed to: Managers

Reasoning: While we are creating an evaluation framework here, we want municipalities to commit to a monitoring framework as these projects evolve over the decades. If these monitoring frameworks are successful in their municipalities, we should look to translate them into other project communities. Different from ER1 & ER3 Q1, this question is not focused on rehabilitation or restoration project outcomes but service delivery by natural

assets or ecosystems over the longer term.

Interview, Survey or Both: Interview

*ER4 QUESTION 2 – WHICH INDICATORS ARE BEING USED FOR THE MONITORING OF NATURAL ASSETS AND ECOSYSTEM SERVICES AND HAVE THE INDICATORS BEEN EVALUATED? *

***Interview Question:** Which indicators is the municipality using for the monitoring of its natural assets and ecosystem services? How have these indictors been decided upon and evaluated for usefulness? *

Who is this addressed to: Managers

Reasoning: This question would be a follow-up to the interview question for ER4 Question 1. The indicators used for evaluation and monitoring could inform how effective these approaches are and whether changes need to occur, especially if the municipality is unfamiliar with program or plan evaluation. As well, if the municipality is familiar with program or plan evaluation, their approach could be beneficial for other project communities starting their natural asset management journey.

Interview, Survey or Both: Interview

ER5 QUESTION 1 – HAS THE CONDITION OF NATURAL ASSETS OR ECOSYSTEMS IMPROVED BASED ON PROJECTS AND SUBSEQUENT LAND-USE CHANGES?

Interview Question: Has the condition of natural assets or ecosystems in the municipality improved? Which actions at the operational or policy level have led to this?

Who is this addressed to: Managers

Reasoning: Overlapping with ER3 Q1 but at a larger scale. ER3 Q1 aims at individual ecosystems while the current questions aim at the landscape-scale. While this study may not have the capacity to verify or compare this improvement to a standard, it does provide insight on what kinds of actions project communities are using and whether other municipalities could also use these actions.

Interview, Survey or Both: Interview

SD1 QUESTION 1 – DUE TO THE REHABILITATION AND RESTORATION PROJECT, ARE DESIRED SUSTAINABLE SERVICE LEVELS BEING REACHED?

Interview Question: Has the delivery of municipal services in your community changed since implementing natural asset or ecosystem services management? If it has improved, has natural asset or ecosystem services management contributed to this improvement?

Who is this addressed to: Managers or municipal staff

Reasoning: While this question could work as just an interview question for managers, a survey question allows us to reach a larger number of staff who may have received more feedback from users, residents, or other stakeholders. As well, one natural asset area may provide several services that can go beyond the scope of one department. However, as a survey question, we lose the ability to ask what municipal services specifically or how staff understand "improvement."

Interview, Survey or Both: Both

*SD2 QUESTION 1 – IS THERE RECORD OF INCREASED CO-BENEFITS? *

***Interview Question:** Are you monitoring any co-benefits of natural asset or ecosystem

services management? Is there evidence of such co-benefits occurring? *

Who is this addressed to: Managers

Reasoning: This question has several different threads it can follow, just based on the sheer number of co-benefits offered by natural assets. However, there may be a select number of co-benefits that most project communities are focusing on, specifically around regulating ecosystem services and cultural ecosystem services. While not the focus of this research, these co-benefits may provide additional insight. As well, the performance of these benefits could also provide evidence for the usefulness of natural asset management. Having said that, these co-benefits might be difficult to establish and connect to natural asset management.

Interview, Survey or Both: Interview

SD2 QUESTION 2 – IS THERE RECORD OF DECREASED NEGATIVE EFFECTS OF URBANIZATION OR ENVIRONMENTAL DEGRADATION?

Interview Question: Are there any negative effects of urbanization or environmental degradation you are monitoring? Is there evidence of these negative effects decreasing because of natural assets or ecosystem services management?

Who is this addressed to: Managers

Reasoning: Like SD2 Q1, this interview question follows similar reasoning. For example, there could be several negative effects of urbanization or other environmental degradation, but municipalities may only be monitoring a select few that are the most concerning. The insights from this question could also warrant additional research on this topic. Having said that, a decrease in these negative effects might be difficult to establish and connect to natural asset management.

Interview, Survey or Both: Interview

*SD3 QUESTION 1 – HAS PRESSURE BEEN REDUCED ON TRADITIONAL MUNICIPAL INFRASTRUCTURE THAT WOULD HAVE BEEN IMPACTED BY CLIMATE CHANGE? *

***Interview Question:** Are spending increases on municipal services due to climate change being limited because of the services provided by natural assets or ecosystems? *

Who is this addressed to: Managers

Reasoning: While our evaluation question may be difficult to get a complete answer for, this interview question can provide some insights on how natural asset management is changing service delivery in project communities in the current climate change context. Specifically, if municipalities are expecting to spend less on municipal services, natural asset management could be providing similar services for that cost.

Interview, Survey or Both: Interview

SD4 QUESTION 1 – ARE MUNICIPALITIES MEASURING AND REVIEWING PROGRESS TO THEIR SERVICE DELIVERY?

Interview Question: Are you, or are you intending to, monitor progress in your municipal service delivery with natural asset or ecosystem services management? What are the results of this monitoring thus far?

Who is this addressed to: Managers

Reasoning: One of the intended goals of MNAI is the independent progress of municipalities in MNAM. Part of our evaluation should look to see what municipalities have planned to do after the conclusion of their pilot project in the long run. As well, we would also want to see if municipalities will share that information not only with us as the evaluators but with other municipalities interested in natural asset management.

Interview, Survey or Both: Interview

Municipal Natural Assets Initiative

Making Nature Count