

APPROACHING MNAM

# **APPROACHING MUNICIPAL NATURAL ASSET MANAGEMENT**

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A Capstone submitted to the Faculty of Graduate Studies of  
The University of Manitoba

April 19, 2019

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## ABSTRACT

Local governments across Canada are continually faced with challenges to asset management. The demand on service provision including for water, waste (water) management, and transportation, are largely dependent on engineered infrastructure assets which will need to be renewed in the future. Added to this, the adverse effects of climate change, in the face of an increasing global population, threaten increased strain on local government budgets going forward. Through semi-structured interviews, I examined the outcomes and perceived benefits, challenges and barriers, and recommendations for the future implementation of municipal natural asset management (MNAM) processes in Canada. I found that while the potential for the effective and practical implementation of these approaches is high, there remain both real and perceived uncertainties regarding process frameworks of MNAM and environmental valuation as a whole, which may limit the adoption of these approaches. Additional evidence to support the practicality of MNAM, policy supports and changes to traditional asset management frameworks are likely needed to advance the adoption MNAM to broader audiences.

## Acknowledgments

This work could not have been completed with the gracious support of many people. I want to thank my internal advisor Dr. David VanVliet for his insightful comments, time, and advice during this project. Thanks also to my external advisor Dr. Henry David (Hank) Venema, and my course instructor Dr. Orly Linovski who played an essential role in shaping this document. I thank the University of Manitoba, the Faculty of Graduate Studies, and the Department of City Planning. I also thank my family, friends, and fellow students who supported me throughout this program.

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## APPENDIX

## 1.0 INTRODUCTION

This chapter introduces the topic of natural asset management and the lack of its inclusion into traditional asset management and municipal accounting frameworks. It begins with a background describing mounting pressures facing governments and increased recognition of environmental value. Next, it introduces natural asset management. The third and fourth sections present my research questions and provide an overview of the paper.

Increasing global population, rising demand for natural resources, and the effects of climate change are fueling governments, at all scales, to identify and adopt alternative management strategies to help ensure the continued growth and development of society while also supporting the long-term functioning of the Earth's life-support systems. With respect to local governments, asset management, the provision of cost-effective and resilient community services such as water and wastewater management, and transportation and environmental services, are vital responsibilities which are in many ways dependent on engineered infrastructure (MNAI, 2017, p. 4). Mounting evidence suggests that natural assets such as wetlands, aquifers, and forests provide substantial financial value, which has not been captured or recognized by traditional asset management or accounting frameworks, particularly at the local level. By not recognizing the value of these assets or incorporating this value into management strategies, governments are risking the degradation or loss of the asset. Advancing asset management in the development and integration of processes or frameworks which enable the recognition of natural assets, as well as guide municipalities and local governments considering natural asset solutions, is required. Such processes may offer local governments a means to retain and generate a previously unexplored value stream, helping to counteract the impending financial challenges associated with increasing populations, environmental degradation, and climate change.

The concepts of 'natural assets' or 'natural capital' that have emerged in recent decades reflect the recognition that environmental assets, systems, and services provide a fundamental role in facilitating societies economic and social structures (European Environment Agency, 2016). The major challenge here is that although these services are essential to the functioning

of society, they have remained largely or entirely ignored by traditional accounting and financial reporting systems. By not taking stock or recognizing the value of our natural assets, we risk: increased financial costs for the construction engineered assets, the inability to replace the assets (with limited knowledge on the means and method of replacement), and the loss of potential value streams that may be provided by these assets.

To counteract these challenges and to advance new and far more effective asset management, we need to address the current lack of framework and of understanding of how to go about valuing our natural assets. As there is little legal framework or precedents that include natural asset management (most notably at the municipal and regional level), there has traditionally been little to no support begin to expand management to include of these assets. Recent examples of potential support for this include the establishment of natural resource asset accounts (from the Canadian System of Environmental and Resource Accounts), which measure quantities of natural resource assets (oil, natural gas, minerals, and timber). Second, as part of the Federal Gas Tax Agreement, municipalities, such as those in Manitoba are required to implement asset management. This agreement required municipalities to develop and implement asset management plans before March 31, 2018 (Association of Manitoba Municipalities, 2015). Gas Tax funding supports municipalities in implementing sustainable infrastructure. Third, and most relevant for this research, is the formation of Municipal Natural Asset Initiative (MNAI) which supports and guides municipalities in identifying, evaluating, and accounting for natural assets in their asset management and financial reporting using scientific, economic, and local expertise.

## 1.1 NATURAL ASSET MANAGEMENT

Natural asset management (NAM) is a strategy for identifying, evaluating, and planning for the Earth's stock of natural assets. These assets, which may include soil, air, water, flora, and fauna, also include the flows of goods and services provided by nature, otherwise known as ecosystem services (World Forum on Natural Capital, 2017). Governmental and jurisdictional bodies at multiple scales, including those in Canada, have begun to realize both the potential

values offered by ecosystem services, including their tangible and intangible values as well as the risks associated with their degradation or loss (European Environment Agency, 2016).

At the local scale, natural asset management has remained a relatively under-researched topic area, with still few applications. While natural assets, such as local aquifers, rivers, wetlands, foreshore areas are typically heavily relied on by local communities for the value and services they derive from those assets, this is often unrecognized. With this in mind, natural assets are rarely valued in the same way that engineered assets are, and furthermore, their value is often not optimized and is instead risked, due to mismanagement. Risks of maintaining the status quo with regards to the treatment of our natural assets include: increased financial costs (cost of constructing engineered infrastructure) when the natural asset degrades or ceases function, the inability to replace the service offered by a particular asset, losing a potential value stream that could help replace the costs of municipal infrastructure.

As NAM at the municipal or local government scale is an emerging topic, it is essential to understand the current frameworks for its implementation and the challenges that have been faced in its adoption. The outcomes of these processes provide crucial information that may help us better understand how to improve or adopt similar processes in other municipalities more effectively. By providing insight into the formal processes which have been adopted for use, this research may help identify what MNAM strategies have been effective and whether these processes are versatile and able to be applied in different contexts and scales.

## 1.2 RESEARCH QUESTIONS

The following research questions guide this capstone's examination of the opinions and experiences of individuals who have or currently are participating in undertaking one or more of the Municipal Natural Asset Initiative's (MNAI's) projects found across Canada.

1. What are the outcomes and perceived benefits of MNAM processes and frameworks in Canada?
2. What challenges or barriers have been faced in implementing these processes?
3. What recommendations could be made to advance MNAM in future communities?



### 1.3 PROJECT OVERVIEW

In Chapter 1, I introduced the topic of natural asset management, identified the need for change regarding current practice in Canada, and presented the key research questions directing the project. In Chapter 2 I provide an overview of the literature relating to the scope for municipal natural asset management, the valuation of the environment and ecological services, and the role of municipalities. Chapter 3 describes the research methodology I used to collect, code, and analyze my data. To provide both a theoretical context as well as a framework to guide the research, Chapter 4 provides a comprehensive review of the current context of MNAM. In chapter 5 I present the results of my research though, as much as possible, direct observation. These results were aggregated based on my three research questions. Chapter 6 includes the discussion and interpretation of the results of the research. I attempt to distill the analysis from the preceding chapters by applying the theoretical data gathered in Chapter 3 to the research. Lastly, Chapter 7 provides a conclusion to the research by summarizing how the research questions were addressed, extracting lessons learned, and offering some final thoughts for future research.

## 2.0 LITERATURE REVIEW

This chapter focuses on literature addressing the valuation and inclusion of nature and natural systems into municipal management practices. It begins by scoping the management of natural assets. The review then transitions to a discussion of the discourse in the valuation of the environment and ecological services.

### 2.1 SCOPING MUNICIPAL NATURAL ASSET MANAGEMENT (MNAM)

According to MNAI (2017) “[M]unicipal natural asset management (MNAM) is one of many approaches being developed to advance the recognition of natural assets in decisions about the management of municipal infrastructure assets” (p.4). With this in mind, differentiating how MNAI define and scope MNAM from other approaches that relate to the management of municipal infrastructure assets is essential to understand and assess the concept.

#### 2.1.1 WHAT ARE NATURAL ASSETS AND NATURAL CAPITAL?

The terms natural capital, and natural assets, functionally have the same meaning but have accrued a number of variable definitions over time (MNAI, 2017). Guerry et al. (2015) claim that “[n]atural capital refers to the living and nonliving components of ecosystems—other than living people and what they manufacture and contribute to the generation of goods and services of value for people” (p. 7349). According to the Natural Capital Declaration, “[t]he term ‘capital’ has been borrowed from the financial sector to describe the value of the resources and ability of ecosystems to provide flows of goods and services such as water, medicines and food” (UNEP Finance Initiative, 2012, pg.1). These flows of goods and services refer to ecosystem services which are defined by Constanza et al. as: “The flows of materials, energy, and information from natural capital stocks which combine with manufactured and human capital services to produce human welfare (1997, p. 254).

The term ‘natural capital’ has been used for almost a century, but it was not until the late twentieth century that ecological economists such as Robert Costanza (1989) and Herman Daly (1989) introduced the term into the dialogue around sustainability. Based on the Community Capital Framework summarized by Roseland (Roseland, 2012), natural capital exists

as one of the six forms of community capital (the others being physical, economic, human, social, and cultural capital) which are required to maintain sustainable community development. Roseland notes that “the flow of benefits from ecosystems often requires that they function as intact systems, the structure and biodiversity of ecosystems is another important component of natural capital” (Roseland, 2012, p. 13).

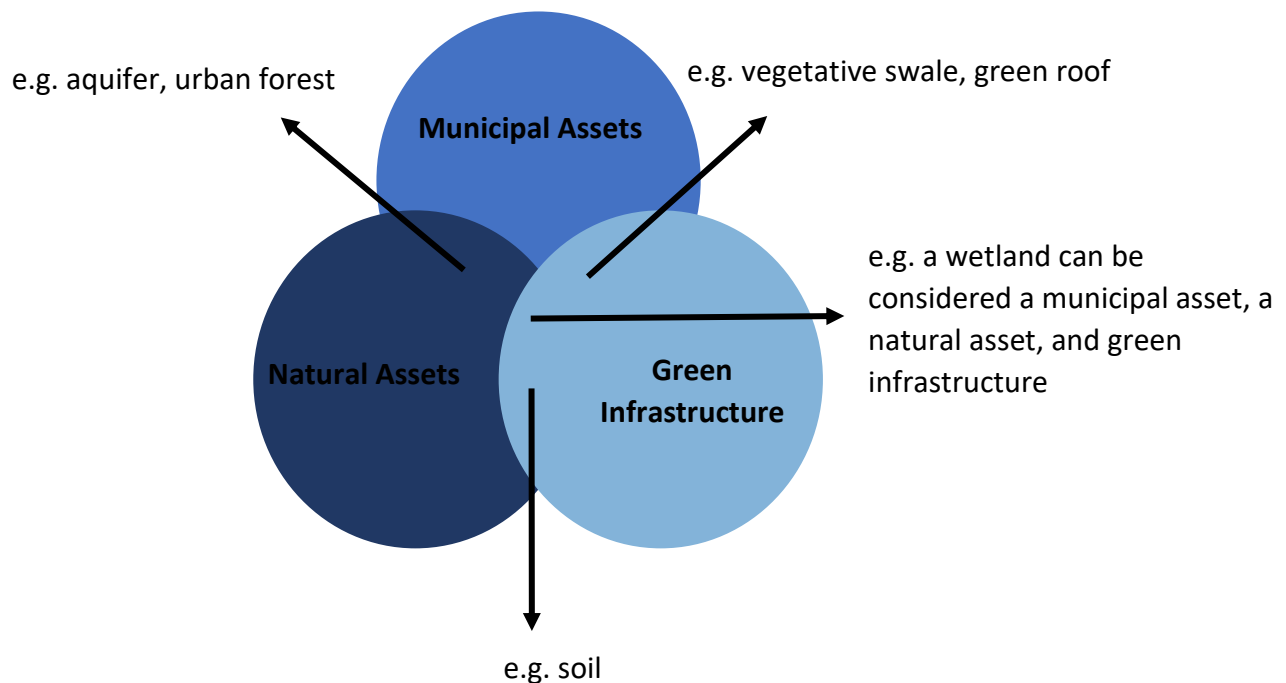
The World Forum on Natural Capital defines natural assets as “the world’s stocks of natural capital which include, geology, soil, water, and all living things” (2017). The use of the term ‘asset’, also borrowed from the financial sector, denotes the idea of ownership, which can apply to both tangible and intangible assets. Natural assets provide a range of services which if preserved and managed systematically, would yield sustained benefits for communities and their residents. These services are known as Ecosystem Services. In general, these services can be defined as all the benefits that natural assets provide for both human and environmental settings. The notion that the terms natural capital and natural assets are used interchangeably suggests that what they are attempting to describe is a concept that requires broad understanding.

#### 2.1.2 NATURAL ASSETS VS GREEN INFRASTRUCTURE

The term ‘natural assets’ has been used interchangeably with green Infrastructure, and although the terms are interrelated, they are ultimately different (MNAI, 2017). While natural assets relate to the spectrum of natural capital, ecosystem services, as well as the ecosystems themselves that contain those features, green infrastructure also includes a range of engineered and enhanced assets designed to provide similar functions to those of natural capital (MNAI, 2017).

Chenoweth (et al., 2018) explore natural capital and green infrastructure to consider the extent to which these concepts interrelate. By considering a range of definitions for both natural capital and green infrastructure, and contesting a series of case studies, the authors find despite their clear interrelationship the terms ultimately emphasize different aspects of a system. While the term “natural” may infer a range of naturalness, it nonetheless emphasizes assets which may exist without substantial human input (Chenoweth, et al., 2018, p. 142).

Alternatively, green infrastructure, despite differences in the UK and US application of the term, more frequently refers to projects which are emphasized by higher human input. The authors note that the United States' use of the term green infrastructure, may be focused more on "built" end of the spectrum than the UK understanding. MNAI's conceptualization of natural assets and green infrastructure aligns with Chenoweth (2018). While natural assets, green infrastructure, and municipal assets may refer to independent sets of assets existing distinctly, in some cases, these assets will fall under two or more of these categories. Figure 1 below illustrates the difference in scope between natural capital, green infrastructure, and municipal assets.



**Figure 1: Conceptualization of the relationship between natural asset, green infrastructure, and municipal Assets.** Adapted from: Municipal Natural Asset Initiative. (2015). *Defining and Scoping Municipal Natural Assets Discussion Paper*. Retrieved from <https://www.assetmanagementbc.ca/wp-content/uploads/defining-scoping-municipal-natural-capital-final-15-mar-2017.pdf>

As seen in figure 1, depending on ownership, location, or jurisdiction of an asset, and whether it exists naturally or was designed, how the asset may be conceptualized can change. For example, a wetland that exists externally from a municipality would be a natural asset but not a municipal asset (regardless of whether or not it was built or not). If this same asset was within the jurisdiction of a municipality and regarded as owned or as the responsibility of a

municipality, the wetland could be considered a municipal asset, a natural asset, and depending on if it was in some way engineered humans, green infrastructure as well. Another example is that a municipal asset such as a street or roadway could be considered a municipal asset, however, if this roadway was designed as part of a low impact or water sensitive urban design strategy, the asset could be considered a part of green infrastructure. The conceptualization of natural assets becomes more complicated when considering the ownership and jurisdiction of natural features. This question however, lies outside of the scope of this research.

### 2.1.3 DEFINING MUNICIPAL NATURAL ASSETS

The management of natural assets by municipalities and local governments is an emerging approach intended to address inherent gaps in the majority of current asset management frameworks. In order to understand the challenges and benefits of the management of natural assets at the municipal or local government level, it is essential to clarify what this concept means and how it compares to both traditional asset management and infrastructure classifications. As described by MNAI (2017), municipal natural asset management (MNAM) is one of several approaches/initiatives developed to advance the recognition of natural assets in decisions about the management of municipal infrastructure assets. MNAI has defined municipal natural assets as: “the stocks of natural resources or ecosystems that contribute to the provision of one or more services required for the health, well-being, and long-term sustainability of a community and its residents” (2017, p. 8). The terms “municipal” and “community” are used broadly here and are applied at different scales through the pilot projects.

## 2.2 VALUING THE ENVIRONMENT AND ECOLOGICAL SERVICES

Recognizing and assigning value to the natural environment has been a long-contested topic and one that is increasingly relevant in the world today (Fenichel, et al., 2016). Environmental degradation, global population increase, climate change, and various other factors, have led to increased awareness that human development is fundamentally dependent on the provision of natural resources and services. Costanza (et al., 1997) notes the importance of this: “The economies of the world would grind to a halt without the services of ecological

life-support systems.”. However, awareness of the importance of nature alone is not enough. Guerry et al. (2015, p. 7348) note the need for the incorporation of natural capital and the ecosystem services nature provides into decision-making. As Guerry notes, though discussions about natural capital (and by extension natural assets) have been “common” in governments and corporate boardrooms, real-world implementation of strategies and policies to effectively manage nature and natural systems is lacking.

The concept of assigning value to the environment is not new but has taken on new meanings in the twenty-first century following the depletion of natural resources, the deterioration of Earth’s ecosystems and climate change. Since the foundation of the International Union for the Protection of Nature in 1948, various international conference and treaties have increasingly acknowledged both the importance of the biosphere as well as its biodiversity (Gross, 2011). The United Nations Environmental Programme, World Bank, and other agencies have called for the inclusion and valuation of natural capital into sustainability metrics, however consistent and rigorous valuation approaches compatible to the pricing of traditional forms of capital have remained elusive.

The concepts of natural or environmental valuation give rise to contention about various topics. What in our natural environment should be valued? Whose responsibility is it to do so? How do we go about this valuation? These are essential questions inherent to the problem but are undermined by lack of available data, lack of understanding, and lack of social and political will to effectively answer. Addressing this issue has been the subject of abundant research (Wackernagel, et al., 1997) (Costanza, et al., 1997). Guerry et al. (2015) note both the lack of clarity regarding the valuation of ecosystem services for decision-makers or the public, as well as the need for natural capital accounting frameworks to maintain future flows of ecosystem services.

The challenge of environmental valuation is a fundamental issue related to the sustainability crisis. This value has typically been misunderstood, ignored, or underestimated. The valuation of natural assets has seldom been based on ecosystem services and the high values their full contribution to both human and natural settings. There is a great paradox

between the current real valuation of ecosystem services. Despite the existence of a wide variety of ecosystem services essential for both economic prosperity and human well-being, current markets only consider the value of a small subset of ecosystem processes and components being priced and incorporated in transactions as commodities (i.e. final products). This poses structural limitations on the ability of markets to provide comprehensive pictures of the ecological values involved in decision processes (Brander, Gomez-Baggethun, Marin-Lopez, & Madhu, 2010). Furthermore, this shows the importance of providing policymakers with robust estimates of the value and benefits of well-functioning ecosystems to enable them to have a better understanding of the real values of natural assets.

Adamowicz (2004) reviews both the trends in publication of environmental valuation literature over the three decades prior to 2004 and the demand for environmental valuation by both academic and policy markets. Adamowicz notes that while critical policy applications involving human health, tied to pollution control, have been made, the application of valuation in resource management is limited (p. 430). Based on his analysis (focusing on the public sector), while there has been an increase in both the interest in academic research on the topic, Advancement in the theory, methods, and data availability to economists and policymakers as well as there has been a lack of policy implementation. He notes that this is in part due to the institutional setting that environmental and resource policies are made in, highlighting the complexity and politicized context. Furthermore, the challenge of balancing the subjective nature of environmental valuation (individual preferences) into policy implementation is sited (p. 438). Adamowicz notes that a potential reason environmental valuation does not commonly appear in policy analysis as much as it could or should be is due to concern about the methods used, or lack of communication and focus between the research and policymakers.

### 2.2.1 ASSIGNING AND ESTIMATING NATURAL VALUE

The literature provides numerous examples of attempts made to estimate both the market and non-market components of nature and ecological services (Mitchell & Carson, 1989) (Costanza, Farber, & Maxwell, 1989). These attempts take place at various scales (ex. global, national) with different levels of success. A well-known attempt to estimate the value of 17 ecosystem services for 16 biomes was made by was made up of 13 ecologists, economists,

and geographers. The researchers found that the value of these services ranged from \$16-54 trillion per year (Costanza, et al., 1997). On the premise that ecosystem services are essential to climate change regulation, the human economy, water supply as well as various other factors, the team estimated the replacement costs of these services (assuming this were possible). The researchers note the global gross natural product in that year to be around \$18 trillion, as a comparison.

Challenges to the valuation of the environment include that estimates often reflect the minimum value of an asset or potential capital stock, such as with replacement value, or the estimate of an assets worth based on the cost of the value of infrastructure that would 'replace' the asset. The true value of nature is often difficult or impossible to accurately quantify and is therefore often misrepresented (Costanza, et al., 1997, p. 255). Similarly, a second challenge is that intangible, aesthetic, or the value attributed to long-term benefits is incalculable. Thirdly, some valuations of assets are based on willingness to pay, which, in the case of the natural environment, suffers from ignorance and lack of understanding.

As indicated by the literature, the current state of the valuation of the environment has improved drastically from the nineteenth and twentieth century. The value of the natural environment and its associated ecosystem services is at least a familiar concept to various actors in the public and private sector, even if their understanding is incomplete (Guerry, et al., 2015). It is abundantly clear that the value of the environment makes up a significant portion of the total contribution to human welfare (Costanza, et al., 1997). With this in mind there is a significant disconnect between the true value of the environment, which acts as a foundation for human society as a whole, and how we incorporate, account, and manage it. A number of challenges related to environmental value may perpetuate this issue, some of these include the complexity of the environment and lack of evaluative tools, the perception that environmental services are provided freely and should not be assigned a value, overcoming traditional thinking that has been engrained in policy and management regimes.



## 2.3 RESPONSIBILITIES OF MUNICIPALITIES

While numerous authors, initiatives, programs, and governments have written about their experiences in recognizing and utilizing natural capital and green infrastructure strategies (TEEB, 2019) (Beery, 2017), as the MNAI coined the term ‘municipal natural assets,’ there is little literature on the subject. The majority of the literature which comes from the asset management or green infrastructure topics have not focused specifically on the benefits gained from managing natural capital or green infrastructure assets from the municipal level. Generally, municipalities have responsibilities in promoting the public good and for the welfare of residents. There is little literature regarding whether the management of natural assets and natural capital falls under these responsibilities. This has key implications on the management of assets as it ties directly into questions regarding jurisdiction and the ownership of assets.

### 3.0 RESEARCH METHODOLOGY

In this research, I conducted semi-structured interviews with eight planners, policy analysts, and city staff including department managers to examine their opinions and experiences regarding MNAM and the MNAI projects they have been involved with across Canada. I arranged the key topics of these discussions into three themes that related back to my research questions. These themes included: the outcomes and perceived benefits, challenges and barriers, and recommendations for future communities.

In total fourteen potential interviewees were contacted with eight final participants. Of the six that did not participate, three referred me to another participant, one declined, and two did not respond. Participants were questioned about how the pilot came about in their community, what the process of the pilot was, what successes and challenges they experienced, and their role in the pilot. A general interview schedule which shows common questions that were asked in the interviews is included in Appendix B. The interview questions were subject to change depending on the role of the interviewee and as the interviews progressed. Probes were used to extract additional information where required.

Using a semi-structured interview format allowed me to flexibly approach each interviewee based on their role and involvement with the various projects. Most interviewees came from different contexts and fulfilled different roles in regards to the various projects. As such, this flexibility was needed in order to effectively address and explore their opinions and experiences of the projects.

All interviews were conducted by telephone using an external audio-recording device. Interviews lasted between 30 and 90 minutes, extended past an hour only if the interviewee gave verbal permission to do so. Each interview was transcribed and edited to remove errors and irrelevant information. Following transcription, relevant themes, concepts, were noted as potential preliminary codes and marked for future analysis.

### 3.1 CODING AND ANALYSIS OF THE DATA

The strategy I used for coding was to read and reread the transcripts alongside comments I had made during the interviews that noted intangible aspects of the transcriptions that I felt might have been missed by reading the transcriptions alone. These included aspects such as the interviewee's tone of voice, their use of laughter or the sense of levity or gravity that emerged when questioned on a particular topic, and the sense of confidence or uncertainty about a particular subject reflected by the interviewee. Additionally, the audio recordings were used before transcription to facilitate the creation of codes for the research. Once initial codes were created, they were refined. Similar codes or codes that relayed similar meanings were grouped together. The frequency and perception of importance on topics described in the interviews were used to support the prioritization and grouping of the codes during the recoding stage.

### 3.2 ASSUMPTIONS AND LIMITATIONS

There are several assumptions and limitations to this research project. First and foremost, as this research is limited to the experiences of individuals who have been involved with the MNAI's pilot and cohort projects, it does not include consider experiences from people involved with other projects that may relate to MNAM. There are other projects and programs, and at various scales, which relate to similar themes of green infrastructure and natural assets/capital which was not included in this research. It is assumed that the outcomes and perceived benefits, challenges and barriers, as well as recommendations held by the interviewees, reflect MNAM broadly. With this in mind, this research does not assume whether or not other MNAM or related approaches would find similar or dissimilar findings.

Secondly, the focus of this research is limited to the Canadian experience and does not consider NAM, MNAM, or related approaches or projects outside of Canada.

Third, MNAI was formed in 2016, as such, all pilot programs are relatively new, some are currently underway. The opinions and perspectives of research participants are based on their experiences to date and the long-term success of the projects cannot be ascertained. With this

in mind, a benefit to this newness is that the information is so new that it may offer unique perspectives on the projects which may be different if taken in hindsight.

Furthermore, the policy, regulatory, governance backgrounds of the participants are majorly based on the context in different towns, cities, and provinces. With this in mind, comparisons made between the research data may reflect differences in the contexts rather than the MNAM projects themselves. The project methodologies and scope were also different, which may limit the degree to which the data can be compared.

## 4.0 CONTEXT

This section discusses major background elements related to this research. It Begins by expanding on the need for change regarding how society manages its natural environment and some of the challenges associated with this. I then provide a high-level overview of MNAI and provide brief summaries of the work done (or currently underway) in each of MNAI's project communities. Next, I briefly discuss the Federation of Canadian Municipalities Asset Management Program and the requirements of PSAB and the implications of this for accounting for natural assets. Lastly, I briefly discuss the context of Manitoba and the WMR in regards to MNAM.

### 4.1 THE NEED FOR CHANGE

As of March 2019, the Earth's population reached 7.7 billion people. The United Nations projects global population will rise to 9.8 billion by 2050 and 11.2 billion by 2100 (United Nations, 2017). Declining public infrastructure and environmental health, population growth, and the effects of climate change, are a selection of the forces pressuring local governments across Canada to seek out innovative solutions for the provision of community services.

The *Natural Infrastructure Report* by the Insurance Bureau of Canada (2018) notes that homeowners and communities across Canada are increasingly being impacted by the financial burden attributed to climate change and extreme weather events. This is evidenced by the escalating costs of natural disasters and flooding in Canada, repeated flooding stresses on Canada's mortgage holders, effects to credit ratings, lawsuits, studies indicating increased mental health challenges due to flooding, and commitments to disaster risk reduction through natural infrastructure. Furthermore, with almost one-third of Canadian infrastructure in need of maintenance or replacement and further risk to infrastructure from extreme weather events, governments must work to find new ways to provide community services which are cost effective and sustainable (PMCR, 2017) (United Nations, 2017). As Roseland outlines "[o]ur growing numbers will challenge all nations in terms of food production, the availability of land for human use and the ecological integrity of the land left undeveloped" (2012, p. 4). Added to these challenges, the effects of climate change progressively disrupt global economic,

environmental, and social systems. The Intergovernmental Panel on Climate Change projects continued global warming through the 21<sup>st</sup> century, with Canada warming faster than the global average.

Addressing these challenges is a multidimensional problem and one that has long been contested. On the one hand, there is a lack of recognition of the human transformation of the planet. Population expansion, resource consumption, and development intensity have brought about global environmental changes that have traditionally been either unrecognized, misunderstood, or ignored altogether. On the other hand, current global social, political, and economic systems are not well suited to meeting this challenge (Guerry, et al., 2015). The fundamental asymmetry lying the heart of economic systems which rewards short-term production and consumption of marketed commodities and production at the cost of natural capital cripples our ability to sustain ourselves. This asymmetry is exacerbated when coupled with the previous issue, as the true cost of our toll on natural capital is not incorporated into our management of these systems whose function is largely based on their provision. The effect is that we are utilizing resources we are not accounting for, and risking value we may not be able to afford.

## 4.2 MNAI

Founded in 2017 the Municipal Natural Assets Initiative (MNAI) is a not for profit non-governmental organization. As described on their website “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 in developing leading-edge, sustainable and climate change resilient infrastructure” (MNAI, 2018). See MNAI’s *Steps for Effective Municipal Natural Asset Management* included in Appendix B for further information on their process framework.

Since its creation, MNAI has undertaken a series of pilot and cohort projects, engaging with ten communities/regions across Canada. The projects have provided evidence to support the idea that natural assets such as aquifers, rivers, watersheds, and foreshore areas provide

value to their respective communities that is typically not included in traditional asset management and accounting systems.

MNAI project communities include:

- Town of Gibsons, BC
- City of Nanaimo, BC
- District of West Vancouver, BC
- Grand Forks, BC
- Region of Peel, ON
- Town of Oakville, ON
- City of Courtenay, BC
- District of Sparwood, BC
- City of Oshawa, ON
- Western Regional Service Commission, NB
- Southeast Regional Service Commission, NB: Riverview, Riverside-Albert

#### 4.2.1 MNAI PROJECT SUMMARIES

##### i) Town of Gibsons, BC:

The Town of Gibsons was the first municipality in North America to begin integrating natural assets into asset management and financial planning (MNAI, 2017a). The Town has undertaken multiple natural asset related projects including a report on the Gibson's Aquifer and an assessment of the Whitetower Park ponds. In the case of Whitetower park ponds, through modeling, it was found that the ponds were valued between 3.5-4 million dollars (Sahl, et al., 2016). The town has also completed work to assess their creeks, woodlands, and foreshore area. See Appendix D for a case study of Gibsons.

##### ii) Town of Oakville, ON:

Using modeling the town modeled the existing inflow and outflow of a remnant channel under existing conditions to compare to scenarios where engineered infrastructure was used to replace the asset (MNAI, 2018a). It was demonstrated that it would cost between \$1.24 and \$1.44 million for the Town to replace a 240+ meter channel with engineered infrastructure. See Appendix E for a case study of Oakville.

## iii) City of Nanaimo:

Hydrologic analysis including stormwater modeling was applied to show the existing peak flow attenuation and water volume retention function of the Buttertubs Marsh Conservation Area (BMCA) (MNAI, 2018b). Firstly, the project demonstrated that the stormwater detention benefits offered by the BMCA are comparable with engineered infrastructure. Secondly, it demonstrated that under climate change conditions, although the BMCA would receive higher volumes and velocity of flows, it would provide similar levels of service.

## iv) District of West Vancouver, BC:

This project determined financial issues related to assigning financial value to its natural assets using the daylighting of a buried creek as an example (MNAI, 2018c). The project found that the capital costs of restoring the creek were similar to the costs of upgrading the existing culvert to meet stormwater requirements. The expansion of grey infrastructure alternative was not forecasted under climate change conditions.

## v) Grand Forks, BC:

Hydraulic modeling and economic evaluation on flood-water levels and estimate building damage values were used to assess the storage benefits of floodplains upstream of the city (MNAI, 2018d). The results of the project demonstrated that the Kettle River floodplain provides between \$500 and \$3,500/hectare in flood damage reduction in the city's downtown buildings during heavy flow events. The study provided evidence to support further analysis which the City is currently undertaking.

## vi) Region of Peel, ON:

The project assessed the stormwater performance of wetlands, forests, and open green spaces in the Fletcher's Creek and East Credit River subwatersheds located in the Regional Municipality of Peel (CVC, MNAI, 2018). The study found that all modeled natural assets reduced the 100-year peak flow estimates. Using replacement costing the monetary value of



both subwatersheds stormwater services were estimated at \$704 million and \$764 million under current climate conditions, and climate change conditions, respectively.

vii) City of Courtenay, BC:

The City of Courtenay is part of the second wave of MNAI projects. The City is considering how to mitigate flood risks, including the replacement cost and benefits of engineered infrastructure, with natural assets (MNAI, 2018e).

viii) District of Sparwood, BC:

The District is currently investigating how water quality in the Elk River can be improved by identifying natural assets which provide filtering and storage services so that those assets can be effectively managed and protected (MNAI, 2018e).

ix) City of Oshawa, ON:

The project is planned to incorporate the naturalization of areas along the creek to aid in improving the quality and resilience of the riparian area and stream bank along Oshawa Creek (MNAI, 2018e). As part of the recent second wave of projects, work is still underway.

x) Western Regional Service Commission, NB:

The project focuses on minimizing erosion and the reduction in maintenance costs of culverts and ditches in the Bristol Heights subdivision catchment areas (MNAI, 2018e). The area has been impacted by annual flooding and severe erosion for a number of years and is considering the potential for natural asset management to help address these issues.

xi) Southeast Regional Service Commission, NB:

The SERSC is undertaking two projects. Natural assets that potentially provide drinking water are being considered to address financial constraints impacting their supply of water (MNAI, 2018e).

#### 4.2.2 TECHNICAL DOCUMENTS

MNAI has also created a series of technical documents summarizing their approach and providing guidance regarding MNAM. A selection of these documents includes: *Defining and Scoping Municipal Natural Assets*, *Green Growth Knowledge Platform Submission*, *Primer on Natural Asset Management: FCM 2018 Sustainable Communities Conferences*, and a *Private Lands Document*. On June 2018 *Identifying Barriers and Opportunities within Professional Planning Practice in Ontario* was released. It details a series of interviews with planners and other relevant bodies and identified barriers and opportunities related to planning practice. While this research was based in Ontario, there are similarities between the outcomes described in the document and this research.

### 4.3 FEDERATION OF CANADIAN MUNICIPALITIES MUNICIPAL ASSET MANAGEMENT PROGRAM

The Municipal Asset Management Program (MAMP) began in 2016 as a \$50 million capacity-building fund entrusted to the FCM by Infrastructure Canada supporting the adoption and enhancement of asset management in Canadian municipalities. MAMP, FCM, and the Association of Manitoban Municipalities (AMM) have been involved with the education and promotion and promoting asset management in Manitoba. The MAMP program supports municipalities to meet their responsibilities under the federal gas tax funding agreements, which, among other things, require municipalities to make measurable progress in asset management on an annual basis

### 4.4 THE PUBLIC SECTOR ACCOUNTING STANDARDS

Reprioritization of governmental desire to see the improvements to asset management have been seen in recent years. The public sector accounting standards have trended toward stronger policy implementation of asset management in local governments.

In Canada, Public Sector Accounting Standards or PSAS represent the accounting basis established by the Public Sector Accounting Board (PSAB). The PSAB serve the public interest by overseeing and establishing accounting standards for the public sector (PSAB, 2019).

Accounting standards are authoritative standards for both financial accounting and reporting. These standards specify how the financial statements of public sector entities must recognize, measure, present, and disclose transactions and other events. These standards are the primary source of generally accepted accounting principles. Accounting standards contained within the Canada Public Sector Accounting (PSA) Handbook applies to all public sector entities (governments, government organizations/partnerships) which issue general purpose financial statements unless stated otherwise by PSAB (PSAB, 2019).

#### 4.4.1 PSAB SECTION 3150

Effective in the 2009 fiscal year, Section 3150 of the PSA Handbook defines tangible capital assets, the responsibilities of public sector entities in regards to these assets, how they are to be measured and costed, their amortization, and write-downs and disposals of the assets (BDO, n.d.). Tangible capital assets are non-financial assets having physical substance that (BDO, n.d.):

- Are held for use in the production or supply of goods and services, for rental to others, for administrative purposes or for the development, construction, maintenance or repair of other tangible capital assets;
- Have useful economic lives extending beyond an accounting period;
- Are to be used on a continuing basis; and
- Are not for sale in the ordinary course of operations.

Prior to the adoption of Section 3150, it was not required for tangible capital assets to be accounted for and reported as assets on Statement of Financial Position. Though Section 3150 does not currently apply to intangible assets, natural resources, and Crownlands purchased by the government, these assets may be included in the future.

## 4.5 PROVINCE OF MANITOBA AND THE WMR

The province of Manitoba, including the Winnipeg Metropolitan Region (WMR), are not exempt from the asset management challenges facing municipalities Canada-wide. With almost one third of Canadian infrastructure in need of upgrade or replacement, impacts to property

values, declining water quality, and risk to infrastructure from extreme weather events, Manitoba must work to find new ways to provide community services in a cost-effective and sustainable way (Partnership of the Manitoba Capital Region et al., 2017). Progress in Manitoba is underway.

#### 4.5.1 MNAI AND THE WMR

In October of 2017, over two days, MNAI joined Mayors and Reeves from 23 municipalities in the Winnipeg Metropolitan Region (WMR) and the South Basin of Lake Winnipeg for a discussion about natural assets (Partnership of the Manitoba Capital Region, 2017). The purpose was to increase understanding of these assets and to begin to develop a framework to recognize, measure, and account for them, as well as ensure their inclusion in a potential municipal Asset Management Program currently being considered. A list of common themes arose in four categories: Increased risk and management, embeddedness of the status quo, establishing a common language, and leadership capacity and collaboration. The participants also created a prioritized list of natural assets from their jurisdictions, outlined the barriers to achieving the collective vision of a potential framework, and identified next steps.

## 5.0 RESULTS

This research first examined the perspectives and experiences of eight interviewees who have been, or are currently involved in undertaking one or more of MNAI's pilot projects across Canada. Based on the results of the interviews, the data was organized into three major themes: outcomes and perceived benefits, challenges and barriers, and recommendations for future implementation.

### 5.1 OUTCOMES AND PERCIEVED BENEFITS

The first theme is outcomes and perceived benefits. Interview participants identified and discussed their experiences and opinions (either in their communities or more broadly), regarding MNAM and the MNAI projects. These discussions helped clarify how interest in MNAM and participation in the MNAI projects arose for the communities, how perceptions regarding MNAM and the valuation of the environment have changed over time, and how perceptions regarding MNAM differed between the participants and between the communities.

The following five interrelated key topics areas impacting the outcomes and perceived benefits of MNAM and interviewee experience with the pilot projects emerged:

1. growing interest and understanding;
2. building the business case;
3. integration with asset management;
4. aligning the process; and
5. effective communication.

Relevant discussions regarding these five topic areas are summarized to help analyze key results from the interviews. Where considered useful selected interview quotes are included.

#### 5.1.1 GROWING INTEREST AND UNDERSTANDING

Throughout the interview process, all participants indicated, to a varying degree, the growing interest in, and understanding of, both the range of values provided by the natural environment and the potential for this value to be both recognized and reflected by

municipalities and local governments as assets through MNAM. This included identification that the current practice for local governments and municipalities which does not recognize the value of natural assets/capital and relies solely on the continued creation, maintenance, and replacement of grey infrastructure for service provision, could potentially be enhanced with the adoption of an MNAM approach. It should be noted that this topic area was often directly related to building a business case and as such both contain interrelated findings.

Indicators for growing interest and understanding were variable and included both the repeated mention of the potential to reduce risk and costs associated with the replacement or maintenance of grey infrastructure, as well as the range of ancillary benefits and value streams offered by natural assets and MNAM. Interviewee 3 also linked the potential benefits of MNAM as an opportunity to address a variety of challenges municipalities are facing:

“I think it provides an opportunity to address more than one challenge. The challenge is like financial, environmental, climate impact, and also economic in terms of having a town that people feel safe to live in”.

Interviewees indicated current lack of NAM leaves local governments vulnerable to a variety of challenges such as increasing costs from the replacement, maintenance, and operation of built/grey infrastructure, low infrastructure resilience to climate change, and the inability to access the same range of ancillary benefits natural assets can provide such as improved biodiversity, recreation, and mental health.

During the discussions regarding the benefits of MNAM, the range of ancillary beneficial outcomes offered by natural assets was one of the key motivators in participants reasonings of why municipalities and local governments should adopt an MNAM approach. Climate change resiliency, habitat diversity, recreation, and public health benefits were some of the lead benefits identified by participants. Interviewee 2 claimed that in their opinion the ability of MNAM to address climate change was the most important benefit: “Generally, some intact ecosystems add resilience to climate change projections in a way that engineered infrastructure doesn’t, so that would be number one.” Five of eight interviewees specifically cited the importance addressing climate change noting that its effects have potentially critical

implications on the continued functioning of engineered infrastructure. Building resiliency through the adoption of natural assets was cited as a way to reduce the associated financial burden on strained infrastructure. Interviewees 2 and 3 indicated climate change was perhaps the highest priority or reason for municipalities to begin recognizing and accounting for their natural assets.

Interviewee 2 went on to state that the monetization of the range of co-benefits offered by natural assets represents some of the greatest benefits of MNAM. Interviewee 7 provided a similar opinion stating “...its obviously good for recreation benefits, health benefits, environmental benefits, and basic responsibility...there are tons of benefits.”

The concept that shared understandings of the importance of both environmental value and MNAM are increasingly frequent among municipal staff and professionals was another topic discussed by the interviewees. Interviewee 6 claimed that the shared conceptualization of natural assets in a framework of responsible municipal service delivery among finance departments and asset managers has grown:

“When you reach that point you realize it is a huge tipping point where you have people on the financial side and the asset management side understanding that when we take away our natural assets, we pay in other ways. We put in hard infrastructure and it's not resilient and it takes more maintenance and they're more vulnerable to extreme events” (Interviewee 6)

In the above quotation interviewee, 6 identified the significance of how nature is increasingly recognized, by wider audiences (i.e., asset managers, finance departments, city councils), to have value. Furthermore, interviewee 6 notes that nature provides benefits that hard (grey) infrastructure typically does not and that the value provided by these benefits is being lost. Interviewee 6 went on to state that in their experience, their municipalities council has become increasingly progressive in regards to environmental management noting that council did not require an abundance of time or convincing to support an MNAI pilot project, valuation of their natural assets, and climate change resiliency. “Not having to explain that you know at the get-go, makes it so much easier” (Interviewee 6). Although this directly applies as

evidence that reflects growing interest and understanding in environmental valuation, it also reflects effective communication which is described in section 5.1.5 below.

Other evidence that reflected growing interest and understanding when interviewees discussed how interest for participation in the MNAI pilots occurred in the communities. Interviewee 1 noted that recent trends in legislation related to asset management in their jurisdiction indicated to them that green infrastructure and natural assets may likely be included in future legislation. Based on Interviewee 1's response, their municipal council found it logical to apply to MNAI for the pilot and to begin learning about and address the potential for future NAM projects.

When the interviewees discussed the motivations of communities for becoming interested in MNAM, there was a range of responses. Interviewee 7 found that MNAM was highly appealing in their municipality which was smaller and more rural, noting that the community could never afford large grey infrastructure solutions that may be necessary for their future. This interviewee also noted that many communities (notably rural) receive a number of services from natural assets that they do not recognize or account for. By using an MNAM approach to recognize and protect the value derived from these services Interviewee 7 believed that this would help offset the costs of built infrastructure. In their words, MNAM is "a no-brainer" and is perhaps the "only option" for the future of rural communities (Interviewee 7). Growing understanding for municipalities, councils, planners of the financial benefits derived from implementing MNAM was directly to the idea of building a business case, another key topic which is described below.

#### 5.1.2 BUILDING THE BUSINESS CASE

Seven of eight interviewees specifically identified that building a business case or proof of concept is an important outcome needed for the advancement of MNAM and its adoption by municipalities, local governments, or regions into standard asset management practice. Generally, a business case or proof of concept includes evidence which demonstrates a concept or project is feasible. For interviewees, this included evidence for policymakers, engineering staff, and municipal councils to support and convey why adopting an MNAM approach or



framework could cost municipalities the same, similar, or less than built infrastructure solutions while potentially providing additional ancillary benefits. For Interviewee 5 creating a business case is “when you compare apples to apples, and the net present value with all long-term operations and maintenance costs factored in for natural assets vs-built infrastructure...that’s the business case you have to make”.

Interviewees indicated that it was important to establish a business case in their own community as well as have business cases from other places to refer to. Interviewee 1 noted from an operations perspective, a tool (i.e., a business case) is needed in order to justify the management and maintenance costs associated with natural asset strategy:

“I think the crux of it comes down to being able to build a business case around the savings that are accrued through maintaining and advancing natural assets (Interviewee 1).

Interviewee 5 had a similar opinion:

“I think there has to be a very strong business case to generate any interest in either our public works or finance division that would warrant them to want to pay attention (to managing their natural assets)” (Interviewee 5)

While seven out of eight participants indicated that the creation of a business case is crucial and that this work is ongoing, there was some contention about whether the case has been made yet, either for their communities or in general. Interviewees 1 and 5 seemed to indicate that a convincing business case, either for their community particularly, or more generally, has not yet been made. Interviewee 5 claimed that the calculation and comparison of the net present value with all long-term operations and maintenance costs factored in had not been made. Using low impact development (LID) and the management of a theoretical natural heritage structure for the provision of stormwater management as an example, Interviewee 5 claimed the business case had not been resolved and that to do this, MNAM needs to be addressed at the strategic policy level.

Comments from interviewees 2, 3, and 8 seemed to contradict the claim that an effective business case has not been made instead noting that while further cases need to be made, a strong business case has already been made and that further examples will strengthen it. As building a business case is directly tied to the increasing interest and understanding of environmental valuation and the utility of MNAM approaches, interviewees noted some common factors which may have influence. Interviewee 3 noted “generally speaking nature is cheaper. It is cheaper up front, it is cheaper to operate, and it could last in perpetuity. So the business case is very strong. Interviewee 8’s opinion seemed to support this. Interviewee 8 noted the benefits and necessity of comparing the assets from a total lifecycle perspective and that this supports that a business case is already made for MNAM. Interviewee 8 noted that natural assets function as a regenerative system. If the assets are maintained, the assets will also maintain their condition. Furthermore, Interviewee 8 noted the potential for natural assets never to reach the point of requiring replacement, resulting in much longer service life compared to grey infrastructure.

The majority of interviewees found that building a business case is fundamentally tied to the integration of natural assets with existing asset management frameworks.

### 5.1.3 INTEGRATION WITH EXISTING ASSET MANAGEMENT

The integration of natural assets into existing asset management frameworks was another central topic that arose through the interviews in regards to outcomes and perceived benefits. Seven of eight participants indicated that adding nature into standard asset management or, in other words, having it included in the asset management accounting documentation, was essential to its adoption into standard practice. As interviewee 2 notes in describing the need for change in how municipal assets are managed:

“the public sector accounting board currently doesn’t recognize natural infrastructure as an asset. Although communities can work to understand their annual budgets so that they recognize natural assets, their significance to the budget, they can’t be formally recognized in the same way that grey infrastructure is” (Interviewee 2)

While some participants were optimistic for the future of the PSAB to include natural assets, the current lack of recognition and integration of natural assets due to either lack of buy-in from asset managers, proof of concept, or embeddedness status quo remained a chief concern.

While PSAB does not currently allow natural assets to be incorporated in the same way as traditional assets, the majority of interviewees agreed that to have greater success in integrating natural assets into practice MNAM should be incorporated existing asset management frameworks. Interviewee 8 discussed that one of their first realizations when examining the concept of integrating MNAM with traditional asset management, was because MNAM was scalable and comparable to traditional asset management, that there may be a way to integrate the two into one system. As interviewee 8 explains:

“Treating natural assets, the same as existing assets actually gets the natural assets in the same lexicon as the built environment, with elected officials and local government. It turns it into a discussion about money. And as crass as that sounds, treating it that way is exactly what we’re finding out is the path to success here” (Interviewee 8).

When discussing the efficacy of MNAI’s process framework (see MNAI’s *Steps for Effective Municipal Natural Asset Management* included in Appendix B) for implementation of MNAM, Interviewees noted one of the key reasons why they believe it was effective was that it built on top of existing asset management. In other words, the framework was praised as incorporating natural assets with traditional asset management made it f something familiar to finance, engineering, and operating departments. Interviewee 2 expressly indicated they support this idea stating if MNAM is framed within a “nested” process like asset management and incorporating MNAM into the existing policy and regulation, will help ensure MNAM’s implementation. In interviewee 8’s opinion “this will be the most powerful outcome of this whole process,” and that success can be found in using “replacement costing” (i.e., comparing the costs of replacement of a natural asset with grey infrastructure) as it helps interested parties compare the two options with one another. As interviewee 2 stated: “MNAI tries to

approach this issue in a very transparent way and using engineering models which are already very understood. Generally, they use replacement costs.”

Similar to how interviewee 1 suggested a tool or business case was needed to approach municipal council, Interviewee 8 claimed that integrating natural assets into asset management converts the conversation from merely lobbying for improving environmental management into something that can gain the attention of elected officials and make it easier for them to support.

#### 5.1.4 ALIGNING WITH MNAI’S PROCESS

Interviewee opinions and experiences regarding MNAI’s process framework was another key topic tied to outcomes and perceived benefits. Though there was some contention regarding this topic, responses from interviewees included that MNAM’s process of was clearly scoped, flexible and that the focus was primarily on one specific asset or group of assets as opposed to a broader policy focus which few of the pilots were focused on. Participants also claimed they found the support offered by MNAI to be valuable. Interviewees 2, 3, and 7 noted their opinions about the MNAI process are that the framework is very clear and organized, effectively, and can be flexibly applied to other municipalities and assets. With this in mind, some participants found there have been some difficulties in aligning with MNAI’s process framework. This is elaborated on in Chapter 2 Challenges and Barriers.

A clear outcome of the interviewees was that MNAM and the process framework MNAI has adopted are new. In discussing this with members of MNAI, they indicated that their process framework and strategy is evolving based on their experience with each community and the outcomes of the pilots. Interviewee 2 claimed MNAI has an increasing focus on both scoping the projects as well as more clarity regarding municipality responsibilities and timelines. Creating a “community of learning” was identified as an objective of MNAI, and this work is underway.

#### 5.1.5 COMMUNICATION AND PARTNERSHIPS

A crucial fifth topic area identified from the interviews was the strengths and utility of communication between MNAI and the project communities throughout the pilots and cohorts.

Participants identified several successful instances where both interdepartmental partnerships external partnerships, were effectively used to help implement or advance the projects. Seven of eight participants noted the use and necessity of multidisciplinary teams in implementing the projects.

Interviewees were asked which departments or general actors were involved with the projects. The responses ranged depending on the size of the municipality considered, their capacity, and other factors. The smaller communities tended to have only one or two technical staff on hand to aid them. Larger municipalities such as the Region of Peel indicated their region had much more capacity, having teams of engineers or other departments. From the results of the interviews, there were examples of successful communications occurring across departments/external groups as well as examples of unsuccessful communications. Interviewee 2 claimed in using “cross-disciplinary teams we might have people from the engineering department, or from finance, or utilities, you have to make sure that you're all speaking the same language because we can have very different understandings of a common word”.

Some interviewees noted that as an outcome of the pilot or cohort project, they have been able to create and engage effectively with local partnerships. The following list details some of these partnerships:

- Participant 1 claimed that even with having limited internal capacity they have been able to make headway with the use of local initiatives and partnerships
- Interviewee 4 noted that the timing of the project allowed the communities project team to collaborate with different departments on a floodplain mapping project.
- Interviewee 3 discussed successes in incorporating natural asset management into other work such as subdivision development bylaw amendments.

While the outcomes and perceived benefits indicated by the interviewees provided substantial evidence to support that there is an increasingly positive trend in the perception of MNAM projects, interviewees also identified several challenges and barriers.

## 5.2 CHALLENGES AND BARRIERS

The second theme that came out of the interviews was Challenges and Barriers. Each of the eight interviewees identified challenges or barriers they had experienced first-hand, or were aware of, in the implementation of MNAM. Other challenges were identified during the analysis of the interview findings. Five key factors are reported below. These factors include:

1. lack of understanding and buy-in;
2. embeddedness of the status quo
3. valuation of nature
4. lack of integration with accounting and policy;
5. community capacity and resource limitations
6. scoping and aligning the process; and
7. communication challenges.

### 5.2.1 LACK OF UNDERSTANDING AND BUY-IN

The lack of understanding and buy-in of NAM MNAM was another topic reflected in the interviews. This topic came about in a number of ways including lack of recognition of natural assets and environmental value, and lack of integration into practice. Firstly, as Interviewee 2 emphasized some municipalities (council, public, municipal departments) rely on natural assets and do not recognize the existence or value of these assets. Functionally, this leaves the assets as “undocumented liabilities,” which if not recognized and managed accordingly may leave local governments at greater risk to the loss of those assets. This lack of recognition is also directly linked to the challenge of the valuation of nature (see Section 5.2.4). Secondly, in regards to the lack of practical implementation three of eight participants indicated that that the concept of the valuation of nature has been around for a number of years but has not seen widespread adoption. Participant six noted that while related concepts have existed, they have not been brought forward into implementation: “You know people had had this on the radar for probably almost 40 years in the scientific community. But isn’t it odd that it takes almost that long to

push itself forward?”. This slow progression of the adoption of environmental consciousness is linked to a much broader concept that lies beyond the scope of this project.

Another challenge that was identified in the interviews regarding uncertainty and the lack of buy-in relates to the lack of understanding of environmental systems and their complexity, and how managing these systems is different from managing engineered infrastructure such as bridges. Interviewee 3 indicated that increased understanding and realization of their community’s natural assets has led to the shift from thinking of assets individually, to a systems-thinking mindset. Interviewee 3 went on to say: “understanding that our water system is no longer just the pump and pipes and valves. It [the water system] is connected to nature very directly, so that requires a change”.

Political buy-in was a contested topic that also related to lack of understanding. Participants indicated that while municipal councils and other political leaders were generally on board with the pilot they were hesitant with the lack of business cases. Interviewee 5 noted “Politically we didn’t need a council direction to undertake a bit of a research pilot. It was just using a very small budget and we getting cost-sharing and in-kind from outside organizations. So, it wasn’t really a big deal to participate from that point of view”. However, interviewee 5 went on to note that there has to be a very strong business case to generate any interest for public works or finance division to warrant them to want to pay attention to the concept.

Other challenges related to the lack of understanding and buy-in regarding MNAM and natural assets included:

- jurisdictional questions including how municipalities can manage and account for natural assets across political borders and private/public owned land;
- the lack of public relationships assets and sense ownership or awareness of how the asset impact people’s lives;
- where urban is already built up with in-place infrastructure will limit the effectiveness of natural systems;
- municipalities are subject to changes in political will and shifting priorities; and
- the perception that green infrastructure does not work, and that it is not practical

### 5.2.2 EMBEDDEDNESS OF THE STATUS QUO

Participants cited that the status quo of traditional asset management, which does not include natural assets, remains a key challenge for MNAM going forward. The lack of experience of governments in managing natural assets as opposed to built infrastructure assets, the perception that the valuation of nature is difficult or impossible, were prime concerns expressed by participants. Interviewee 1 noted even if costs of natural asset solutions are found to be lower and require less maintenance than grey infrastructure solutions, a cost for natural assets still exists (ex. cost of land associated with a wetland). Interviewee 1 also discussed that municipalities might opt to continue paying for the engineered assets as there are “familiar” and what municipalities are familiar with.

Participants went on to note that the embeddedness of the status quo is not a challenge for asset management and municipal councils alone. Finance, engineering, planning, as well as a number of other departments and actors will need to change their traditional practice. Workplace culture also has a role in influencing the adoption of emerging ideas. The implications of replacing the status quo being new for almost all departments might make it particularly difficult for municipalities to take the first step. In addition, there are few resources or supports for municipalities wishing to seek out an MNAM approach (MNAI being one such support). Interviewees did suggest potential solutions to these issues. The first, as suggested by interviewee 2 was that that adequate time should be taken at the beginning to both scope what the community seeks to achieve with an MNAM project, as well as scope what a potential project might look like and communicate this with MNAI. Interviewee 2 explained by increasing the clarity between the community and the goals they seek to achieve, and MNAI (and the supports the offer), “it helps to alleviate those who are skeptical or may have preconceived assumptions about the project.” This directly relates to communication as well as the newness of MNAM.

### 5.2.3 VALUATION OF NATURE

The valuation of nature and the challenges associated with it were factors underlying much of the interview discussions. The interviewees indicated much of the hesitancy in regards to environmental valuation and NAM (and by extension MNAM) stems from both a lack of



practical valuation methodology for the natural environment, as well as a way to integrate this meaningfully for municipalities. As interviewee 2 noted: “I think that a key reason that we see environmental degradation is that our economic systems don’t value nature in any way.” In this way, although communities can work to understand their annual budgets, so they recognize natural assets, the significance of natural assets to the budget, these natural assets cannot be formally recognized the same way that grey infrastructure is (as regulated by current PSAB policies). Instead, these assets are, at most, recognized in as notes. This presents a critical challenge as Interviewee 1 discussed:

“[I]t can be a big challenge for a lot of communities who think that if they don’t own the asset, they can’t utilize it. So, whether you are protecting it or degrading it, it has no impact economically. So, I think we’re starting to understand the values of the services that nature provides and hopefully we’ll start to address those issues”.

In some cases, municipalities recognized the potential value of their natural assets and justified its maintenance without the need for a specific valuation protocol. As interviewee 4 noted “we felt that given we are already using the system that looking at the part of the project with an evaluation, and we felt that knowing the value of the system was necessary in order to justify spending money on maintenance of that system.”

#### 5.2.4 LACK OF INTEGRATION WITH ACCOUNTING AND POLICY

Accounting and policy recognition and integration refer to a wide range of frameworks and management strategies, their utility, and how they are perceived. 4 of 8 interviewees indicated the need for policy integration. Interviewee 4 claimed that although nature can be effectively integrated into an existing asset management framework, if asset management has not already been ongoing in that community, then the initial push will require significant support of the elected officials and leaders, tax increases, policies, restructuring of the budget. Interviewee 4 went on to say “while it is critically important for their community to start valuing these assets for the budgeting of maintenance funds, there are no policies right now that tie in”. Interviewee 7 noted the challenge in their community for lax policies and regulations

regarding environmental protection. Policy was also a point of concern for interviewee 5 who felt the need to address MNAM at the strategic policy level. In Interviewee 5's opinion, the policy strategic policy level must be addressed to have a meaningful impact on finance professionals.

Participants indicated that while there were no barriers or official rule declaring research or consideration of MNAM cannot be made, there is also no policy framework to support its consideration, advancement, or implementation. This was due, in part, because of the perception that a convincing business case still has not been made. "Much more work needs to be done to build the policy supports and business case for it. And until that happens, I don't think there's going to be a lot of deep implementation of it" (Interviewee 5).

Interviewee 8 noted a major impediment to the incorporation of nature into asset management has been the lack of progress on asset management itself. Interviewee 8 noted: "the impediment to this approach was that up until 2009 municipalities didn't even have to list or put the value to all of their capital assets. It's an evolution of that process when we were for the first time required to list that value and depreciate the capital assets. Until that happened none of this could have occurred. Because we didn't get asset management into the forefront or the ability to piggyback natural capital on top of it."

#### 5.2.5 COMMUNITY CAPACITY AND RESOURCE LIMITATIONS

Every participant indicated challenges toward capacity and resources. Table 1 illustrates the identified costing barriers based on interviewee responses. There was some contention regarding what the most significant costs were to the community. Funding and time requirements were commonly mentioned as challenges for the communities regardless of the size of the community or the scope of the project. With this in mind, participants indicated that there are costs associated with any project, and perhaps specifically, any new project.

**Table 1: Interviewee Responses to Observed Costing Barriers to MNAM Projects:**

COSTS	INTERVIEWEE'S							
	I1	I2	I3	I4	I5	I6	I7	I8
LAND					x			
CAPACITY	X	x	x	o	o		X	
STAFF/TRAINING	X					o	x	x
TRAINING			X		o	o	x	
FUNDING	X			x		x	x	
TIME	x	x				x		x

X: Major Barrier  
 x: Minor Barrier  
 o: Mentioned specifically as not a major barrier

5.2.6 SCOPING AND ALIGNING THE PROCESS

While the majority of participants praised the MNAI team in establishing an effective scope for MNAM approach, 2 of 8 interviewees noted either the scope of the pilot was not what they had thought it would be when they had submitted their expression, or they found the scope of the pilot did not encompass their understanding regarding what change needed to occur in their community.

Interviewee 1 claimed for their community, the pilot’s focus on stormwater, was much different than they had anticipated. Interviewee 1 noted that although stormwater was an essential topic in their community, the change of the pilot’s focus created a strain on their role in the pilot. The change of focus was largely due to lack of buy-in, interest, and agreement on a project from within the community, stormwater was identified as something an MNAI could help to address. Interviewee 1 went on to state that the communication with MNAI and their department has been challenging, in part to do the scope of the project. The interviewee noted this has resulted in their belief that like the pilot is perhaps being run from the wrong department as the project is so focused on stormwater management.

For MNAI, one challenge in providing support for communities is that they have had to adapt and learn to help support a wide variety of communities with different governance

structures, capacities, and priorities. In speaking with an MNAI team member, it was noted they are continually expanding their knowledge, working to improve their strategies and providing guidance to make the process framework and supports offered by MNAI ultimately more useful for a broader range of municipalities and local governments at various scales.

Interviewee 5 claimed after discussing a pilot for their community, that the scope of a project in their community was more effective if it was based on answering strategic and capacity related questions, rather than looking at a specific asset. “You had to develop the methodology to do it at least with some scientific rigor not back of the envelope kind of analysis” (Interviewee 5). They felt that the scope of the initial project that was decided for their community did not fit the questions about MNAM they were interested in answering.

The practicality of MNAI’s process and MNAM and the integration of financial policies was another concern for some participants. While there was a consensus from all 8 participants that the pilots, and by extension, MNAM projects, in general, should be practical, there was contention about whether or not it will be practical going forward. Four of eight participants noted that while progress has been made, more work is still needed. See section 5.1 for additional information.

#### 5.2.7 COMMUNICATION CHALLENGES

Tied to the lack of understanding of the concept of MNAM, challenges regarding communication were identified in the interviews. Primarily the challenges were split between internal communication within the communities and external communication with MNAI. Interviewee 1 stated difficulty in effectively communicating with other municipal departments due to the differences in the conceptualization of what natural assets are. “I have found it very difficult mostly because I think we all have a different understanding of what a natural asset is.” Interviewee 1 discussed that aligning the project effectively with the engineering department’s priorities was one of the primary challenges in their community’s pilot. Interviewee 1, 2, and 5 noted external challenges between the community and MNAI. Largely these challenges related to scoping and aligning the process (see section 5.2.4), as well as follow-up with MNAI. In these

cases, it appears as though there was miscommunication between the role of MNAI in the project and the community commitments.

### 5.3 RECOMMENDATIONS FOR FUTURE IMPLEMENTATION

Throughout the interviews, participants provided recommendations for other communities or regions who may either be considering or are adopting an MNAM approach. Common recommendations included finding funding and the need to seek out increased policy supports. However, the majority of participants provided more specific recommendations.

Interviewee 1 claimed what they potentially would have liked to see before they had committed to the project was a workshop (or something similar), where other representatives from earlier cohort participating municipalities were brought in to discuss their experiences with their own projects candidly. Potential topic areas would include whether or not the staffing and time requirements surpassed the estimated amount allocated to the projects.

Interviewee 2 discussed as there have been successes in integrating natural asset management into other work, for example into subdivision development bylaw amendments, even greater success could be achieved in the future by continuing with this trend. One interviewee also recommended for new communities to reach out to those communities having already completed their MNAI pilot or cohort projects, and not to become overwhelmed by the approach.

A key recommendation made by multiple interviewees was the identification of a “champion” from the participating community to lead the project work. Interviewee 2 commented that finding a progressive person in the community, someone passionate about the environment, perhaps a council member, is a crucial element in advancing an MNAI project. This was generally supported as 4 of 8 interviewees cited confirming a champion for the cause was a key recommendation for other municipalities. Interviewee 4 stated:

“I think just having that internal champion is key. Someone that is going to do the legwork of reaching out to different departments and working things through the governance of that municipality”.

Interviewee 5 recommended that communities considering MNAM should look at the communities intended outcome first before applying to MNAI. This potentially includes outlining objectives, misunderstanding barriers for their community and scoping the potential project for existing comparable business cases. Interviewee 5 went on to state that communities should consider what the information will be used for and what is the strategic policy advantage to our involvement.

Interviewee 6 also made recommendations: “spend a lot of time laying the groundwork, putting it in a context what makes sense within each community, and deal with an existing problem. Put it in the context of an existing problem and frame it in terms of information that you need, to work towards a potential solution.”. They noted the success of communicating clearly and relaying information in a simplified way. Bring senior leadership together to a common level and try to make them understand the benefit to them. Note the PCAB has a natural assets discussion group. Tie it into a budget benefit.

Other recommendations for communities considering adopting an MNAM approach that came out of the interviews include:

- Raise awareness of the potential of MNAM at a broader and public level;
- include all relevant municipal departments;
- fit the project into an existing municipal service to start;
- if possible, align it with another project or priority from the community;
- communicate to councils what they need to hear (regarding MNAM and environmental considerations) not what they want to hear;
- practice traditional asset management first. Draw in the natural asset approach and integrate it into traditional as so that the natural and built assets cannot be distinguished in the way that they are treated;
- try to recognize the real risk of not valuing these assets even though this may be difficult and may not align with the status quo;
- finding partnerships and bridging conversations is a way to increase awareness and interest;

- Consider workplace culture. For example, if climate change is a sensitive issue for council or other municipal departments, it may be best to approach the issue from a different perspective.

## 6.0 DISCUSSION

This chapter focuses on connecting themes that arose from my research findings, the literature, and implications for application in communities considering adopting an MNAM approach in their region. Interviews reflected that the perceived benefits and outcomes, challenges and barriers, and recommendations interviewees had for communities considering adopting an MNAM approach aligned with the literature. They also revealed that while there is a growing body of evidence to support the notion that MNAM can offer tangible and intangible benefits while offsetting infrastructure costs, there remain challenges, both real and perceived, which may effectively limit its implementation. The discourse came about in multiple ways including a variety of understandings regarding what MNAM is, how the environment should be valued, the range of benefits and ancillary benefits MNAM may offer, as well as others. The discussion around MNAM also directly tied to philosophical questions about societies responsibilities toward the environment and its valuation, however, these discussions go beyond the scope of this research and are mentioned limitedly.

A central theme that was reflected throughout this research, was the interplay or relationship between the perceptions relating to the newness and potential of MNAM to address a variety of the challenges facing municipalities with regard to asset management, and the uncertainty of MNAM, environmental valuation, and their implementation to standard practice.

As indicated throughout section 5.1 Outcomes and Perceived Benefits, there seems to be a strong foundation of support of MNAM among interviewees. Based on the willingness to participate in the pilot, and the perceived benefits for the management of natural assets, this may indicate a high potential for future growth and uptake of the concept by communities going forward. Also, as projects take place in different locations across Canada and at various scales, this supports the practicality and potential for MNAM. With this in mind, I found the interviews reflected an encouraging shift in the way ecological systems and services are recognized and valued by municipalities, local governments, councils, planners, engineers, etc. This shift toward societies improved environmental awareness and understanding and



willingness to seek out sustainable and resilient management strategies was also supported by the literature which also indicated the increased environmental understanding and awareness of society (Adamowicz, 2004) (Guerry, et al., 2015). Though there was some contention about the more effective strategy with which to approach MNAM, interviewees agreed the adoption of MNAM processes which incorporate the recognition and valuation of MNA's can advance the status quo.

The interplay between the newness and potential and uncertainty was also indicated through the range of perceptions regarding the utility and practicality of MNAM that were identified in this research. These perceptions are likely impacted by a range of different factors including personal beliefs and ideologies, profession and experiences, workplace culture, and contexts of the communities or local governments. As Costanza et al. (1997) note, you cannot separate the concept of valuation from the choices and decision society makes about ecological systems (p.255). In this way how society manages the environment is subject to change based on shifting values of society. The challenge of addressing the embeddedness of the status quo ties directly into this conversation and is perhaps exemplified by the frequently referred to disconnect between municipal departments including planning, engineering, and finance. For instance, the status quo regarding the treatment and management of built infrastructure by engineers and other professionals primarily views assets such as stormwater infrastructure as independent entities that have a given cost. How natural assets must be valued and managed is inherently different from this, which as stated in Chapter 5, requires a systems-thinking approach. Once again, this discussion leads to many other related discussions such as the potential perception that if we start managing assets differently, the skill and experience of engineers, finance officers, and other professions will lose merit. This of course ties into the newness and uncertainty of MNAM and related environmental management approaches which although critical to the advancement of MANM, go beyond the scope of this research.

As discussed in the literature review, measuring the value of the environment is a challenge for a number of key reasons. The complexities of natural systems, traditional asset management, and counting frameworks, jurisdictional challenges, lack of information and understanding, and subjective nature of value toward the environment, accurate and full

valuation is of the environment may be impractical. For the integration of MNAM, there is an added challenge of keeping in mind the capacities and budgets of municipalities and local governments. One method MNAI has used to address the challenges of environmental valuation is to compare the replacement cost of grey infrastructure. Although this type of valuation may only reflect a portion of the true costs associated with an asset, comparing the costs of replacement of an asset served as an extremely useful and practical approach for interviewees based on their experiences. The reason replacement valuation may serve as an essential initial step for local governments to begin assigning value to their natural assets because unlike estimates that have been made in the past where ecosystems and ecosystem services have been valued at extraordinarily high margins (Costanza, Farber, & Maxwell, 1989), replacement valuations might be considered more manageable for local governments. Replacement valuations may help to get different municipal staff on board with the concept as it is now perhaps more tangible and less abstract. In this way, replacement costs may help address the lack of buy-in with environmental valuation and allow for increased practicality.

While the concept of assigning a monetary value to the environment has existed for several years, there seems to be a perception that assigning value has had relatively little practical application (Adamowicz, 2004) (Robert Costanza, 1997). This perception was mixed among interviewees as some believed there had been ample examples of the practical application while others believed there has not been. Based on the interviews, assigning a monetary value to natural assets is useful for municipalities as it helps conceptualize, identify, and manage these assets. Assigning the monetary value of a natural asset can help compare the asset's value to grey infrastructure solution. When discussing the replacement of grey infrastructure stormwater management with natural infrastructure, Interviewee 3 claimed "[t]he core of it (MNAM) uses asset management" and that by comparing "oranges to oranges" allows for easy recognition of natural asset value. Interviewee 3 when not to claim that using this type of comparison helps align the goals MNAI seeks to achieve with existing asset management frameworks that municipalities and their finance departments are already familiar with. Assigning a monetary value to a natural asset, even if it is not a full estimate (perhaps even a minimum estimate) simplifies the comparison between natural asset value and

the value of regular assets. This aligns with interviewee 8 who claimed it was useful to put natural assets and traditional assets in the same lexicon as one another.

A factor that ties in directly to the contention regarding the newness and uncertainty of MNAM which also links to perceptions regarding practicality and lack of buy-in or lack of business cases, is that while similar NAM and green infrastructure concepts and projects have existed for a number of years, MNAM, as it is referred to by MNAI and used in the pilots, was only recently created by MNAI in 2017 (Chenoweth, et al., 2018) (MNAI, 2017). Furthermore, the interviews and the literature review indicate there is a mixed understanding of whether natural assets can be valued accurately, and if this value can be leveraged and integrated into MNAM frameworks. While the newness of the projects was identified as a limitation of this research the experiences of the interviewee and by extension, the communities have had little time to monitor long term benefit to the communities, it is also a potential advantage as it provided the opportunity to glean unique perspectives from the interviewees.

Another factor that should be addressed as the project communities applied to MNAI for the pilot, they may be considered progressive communities in their own right. With this in mind, as indicated in the results, there were still challenges trying to align municipal department and professional perspectives on how to prioritize and scope the pilot projects. One of the inherent challenges in this process seemed to be having a shared understanding of what natural assets are and having them viewed as assets in the same way traditional grey infrastructure is viewed. This might indicate the challenge ahead for other, perhaps less progressive communities that may also have natural assets which are not being valued. These concepts fall into more extensive discussions about the various ways people understand and perceive the environment and its value, how to manage assets, and how financing is undertaken, which are also influenced by workplace culture, and the bureaucracy of various professions.

Many of the discussions on perceived benefits and outcomes, and challenges and barriers were again addressed in the recommendations for future communities (see section 5.3). The recommendations that were provided by the interviewees helped shape my understanding of both the interviewee and their community's priorities regarding their natural

assets and how they are to be managed. Many other recommendations such as the need for the changes to the PSAB were addressed repeatedly and this helped me create an additional list of recommendations which key policy considerations as well as recommendations for next steps needed to support the advancement of MNAM, these include:

1. PSAB standards should be addressed so as to allow natural assets to be held at the same status as engineered assets. This will help increase buy-in by municipalities, municipal councils, and various municipal departments (finance, engineering, operations, etc.)
2. Using federal gas tax requirements to leverage the inclusion of MNAM into municipal accounting would potentially be an effective way to advance the buy-in of MNAM concept and increase its adoption by municipalities and their departments
3. Advancing market-based solutions and other economic instruments such as water quality trading could help communities maximize economic efficiency while maintaining environmental integrity. Further research should investigate the availability and practicality of these options in Canada
4. Increased awareness and recognition of NAM and MNAM would benefit communities in understanding both the existing benefits that natural assets may provide that communities may not be aware of as well as the potential benefits that could be achieved. There are currently few sources of information or support regarding NAM and MMAN and these would help address this issue.
5. As part of the increased awareness of NAM and MNAM municipal departments should work to have shared understandings of these assets. This may help address the cultural barrier and disconnect between planners, engineers, and finance departments, as well as others. Having a shared understanding may also remove the notion that these new approaches would result in a reduction of jobs
6. Engaging with relevant departments such as finance and engineering at the ground-level might help attain their support over time. Addressing workplace culture is something that will require time and patience.
7. To help convince local governments of the practicality of MNAM, a solid business case and proof of concept is essential. While having precedent cases from other

municipalities to compare to and learn from is crucial, for some municipalities, councils, and professionals, the business case in their community must also be made in order to begin or advance an MNAM project. Creating a business case will also help support buy-in for engineers, a potentially critical step in advancing widespread adoption of MNAM.

8. If MNAM is to be advanced dealing with challenges with regards to municipal or regional jurisdiction, ownership of an asset, how to define the roles and responsibilities of local governments will be an essential next step for society as a whole, going forward.

## 7.0 CONCLUSIONS

In conclusion, in the face of increasing global populations, climate change, and deteriorating infrastructure, alternative management strategies which incorporate the concepts of sustainable development and resiliency have grown more appealing for Canadian municipalities. Added to this, the identification of ancillary benefits and value streams that are not realized in the implementation of traditional grey infrastructure is increasing as well. The need for change regarding how municipalities and local governments recognize and manage their assets is growing, and natural asset management has been identified as a potential method to advance current management practices.

Traditionally, the demand on service provision including for water, waste (water) management, and transportation in municipalities have been largely dependent on engineered infrastructure assets which will need to be renewed or replaced in the future (MNAI, 2017). To reduce the associated costs of infrastructure development and operation, adopting a natural asset management approach can potentially reduce these costs. Governments at all scales must continue to identify and adopt alternative management strategies to help ensure the growth and development of society while also supporting the sustained functioning of Earth's life-support systems.

My first research question was: What are the outcomes and perceived benefits of MNAM processes and frameworks in Canada? I found six factors that arose as the most common and significant for the eight interviewees I interviewed these included: growing interest and understanding, building a business case, integration with asset management, aligning with MNAI's process, and Communication and Partnerships. While all 6 factors related to one another, the importance of building a business case was perhaps the most significant and frequently referred to outcome. Both the addition of external business cases which provide proof of the practicality of an approach and internal business cases which can improve buy-in in a community are essential for the advancement of MNAM and its adoption by a broader host of community's or regions.

The outcomes and perceived benefits also reflected an increased awareness of the benefits and value attributed to the natural environment including environmental services which our society is founded upon, as well as the risks and costs associated with the degradation of these features. While the range of perceived benefits was commonly referred to, outcomes were in some respects limited as MNAM and the experiences of the Interviewees are relatively new, with a number currently underway.

My second research question was: What challenges or barriers have been faced in implementing these processes? The seven factors that arose under this theme were: the lack of understanding and buy-in, embeddedness of the status quo, valuation of nature, lack of integration with accounting and policy, community capacity and resource limitations, scoping and aligning the process, and communication challenges. Similarly, to the outcomes and perceived benefits, each of these factors were directly related to one another. As discussed above, many of these challenges and barriers related to the newness and uncertainty related to both MNAM and the valuation of the environment and the inherent philosophical questions tied to this. Despite differences in the contexts of each of these communities, similar challenges and barriers affected each of them. If the lack of policy supports (including the exclusion of natural assets by PSAB) are addressed, it may serve to alleviate many of perceived and tangible challenges facing communities throughout Canada who may be considering adopting an MNAM approach.

My third and final research question included: What recommendations could be made to advance MNAM in future communities? The recommendations provided by interviewees included in section 5.3 reflected both general recommendations that would apply to all communities seeking to adopt an MNAM approach, as well as more specific recommendations that were based more on a challenge that was faced by the community. Regardless, the recommendations provide relevant information that can be addressed, applied, or considered by municipalities going forward. The recommendations I provide in section 6 are meant to supplement those provided in the interviews.





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## APPENDIX A

### INTERVIEW GUIDE

1. When did you first learn about the concept of municipal natural assets?
  - a. What was your impression of this topic the first time you heard about it?
2. What has been your involvement with MNAM processes in your community?
3. How did MNAM in your community first begin?
  - a. Where/when did interest arise?
  - b. Was there any political resistance?
  - c. Was everyone on board?
4. What was the process of MNAM in your community?
5. Were there any key factors or influences affecting adoption or interest in MNAM in your community?
  - a. What were they?
6. What have been or are some of the greatest impacts on your community from this process?
  - a. Were there any surprises?
  - b. Which departments/actors in your community were involved?
    - i. Who should be involved?
    - ii. Group or individual leader?
7. What is the most important factor in advancing the concept MNA's? How or why is the 'municipal' scope useful.
  - a. How is this different from any NAM projects you have done?
8. What do you view are some of the greatest benefits of MNAM processes? Why do you think recognizing or addressing MNA's is important?
  - a. In your opinion, what is the most important factor in advancing MNA's?
9. What do you view are some of the greatest challenges or barriers faced in implementing MNAM processes?
  - a. What are the key factors affecting these challenges?
  - b. How could these be addressed?
10. What is your advice for other local governments considering adopting an MNA approach?
11. Where do you see the state of MNA's in 5 years?
  - a. 10 years
  - b. What is your advice for other local governments considering adopting an MNA approach?
12. Where do you see the state of MNA's in 5 years?
  - a. 10 years

APPENDIX B

MNAI'S STEPS TOWARD EFFECTIVE MNAM



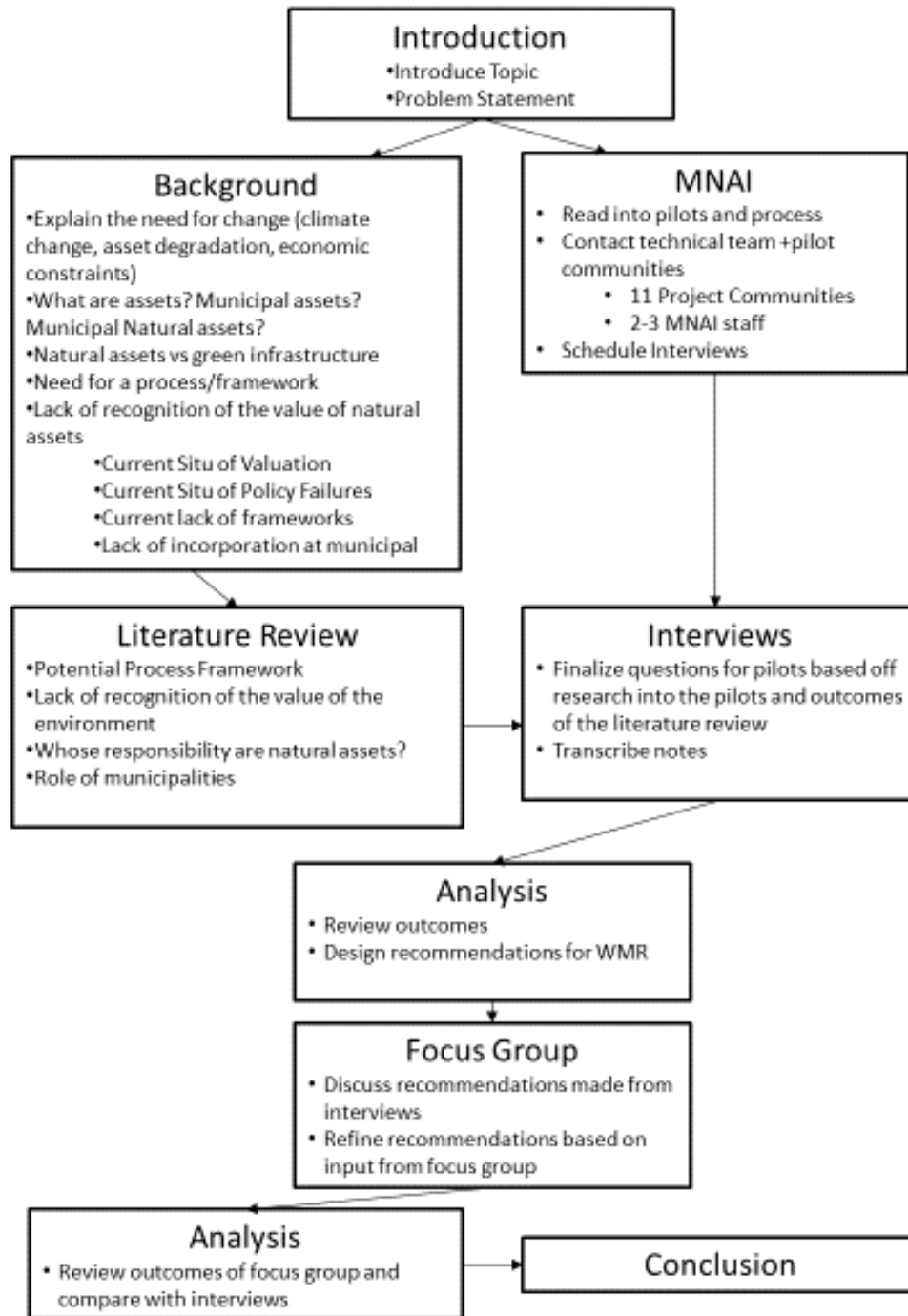
1 = low; 2 = medium and 3 = high

Ecosystem services in municipality	Municipally-owned			Private, provincial or federal ownership		
	Urban forests	Wetlands	Shoreline/coastal area	Terrestrial parks	Forests	Boys & waterways cultural assets
Water supply	1	2	1	3	3	5
Water purification	4	4	5	1	3	4
Flood protection	4	5	5	2	3	4
Climate regulation	1	2	2	4	2	5
Soil quality & stability	4	4	4	2	4	5
Landscape and neighbourhood amenity	5	5	1	3	5	4

Natural asset	Services	Hazards	Impact	Likelihood	Risk
Aquifer	Water provision	Leak from gas storage tank	High	Medium	High
Foreshore	Protection of businesses and residential districts from storms	Spill from transport truck	High	Low	High
Healthy creek, distant from developments	Stormwater absorption, conveyance, and flood protection	Storms, development	High	Low	Medium-high
Degraded creek near area with land intensification	Stormwater absorption, conveyance, and flood protection	Development and erosion	Low	Low	Low
	Stormwater absorption, conveyance, and flood protection	Development and erosion	Medium	High	High

Source: MNAI

## APPENDIX C FRAMEWORK FOR CAPSTONE



## APPENDIX D

### CASE STUDY 1 THE TOWN OF GIBSONS

The Town of Gibsons, located in southwestern British Columbia was the first municipality in North America to begin integrating natural assets into asset management and financial planning (MNAI, 2017a). Limited largely by economic constraints, Gibsons identified that value toward replacing and maintaining infrastructure can potentially be sought elsewhere than from human-made solutions (Town of Gibsons, 2018b). Natural services provided ‘freely’ by nature could be managed or sustained to allow for economical effective service delivery while also providing other benefits such as recreation and environmental aesthetics. How these insights developed, occurred over time, and involved adopting a holistic as well as grounded approach to identifying and assessing the value of their natural environment.

“Today, for example, we have the numbers and evidence to show that it is smarter and cheaper, by orders of magnitude, to invest in maintaining and expanding green infrastructure, such as forests, urban parks and stormwater ponds, than to design, build and manage engineered stormwater infrastructure.”  
(Town of Gibsons, 2018a, p. 4)

2009 to 2013 marked a non-trivial turning point in Gibsons’ journey toward developing its strategy for natural asset management. During this time, an aquifer mapping study was commissioned for The Gibsons Aquifer by The Town of Gibsons to expand on the Towns understanding of the aquifer as well as conceptualize its boundaries, hydraulic properties, flow characteristics, as well as spatial and temporal qualities characterizing the aquifers development (Waterline Resources Inc., 2013). The Gibsons Aquifer, which represents the Town of Gibsons most important natural asset also represents a significant potential loss to the community should the aquifer be damaged or mismanaged. The report produced in collaboration by the Town of Gibsons itself, along with the Waterline Resources Inc., Gordon Groundwater Consultancy, and the University of British Columbia (UBC) resulted in an improved understanding of the aquifer that in the Town of Gibsons perspective allows future stakeholders a better understanding how their actions can impact the aquifer. Included in this



report among other things are an acknowledgement of the usefulness of a groundwater management zone, water management plans and development bylaws/policies, community engagement and communication, an updated inventory of potential contaminant sources, a maintenance program, and a groundwater monitoring program.

From 2014 to the present the Town of Gibsons has made significant strides in developing its strategies for natural asset management (Town of Gibsons, 2018b). In 2014 Gibsons adopted a natural asset management strategy that both established their definition of natural assets as an asset class, as well as created policies specifying operational, maintenance, and sustainability targets for these assets including strategies for their implementation and financial supports. Furthermore, in this same year financial auditors contented to include and acknowledge the significance of the municipality's natural assets in their financial statements.

*Lessons Learned:*

As indicated by Gibsons' journey, the process of moving toward an asset management plan that acknowledges natural capital and ecosystem services is unlikely a process that happens at once. Realistically, to move toward such a plan, municipalities will undergo numerous iterations adopting different variations of strategies that may eventually lead or optimistically surpass the strategies adopted by Gibsons and provide a holistic, but grounded approach to natural asset management. As indicated by table 1 below, Gibsons acknowledges that they had to make a number of changes to their asset management processes. Other than the development of a natural asset policy or the alteration of financial statements to include acknowledgement of natural capital assets as mentioned above, Gibsons also changed its process to (Town of Gibsons, 2017):

1. Move toward an evidence-based approach that encourages promoting preventive strategies instead of responsive ones
2. Encourage collaborative management and training
3. Acknowledge the limitations of their resources and capabilities and develop partnerships to supplement these limitations

4. Engage in long-term financial planning to encourage proper management over an asset's entire lifecycle