Wetland Offsetting: A Policy tool for Sustainable Wetland Management in the Grand River Watershed?

by

Ejiro Movoria

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Author’s Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Wetlands, once considered wastelands, are crucial ecosystems that sustain biodiversity, regulate water resources, and provide essential services. Functioning as the "kidneys of the biosphere," they purify contaminants and maintain water quality. However, land conversion for industrial, residential, and farmland development has been identified as a major threat to wetland sustainability in Ontario. Other threats that have been identified include invasive species, natural water level alterations, pollution, and climate change. The wetlands of Ontario are further threatened by several policy changes that have been implemented by the Ontario Government in support of ‘Bill 23’, which is the government's plan to build 1.5 million homes in the next 10 years. Wetland offsetting is being positioned as the solution to wetland loss in the province and four conservation authorities have developed detailed offsetting policies. This thesis evaluates wetland offsetting policy as a viable tool for promoting sustainable wetland management and conservation in the Grand River Watershed. It theorizes that as part of a collaborative governance framework, wetland offsetting can function as a government-regulated mechanism that unites all stakeholders or enables a satisfactory compromise in favour of sustainability. The research data was gathered through an examination of academic and non-academic literature, alongside semi-structured interviews with key representatives from Ontario conservation authorities implementing wetland offsetting policies, the Grand River Conservation Authority, Ducks Unlimited Canada, Alberta Land Institute, Fiera Biological Consulting, Alberta Environment and Protected Areas, the City of Guelph, and the County of Brant. The study reveals that the shift in responsibilities from conservation authorities to municipalities, coupled with weakened regulatory frameworks, has created significant challenges for effective wetland management. While ecological offsetting offers a potential solution for mitigating wetland loss, its effectiveness is limited by current monitoring practices, land unavailability, resource constraints

and the uneven implementation of policies across different regions. The study concludes that there is a need for a more integrated and collaborative approach to wetland conservation, one that involves all relevant stakeholders, including Indigenous communities, municipalities, and conservation authorities, prioritizing direct protection and restoration of wetlands, with offsetting used as a complementary tool rather than a primary strategy. Recommendations include developing and implementing more robust monitoring frameworks that go beyond visual inspections and presence/absence data but include detailed functional assessments that can provide a clearer picture of the ecological success of wetland offsetting projects.

Keywords: Wetlands, Wetland offsetting, Grand River Watershed, Conservation Authorities, Collaborative governance, Sustainable wetland management.

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Chapter 1: INTRODUCTION

1.1 Context

Wetlands, once thought of as wastelands are now recognized as valuable ecosystems that play a crucial role in maintaining the delicate balance of our planet's ecosystem (Junk et al., 2013). Wetlands consist of a wide variety of ecosystems, such as marshes, swamps, bogs, and fens, and are defined by distinctive hydrological and ecological conditions (Mitsch, 2015). As very important ecosystems, wetlands offer a variety of ecological, hydrological, and social benefits. By generating all necessary resources like fish, lumber, and bush meat, they support human livelihoods and serve as a habitat for a wide variety of plant and animal species (Dahl and Fish, 2011). They also help to mitigate climate change, improve shoreline stabilisation, and regulate floods (Mitsch and Hernandez, 2013). In addition, they play a crucial role in filtering and purifying water in the biosphere much like the kidneys of the human body. They absorb pollutants, excess nutrients, and sediments from surface and groundwater, breaking them down and releasing clean water back into the ecosystem. Wetlands are thus essential for maintaining the overall health and balance of the biosphere, making them the “kidneys of the biosphere” (Mitsch, 2015).

They cover a total land area of about 12.1 million km^2 and are estimated to account for over 40 percent of global ecosystem services (Costanza et al., 2014; Gardner & Finlayson, 2018; Xu et al., 2020). In Southern Ontario, wetlands function as natural infrastructure — producing at least $14 billion in economic benefits each year for residents of Ontario (Troy and Bagstad, 2013). In the context of the Grand River Watershed, a vast and ecologically diverse region in Southern Ontario, wetlands are of particular importance - It is estimated that wetland ecosystem

services are worth $22,000 per hectare per year, making the combined value of all Grand River wetlands about $1.4 billion (GRCA, n.d. - a).

However, land conversion for industrial, residential and farmland development have been identified as major threats to wetland sustainability in Ontario (OMNRF, 2015). Other threats that have been identified include invasive species, natural water levels alterations, pollution, and climate change (OMNRF, 2015; OMNRF, 2017). The wetlands of Ontario are further threatened by the lack of strong legal policy and framework to enhance wetland restoration once development decisions on them have been made (Ducks Unlimited Canada, Earthroots, Ecojustice & Ontario Nature, 2012; Spence, 2021).

While the Wetlands of Northern Ontario (Hudson Bay Lowlands and Ontario Shield Ecozones) have remained largely intact, over 85 percent of the pre-settlement wetlands in Southern Ontario (Mixedwood Plains Ecozone) including southwestern Ontario, the Niagara and Toronto areas have been lost as a result of land conversion for other uses (OMNRF, 2015; OMNRF, 2017). These losses continue even though there are wetland policies, programs and partnerships that have been in place since the 1984 ‘Guidelines for Wetlands Management in Ontario’ policy (OMNRF, 2015; OMNRF, 2017; Ontario Nature, 2017). Throughout the Grand River watershed, many forests, wetlands, and other natural landscape features have been converted for housing, industrial, agricultural, and recreational uses (Grand River Watershed Characterization Report, 2008). Furthermore, it is estimated that 65 percent of historical wetlands within the basin have been lost, thereby reducing their coverage from 27 percent to only 10 percent of the Watershed (Grand River Watershed Characterization Report, 2008). To protect provincially significant wetlands, the Ontario Ministry of Natural Resources established the Ontario Wetland Evaluation system (OWES) in 1984. However, the Ontario government

made revisions to the system in support of ‘Bill 23: More Homes Built Faster Act, 2022’, which is the government’s plan to address the housing crisis by building 1.5 million homes in the next ten years. The revisions were implemented on January 1, 2023, despite pushback from conservation groups and authorities and concerns from the province’s Auditor General (Mann Lawyers, 2023). In 2022, the Ontario Government posted a discussion paper on the Environmental Registry, seeking feedback on ways Ontario could offset development pressures on natural heritage, wetlands included, therefore implying that wetland offsetting is being positioned as a solution to wetland loss in the province (Ontario Nature, 2023). This approach was also explored in the report, "A Wetland Conservation Strategy for Ontario 2017 – 2030," published by the Ministry of Natural Resources and Forestry in 2017, which serves as a framework to guide the future of wetland conservation across Ontario.

Wetland offsetting is the last stage in the wetland mitigation sequence when wetland damage cannot be avoided, minimized, or mitigated. It is the practise of taking deliberate conservation actions to compensate for negative impacts on wetlands. The stated objective is normally to deliver positive environmental consequences of equal or higher quantity and type, with the offsets lasting at least as long as the initial wetland damage (Ontario Nature, n.d - a.). The goal is no-net loss or ideally a net gain in wetland area and value. This concept originated in the United States and had since expanded internationally, with countries like Australia, South Africa and those in the European Union adopting similar approaches.

While wetland values are recognised and many actions have been adopted at local, global, and international levels to protect them, the deterioration of wetlands persists. Within a collaborative governance framework, this thesis theorizes that wetland offsetting can function as a government-regulated mechanism that unites all stakeholders or enables a satisfactory

compromise in favour of sustainability. Through this approach, wetland offsetting can help reconcile the conflicting and opposing interests of stakeholders, so promoting more efficient collaboration among many stakeholders and the preservation of wetlands.

In Canada, federal legislations that have adopted the goal of no net loss include the 1991 Federal Policy on Wetland Conservation and the Fisheries Act. Furthermore, there are wetland offsetting approaches as part of Wetland conservation policies in Nova Scotia, Alberta, New Brunswick, and Quebec.

Although Ontario is yet to establish a wetland offsetting policy for the province, four conservation authorities (Toronto and region, Lake Simcoe region, Credit valley, and Nottawasaga Valley) have produced detailed ecosystem offsetting policies to guide the effective and consistent application of offsetting practices in their jurisdiction. However, the Grand River Conservation Authority (GRCA), which oversees the Grand River Watershed, does not currently have a wetland offsetting policy in place. This research thus seeks to investigate the potential of a wetland offsetting policy as part of a collaborative governance framework, serving as an effective sustainable wetland management tool in the Grand River Watershed, by drawing on the lessons and experiences from other conservation authorities that have developed detailed ecosystem compensation policies.

1.2 Research Purpose

The purpose of this study is to perform a complete evaluation of a wetland offsetting policy as a viable tool for promoting sustainable wetland management and conservation in the Grand River Watershed. This inquiry will draw on the experiences and practices of four Ontario conservation authorities as well as the Province of Alberta that have implemented detailed wetland offsetting

policies, with the goal of assessing their efficacy, identifying obstacles, and exploring potential to improve present wetland management measures.

1.3 Research Questions

- Has the wetland offsetting policy yielded its expected economic and environmental benefits in the jurisdictions where it has been implemented?
- To what extent do conservation authorities incorporate non-economic wetland values, particularly indigenous cultural values, into their wetland offsetting protocols, and what factors influence the inclusion or exclusion of these values?
- What logistical challenges have other conservation authorities encountered during the implementation of wetland offsetting policies, and what strategies have they employed to address these challenges?
- Can a Wetland offsetting policy enhance collaborative wetland governance and management strategies in the Grand River Watershed?

1.4 Thesis Structure

This chapter introduced the thesis by establishing the context and stating the research questions. Chapter Two provides a comprehensive review of the relevant academic and practitioner literature, organised as follows: an overview of wetland ecosystems, drivers of wetland loss and degradation, approaches to wetland protection, wetland conservation in Canada, and related policies in Ontario.

Chapter Three explores the concept of wetland offsetting, covering various approaches, international policies, Canadian provincial policies, and specific wetland offsetting policies in Ontario. Additionally, it discusses the limitations of wetland offsetting and concludes with criteria for a strong wetland offsetting policy.

Chapter Four details the methodology and research design of this qualitative study, explaining the data collection, analysis, and interpretation methods.

Chapter Five presents the results of the study, providing detailed findings based on the data collected and analysis. It also includes the discussion of the findings, connecting it to the existing literature.

Finally, Chapter Six presents the summary of the findings, conclusions are drawn, and recommendations are offered for policy and practice.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter thoroughly examines wetlands, highlighting their distinct ecological characteristics, and the ecosystem services they provide. Wetlands serve an important role in biodiversity conservation, water resource regulation, and socioeconomic development. Despite their importance, wetlands confront a variety of concerns, including agricultural development, climate change, invasive species, and urbanization, all of which contribute to their degradation and disappearance.

The chapter also examines some of the different wetland conservation and management policies at the international level, Federal (Canada) level as well as in Ontario before introducing the case study, the Grand River Watershed. This chapter will also highlight 'Bill 23' and how it has impacted the wetland conservation and management policy framework in Ontario.

2.2 What are wetlands?

Wetlands are unique ecosystems found at the interface between terrestrial and aquatic environments and have thus been described as ecotones or transitional habitats (W. J. Mitsch, 2015). Typically, wetlands are located in landscapes with sufficient water supply near the surface, thriving in areas where precipitation exceeds evaporation or when steady inflows from surface or subterranean sources compensate for water scarcity (Price et al., 2005).

There is considerable uncertainty on how to define wetlands, especially for legal contexts, due to their diverse hydrologic conditions, gradient between uplands and deepwater systems and as well as substantial variation in location, size, and anthropogenic impact (W. J. Mitsch, 2015). However, the Ramsar Convention of 1971 provides the most cited wetland definition. Article 1.1 of the Ramsar Convention (RC, 1971, p. 1), defines a wetland as:

> Areas of marsh, fen, peatland, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed six metres. These areas may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands.

The Ramsar Convention's definition is largely acknowledged as the worldwide benchmark; however, it is more expansive than some national definitions, sparking significant discussion among different jurisdictions (Finlayson et al., 2011). In contrast, the Provincial Policy statement which guides land-use planning and development in Ontario defines wetlands as:

> Lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. In either case the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic plants or water tolerant plants. (p. 37)

In both definitions, the abundance of water has led to the development of hydric (waterlogged) soils and has promoted the prevalence of hydrophytic (water-loving) or water-tolerant vegetation (OMNRF, 2017). Furthermore, Ontario’s provincial policy statement’s definition underscores key wetland features that have been described in Mitch and Gosselink (2023) as the distinguishing features of wetlands. The authors posit that any comprehensive wetland definition must include three major components:

1. Wetlands can be distinguished by the presence of water, either on the surface or within the root zone.

2. The presence of unique soil conditions that are different from surrounding or adjacent uplands
3. The presence of hydrophytes or vegetation adapted to such temporary or permanent water-inundated conditions and the absence of biota intolerant to these conditions

Understanding these fundamental characteristics of wetlands is important for recognizing the various ecosystem services they provide and their overall role in the environment. In the next section, we will explore the different types of wetlands, each distinguished by its specific hydrology, vegetation, and soil attributes.

2.3 Classification of Wetlands

Wetland classification is a system used to group wetlands based on their hydrology, vegetation, soil types, and landscape position. The classification of wetlands helps in understanding the ecological functions, biodiversity, and conservation needs of different wetland types (Finlayson & van der Valk, 1995; Gerbeaux et al., 2018). However, the complexity of the gradients found where land intersects with streams, rivers, lakes, and estuaries, as well as within "wet" lands, makes the classification of wetlands particularly challenging. This complexity leads to difficulties comparable to those encountered in reaching an agreement on a standardized definition of wetlands (Finlayson & van der Valk, 1995; Gerbeaux et al., 2018; Scott & Jones, 1995). As a result, the necessity for and acceptance of a specific classification system is frequently debated.

Since the early 1900s, wetlands have been classified, beginning with the peatland categories in Europe and North America (Mitsch, 2015). The Cowardin et al (1979) wetland classification system developed for the United States stands out as one of the most detailed and widely accepted wetland classification systems and at the basic level, it classifies wetlands into

marine, estuarine, riverine, lacustrine and palustrine. Within the Canadian context, the Canadian Wetland Classification System developed by National Wetlands Working Group (1997) identifies five wetland classes (bog, fen, swamp, marsh and shallow water) based on the nature of the wetland environment. Numerous other regional, national and local wetland classification systems have since been created and successfully implemented, focusing on conservation and management objectives, and the data use for evaluating wetland loss or determining management priorities (Finlayson & van der Valk, 1995).

However, this varying classification systems poses a challenge at the international level and the Ramsar Convention on Wetlands of International Importance has been the sole attempt to create a global system (Gerbeaux et al., 2018). The convention classifies wetlands into 42 types and three categories which include: marine and coastal wetlands, inland wetlands, and human-made wetlands (Ramsar Convention Secretariat, 2013). These categories and wetland types are highlighted in the table below.

Table 2.1: Ramsar Wetland Type Classification (Ramsar Convention Secretariat, 2013)

Marine/Coastal Wetlands	Inland Wetlands	Human-made wetlands
• Permanent shallow marine waters • Marine subtidal aquatic beds • Coral reefs • Rocky marine shores • Sand, shingle or pebble shores • Estuarine waters • Intertidal mud, sand or salt flats • Intertidal marshes • Intertidal forested wetlands • Coastal brackish/saline lagoons • Coastal freshwater lagoons • Karst and other subterranean hydrological systems	• Permanent inland deltas • Permanent rivers/streams/creeks • Seasonal/intermittent/irregular rivers/streams/creeks • Permanent freshwater lakes (over 8 ha) • Seasonal/intermittent freshwater lakes (over 8 ha) • Permanent saline/brackish/alkaline lakes • Seasonal/intermittent saline/brackish/alkaline lakes and flats. • Permanent saline/brackish/alkaline marshes/pools. • Seasonal/intermittent saline/brackish/alkaline marshes/pools. • Permanent freshwater marshes/pools • Seasonal/intermittent freshwater marshes/pools on inorganic soils • Non-forested peatlands • Alpine wetlands • Tundra wetlands • Shrub-dominated wetlands • Freshwater, tree-dominated wetlands • Forested peatlands • Freshwater springs • Geothermal wetlands • Karst and other subterranean hydrological systems, inland	• Aquaculture • Ponds • Irrigated land • Seasonally flooded agricultural land • Salt exploitation sites • Water storage areas • Excavations • Wastewater treatment areas • Canals and drainage channels, ditches • Karst and other subterranean hydrological systems

2.4 Wetlands Ecosystem Services

Wetlands are among the most important ecosystems vital for human survival and sustenance (Gardner & Finlayson, 2018; W. J. Mitsch et al., 2015). They are estimated to cover about 1.5 – 1.6 billion hectares of the world's total land area and provide 40.6 percent of the total global ecosystem services (ES), which contributes about US$47.4 trillion per year to global economies (Constanza et al., 2014; Davidson et al., 2019; Convention on Wetlands, 2021). They remain the most valued components of our environment as evident in ecosystem assessments conducted by Constanza et al. (1997) and Constanza et al. (2014). In both studies, wetlands

(especially inland swamps and floodplains) were found to be significantly more valuable than forests, grasslands, lakes and rivers. Other ecosystem assessment studies by De Groot et al. (2012), Mitsch & Gosselink (2000), and McInnes (2013) also highlight the exceptional value of wetlands therefore collectively affirming the unparalleled ecological and economic importance of wetlands in comparison to other terrestrial and aquatic ecosystems. Furthermore, there is growing evidence that the economic advantages of preserving intact wetland ecosystems are greater than the profits obtained from exploiting or converting wetland resources (Balmford et al. 2002; Barbier 2011; de Groot et al. 2012; ten Brink et al. 2013).

Ecosystem services are the benefits humans derive from natural ecosystems either directly or indirectly (OMNRF, 2017). They are important for human health, economic development, and overall quality of life. The services provided by wetlands were grouped into three hierarchical levels by Mitsch & Gosselink (2015): population, ecosystem and global. Population values are those for a specific ecological population such as providing a habitat for waterfowl. Ecosystem values such as flood mitigation require the whole wetland ecosystem while global values maintain air and water quality on a much larger scale than the ecosystem level (Mitsch et al., 2015). Furthermore, these services have been categorized as provisioning, regulating, cultural and supporting in Millennium Ecosystem Assessment (2005). Using this categorization, the ecosystem services provided by wetlands will be explored in the following sections.

2.4.1 Provisioning Services

These include the products derived from wetland ecosystems including food, fresh water, fiber, fuel, natural medicines and genetic resources (MEA, 2005). Among these, two of the most vital resources for human well-being are food (mainly fish) and clean drinking water (MEA,

2005). Renewable fresh water for human consumption is supplied by different inland wetlands, including lakes, rivers, swamps, and shallow groundwater aquifers (MEA, 2005). Wetlands also support the production of diverse food sources such as waterfowl, wild game, fruits, fish and shell fish (D. de Groot et al., 2018; Zedler & Kercher, 2005). In addition, wetlands provide timber, fuel wood, aggregates and peat for fuel and horticulture (de Groot et al., 2018; Mitsch et al., 2015). Traditional medicines are also another resource provided by wetlands and it is estimated that about 80 percent of the world's population rely on these ecosystems for primary health care (Bureau, 2001; Mitra et al., 2003). Furthermore, these natural goods and services provided by wetlands lead to employment opportunities therefore making significant contributions to a country's gross domestic product as seen in Bangladesh (Khan & Haque, 2010).

2.4.2 Regulating Services

These are the services derived from regulating ecosystem processes such as climate change mitigation (MEA, 2005). Wetlands are huge carbon sinks thereby aiding in climate change mitigation as seen in studies by Hernandez et al. (2015) and Villa and Mitsch (2015). They play a major role in carbon storage in Canada's boreal regions (Mitsch & Hernandez, 2013). Although peatlands account for only about 3-4 per cent of the world's total land area, MEA (2005) estimates that these ecosystems store up to 540 gigatons of carbon.

Wetlands also help in improving water quality and have been described as the 'kidneys of the biosphere' due to their purification abilities. Marshes, as a good example, play an important role in purifying water and detoxifying wastes (de Groot et al., 2012). Moreover, the reduction of nitrate levels by more than 80 percent was attributed to certain wetlands in MEA (2005). In

1992, approximately half of the Danube River Floodplain's total economic value was credited to its function as a nutrient sink (MEA, 2005).

Other ecosystem processes regulated by wetlands include water regulation (Cugusi and Piccarozzi, 2009), pollination (Dupont et al. 2000), and coastlines protection from coastal storm surges (Gardner & Finlayson, 2018; Turner et al; 2000).

2.4.3 Cultural and Social Services

These are intangible values humans derive from wetland ecosystems: spiritual enrichment, aesthetic experiences, recreation, tourism, and cognitive development (MEA, 2005). Many wetlands serve as sacred sites and hold high cultural values for various communities (MEA, 2005). The rich biodiversity found in wetlands means they can serve as a foundation for both formal and informal ecology education (MEA, 2005; Mitch et al., 2015).

Recreation and tourism are other important non-material value humans obtain from wetlands. Nature tours and ecotourism are among the fastest expanding activities in Mexican and Central American wetlands. These activities are integrated with bird watching, waterfowl and wildlife observation, sport fishing, snorkelling, coastline and cenote diving, boating, and kayaking (Mitsch & Hernandez, 2013). The Niger Delta wetlands, for example, host fishing festivals which attract many visitors (Adekola & Mitchell, 2011). In the United States, recreational fishing alone generates about $27 – 37 billion annually (MEA, 2005). These various recreational opportunities not only enhance overall human well-being but also make significant contributions to local and national economies.

Wetlands has special cultural significance in settler-colonial countries such as the United States, Canada, and Australia. Indigenous peoples across settler-colonial nations maintain cultural linkages to wetlands in their original territories (Bangalang et al., 2022). Non-Indigenous

planners and policy makers in charge of wetlands management may be unaware of these cultural connections. The importance of actively engaging Indigenous Peoples is frequently recognised in policies and international agreements governing the conservation of wetlands and other valuable ecosystems (Convention of Biological Diversity, 2022; Hobbs, 2024; Ontario Ministry of Natural Resources and Forestry, 2022). Nonetheless, Indigenous Peoples' engagement in conservation concerns is sometimes limited, with governments and developers viewing it as a reluctant responsibility (Youdelis, 2016). It is therefore paramount that wetlands are managed in a way that involves the inclusion, consultation and active engagement of indigenous peoples.

2.4.4 Supporting Services

These are services that necessitate the production of other ecosystem services. They include foundational ecosystem processes of soil formation, nutrient cycling and primary productivity that could lead to the three categories of ecosystem services listed above (de Groot et al., 2018; MEA, 2005; Mitsch et al., 2015). They differ from the other kinds of ecosystem services due to their indirect and long-term impact as opposed to the direct and short-term impacts associated with provisioning, regulating and cultural services (MEA, 2005).

Overall, wetlands are extremely valuable ecosystems which provide numerous services and values that are far greater than those of terrestrial ecosystems. Despite their enormous ecological, economic, and cultural importance, wetlands around the world face a number of threats to their health and survival. The following section will look at the main risks to wetlands, offering insight on the causes that lead to their loss and degradation.

2.5 Drivers of Wetland loss and degradation

Despite the recognition of the importance of wetlands, they still till date face severe threats of loss and degradation because of climate change and human-induced pressures.

Freshwater ecosystems including wetlands, rivers and inland waters have been described as the most endangered of all biomes (Lee, 2015). There is some uncertainty around the exact rate and total lost wetland area chiefly due to limited availability of historical data and differing wetland definitions (Hu et al., 2017). However where data exists, it is estimated that 35 percent of wetlands have been lost since 1970, at a rate that is 3 times greater than that of forest ecosystems (Gardner & Finlayson, 2018). According to Junk et al. (2013), 30–90percent of the world's wetlands have already been lost or significantly altered in several nations, and there is no sign that this trend is slowing down.

Majority of the wetlands area lost in the first half of the twentieth century were in northern countries, however since the 1950s. there has been a rapid increase in wetland conversions in tropical and subtropical countries (Zedler & Kercher, 2005). Hu et al. (2017) aggregated worldwide wetlands-related datasets to quantify the amount of wetland loss, concluding that at least 33% of global wetlands had been lost by 2009 when compared to pre-industrial levels. In their study, they discovered considerable regional differences in wetland loss, with Europe having the most severe decline of almost 45%. This was followed by South America and Asia, which lost around 32% and 27%, respectively. Furthermore, direct anthropogenic activities have resulted in the loss of roughly 29% of China's wetlands. There is a lot of uncertainty regarding the extent of wetland loss in North America, with estimates ranging from an 8 percent loss as seen in Hu et al. (2017) to a 56 percent loss since the start of the 18th century, according to Davidson (2014). However, according to the US Fish and Wildlife Service's 'Status and Trends of Wetlands in the Conterminous United States 2009 to 2019' report, net wetland loss in the United States has increased by more than 50% since the previous Wetlands Status and Trends study period (2004-2009) (Lang et al., 2024). According to the report, more than half of

the wetlands in the lower 48 states have disappeared, with losses primarily occurring in the southeast, Great Lakes, and Prairie Pothole regions.

Gardner and Finlayson (2018) Global Wetland Outlook report classified the multiple risks to the health and sustainability of wetlands into three categories. Threats were categorised as direct drivers, indirect drivers, and global megatrends. Direct drivers are activities that have an immediate impact on wetland ecosystems, such as urbanisation, agriculture, invasive species, infrastructure development, pollution, water diversion and extraction. Indirect drivers are fundamental societal processes that influence direct drivers, such as population growth, policy/government, tourism, and recreation. Climate change, globalisation, changing consumption, urbanisation, and demographic shifts are examples of global megatrends, which are large-scale and long-term changes that have far-reaching consequences for wetlands. The following sections will explore five of these threats to wetland ecosystems.

2.5.1 Agriculture

Agriculture is one of the main causes of wetland degradation and it is estimated that approximately 50 percent of internationally significant wetlands have been negatively impacted by agriculture (Convention on wetlands, 2021). With the human population of 7.7 billion people in 2019 expected to grow to 9.7 billion by 2050 (United Nations, 2019), there will be expansion and intensification of agriculture to meet the growing demand for food. While there is no global calculation of the proportion of wetland loss caused by agriculture, regional studies (Mitsch & Hernandez, 2013; Patino & Estupinan-Suarez, 2016; Robertson et al., 2019; Zou et al., 2018) suggest that agricultural development is the primary cause.

Natural wetlands, especially floodplains, have frequently been cleared and drained to allow for agricultural activity (MEA, 2005; Tolentino, 2013; Zedler & Kercher, 2005). By 1985,

about 56-65 percent of the inland and coastal marshes in Europe and North America had been drained (MEA, 2005), with an estimated 26 percent of worldwide wetlands converted for agricultural use (Coyle 2020; Zedler & Kercher, 2005). For example, the wetlands of the Prairie Pothole Region and the Nebraska Sandhills which are both important nesting sites for waterfowl, have lost considerable wetland area due to drainage for agricultural activities (Mitsch & Hernandez, 2013).

The intensification and expansion of agriculture has led to a significant increase in the application of fertilizers and herbicides as seen specifically in Asia and Latin America where there has been a nine-fold increase in nitrogen-based fertilizers (Convention on wetlands, 2021; FAO, 2020). Furthermore, about 70 percent of global extraction and diversion of freshwater is for agricultural irrigation (FAO, 2020). This extensive chemicals and water resources use is bound to impact the ecosystem services of these valuable ecosystems. Verhoeven & Settler (2010) study showed that the cumulative impact of drainage for agriculture and soil alterations results in the destruction of wetland ecological function.

While wetlands are crucial for maintaining ecosystem services that support agriculture, the expansion of agricultural activities often leads to wetland degradation. This competition for land can undermine the ecological functions of wetlands, potentially affecting long-term agricultural sustainability (Convention on Wetlands, 2021).

2.5.2 Climate Change

Climate change stands out as another major threat to the health and sustainability of wetland ecosystems. The IPCC (2021) report suggests that the global climate is changing at unprecedented levels thereby compounding the loss and degradation of wetland ecosystems. Junk et al. (2013) posits that additional stressors on wetlands are predicted under climate change

scenarios, mostly because of hydrological changes, temperature rises, and a rise in sea level. This poses an increasing threat to human and animal populations reliant on the ecosystem services wetlands provide (MEA, 2005). For instance, sea level rise from climate change will have an impact on coastal wetlands, while changes in precipitation, air temperature, and river discharges will have an impact on inland wetlands (Mitsch and Hernandez, 2013). There is a significant chance that these modifications will cause sudden changes to the overall composition, structure and function of wetlands and other freshwater ecosystems (Gardner & Finlayson, 2018; Moomaw et al., 2018). For instance, coastal wetlands are experiencing saltwater intrusion due to sea level rise, which makes them less appropriate for freshwater species and changes the ecology (Zhang et al., 2021).

Climate change has led to a net loss of wetland area as a result of increasing temperatures (Xi et al., 2021) and also threatens the species distribution and structure of the plant and animal communities of wetlands (Junk et al., 2013; Kibria & Yousuf Haroon, 2017). Additionally, changing hydrology and warming temperatures can alter the biogeochemistry and function of the wetland to the point where some critical services may become detrimental. As a result, they will no longer serve as a source of purified water and may begin to deteriorate and release nutrients into the surface water, causing eutrophication, acidification, and brownification to occur (Salimi et al., 2021). Moreover, if decomposition occurs faster than primary production (photosynthesis), wetlands may transition from carbon sinks to carbon sources, further aggravating climate change impacts (Salimi et al., 2021).

2.5.3 Invasive Species

The introduction of alien plant and/or animal species can compete with wetland native species and this can alter the ecological structure of wetlands (Gell et al., 2023). A good example

is the Invasive crayfish which has negatively altered the trophic structure, species composition and energy flows in the Okavango Delta, Botswana (Gardner & Finalayson, 2018; Nunes et al. 2016). These invasive species are either deliberately or accidentally introduced into wetland ecosystems via human activities such as trade, tourism, and transportation networks (Crowl et al., 2008; Gallardo et al., 2016). Wetlands are prone to invasion because the combination of sediments, nutrients, and water produces conditions for opportunistic species to thrive, which is occasionally aided by disturbance (Zedler & Kercher 2004). Additionally, climate change can create favorable conditions for the growth and sustenance of invasive species (Kernan, 2015).

Invasive species have been linked to major local extinctions of native freshwater species, significantly reducing the ecosystem's richness. Two-thirds of introduced freshwater species in the tropics and more than half in temperate regions have established self-sustaining populations (MEA, 2005), typically because of nutrient-rich runoff or groundwater sources (Zedler & Kercher, 2005). A notable example is the global invasion of water hyacinth, originally endemic to South America, which has affected many lakes worldwide (Gardner & Finlayson, 2018). In marine ecosystems, the number of alien species has also been rising; for example, 140 alien species have been identified in Europe's Baltic Sea; 14 of them were introduced between 2011 and 2016 (HELCOM, 2017).

2.5.4 Urbanization

According to Cheng & Lee's (2008) study, urbanisation is a significant process that accounts for 68% of all land conversion and is typically a major factor in the loss of wetlands (SchulteHostedde et al., 2007). Through changes in hydrological connections, habitat modification, water tables and soil saturation, pollution, and eventually species richness and abundance, the urbanization process impacts wetlands (Faulkner, 2004). It is expected that by

2050, two-thirds of the world's population will live in urban areas, and this will likely double in the global south driven by economic opportunities in urban areas, diminishing rural employment from mechanized agriculture, and environmental deterioration impacting rural livelihoods (EEA, 2015; UN, 2015).

This rapid urbanization creates pressure on wetlands, specifically in coastal areas and river deltas as nearly half of the world's major cities are situated within 50 kilometers of a coastline and are generally 2.6 times more densely populated than inland cities (MEA, 2005). Such high population densities put coastal wetlands, particularly the highly productive mangroves at significant risk of urban and suburban expansion (MEA, 2005; Rojas et al., 2019).

2.5.5 Governance

Wetlands are further impacted by a complex web of actions and interactions between actors in different development sectors and jurisdictions, influenced by written and unwritten rules, socio-cultural and economic influences (Gell et al., 2023). Effective governance plays a crucial role in determining the effectiveness of wetland conservation efforts (Amano et al., 2018). Conversely, inadequate governance results in short-sighted decision-making, disregard for the interests of marginalised groups, and the undermining of conservation efforts (Adaman et al., 2009).

Attempts to come to a shared understanding regarding the benefits provided by wetland ecosystems may be impeded by disparities in the knowledge and perspectives of various individuals. Resources are frequently contested by a number of local players and stakeholders, and rival government and nongovernmental groups may exhibit similar horizontal contestation (Gell et al., 2023; McCartney et al., 2011). Vertical competition may arise when local resource

users' interests clash with those of regional or national stakeholders, as noted by Adaman et al. (2009).

Overall, Wetland health and sustainability rely heavily on good governance. Wetlands must be sustainably managed through strong, effective governance mechanisms that include powerful regulatory processes, proper resource allocation, stakeholder involvement at all levels, transparency, and integrated management techniques. Poor governance, on the other hand, can result in wetland degradation, biodiversity loss, and a decline in ecosystem services critical to human and environmental health.

Understanding the multiple causes of wetland loss emphasises the urgent need for coordinated and effective conservation initiatives from the global to the local level. At the global level, the Ramsar Convention on Wetlands is one of the world's major efforts to address these concerns, hence, for the sustainable use, management and governance of wetlands, the Ramsar Convention serves as the global mechanism. This international convention is critical to promoting the long-term use and protection of wetlands around the world. The next section will explore the Ramsar Convention's objectives, methods, and impact on wetland conservation.

2.6 The Ramsar Convention: Global Wetland Conservation Framework

The Ramsar Convention was signed in Ramsar, Iran in 1971 and came into effect in 1975 as an effort to globally protect wetlands. It is the only international treaty with a main emphasis on wetlands and therefore provides a platform to achieve several global wetland related targets as these ecosystems directly or indirectly support 75 SDG indicators (Ramsar Convention on Wetlands, 2018). It is the first global Multilateral Environmental Agreement and represents the largest assembly of officially recognized areas of international importance worldwide and offers a voluntary international framework for national and local wetland conservation efforts (Ramsar

Convention Secretariat, 2016). The Convention's goal is to encourage the conservation and sustainable use of wetland ecosystems, which include lakes, rivers, and saltwater environments to depths of up to six metres at low tide (Ramsar Convention on Wetlands, 2018). Its mission is to promote the prudent use of all wetlands through collaboration at the local, national, and international levels, with the aim of facilitating sustainable development globally (Ramsar Convention Secretariat, 2016).

According to Davidson (2016), there are three pillars that support the Convention's implementation: international cooperation, including for shared wetlands, designation, and management of Wetlands of International Importance (Ramsar sites), including reporting on adverse change, and wise use of all wetlands. The designation of qualifying sites as Ramsar Wetlands of International Importance promotes the responsible use and conservation of water ecosystems. At least one of the nine designation requirements must be satisfied to qualify for Ramsar designation (Ramsar Convention, 1971). The Ramsar designation criteria acknowledge the proposed Ramsar site's contribution to global biodiversity, with most criteria focusing on the significance of ecological traits contributing to world species populations of mostly birds and fish (Baker et al., 2021).

The Ramsar Treaty has 172 signatory countries as of November 7, 2022, and 2,471 sites have been classified as Ramsar sites, comprising over 256 million hectares of wetlands. With Ramsar Sites encompassing 13–18% of the world's terrestrial and coastal wetlands, Contracting Parties have shown a significant level of commitment (Davidson and Finlayson, 2018). Countries that are signatories to the convention have three fundamental commitments referred to as Convention Commitments (Ramsar Convention Secretariat, 2016). These include:

1. Promoting the wise use and conservation of designated wetlands through national and local projects.
2. Identifying and sustainably managing appropriate wetlands for inclusion on the Ramsar list of Wetlands of International Importance.
3. Fostering international cooperation on transboundary wetlands and shared species.

Globally, the convention recognizes that synergies and cooperation with other conventions, policies, and laws dealing with or containing an element of wetlands management are required to achieve sustainable management of wetlands (Njagi, 2016). Some of these international policies that the Convention aligns with are: the Convention on Biological Diversity (CBD), the Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), World Heritage Convention (WHC) and the International Plant Protection Convention (IPPC).

Despite international attempts by the Ramsar Convention, global wetland coverage is declining in the face of an increasing number of wetland policies. This has caused some to question the Convention's effectiveness as well as the national frameworks (Farrier and Tucker, 2000; Finlayson, 2012; Tolentino, 2013). Critics claim that the Convention's approach to wetland management is restricted since it focuses on land and water separately rather than considering the catchment as a whole (Farrier and Tucker, 2000). They argue that considering the complete system would help identify risks from multiple sources (Farrier and Tucker, 2000). Moreover, the emphasis on 'wise use' has been criticized for placing human values ahead of the preservation of pristine environments (Farrier and Tucker, 2000).

Canada, a signatory to the agreement, has demonstrated its commitment by designating multiple Ramsar sites. However, wetland protection in Canada goes beyond international treaties, including government policy, local initiatives, and collaborative activities. The following section summarizes key wetlands conservation policies in Canada.

2.7 Wetland Conservation in Canada

Wetland habitats play a crucial role in Canada's social, economic, and ecological health. They provide important ecosystem services that have been valued at above $225 billion annually (Institute for Sustainable Finance, 2024). They cover 14% of the country's geographical area and account for a quarter of the global wetlands (Kennedy & Mayer, 2002). Canada's wetlands are primarily located in the Boreal Shield (25%), Hudson Plains (21%), and Boreal Plains (18%). Wetlands make up over 80% of the Hudson Plains, while mountainous sections like the Arctic Cordillera (less than 0.5%) and Montane Cordillera (less than 2%) have lower proportions (Environment and Climate Change Canada, 2016).

Wetlands have been historically viewed as wastelands, leading to extensive loss and deterioration, despite growing acknowledgment of their socio-economic and environmental significance in recent decades (Kennedy & Mayer, 2002). It is estimated that about 70% of wetlands in settled regions of Canada have either been degraded or destroyed (OBC, 2021). For example, more than 40% of the wetlands in the southern sections of the central Prairies, 68% in southern Ontario, and 80% in British Columbia's Fraser Lowland have been converted to other land uses. However, wetland disturbance has been low in Canada's lightly inhabited areas, such as the boreal and subarctic zones, which contain the majority of our forested wetlands (Rubec & Lynch-Stewart, 1998) Where wetlands monitoring has occurred, there is a general trend of decline in their extent, primarily as a result of conversion for agriculture and other development

activities (Federal, Provincial and Territorial Governments of Canada, 2010). In addition to agriculture, the wetlands of Canada are further threatened by industrial development, ports expansion, urban expansion, hydro-electric reservoirs construction, and fluctuations in water levels (Rubec & Hanson, 2009).

Canada's approach to wetland governance is best described as a mix of top-down and collaborative approaches. At the federal level, the federal policy on wetland conservation provides the foundational goals and principles for wetland conservation. Furthermore, the Canadian Environmental Protection Act (CEPA) stresses environmental conservation, although its execution is frequently dependent on local-level actors such as Conservation Authorities in Ontario or regional equivalents in other provinces (Government of Canada, 1999).

The importance of community input and NGO participation has increased recently, indicating a shift in governance toward collaboration. As an illustration, the recognition of Indigenous people's traditional knowledge and stewardship practices has led to a rise in their involvement in wetland management (Dinneen, 2020). This move toward collaborative governance is demonstrated by many programs in which NGOs and local communities are heavily involved in conservation and decision-making processes (Wetlands International, 2024).

The following sections will describe related wetland conservation policies at these levels: International, Federal, and Provincial.

2.7.1 International Agreements

2.7.1.1 The Ramsar Convention

Canada became a signatory of the Ramsar convention on wetlands on 15 May 1981 and currently has 37 Ramsar sites covering a surface area of about 13 million hectares. As one of the first countries to join the world's first environmental convention, Canada's membership in the

Ramsar Convention has significantly increased its commitment to wetland conservation and management. This pledge has prompted most provinces and territories to enact further wetland policies (Rubec & Hanson, 2009). These Canadian Ramsar wetlands, such as the Whooping Crane Summer Range and the Delta Marsh, are critical for preserving the country's biodiversity and migratory bird populations. By adding these sites in the Ramsar network, Canada demonstrates its commitment to preserve important wetland habitats while also contributing to the worldwide wetland conservation effort. These wetlands, however, only make up a tiny portion of Canada's total wetland area. The vast majority of wetlands are neither immediately covered by the Convention nor fall under the purview of federal sovereignty. It is the duty of provincial and local governments to protect wetlands (Schulte-Hostedde et al., 2007).

2.7.1.2 The North American Waterfowl Management Plan

The NAWMP is a trinational agreement, initiated in 1986, among Canada, the United States, and Mexico to protect waterfowl populations and habitats, particularly wetlands. It entails coordinating efforts across borders to protect critical migratory bird habitat (North American Waterfowl Management Plan, 2018). The Plan focuses on reversing or modifying activities that damage or degrade waterfowl habitat, particularly wetlands. Canadians are active in a variety of habitat restoration, or enhancement programmes funded by the NAWMP, as well as regional conservation programmes. These regional programmes include the Great Lakes Wetland Action Plan, Plan 2000 for the St. Lawrence River system in Quebec, and the Fraser River Action Plan in British Columbia (Rubec & Lynch-Stewart, 1998).

2.7.2 Federal Level

To support the delivery of Canada’s commitments to the International agreements – Ramsar convention on wetlands and the North American Waterfowl Management Plan – the federal policy on wetland conservation was approved by cabinet in 1991(Lynch-Stewart et al.,

1999). Although it is Canada's primary policy instrument for wetland conservation, the policy is directly applied to about 29% of Canada's wetland base (i.e federal lands) while provincial wetland programs are applicable to the rest (Rubec & Lynch-Stewart, 1998). Therefore, the Federal Government collaborates with provincial, territorial governments and the corporate sector to conserve wetlands and serve the national interest. It aims to lead by example by providing models, tools, and experience to support national initiatives in wetland conservation and expanding knowledge of Canada's wetland resources (Government of Canada, 1991).

The Policy requires all federal departments to maintain wetland functions in the performance of their programmes. It is a broad policy that guides the creation of policies and programmes within various federal departments (Rubec & Hanson, 2009). The Policy's objective is to "promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future" (Government of Canada, 1991, p 5).

The key commitments of this policy are:

1. No net loss of wetland functions on federal lands and waters, and in regions influenced by federal initiatives, by mitigating the impacts of development on these wetlands.
2. Prevent further loss of wetland areas in regions where considerable wetland loss has occurred.
3. Promote the enhancement and restoration of wetlands in regions where ongoing wetland loss has become critically severe.

To achieve these objectives, Canada focuses on the mitigation sequence, despite criticism for its ineffectiveness in ensuring no net loss (Austen & Hanson, 2007). Initially, the first two stages of the mitigation sequence (avoidance and minimization) received the most attention during the early years of the FPWC. However, compensation was considered a necessary step to prevent net

loss of wetland functions (Rubec & Hanson, 2009). Nevertheless, there is no objective formula to determine the required compensation, and requirements are usually decided on a case-by-case basis, making it challenging to implement a standardized national mitigation sequence (Rubec & Hanson, 2009).

In addition to the federal policy on wetland conservation, seven federal statutes contribute to wetland conservation in Canada: Migratory Birds Convention Act, Canada Wildlife Act, National Parks Act, Canada Oceans Act, Fisheries Act, Canada Environmental Assessment Act, Income Tax Act of Canada (Lynch-stewart et al., 1999).

2.7.3 Provincial Policies

Attridge (1996) defines provincial and territorial authority in terms of biodiversity:

> "Provincial governments have exclusive control over natural resources, public lands belonging to the province and the timber and wood located on these lands, municipalities and any other merely local and private matters, and broad property and civil rights. The provinces share jurisdiction with the federal government over some areas, such as agriculture, and may impose taxes of various sorts. In aggregate, this jurisdiction gives the provinces the primary lead in conserving wildlife and habitat, and in managing how biodiversity is used." (p 19)

> "Territorial governments are established on the basis of delegated powers from the federal government; they thus do not have their own independent constitutional mandate, as do the federal and provincial governments. Municipal governments also have this derivative authority, conducting their affairs within the limits prescribed by the provinces. While both territorial and municipal governments are established and operate at the discretion of their

parent governments, they nonetheless are well-entrenched institutions and exercise substantial powers and political influence." (p 19)

The development of various statutes pertaining to land use planning, protected area designation, and wildlife management has occurred in every province and territory in Canada as a result of constitutional authorities granted to the provinces and territories (Lynch-Stewart et al., 1999). No one jurisdiction has a specific statute in place to protect wetlands. To accomplish wetland preservation and conservation goals, however, every territory and province use a variety of legal tools. Protected area, wildlife, water, land-use planning, environmental protection, environmental assessment, sustainable resource use, and private land conservation are among the legal instruments that fall under this category (Rubec & Lynch-Stewart, 1998).

2.7.4 Community based Initiatives and Non-Governmental Organizations

Through a variety of programmes, local governments, community groups, and non-governmental organisations (NGOs) support the conservation of wetlands. Projects like habitat restoration, public awareness campaigns, and volunteer-based monitoring programmes are a few examples. These initiatives benefit greatly from the knowledge, resources, and advocacy of groups like Ducks Unlimited Canada and the Nature Conservancy of Canada.

Wetland policy is significantly shaped by community groups and non-governmental organizations (NGOs) through both official consultative procedures and grassroots activity. Their engagement guarantees that policies are impacted by scientific knowledge and community demands rather than being purely top-down. In Ontario, public comment are sought on government policies that affect wetlands and other natural areas through venues such as the Environmental Registry of Ontario (ERO), an online database accessible to individuals and interest organizations (Government of Ontario, 2023). Through the use of this tool, stakeholders

can examine and offer feedback on proposed rules and policies, promoting openness and public involvement.

Public forums and town hall gatherings are two more typical venues for participation. These forums give local communities and NGOs a chance to address legislators with their issues and recommendations directly. For example, feedback from a wide range of stakeholders was incorporated in public consultations on the Wetland Conservation Strategy for Ontario, ensuring that different perspectives are taken into account in policy creation (Ontario Ministry of Natural Resources and Forestry, 2017).

NGOs like Ontario Nature and Ducks Unlimited Canada have been instrumental in creating wetland legislation at the federal level. For instance, Ducks Unlimited Canada has played a significant role in advocating for stronger protection measures and helping to develop the wetland offsetting parts of a number of regulations (Ducks Unlimited Canada, 2021). To carry out restoration initiatives and keep an eye on the condition of wetland ecosystems, these NGOs also work with governmental organizations and conservation authorities. Their knowledge of science and practical experience provide them with important insights that improve the efficacy of policies.

Furthermore, the importance of Indigenous tribes' involvement in wetland management has grown. Policy frameworks are incorporating indigenous knowledge and stewardship practices, acknowledging the significance of traditional ecological knowledge in conservation endeavors (Dinneen, 2020). In addition to upholding Indigenous rights, this cooperative approach enhances conservation techniques by including a holistic viewpoint. In addition, grassroots activism is essential for influencing policy. Local community organizations frequently take part in advocacy campaigns to bring attention to wetland issues and rally support for

conservation efforts. Numerous effective campaigns across Canada have demonstrated that these initiatives can result in major policy changes (Artelle et al., 2020).

2.8 Wetlands Conservation in Ontario: Related Policies

2.8.1 Overview of Ontario wetlands

Wetlands cover about 350,000 square kilometres of the total land area in Ontario, which is about 25 percent of all the wetlands in Canada and 6 percent of all the wetlands in the world (OMNRF, 2017). In Ontario, there are four wetland types including marshes, swamps, bogs, and fens. Bogs and fens are collectively known as 'peatlands' because they contain peat, a partially decomposed plant material.

Although marshes are the most recognisable type of wetland, they are the least common in Ontario. In southern Ontario, swamps are more abundant than peatlands, whereas in central and northern Ontario, swamps and peatlands dominate. In the far north, peatlands are the major wetland type (OMNRF, 2015).

Ontario is divided into four ecozones (Hudson Bay lowlands Ecozone, Ontario Shield Ecozone, Mixedwood Plains Ecozone, and The Great Lakes Ecozone) reflecting the varying differences in climate, geology and ecology throughout the province (OMNRF, 2015) as seen in figure 2.1 below. Wetlands size, type, number and distribution vary significantly across these ecozone with the majority situated in Northern Ontario. For example, the wetlands in northern Ontario's Hudson Bay Lowlands Ecozone include over 20,000,000 hectares, or 57% of all the wetlands in the province. In comparison, there are roughly one million hectares of wetlands in the Mixedwood Plains Ecozone in southern Ontario (OMNRF, 2017; Ontario Biodiversity Council, 2015).

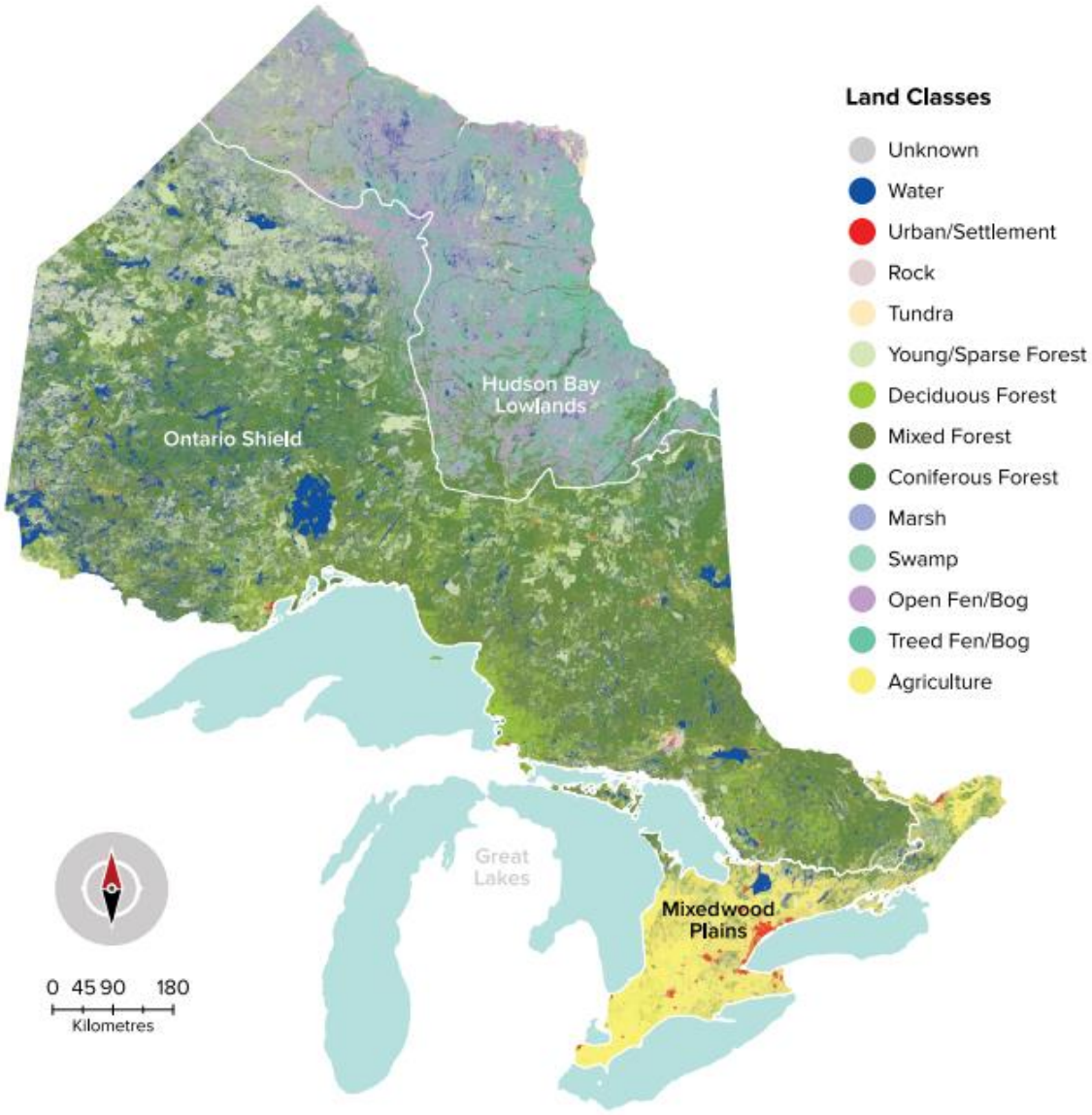


Figure 2.1: Ontario's Ecozones and associated land cover (OMNRF, 2017)

These ecosystems play very important roles in supporting Ontario's rich biodiversity and offer several ecosystem benefits. These include a habitat for fish and wildlife species, air and water filtration, flood and erosion mitigation, carbon sequestration, biochemical transformation,

nutrient and sediment retention as well as providing various tourism and recreational opportunities (Bradford, 2016; The Wetland Conservation Strategy Advisory Panel, 2018; Yang et al., 2016). Furthermore, Southern Ontario wetlands have a capacity to store organic carbon and the amount of peat and organic carbon stock these wetlands hold have been historically underestimated (Byun et al., 2018).

There have been attempts at monetary valuation of Ontario wetlands. A study by Troy and Bagstad (2009) estimates that the filtration capacity of wetlands generates $40 billion in annual economic benefits, with its overall contribution to human well-being in Southern Ontario exceeding $51 billion annually. Furthermore Aziz and Van Cappellen (2021) estimates that the value of suspended sediment and phosphorus filtration and removal capacity by Southern Ontario wetlands is $\$4.2 \pm 2.9$ billion per year, with swamps accounting for over 80%. Additionally, Wilson (2008) estimates that Greenbelt wetlands contribute almost $1.3 billion in ecological services including climate management, flood control, water filtration, waste treatment, habitat provision, aesthetics, and recreation. Preserving wetlands can lower flood-related financial expenditures by up to 38 percent, according to a study that examined the financial effects of significant flood occurrences in both urban and rural locations (Moudrak et al., 2017).

Despite the huge economic, social and environmental benefits derived from Ontario wetlands, these ecosystems have increasingly been threatened or lost by urban development, agricultural expansion, alterations to natural water levels, invasive species, pollution and climate change. Most of these losses have occurred in the Mixedwood Plains Ecozone (southern Ontario). Southern Ontario wetlands have historically been drained for agriculture, filled in for

construction, contaminated by toxic runoff, and degraded by artificially altered water levels (Environment Canada, 2010; Ontario Biodiversity Council, 2015).

The rapid economic and human population growth in this region has led to the draining of many wetlands to support infrastructure, agriculture, industry and residential development (OMNRF, 2017). Wetlands in southwestern Ontario, parts of eastern Ontario, Niagara and the Toronto area have experienced the greatest wetland loss with over 85 percent of the original pre-settlement wetlands converted to other uses (Ducks Unlimited Canada, 2010).

Ontario Biodiversity Council (2021) report on the state of Ontario's biodiversity showed that between 2011 and 2015, a total of 7,303 hectares of wetlands were lost, surpassing the 6,152 hectares lost from 2000 to 2011. This recent loss accounted for 0.7% of southern Ontario's remaining wetland area, somewhat more than the 0.6% loss documented between 2000 and 2011 (Figure 2.2). Additionally, Birch et al. (2022) found that 95.5 hectares of wetlands were lost between 2002 and 2010 in seven southern Ontario municipalities, with majority being wetlands not protected by provincial policies due to their small size (less than 2 ha). The significant losses partially indicate a failure to acknowledge the economic value of the ecosystem services offered by wetlands (Gustavson & Kennedy, 2010). With Southern Ontario's population anticipated to increase by 33% to 17 million by 2041 (Ontario Ministry of Finance, 2014), the demand for wetland conversion is expected to increase.

In contrast the wetlands of Northern Ontario have remained largely intact although there is concern for urbanization and agricultural expansion in the more settled areas of the region (The Wetland Conservation Strategy Advisory Panel, 2018).

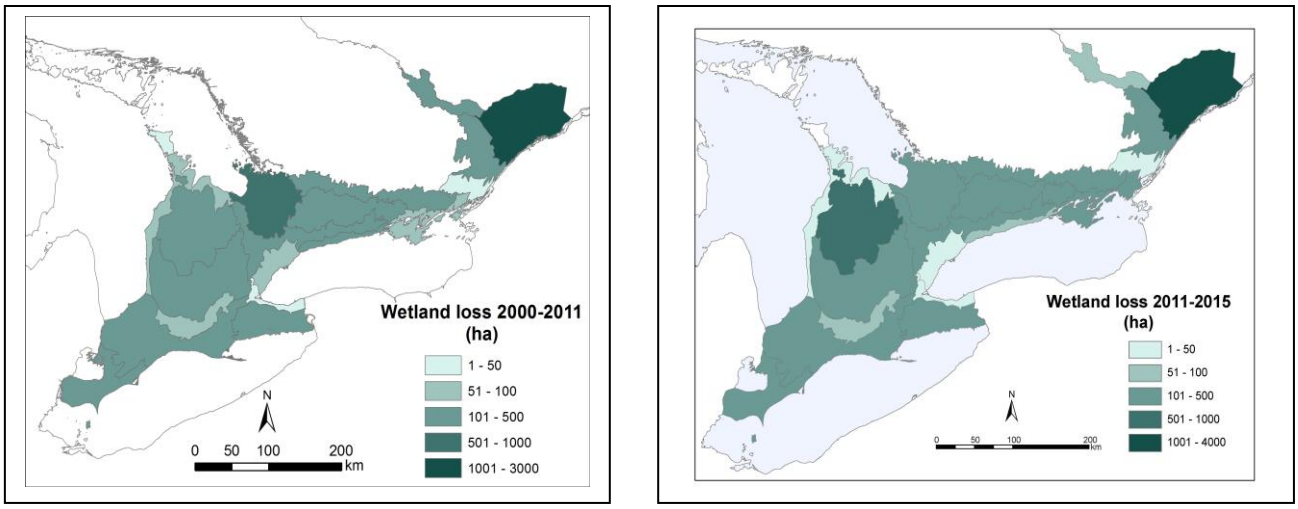


Figure 2.2: Area of wetland loss in southern Ontario between 2000 and 2015 (Ontario Biodiversity Council, 2021)

2.8.2 Ontario's Wetland Policy Framework

Ontario's approach to wetland conservation began in the early 1980s with the establishment of the Ontario Wetland Evaluation System (OWES) which provides a standardized method for wetland classification. Furthermore, in 1992, the province created a Wetland Policy Statement under the planning act, a predecessor to the current wetland-related natural heritage policies under the Provincial Policy Statement (OMNRF, 2015; Schulte-Hostedde et al., 2007). Today, wetlands are managed by multiple policies, including over 20 pieces of legislation overseen by five provincial ministries, two federal departments, a provincial agency (Niagara Escarpment Commission), 36 conservation authorities, and 444 municipalities (OMNRF, 2017). Under the Crown Forest Sustainability Act, wetland values are taken into account while planning forest management in northern Ontario while in southern Ontario, the Planning Act and the Provincial Policy Statement, which comprise the land use planning framework, are the main tools used to manage wetland conservation (The Wetland Conservation Strategy Advisory Panel, 2018).

The following sections will provide an overview of the provincial policy statement, the Ontario wetland evaluation system (OWES), and the conservation authorities act while Table 2 highlights the other policy instruments that currently influences wetland protection in the province.

2.8.2.1 The Provincial Policy Statement (PPS) 2020

The Provincial Policy Statement is issued under section 3 of the planning act which mandates that all land use planning choices "shall be consistent with" the provincial policy statement. The Provincial Policy Statement (PPS) is used by municipalities to create official plans and guide decisions on planning matters across the province (OMNRF, 2017). It emphasizes the protection of provincially significant wetlands (PSWs) by prohibiting development and site alteration throughout southern and central Ontario, as well as Great Lakes coastal wetlands across the province. Development and site alteration is also prohibited in areas next to PSWs, PSWs in northern Ontario and non-PSW coastal wetlands in central and southern Ontario, unless it is proven that there will be no detrimental impacts to wetland features or ecological functions (OMNRF, 2017; Provincial Policy Statement, 2020).

It is noteworthy to mention that nothing in this policy restricts agricultural activities, the largest contributor to wetland loss in Ontario (Snell, 1987; Walters & Shrubsole, 2003), and this exemption has been a source of criticism since the first provincial policy statement in 1996. A report by Environmental Commissioner of Ontario (2018), highlighted that the Ontario Ministry of Agriculture, Food and Rural Affairs fails to specifically monitor wetland loss due to agricultural drainage and is unable to provide adequate data on the rate and extent of this loss to drainage for agricultural activities (Penfound, 2023).

2.8.2.2 Ontario Wetland Evaluation System (OWES)

The Ontario Ministry of Natural Resources established the Ontario Wetland Evaluation System (OWES) in 1984 to provide a standardised method for classifying wetlands. Wetlands are classified in this system using four components (hydrology, biological, social, and distinctive features), with each component worth 250 points for a total of 1000 points. Wetlands are considered provincially significant if they receive at least 600 points in total, or 200 points for either the biological or special features components (Schulte-Hostedde et al., 2007). As of 2015, over 600,000 acres of land were covered by over 2,500 evaluated wetlands with the Mixedwood Plains ecozone being home to 88% of the evaluated wetlands. This ecozone is estimated to have around 460,000 hectares (or 43%) of wetlands that have not yet undergone evaluation. In Ontario, over 60% of the wetlands that have been evaluated are provincially significant (OMNRF, 2015).

Given that the rate of wetland degradation in Southern Ontario has decreased to less than 2%, one may claim that the OWES approach has been mainly successful in protecting wetlands (OMNRF, 2017). This amount, however, is insufficient to meet Ontario's objectives for 2030, which include attaining a net gain in wetland area and function, and for 2025, which is to stop the net loss of wetlands (OMNRF, 2017). According to the Provincial Policy Statement, wetlands classified as PSWs are meant to be shielded from activities that could negatively affect their natural features or ecological functions. Nevertheless, research has revealed that certain efforts to preserve these functions have not been successful thereby raising concerns about the efficacy of the monitoring and enforcement systems (Coyle, 2020; Stadel et al., 1993).

Furthermore, many wetlands remain unevaluated due to the long, labour-intensive, and expensive process thereby leaving many wetlands unprotected (Interviewee 4, 2024; Penfound,

2023). Additionally, the process fails to consider smaller wetlands (less than 0.5 hectares in size) due to the challenge in mapping them (Environmental Commissioner of Ontario, 2018). Moreover, wetlands are classified as provincially significant or not provincially significant, which means that wetlands scoring just below the significance threshold receive no more protection than those scoring far below the significance threshold (Environmental Commissioner of Ontario, 2018).

2.8.2.3 Conservation Authorities Act

Conservation authorities are cumulatively one of the biggest landowners in the province and have long played a major role in wetland conservation and restoration throughout their watersheds (OMNRF, 2017). Conservation authorities were established by the Ontario Government in the early 1940s as a response to prolonged and intense flooding and erosion problems in the province. Following the passing of the Conservation Authorities act in 1946, CAs were empowered to regulate development in and around wetlands, for impacts on the control of natural hazards (for example flooding, erosion) as well as activities that may interfere with a wetland (Conservation Ontario, n.d). Section 28 of the Act allows Conservation Authorities to limit the use of water in or from wetlands. They may prohibit, regulate, or require permits for changing or interfering with wetlands, as well as development that may impact flood control, erosion, pollution, or land conservation.

Ontario's 36 conservation authorities help communities align official plans and planning decisions with the PPS policy direction. Conservation authorities assess municipal planning policies and applications to ensure they align with natural hazard rules in the PPS. Additionally, many municipalities rely on conservation authorities to review natural heritage evaluations for Planning Act applications (OMNRF, 2017). Another key role played by conservation authorities

is the delineation of wetland boundaries by identifying and mapping wetland area limits specifically for permit applications (Interviewee 9, 2024).

Table 2.2: Summary of other key policy Instruments for wetland conservation and management in Ontario (OMNRF, 2015; OMNRF, 2017)

Policy Tool	Connection to Wetland Conservation and Management
Niagara Escarpment Planning and Development Act & Plan	Preserves wetlands situated within the planning area of the Niagara Escarpment by preventing any form of development.
Oak Ridges Moraine Conservation Act, 2001 & Plan	Protects wetlands in the Oak Ridges Moraine planning area against development.
Greenbelt Act, 2005 & Plan	Wetlands in the Greater Golden Horseshoe's Protected Countryside area are protected under the Greenbelt Plan.
Lake Simcoe Protection Act, 2008 & Plan	Protects wetlands in the Lake Simcoe watershed (as defined) from development activities.
Crown Forest Sustainability Act, 1994; Forest Management Guides	Mandatory guidelines to safeguard the integrity of aquatic ecosystems, including seasonal and permanent wetlands (including those identified as provincially significant), are included in forest management guides used throughout the planning, execution, and building of highways.
Far North Act, 2010	Contains goals for community-based land use planning, safeguarding 225,000 square kilometres of land in Ontario's Far North, and preserving biological diversity, ecological processes, and functions, such as the sequestration and storage of carbon in the region.
Endangered Species Act, 2007	Protects endangered or threatened species, including those that live in wetlands, against habitat loss.
Municipal Act, 2001	Allows municipalities to enact by-laws that limit tree cutting, fill placement, and topsoil removal (including peat).
Environmental Assessment Act	All big public sector projects with considerable environmental impact must be evaluated. Ministries, such as Ministry of transportation, must make design decisions to minimise consequences or compensate for those that cannot be avoided.

2.8.3 Bill 23 and Its Impact on Ontario's Wetland Conservation Framework

Bill 23 known as the 'More Homes Built Faster Act, 2022' received Royal Assent on November 28, 2022, and is now in effect. The bill represents the current government's plan to address the housing crisis by building 1.5 million new homes over the next 10 years. The land use planning and natural heritage frameworks in the province will undergo significant changes because of this comprehensive measure. It modifies several laws, including the Conservation Authorities Act and the Planning Act, weakening environmental protections and decreasing public participation in land use planning and decision-making procedures that affect their local communities (Ontario Nature, n.d. - b).

While there is a genuine need to address the housing crisis, it should not come at the expense of sacrificing environmental protection (Ontario Nature, n.d - b). Ontario Housing Affordability Task Force (2022) reports that:

"… a shortage of land isn't the cause of the problem. Land is available, both inside the existing built-up areas and on undeveloped land outside greenbelts. … Most of the solution must come from densification. Greenbelts and other environmentally sensitive areas must be protected, and farms provide food and food security." (p 10)

Below are some of the changes associated with the passing of Bill 23

1. **Modifications to the Ontario Wetland Evaluation System**

In support of Bill 23, the government of Ontario has made changes to the Ontario Wetland Evaluation System (OWES) despite much pushback and criticisms.

Firstly, there's no longer a recognition of Wetland complexes (group of wetlands connected ecologically or hydrologically) and so wetlands that once had a provincial significance

status because of being associated with a wetland complex would lose this status upon reassessment, as this was a criterion that many small wetlands were deemed provincially significant. This means that smaller wetlands could therefore be spatially isolated from larger wetland complexes and be prone to agricultural expansion and urban development (Penfound & Vaz, 2022). Small wetlands are important habitats for species like amphibians, water birds and rare plants (Kushlan, 1986; Porej and Hetherington, 2005; Richardson et al., 2015). They also play important roles in landscape hydrology (McLaughlin et al., 2014) and biogeochemical cycling (Marton et al., 2015)

Another change involves the removal of points for endangered species or species at risks in the OWES process. Before now, during the wetland evaluation process, points were awarded for the presence of endangered species in a wetland, but this is no longer considered as a criterion for determining wetland provincial significance. Endangered species will be valued substantially less in the assessment and will only be regarded as "provincially tracked species" (National Farmers Union, 2022). The majority of wetlands in Ontario would no longer be evaluated the way they currently are, making many of them and the important species that depend on them exposed to the negative effects of development (National Farmers Union, 2022).

Furthermore, the Ministry of Natural Resources and Forestry has removed itself from providing oversight on the evaluation process with no central agency involved in the coordination or approval of evaluations. Wetland evaluation and re-evaluations would thus be carried out by private wetland evaluators who more often than not would be working for development proponents (Mann Lawyers, 2023; National Farmers Union, 2022). This shift raises concerns about potential conflicts of interest and the integrity of the evaluation process, which may jeopardise the protection of Ontario's wetlands.

2. Reduced Regulatory Authority of Conservation Authorities

Modifications have also been made to the conservation authorities act. As part of the permitting process for development proposal applications, Conservation Authorities could comment on and therefore approve or deny a project based on its potential impacts on wetland's ecological values, the presence of endangered species in that wetland or other factors. Now with the changes, CAs are only allowed to assess a proposed development project based on its connection to the natural hazard (erosion or flood) control feature of that wetland (Interviewee 5, 2024; Interviewee 9, 2024; Ontario Nature, 2022). Conservation authorities would lose the power to evaluate land conservation or pollution when granting or denying permits. This role will now be played by municipalities who lack the capacity and expertise in environmental planning and have traditionally relied on Conservation Authorities (Ontario Nature, 2022).

2.9 The Grand River Watershed: Wetland Conservation Framework

2.9.1 Background

The Grand River Watershed (Figure 2.3) is the largest watershed in Southern Ontario, and it extends from Dundalk in the North to Lake Erie in the South. Across the Canadian side of the border with the United States, the Grand River and its principal tributaries, the Speed, Eramosa, Nith, and Conestogo Rivers, drain an area of little over 6800 km2, making it the largest direct drainage basin to Lake Erie (GRCA, 2015). The Grand River watershed was home to around a million people in 2021, with the majority of them residing in the cities of Kitchener, Waterloo, Cambridge, Guelph, and Brantford (GRCA, 2024a). The watershed is made up of roughly 14% urban area, 61% rural and agricultural area, and 26% wetlands and forests (GRCA, 2024a). It is a varied region that includes expansive commercial and industrial zones, densely populated

residential metropolitan cores, and areas of intensive agricultural production which has undoubtedly negatively impacted wetlands and other natural heritage.

Throughout the watershed, wetlands and other natural landscape features have been converted for housing, industrial, agricultural and recreational uses (Grand River Characterization report, 2008). Wetlands historically covered about 27 percent of the watershed but now make up 10 percent. It is estimated that the watershed has lost about 65 percent or two-thirds of its wetland area thereby necessitating wetland management and protection (GRCA, n.d. - b; Grand River Characterization report, 2008). Figure 2.4 is a map showing the watershed's wetland cover grade ranging from A (excellent) to D (poor) which corresponds to the proportion of wetland cover.

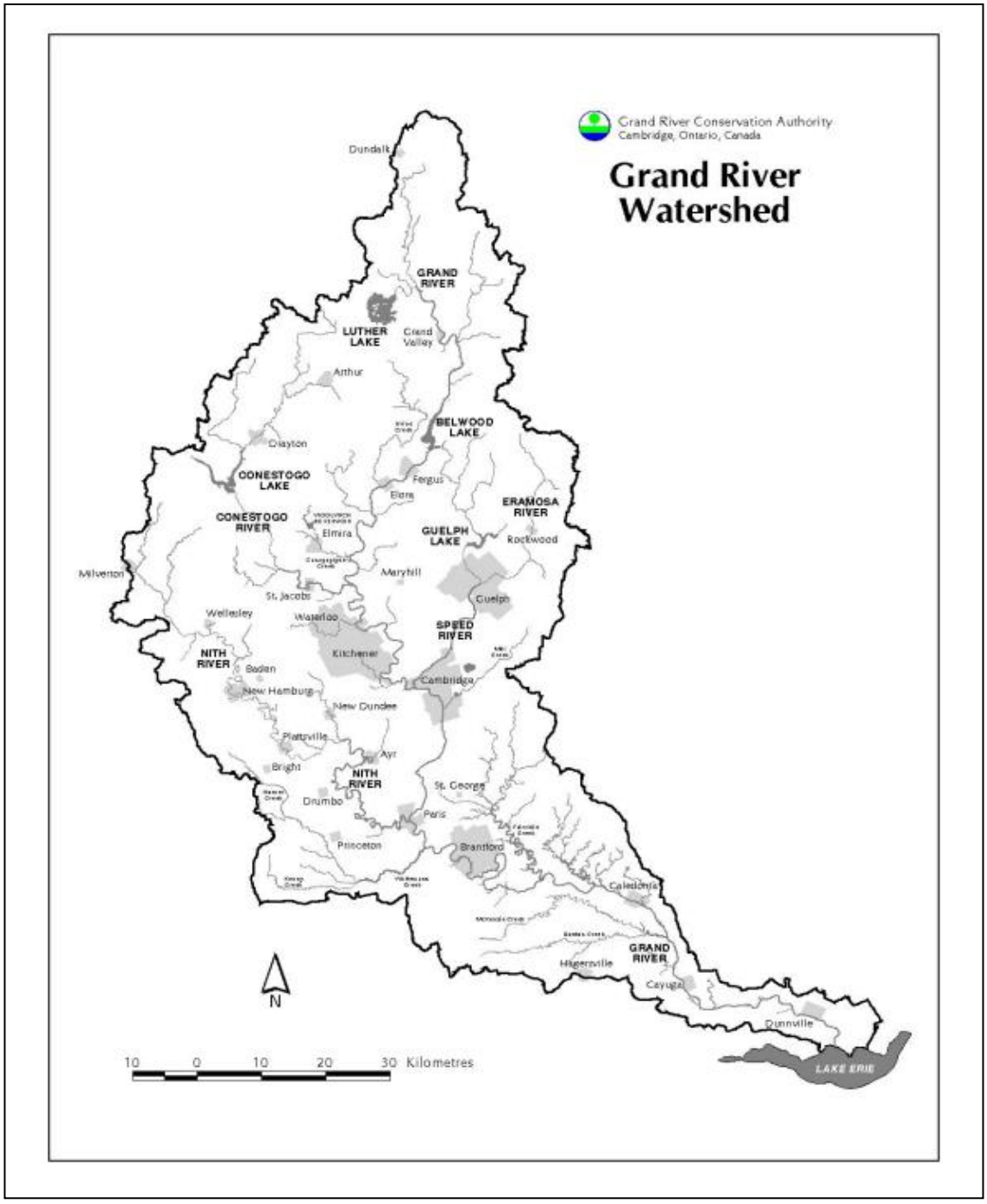


Figure 2.3: The Grand River Watershed (GRCA Wetlands Policy – Appendix, 2003).

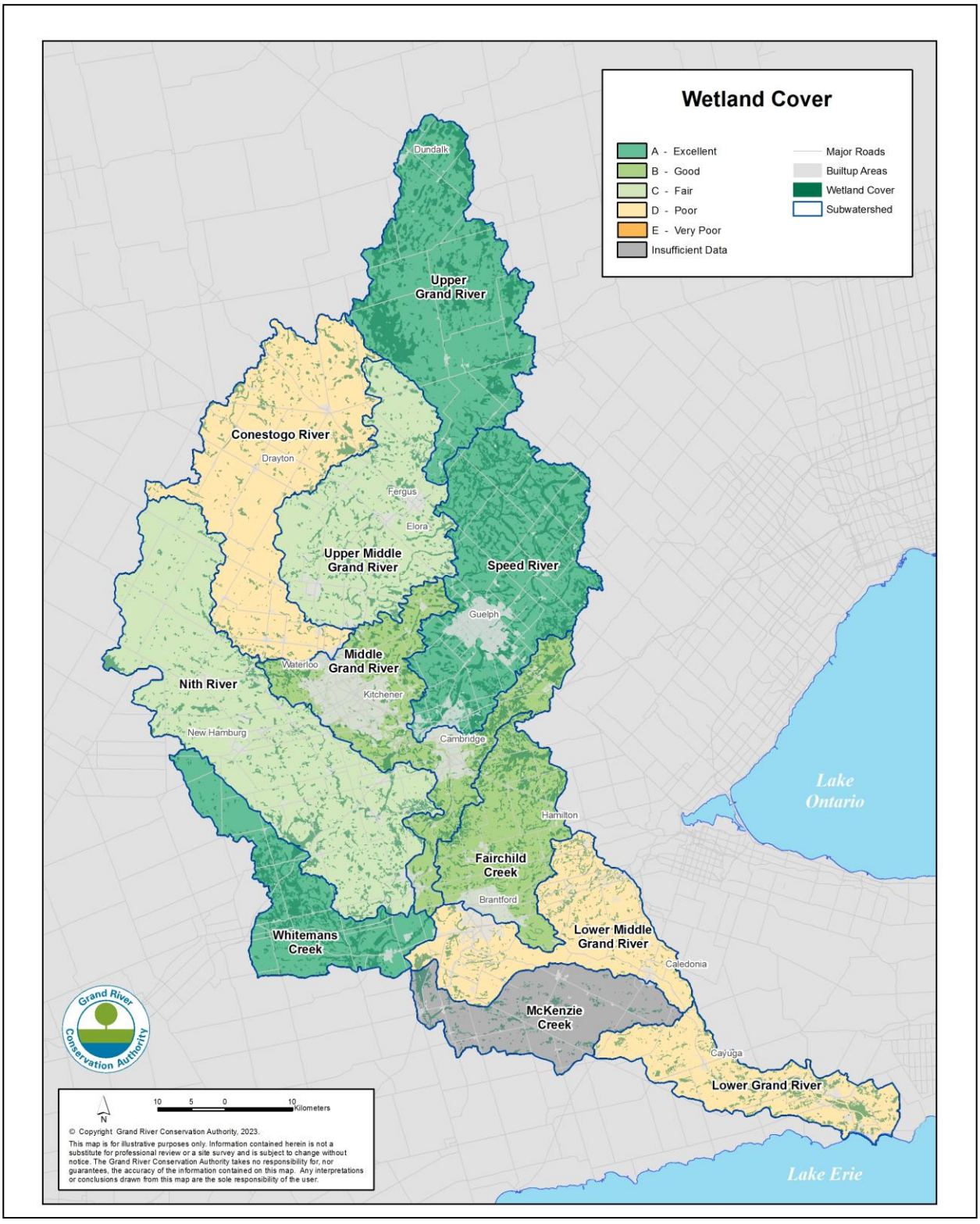


Figure 2.4: Wetland Cover Grades (Grand River Conservation Authority, 2023)

2.9.2 The Grand River Conservation Authority

The Grand River Conservation Authority is responsible for the management of water and other natural resources for the 38 municipalities and nearly one million residents of the Grand River Watershed (GRCA, n.d. - a). The members of its governing body are chosen by the member municipalities. This board directs the GRCA's operations and sets its budget and policy. The GRCA collaborates closely with all tiers of government to coordinate and carry out programmes and services that support watershed planning, enhance water quality, preserve water supplies, lessen flood damage, safeguard natural areas, inform the public, and offer top-notch outdoor recreational opportunities to fulfil its mandate (GRCA, 2024a). It is one of the biggest landowners in the Grand River Watershed and it owns about 50,000 acres of land which includes wetland area (Interviewee 4, 2024).

The wetland conservation framework in the watershed has undergone several changes since the conservation authorities act was passed in 1946. The most recent change has been because of the passing of Bill 23. Until the passing of Bill 23, the Policies for the administration of the Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation (Ontario Regulation 150/06) served as the key policy document for the GRCA planning and permitting role, however, it was replaced by Ontario Regulation 41/24 (Prohibited Activities, Exemptions and Permits) on April 1st, 2024.

2.9.3 Before Ontario Regulation 150/06

The Conservation Authorities Act gave conservation authorities the authority to enact laws that forbade filling in floodplains below the high-water mark in 1956. In 1960, this authority was expanded to include the ability to forbid or regulate the putting or dumping of fill (sand, gravel, soil or other earth materials) in specific places where, in the conservation

authority's judgement, the management of flooding, pollution, or land conservation may be impacted (GRCA, 2024a).

In 1968, the Conservation Authorities Act underwent an amendment that expanded its authority to forbid or regulate not only filling but also building and alteration to waterways (GRCA, 2024a). To make sure that the regulations under the Conservation Authorities Act were uniform throughout the province and in line with current provincial policies, the Act was modified in 1998 as part of Bill 25 - the 'Red Tape Reduction Act' (GRCA, 2024a). The Conservation Authorities Act was amended to better reflect provincial direction and to strengthen protection of the environment and public safety. This allowed conservation authorities to replace the Fill, Construction and Alteration to Waterways Regulation (Ontario Regulation 416/94) with the Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation (Ontario Regulation 97/04) (GRCA, 2024a).

Ontario Regulation 97/04 gave conservation authorities the power to stop or limit development in areas where it could have an impact on pollution, dynamic beaches, flooding, erosion, or land conservation (GRCA, 2024b). For the GRCA, the Minister of Natural Resources approved Ontario Regulation 150/06 (Development, Interference with Wetlands and Alteration to Shorelines and Waterways Regulation), aligning it with the province-wide Ontario Regulation 97/04. The GRCA subsequently developed consolidated policies for the Administration of Ontario Regulation 150/06, and they became effective on January 1st, 2008. These policies were therefore the most applicable to the GRCA's planning and permitting role as it relates to wetlands (Interviewee 4, 2024).

2.9.4 GRCA Policies for the Administration of Ontario Regulation 150/06

The GRCA consolidated policies for the administration of Ontario Regulation 150/06 went through several revisions since it first came into effect on January 1st, 2008, with its most recent revision being in January 2024. Two of the seven goals of this policy were to prevent interference with the hydrologic functions of wetlands across the Grand River watershed, to prevent the loss and degradation of important natural features and hydrologic and ecological functions in wetlands, river or stream valleys, shorelines, and hazardous lands, and to promote restoration and enhancement wherever feasible (GRCA, 2024b).

In accordance with Ontario Regulation 97/04, which grants conservation authorities the authority to prohibit development activities in areas—including wetlands—that could impact pollution, dynamic beaches, flooding, erosion, or land conservation, the wetland policies within this framework prohibit development or disturbance in small wetlands (under two hectares), whether they are naturally occurring or anthropogenic, under specified conditions.

Development may be allowed if it was demonstrated that the wetland was not a) Part of a Provincially Significant Wetland; b) situated within a riparian community or floodplain; c) a portion of a natural heritage feature designated by the Province or the municipality; d) a bog, fen; e) fish habitat; f) significant wildlife habitat; g) confirmed habitat for a Provincially or regionally significant species as determined by the Ministry of Natural Resources and Forestry or as determined by the municipality; h) a portion of an ecologically functional corridor or linkage between larger wetlands or natural areas; i) a portion of a groundwater recharge area; or j) a groundwater discharge area connected to any of the aforementioned (GRCA, 2024b).

Furthermore, development within a wetland or its interference zone (a designated area surrounding a wetland) is subject to strict limits. Such development may be allowed within the

interference zone, set at 120 meters from a provincially significant wetland or any wetland greater than or equal to 2 hectares, and at 30 meters from smaller, non-provincially significant wetlands (wetlands less than 2 hectares), provided it can be proven that there will be no adverse impacts on the hydrologic or ecological functions of the wetland (GRCA, 2024b). Overall, any development within wetlands or their interference zones requires prior permission from the GRCA.

From the above, it is evident that the GRCA could restrict development within wetlands beyond its potential impact on the hydrologic or natural hazard (flooding, erosion) control function of the wetland. However, with the passing of Bill 23 and subsequent repealing of Ontario Regulation 150/06 this is no longer the case.

2.9.5 GRCA Policies for the Administration of Ontario Regulation 41/24

Following Bill 23, modifications were made to the Conservation Authorities Act and a new Regulation - Prohibited Activities, Exemptions and Permits Regulation (Ontario Regulation 41/24) – under the Conservation Authorities Act came into effect on April 1, 2024 (Ross and Marun-Batista, 2024). The regulation repealed the existing 36 individual conservation authority regulations and replaced them with a single province-wide regulation covering prohibited activities, exemptions, and permits under the Act (Ross and Marun-Batista, 2024; GRCA, 2024a). A key difference between this regulation and the Ontario regulation 150/06 and 97/04 is the removal of ‘pollution’ and ‘conservation of land tests’ for granting development permits. So, conservation authorities in their permitting role can no longer comment on the impact on the ecological function of a wetland and this consideration is no longer a condition for permit approval (Interviewee 9, 2024). Conservation Authorities are now mandated to focus on the natural hazard (flooding, erosion) control feature of wetlands.

The GRCA Policies for the Administration of the Prohibited Activities, Exemptions, and Permits Regulation were approved on May 24, 2024, and two of the six objectives are to: a) avoid disrupting the hydrologic processes of wetlands across the Grand River watershed and b) prevent the loss and deterioration of hydrologic and hydraulic functions in wetlands, shorelines, river or stream valleys, and hazardous areas; instead, encourage restoration and improvement. These objectives emphasize the hydrologic functions of wetlands and do not mention ecological functions, which were included in the previous regulation, Ontario Regulation 150/06.

Furthermore, the conditions that limited development in a small naturally occurring or anthropogenic wetland, such as if it was part of a provincially significant wetland, as outlined in the earlier consolidated policies for Ontario Regulation 150/06, have been reduced to only those related to the wetland's hydrologic or natural hazard control function. The 'area of interference' has also been lowered from 120 to 30 metres.

The dynamic character of environmental governance is exemplified by the development of wetland-related legislation in Ontario, especially in the Grand River Watershed. With Bill 23 acting as a catalyst, the recent change from Ontario Regulation 150/06 to Ontario Regulation 41/24 signifies a substantial shift in ecological concerns being considered a condition for permit approval by CAs to a strict emphasis on hydrologic functions and the minimization of natural hazards. By highlighting the continuous conflict between environmental preservation and developmental demands, this regulation change highlights the necessity of a form of collaborative governance that facilitates inclusive decision making to the satisfaction of all stakeholders

2.10 Collaborative Governance in Natural Resource Management

Collaboration among diverse actors has become an essential and defining characteristic of contemporary environmental governance, as few serious environmental problems can be effectively addressed by a single actor alone (Polajnar Horvat et al., 2022a). Collaborative management refers to the engagement of multiple stakeholders in the decision-making process of utilizing natural resources. This approach often requires the participation of several stakeholders with different influences and experiences to find solutions to their conflicting interests and concerns over the use of natural resources (Hossu et al., 2018).

Emmerson et al. (2011) defined collaborative governance as the process and structure in public policy decision-making and management that constructively engage people across boundaries of governance levels, public agencies, and civil spheres. Collaborative engagement is important in successfully implementing the frameworks and models developed to improve the management of natural resources. Lukman et al. (2023) suggests that collaborative governance of natural resources is a pragmatic approach to addressing natural resource conflicts. By taking actions to include all stakeholders, including local community members, the complexities faced by local communities in governing natural resources are more effectively managed. It improves the decision-making regulatory processes and organizations through various actors that influence and take responsibility for outcomes. Furthermore, Olvera-Garcia & Neil (2020) demonstrate that collaborative management improves the effectiveness of operational activities and outcomes.

Traditionally, natural resource governance has been determined by government authorities (Freyfogle, 2011). However, communities also play an important role in the success of these projects. According to Rapp (2020), collaborative governance challenges the conventional top-down control and instead, focuses on bringing the affected stakeholders

together to participate in consensus-based policy and management. The most important thing in collaborative governance is winning the trust and support of all the identified stakeholders. In addition, the concept has emerged as an alternative to conflict-oriented and adverbial modes of governance. Hossu et al. (2018) argue that collaborative management is essential in addressing the complexities of adaptive systems characterized by non-linearity, self-organization, adaptation, and uncertainty. It is particularly valuable in cases where multiple stakeholders with opposing views are involved.

The inclusion of the indigenous people in the management of natural resources is important and such actions promote sustainability in the management of natural resources. Indigenous knowledge systems (IKSs) which integrates both 'traditional ecological knowledge' and 'Indigenous ecological knowledge' (Tang Kai & Swatuk, 2023) have the potential to make valuable contributions to natural resource management (NRM) (Berkes et al., 2000; Ens et al., 2015) when indigenous people, scientists, and NRM practitioners have the opportunity to collaborate effectively (Pyke et al., 2018). Collaborative natural resource management (NRM) frequently depends on the integration of indigenous knowledge (IK) with traditional NRM practices and scientific knowledge (SK) derived from academia (Bohensky and Maru, 2011). The integration of traditional ecological knowledge through community participation and local engagement in natural resources management can ensure that local knowledge, values, and views are considered when developing management strategies, which can result in more successful and long-lasting results (Rai, 2007). Research on the local management of Andean wetlands in Sajama National park, Bolivia (Villarroel et al., 2014), Indigenous nation building serving as a strategy for water management in Australia (Hemming et al., 2017) and the governance and conservation of wetlands in the Songor Ramsar Reserve (Fianko and Dodd, 2018) have

contributed to the growing body of literature that suggests that the incorporation of TEK and local participation into decision-making processes can lead to more sustainable and effective natural resource management strategies According to Dawson et al. (2021), the engagement of the local stakeholders represents a holistic approach to natural resource management characterized by interaction with others and the surrounding environment.

Different stakeholders are likely to have unique interests in natural resources, therefore collaboration among these diverse stakeholders is essential for sustainable management. Collaborative governance has been demonstrated as the key ingredient in facilitating the effective management of natural resources (Carr Kelman et al., 2023). Beyond improving resource management, collaborative governance also helps reduce conflict among stakeholders. Some of the key contextual factors to be considered in collaborative governance include social and cultural contexts that may vary from one stakeholder to the other (Carr Kelman et al., 2023). Engaging all the stakeholders in the policy formulation and direct management of the natural resources creates a scenario where all members are contented and are willing to accommodate one another. Importantly, the local communities that interact with the natural resources cannot be ignored considering that their daily activities have a direct impact on the resource wellbeing.

The role of collaborative governance in wetland management has been widely explored. For example, Polajnar Horvat et al. (2022b) provide a case of participatory management of Wetlands based on the Secvije Salina Nature Park. The study reported that participatory or collaborative governance on wetlands is important considering that they are among the most endangered ecosystems on earth (Polajnar Horvat et al., 2022b). The integrated approach in planning and management of the wetlands is the starting point for the effective management of wetlands and their natural resources. As shown in the study, collaborative management can be

formalized by introducing a wetland contract which is a voluntary agreement that guarantees sustainable management and development of the wetlands. These agreements should involve various stakeholders including the public and private participants who have different interests and capacities in the wetland and water conservation. The Wetland Contract has also been effectively implemented in Slovenia's Ljubljansko Barje Nature Park, therefore showing its capacity to balance the interests of multiple stakeholders while improving ecological results (Horvat & Smrekar, 2021; Smrekar et al., 2019).

Collaborative governance is also apparent in the conservation of Ontario Wetlands. The first public discussion on wetland policy in Ontario occurred in 1984 and the policy continues to evolve and improve to meet the changing needs and socio-economic and environmental conditions (Ontario Ministry of Natural Resources and Forestry, 2017). Furthermore, the long-term conservation plan for Ontario Wetland involves a collaborative agreement between the government and non-government institutions. The Ontario Government understands the importance of the collaborative approach in wetland conservation, and this is an important tenet in the guiding principles and values outlined in the Wetland conservation strategy for Ontario (Ontario Ministry of Natural Resources and Forestry, 2017). One of the action items listed in 'A wetland conservation strategy for Ontario' was the creation of a wetland offsetting policy to prevent the net loss of Ontario wetlands. Following this, an advisory panel, co-chaired by Conservation Ontario and Ducks Unlimited Canada, was established to facilitate conversations between diverse stakeholders including Indigenous peoples, the agriculture sector, industry, development community, and non-government organizations to "provide recommendations to the Ministry of Natural Resources and Forestry to inform the development of a wetland offsetting

policy as a component of a mitigation sequence in Ontario" (The Wetland Conservation Strategy Advisory Panel, 2018, p. ii).

Furthermore, conservation authorities in Ontario present an example of collaborative governance over natural resources as they represent aggregation of municipalities on a watershed basis and work in collaboration with other agencies for natural resources management within their respective watersheds. They were established under the conservation authorities act of 1946 and are governed by board of directors made up of representatives from each of the municipalities within the watershed.

At the national level, through the Global Biodiversity Framework, the government of Canada is committed to ensuring that 30% of land and water are conserved by 2030. The government has already invested about $470 million in the Natural Heritage Conservation in collaboration with community members (Environment and Climate Change Canada, 2024,). Additionally, in recognition of the vital role Indigenous communities play in natural resource management, the Canadian government declared in 2021 its commitment to allocate $340 million in additional financing over five years to promote Indigenous leadership in nature conservation. This initiative is part of Canada's broader investment of $2.3 billion over five years in nature conservation, as outlined in Budget 2021, demonstrating a deep understanding of the importance of Indigenous involvement in managing natural resources (Environment and Climate Change Canada, 2021).

Table 2.3 below shows that the different stages or levels of wetland policy formulation includes some collaborative governance offering different spaces stakeholder engagement and inclusion.

Table 2.3: Towards Effective Collaborative Governance

Governance Level	Responsible for Policy Making	Spaces for Stakeholder Engagement
International	Ramsar Convention, North American Waterfowl Management Plan (NAWMP)	NGO involvement (e.g., Ducks Unlimited), Indigenous knowledge integration, and global consultations on wetland conservation (e.g., Ramsar sites nomination)
Federal	Environment and Climate Change Canada, Canadian Wildlife Service.	Consultations with national NGOs (e.g., Nature Conservancy Canada), Indigenous-led stewardship programs, public feedback on Federal Wetland Conservation Policies
Provincial	Provincial governments (e.g., Ministry of Natural Resources and Forestry)	Ontario's Environmental Registry for public comments, public forums, town hall meetings, provincial wetland strategy consultations, and Indigenous consultations.
Community-Based Initiatives	Local municipalities, conservation authorities (e.g., GRCA)	Local NGOs, public consultations, community-based restoration initiatives, volunteer monitoring programs, and town hall meetings

2.11 Conclusion

The Grand River Conservation Authority (GRCA) has played a crucial role in the implementation of these regulatory frameworks to safeguard the wetlands within its jurisdiction. The more thorough ecological protection offered by the earlier rules has been replaced by new policies that place a higher priority on the maintenance of hydrologic processes and the avoidance of natural hazards. Municipalities are now being tasked with taking ecological functions into account during the planning and permit process for development projects, a role that many of them are unprepared for and have traditionally relied on CAs to perform. Wetland conservation faces both opportunities and challenges because of this shift, which makes it

necessary to investigate alternate approaches more closely in order to lessen the effects of development.

Wetland offsetting is a conservation approach that creates, restores, enhances, or preserves other wetlands to compensate for the loss of wetland areas. While a provincial wetland offsetting policy has yet to be produced (despite the Ministry of Natural Resources and Forestry's considering doing so in December 2022), certain conservation authorities in Ontario have developed thorough offsetting plans. It is also a conservation practice that has been adopted by other provinces and countries, including the United States and Australia.

Wetland offsetting has the potential to ensure that wetland ecosystems continue to offer their ecosystem services in the face of urbanisation pressures and regulatory changes. By better understanding this process, we can evaluate its significance in accomplishing long-term conservation goals and sustainable development.

CHAPTER 3: WETLAND OFFSETTING CONCEPT

3.1 Introduction

Wetlands are among the world's most precious and fragile ecosystems, performing critical roles in biodiversity conservation, water cycle regulation, and ecosystem services such as flood prevention and carbon sequestration. However, economic development, urbanization, and infrastructure developments continue to jeopardize their survival. As wetlands disappear or degrade, it becomes increasingly important to strike a balance between development and ecological conservation. This has resulted in the birth of wetland offsetting, a type of biodiversity offsetting that seeks to compensate for development's negative consequences on wetlands.

The mitigation hierarchy, a systematic method that puts preventing and mitigating environmental effects ahead of compensatory measures, provides the foundation for the idea of wetland offsetting. Wetland offsetting gives developers a way to make up for ecological losses by restoring, improving, or creating new wetland habitats in situations when avoidance is not practical. Wetland offsetting is not without its difficulties, though. Ensuring ecological parity between the impacted and offset sites, choosing sites wisely, conducting thorough monitoring, and adhering to offset policies are all necessary for offsetting to be successful.

This chapter conceptualizes biodiversity offsetting and its use in wetland conservation. It looks into the ideas, procedures, and policies that regulate wetland offsetting, covering important frameworks like permittee-responsible offsetting, in-lieu fee arrangements, and wetland mitigation banks. These approaches differ in complexity and risk, with success largely dependent on regulatory enforcement, financial viability, and environmental effects.

The chapter also looks at the global and regional policies that have influenced wetland offsetting methods. Notably, wetland offsetting in the United States is examined, focusing on the

country's complete structure for compensating wetland losses under the Clean Water Act. Furthermore, the chapter examines wetland offsetting policies in Canada, assessing federal, provincial, and territorial approaches to wetland protection, with a particular emphasis on policies in Alberta, Nova Scotia, Ontario, and New Brunswick.

Despite its expanding popularity, wetland offsetting has significant drawbacks, including difficulty with site selection, noncompliance with rules, time gaps between impacts and offset success, and challenges in attaining no net loss of wetlands. These problems highlight the importance of strong and adaptable policies that include environmental, social, and cultural values in offset schemes. To address these constraints, strong policy criteria have been proposed, emphasizing the importance of a net increase in wetland function, interaction with Indigenous groups, strict adherence to the mitigation hierarchy, and long-term monitoring of offset outcomes.

3.2 Biodiversity Offsetting

In the face of rapid economic growth and urbanisation, biodiversity protection has emerged as a key worldwide challenge (Bull et al., 2013). The increasing tensions between environmental protection and economic growth is causing the depletion of earth’s natural capital as the global population approaches seven billion (Maron et al. 2012). It is estimated that by 2050, between 200 million and 1 billion hectares of the remaining terrestrial vegetation will have been transformed for human land uses (MEA, 2005; Tilman et al., 2011). Although infrastructure expansion can effectively reduce poverty and promote economic prosperity, if it is not accompanied by robust environmental protections, it can also significantly contribute to the worldwide decline of biodiversity and ecosystem services (Laurance et al., 2015; Zu Ermgassen et al., 2019). Infrastructure can impact biodiversity in a number of ways, such as through directly

causing habitat loss within the footprint of built infrastructure (Torres et al., 2016), altering or fragmenting ecosystem properties, and intensifying the use of biological resources by promoting economic activity (Zu Ermgassen et al., 2019). In addition, conservation issues are not successfully integrated into development plans and risk being viewed as incompatible with economic growth (Bull et al., 2013).

Biodiversity offsetting has emerged as a strategy to balance development with biodiversity conservation. By connecting industry and conservation, it presents an approach that could lead to both development and better ecological results (Bull et al., 2013). The widely cited definition of biodiversity offsetting is provided by the Business and Biodiversity Offsets Programme (BBOP), an international partnership for offset methodology development. BBOP (2018) defines biodiversity offsets as:

> "Measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to achieve no net loss and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure, ecosystem function and people's use and cultural values associated with biodiversity". (p. 9)

Essentially, this concept posits that the environmental degradation from the development of one site (the "development site") will be compensated for by an equal or better environmental enhancement on another (typically more or less adjacent) site or array of sites (the "offset site(s)") (D. W. Poulton, 2014). These offsets are implemented at the final step of No Net Loss (NNL) policies, which necessitate the use of a mitigation hierarchy to avoid, minimise, rectify, and offset the biodiversity impacts of development activities (Bennett, 2017). No Net Loss

(NNL) policies are currently one of the most extensively employed solutions for addressing the environmental implications of development activities (Bennett, 2017).

3.3 Wetland Offsetting

Wetland offsetting is a specialized form of biodiversity offsetting, which focuses on wetlands, one of the world's most valuable and vulnerable ecosystems. Given that wetlands play extremely important roles in biodiversity maintenance and the provision of ecosystem services, wetland offsetting has become a vital subset of biodiversity offsetting. It is a strategy that involves counterbalancing the adverse effects on wetlands by deliberately restoring or establishing new wetlands that can generate comparable or greater positive environmental effects (The Wetland Conservation Strategy Advisory Panel, 2018). It can involve the creation, restoration, enhancement or in specific circumstances, the preservation of wetlands to compensate for unavoidable adverse impacts. Like any other type of biodiversity offsetting, it follows a mitigation hierarchy that includes efforts to first avoid causing wetland damage, then minimise impacts, and finally mitigate development impacts before considering wetland offsetting as a last resort to compensate for residual damage (Ontario Nature, n.d - a).

It is important for wetland offsetting to make sure that the newly created or restored wetland accurately represents the lost or deteriorated wetland. This is known as ‘like for like’ or ‘in-kind’ offsetting. In contrast to "out-of-kind" offsets, which permit other forms of compensation, it offers habitat, functions, values, or other characteristics comparable to those impacted by the project (Mckenney, 2005). Wetland offsetting policies often emphasize ‘in-kind’ offsetting, however, in cases where this is not feasible or there is potential for greater environmental benefits to the watershed, ‘out-of-kind’ offsets has been considered as

appropriate (Federal Interagency, 2004; Mckenney, 2005). This also applies when deciding whether to carry out wetland offsetting on-site or offsite.

3.3.1 Approaches to Wetland Offsetting

There are generally three approaches to wetland offsetting and they include permittee-responsible offsetting (also known as proponent-led offsetting), In-Lieu Fee Mitigation, and Wetland Mitigation Banking. Permittee-responsible mitigation involves the permittee being responsible for the site's development and long-term success. Mitigation banking and in-lieu fee mitigation are "third-party" compensation models that transfer project success liability to the sponsoring entity (EPA, n.d.-a).

3.3.1.1 Permittee-Responsible Offsetting

This involves the restoration, creation, enhancement, or preservation of wetlands by a permit holder or development proponent to offset the impacts on wetlands from a particular project (EPA, n.d). The permit holder carries out the compensation following the issuance of the permit and is responsible for the execution and success of the wetland offset. The compensation by the permit holder can take place either at the site of the permitted impacts or at an off-site location within the same watershed (EPA, n.d.-a).

3.3.1.2 In-Lieu Fee Arrangements

This is one of the third-party approaches to wetland offsetting. In this scenario, a third party collects payments from many smaller developments until sufficient funds are gathered to support a larger offset project meant to compensate for the cumulative negative impacts of these developments (Ontario Nature, 2023). It is typically an agreement between a regulatory agency and a mitigation sponsor (state agency, land trust, or conservation organisation) that allows the sponsor to collect funds from project proponents "in lieu of" their required project-specific wetland compensation or offsetting (Mckenney, 2005).

3.3.1.3 Mitigation Banking

Mitigation Banking is another third-party approach to wetland offsetting. Bean and Dwyer (2000) define wetland mitigation banking as the proactive establishment, repair, improvement, or conservation of wetlands before any particular project necessitating mitigation. The resulting "credits" obtained from these endeavours can be used to fulfil the mitigation obligations for future projects, whether owned by the same individual or a different one. This form of banking has its roots in the United States but is now highly developed and extensively practiced in both the United States and Germany (Bennett, 2018). Under this model, project proponents who expect to cause unavoidable impacts to a wetland ecosystem can compensate for these losses by buying "credits" from a third-party wetland banker (Mckenney, 2005). Wetland functions or acres developed or restored are quantified to calculate the worth of these "credits' and the offset project's success ultimately rests with the wetland banker (EPA, n.d.-a). Mitigation banking is done "off-site," similar to the "in-lieu fee arrangement," but it differs in that it usually happens after authorised impacts.

Table 3.1: Approaches to Wetland Offsetting

Offsetting Approach	Description//Scale	Feasibility/Effectiveness	Empirical Source
Permittee-Responsible Offsetting (Proponent-Led)	Permit holder carries out wetland restoration or creation to offset project impacts. Compensation is often done on-site or off-site within the same watershed.	**Feasibility**: Suitable for small-scale projects. Complex for larger projects. Proponents are responsible for long-term success, which can be resource-intensive. **Effectiveness**: Varies widely. Site-specific conditions may limit the success of restoration efforts. On-site approaches may struggle with scale and expertise issues.	(EPA, n.d.), (Mckenney, 2005)
In-Lieu Fee Arrangements	Proponents pay a fee to a third-party mitigation sponsor (government agencies, NGOs) who pools funds to carry out larger wetland restoration/creation projects.	**Feasibility**: Effective for small developers who cannot handle compensation independently. Economically viable and provides pooled resources for larger-scale projects. **Effectiveness**: Depends on the sponsor's expertise and the scale of projects. The time lag between damage and restoration is a concern, as compensatory projects may take longer to implement.	(Ontario Nature, 2023), (Mckenney, 2005)
Mitigation Banking	Credits are purchased from a wetland mitigation bank that has proactively restored or created wetlands. Projects can "buy" credits to offset future unavoidable impacts.	**Feasibility**: Highly feasible for developers due to credit availability. Ensures compliance by transferring responsibility to bankers. Particularly effective for large-scale and long-term projects. **Effectiveness**: Considered one of the most effective forms due to the pre-established wetlands and oversight. However, long-term functionality may still vary depending on monitoring and management.	(Bean & Dwyer, 2000), (Mckenney, 2005), (Bennett, 2018)

3.4 International Biodiversity Offsetting Policies

Many countries all over the world have developed frameworks or policies that allows for the compensation of residual environmental impacts after avoidance and minimization, thereby

aiming for a no-net-loss of biodiversity. Several European countries, including Germany, France, Spain, and the UK, have implemented or plan to employ mitigation banking (Condon, 2020; Droste et al., 2022; Enríquez-de-Salamanca et al., 2017; Wende et al., 2018). When no appropriate compensation mechanism is available on-site or off-site, certain countries, like Germany, accept in-lieu fees (Wende et al., 2018).

In Australia, offset policies have both been developed at the federal, state and local levels with most of them geared towards compensating for natural vegetation clearance in forests, wetlands and marine habitats (Droste et al., 2022; McKenney & Kiesecker, 2010). In Africa, offsetting frameworks have been developed in Mozambique, South Africa, Sierra Leone, and Namibia (GIBOP, 2019). South Africa, for example, has a national wetland offsetting policy (GIBOP, 2019). Biodiversity offset programmes have been in place throughout Latin America since the early 2000s (Droste et al., 2022). According to Villarroya et al. (2014), Brazil, Mexico, Columbia, and Peru expressly demand their implementation through environmental regulations.

Based on national laws, Azerbaijan, China, Indonesia, and Mongolia all have programs in place to offset biodiversity (GIBOP, 2019). Since 2014, China has implemented a comprehensive eco-compensation programme that includes agri-environmental payment for ecosystem service programs in grasslands and forests, as well as compensating programs for both mining sites and watersheds (Droste et al., 2022; Pan et al., 2017).

From the above, it is evident that various forms of biodiversity offsetting policies are increasingly being developed in many countries around the world. However, when it comes specifically to wetland offsetting, the United States is known for having the most comprehensive framework.

3.4.1 Wetland Offsetting in the United States

In the United States, the term used for wetland offsetting is ‘wetland compensation’ (Poulton & Bell, 2017). Its origins can be found in Section 404 of the 1972 Clean Water Act (CWA), which governs the release of fill material and dredging material into waters, including wetlands (McKenney & Kiesecker, 2010). The mitigation hierarchy forms the basis of wetland compensation in the United States, and the idea of "no net loss" was initially introduced in the US political scene in the 1980s and has now become a foundational principle for wetland conservation efforts (Robertson, 2004). The Clean Water Act also allowed for the implementation of the stream mitigation (banking) strategy in 2000 (Doyle et al., 2013; Lave, 2014).

Wetland compensation in the United States occurs through three primary mechanisms: mitigation banking, in-lieu fee (ILF) programs, and permittee-responsible mitigation (EPA, nd. -a). While the permittee-responsible mitigation was the more common practice in the 1970s, the third-party approaches – in-lieu fees and mitigation banking- have become more dominant since their introduction in the 1990s (Droste et al., 2022; Lave, 2014). Of these three approaches, a 2008 mitigation rule, enacted jointly by USACE and EPA prioritized mitigation banking due to its higher likelihood of success, provided that the necessary credits are available (EPA, n.d.-b; Poulton & Bell, 2017). As of 2011, 26 percent of wetland offsetting projects involved mitigation banking (Poulton & Bell, 2017). Moreover, banked wetland projects enable lower risk and more predictable results because the offsetting occurs before the negative impact (Poulton & Bell, 2017). According to Poulton and Bell (2017), US regulations also prioritise permanence, so these banked sites are frequently conservation easements or have been given to nonprofits or resource agencies for long-term conservation, or, in the case of public lands, have continued

protection in resource management plans. Furthermore, Whipps (2014) argues that this system can incentivize private landowners to carry out ecosystem and species preservation to sell credits to mitigation banks.

3.5 Wetland Offsetting in Canada: Federal Legislation

Biodiversity offsetting is incorporated into major federal legislation in Canada, including the 1991 Federal Policy on Wetland Conservation, the 1986 Fisheries Act, the 2002 Species at Risk Act, and the Offsetting Policy for Biodiversity, which was developed by Environment and Climate Change Canada in 2020. The following sections will explore the 1991 Federal Policy on Wetland Conservation and the 1986 Fisheries Act as they explicitly mention wetlands. The 2002 Species at Risk Act and Environment and Climate Change Canada's 2020 Offsetting Policy for Biodiversity may contain provisions that have an indirect impact on wetlands, particularly when wetlands are critical habitats for endangered species or when biodiversity offsets include wetland restoration or creation. However, they do not place the same emphasis on wetlands as the first two policies.

3.5.1 1991 Federal Policy on Wetland Conservation

Wetlands on federal land and those impacted by federally approved projects are governed under the federal wetland conservation policy (Poulton, 2021). Its overall objective is “to promote the conservation of Canada’s wetlands to sustain their ecological and socio-economic functions, now and in the future” (Government of Canada, 1991, p.5) while one of its seven goals is the “no net loss of wetland functions on all federal lands and waters” (Government of Canada, 1991, p.5). The inclusion of this goal acknowledges the need for compensation in cases where the loss of wetland functions is inevitable (Poulton & Bell, 2017). For the past 20 years,

federal authorities have often demanded compensating for the wetlands covered by this policy (Poulton, 2021).

Although this policy was drafted more than thirty years ago, it established a very positive precedent (Poulton & Bell, 2017). It acknowledged that when policies affecting indigenous people are implemented, they must be engaged and consulted. It also took into consideration limiting offsetting in regions with significant wetland loss. Lastly, it underlined how important monitoring is to building a solid scientific foundation for policy (Poulton & Bell, 2017).

3.5.2 The 1986 Fisheries Act

One of the first countries to embrace the "no net loss" policy and rely on offsetting to preserve fish and their habitat was Canada in 1986 (Poulton & Bell, 2017). The guiding principle was to assist in accomplishing the overarching goal of the strategy, which was to provide a net gain in habitat for Canada's fisheries resources (Poulton & Bell, 2017). The HADD provision, which is found in Section 35 of this Act, forbids the "harmful alteration, disruption, or destruction" of fish habitat which includes wetlands as they are critical fish habitats. On the other hand, it permits such activities subject to restrictions set by the relevant Minister, who is now the Minister of Fisheries, Oceans, and the Canadian Coast Guard (Poulton, 2021).

The most recent policy guidance supports the mitigation hierarchy and offsetting principles while establishing a less specific standard aimed at "supporting the conservation and protection of fish habitat by counterbalancing residual fish death and/or harmful alteration, disruption, or destruction of fish habitat" (Fisheries and Oceans Canada, 2019 p. 8; Poulton & Bell, 2017). This is supported by the principle that "benefits from measures to offset should balance the adverse effects," which could be understood as maintaining the goal of no net loss (Fisheries and Oceans Canada, 2019 p. 9; Poulton & Bell, 2017).

3.6 Provincial Wetland Offsetting Policies

3.6.1 Alberta Wetland Policy

The province-wide Alberta wetland policy was released in 2013, and it replaced 1993's Wetland Management in the Settled Areas of Alberta: An Interim Policy (Government of Alberta, 2013). The previous policy only addressed wetland management in the White Area (settled region) of the province and excluded the Green Area or Crown Lands (Government of Alberta, 2013). The Water Act serves as the legislative foundation for Alberta's Wetland Policy. One of the policy's key outcomes is the sustainable management of wetlands achieved by avoiding wetlands, minimizing impact, and if essential, replacing lost wetland value, thereby emphasizing the mitigation hierarchy. Regardless of wetland value, the policy underscores that avoidance should always be the first consideration for any development activity that would negatively impact a wetland (Government of Alberta, 2013).

Wetlands are valued and compared based on the "relative wetland value" concept which uses a five-metric method that considers the following: hydrologic function, human uses, biodiversity and ecological health, water quality enhancement, and relative abundance (Poulton & Bell, 2017; Spence, 2021). Following this assessment, wetlands are assigned a value between A and D, with 'A' having the highest value. This scoring strictly emphasizes function and not the different wetland types. The assigned value of the impacted wetland and the proposed replacement value are critical considerations when using certain multiplier ratios. A 1:1 ratio is utilised for replacing equivalent values (for example, A for A or B for B) (Poulton, 2021). However, for replacements with considerable value changes (such as A for D), an 8:1 ratio is used. This principle also works in reverse, so replacing a D-value wetland with an A-value wetland results in a ratio of 1:8 (Government of Alberta, 2013). The evaluation of relative

wetland value is designed to facilitate cumulative effects management within a larger landscape framework (Government of Alberta, 2013).

Alberta implemented the Alberta Wetland Mitigation Directive in 2015, with the goal of guiding planning and decision-making to avoid and minimise negative impacts on wetlands, as well as compensating for lost wetland acreage and value (Government of Alberta, 2015). The Directive uses "Relative Wetland Value Assessment Units" (RWVAU) to identify acceptable offset sites. These units are divided according to watershed and natural region boundaries. The Directive proposes that offsets be located within the same municipal boundaries, watershed, and with the same RWVAU. Furthermore, they should be in the same natural zone or an area with a long history of wetland loss (Poulton & Bell 2017).

The Alberta Wetland Policy permits the provision of replacement wetlands via two approaches: "non-restorative replacement," which entails contributing to an in-lieu fund, and "restorative replacement," which entails actually restoring, enhancing, creating, or protecting a comparable wetland (Poulton, 2021). In Alberta, the notion of in-lieu payments is not new as regulators frequently demanded payments to a nonprofit organisation dedicated to wetland protection in order to promote wetland conservation initiatives under the former wetland policy (Poulton, 2021). Initially, the present strategy sought to create a variety of "wetland replacement agents," but it has subsequently changed to become a fund administered by the government, which makes grants and disbursements as it sees fit (Poulton, 2021).

Unfortunately, the province only requires replacement for projects that will result in permanent losses—losses that do not come under the category of oil, gas, and forestry development—and does not impose limits on offsetting rare and vulnerable wetlands, such as fens and bogs (Poulton & Bell, 2017). Moreover, the policy does not handle the lag timings and

offset length requirements, nor does it apply to ephemeral wetlands, however activities that may affect these ephemeral wetlands are subject to the Water Act (Government of Alberta, 2013).

3.6.2 Nova Scotia Wetland Conservation Policy

The Nova Scotia Wetland Conservation Policy was released on October 14, 2011, and it adds context to existing legislation, regulations, and operational strategies aimed at protecting and managing wetlands in Nova Scotia like the Environment Act and the Environmental Goals and Sustainable Prosperity Act (Government of Nova Scotia, 2011). The goal of this policy "to prevent the **net loss** of wetland in Nova Scotia through wetland conservation practices that integrate the need for wetland protection with the need for sustainable economic development, now and in the future" (Government of Nova Scotia, 2011, p. 9). One of its objectives is "to manage human activity in or near wetlands, with the goal of **no loss** in Wetlands of Special Significance and the goal of preventing **net loss** in area and function for other wetlands aligning with globally recognized No Net Loss (NNL) Policies

Wetland offsetting in the province operates under this policy and wetlands with exceptionally high ecological significance ("Wetlands of Special Significance") are fundamentally considered non-offsetable, with disturbance permitted only under rare circumstances. The mitigation hierarchy—which includes offsetting—applies to all others (Government of Nova Scotia, 2011; Poulton, 2021). There is no in-lieu fee offsetting approach, instead the Ministry of Environment requires proponents seeking offset requirements to work with experienced wetland experts to develop tailored offset projects. Alternatively, proponents can collaborate with wetland restoration organisations such as Ducks Unlimited Canada or East Coast Aquatics, which have agreements with the Ministry and keep directories of pre-approved restoration projects (Poulton, 2021).

Unfortunately, this policy is limited as it includes several restrictions on requiring a permit application. These restrictions include negative impacts on wetlands on federal lands, wetlands smaller than 100 square meters, artificially created upland wetlands, infrastructure wetlands, and wetlands within agricultural drainage ditches, among others (Poulton & Bell, 2017). Furthermore, the policy allows a simplified application process for projects affecting less than half a hectare of wetland, which neglects small, ephemeral wetlands (Poulton & Bell, 2017). However, the policy requires the mandatory use of replacement ratio multipliers to address the time lags associated with wetland offsetting projects. These multipliers vary based on the offsetting method: restoration or expansion (2:1), wetland enhancement (3:1), or the creation of a new wetland (4:1) (Poulton, 2021).

3.6.3 New Brunswick Wetlands Conservation Policy

One of the objectives of the New Brunswick Conservation Policy is "to manage human activity on or near wetlands in a manner which will achieve no loss of Provincially Significant Wetland habitat and no net loss of wetland function for all other wetlands" (New Brunswick Natural Resources and Energy & New Brunswick Environment and Local Government, 2002, p. 3).

To achieve this objective of no net loss of wetland function, compensation for wetland loss is required when a permit to impact a wetland is granted under the Clean Water Act or Clean Environment Act (or via a Ministerial Order) (Department of Environment and Local Government, 2020). The compensation ratio is currently 2:1 which means that the required compensation area should be twice the impacted area.

The policy defines Provincially Significant Wetlands as those having special legal status or conservation importance. Development in these wetlands is prohibited, and for all other

wetlands larger than one hectare, a “no net loss” approach based on function guides management decisions (Poulton, 2021).

The mitigation hierarchy is recommended for the default category (non-Provincially Significant Wetlands over one hectare), with a warning in the policy that compensation might not be permitted unless avoidance and minimization options are thoroughly explored (New Brunswick Natural Resources and Energy & New Brunswick Environment and Local Government, 2002; Poulton, 2021). If residual impacts persist and compensation is permitted, the permittee may directly offset the effects through creation, enhancement, preservation, or restoration; alternatively, the permittee may finance a project chosen from a pre-approved project inventory maintained by a wetland compensation consultant. Ducks Unlimited Canada is the biggest consultant for wetland compensation. The province has also considered the In-lieu fund wetland compensation approach.

3.6.4 Ontario

In response to population and economic growth, and the increasing demand for resources and infrastructure, the Ontario Government has considered developing a wetland offsetting policy as a strategy for the conservation and protection of these valuable ecosystems, in the past. The possibility of developing a No-Net-Loss Policy was first explored in ‘Wetland Conservation in Ontario: A discussion Paper’ released in 2015 by the Ontario Ministry of Natural Resources and Forestry.

In 2017, the OMNRF released “A Wetland Conservation Strategy for Ontario 2017-2030” which outlined two targets:

1. “By 2025, the **net loss** of wetland area and function is halted where wetland loss has been the greatest” (OMNRF, 2017, p. 27).

2. “By 2030, a **net gain** in wetland area and function is achieved where wetland loss has been the greatest” (OMNRF, 2017, p. 27).

To achieve the targets, creating a wetland offsetting or No-Net-Loss Policy for Ontario’s wetlands was listed as an action item, placing offsetting within a mitigation hierarchy to be considered only as a last resort for impacts that cannot be avoided, minimized or mitigated. The document goes further to list out important considerations for wetland offsetting for the province such as offsets duration, ensuring offsets are greater or equivalent, proximity of offsets to impact site, and the importance of monitoring to ensure the restoration of wetland functions.

Following the release of the Wetland Strategy, the Wetland Conservation Strategy Advisory Panel was set up to create a report for the Minister, which provided suggestions and factors to take into account for the creation of a wetland offsetting policy in Ontario. Their 2018 report, ‘Considerations for the Development of a Wetland Offsetting Policy for Ontario’, stresses the importance of preventing negative effects on wetlands, which can be most effectively accomplished by adhering to the full mitigation process. It is only when avoidance, minimization, and mitigation measures have been exhausted that offsetting should be considered. Therefore, it is crucial that offsetting and the full mitigation sequence be incorporated into laws and policies, with a strong emphasis on their implementation (The Wetland Conservation Strategy Advisory Panel, 2018).

Furthermore, the province released a discussion paper in 2022 titled. “Conserving Ontario’s Natural Heritage” on the Environmental Registry of Ontario (ERO Posting #019-6161) to seek feedback on the Government’s intention to develop an offsetting policy for wetlands, woodlands and other wildlife habitat. However, no progress has been made in this direction to date.

Although, there is currently no provincial wetland offsetting policy, four conservation authorities in the province have developed detailed offsetting or compensation policies. These include Toronto and Region conservation authority, Nottawasaga valley conservation authority, Lake Simcoe region conservation authority, and Credit Valley conservation authority.

3.6.4.1 Toronto and Region Conservation Authority (TRCA)

The TRCA released "Guideline for Determining Ecosystem Compensation" in 2018 and recently updated it in June 2023. It was developed to provide a transparent and repeatable approach for determining the entire amount of compensation required to replace or restore ecosystems that have been destroyed or altered, as soon as the need for compensation has been determined (TRCA, 2023). This determination is influenced by any applicable compensation policies and determined through the planning, environmental assessment, or permit processes (TRCA, 2023).

Like other ecosystem offsetting regulations or frameworks described above, the guideline emphasizes the full application of the mitigation hierarchy in the planning process for development and infrastructure that would negatively impact natural features. The guideline was designed to be applicable for any natural feature including wetlands that has been found to need compensation after applications and undertakings for infrastructure, TRCA, or development planning approvals have been reviewed (TRCA, 2023). This compensation may be proponent-led or via cash-in-lieu funds provided to TRCA or another public agency.

Section 3.2 of the guideline emphasizes the importance of taking into account proximity to areas of loss, compatibility with natural systems, land ownership and designation (with a preference for publicly owned land with environmental protection zoning), land availability, and ecosystem connectivity and configuration when selecting an offset site (Ontario Nature, n.d;

TRCA, 2023). It is essential to document the rationale for site selection when offsets are implemented by parties other than TRCA, and this selection must be approved by TRCA. TRCA-led offsets are to be located using their "Restoration Opportunities Database" and other site selection tools (Ontario Nature, n.d - c; TRCA, 2023).

Furthermore, in 2019, TRCA developed the Ecosystem Compensation Management Framework (The Framework) to outline the tools and procedures for providing cash-in-lieu of compensation to TRCA for restoration projects and/or conservation land securement. The Framework also provides guidelines for evaluating and managing the overall compensation program (TRCA, n.d.).

3.6.4.2 Nottawasaga Valley Conservation Authority (NVCA)

The Nottawasaga Valley Conservation Authority (NVCA) released “Achieving Net Gains through Ecological Offsetting” policy document in September 2021, which provides formal standardized metrics and criteria for wetland offsetting (NVCA, 2021). The policy document acknowledges that offsetting has limitations and includes characteristics with uncommon vegetation communities as described by the Natural Heritage Reference Manual, as well as bogs and fens. The strategy aims to promote responsible growth and development within the watershed, but not at the cost of the local natural heritage system (NVCA, 2021).

The policy outlines two approaches to wetland offsetting which includes proponent-led offsetting and a ‘cash-in-lieu’ payment option to a qualified third party with considerable wetland restoration and creation experience, such as Ducks Unlimited Canada, the Nature Conservancy of Canada and the NVCA. In addition to a strict adherence to the mitigation sequence, the policy requires development proponents to replace twice as much impacted wetland area, with the goal of a net gain in wetland area and function (NVCA, 2021).

The offset site selection procedure is described in Section 4.1.1. It considers the following factors: land ownership (public ownership preferred), geographic location (sites close to the impacted site preferred), suitability of the site to support the desired ecosystem type, and capacity to replace essential ecosystem functions. Furthermore, in their Fisheries Habitat Management Plan, NVCA also designates priority restoration locations (NVCA, 2021).

3.6.4.3 Lake Simcoe Region Conservation Authority (LSRCA)

The Lake Simcoe Region Conservation Authority published its “Ecological Offsetting Policy” in July 2021 with a goal of a “net gain” in natural heritage features. According to this policy, development proposals and infrastructure projects that require approvals under the Planning Act or the Environmental Assessment Act and result in the loss of wetland or woodland natural heritage features, even after following the mitigation hierarchy, must provide compensation for the loss of these features (LSRCA, 2021).

Like the NVCA policy, this policy recognizes that there are limits for offsetting and it should not be considered for bogs or fens or features with rare vegetation communities as described the Natural Heritage Reference Manual (LSRCA, 2021).

Section 3.3 of the policy specifies that in scenarios where compensation is the only viable option after a strict adherence to the mitigation hierarchy, an Ecological Offsetting Strategy (EOS) is required. The developer or proponent is responsible for establishing and implementing this EOS. To ensure that the offset results in a "net gain" of natural heritage characteristics, the EOS must demonstrate how the loss of the feature will be compensated for. Furthermore, projects to compensate for ecological offsetting must be feasible and finished in a reasonable length of time, preferably before the original feature is removed. In addition, an EOS monitoring

component must be included to ensure that offset projects are correctly carried out (LSRCA, 2021).

3.6.4.4 Credit Valley Conservation (CVC)

The Credit Valley Conservation (CVC) published its "Ecosystem Offsetting Guidelines" in 2020. A net gain in ecosystem value is the policy's main goal, as stated in Section 1.8, which also suggests that offsetting efforts should strive for an ecological net gain. If a net gain is not considered practicable, the policy then seeks to guarantee no net loss (CVC, 2020; Ontario Nature, n.d. - c). The strict commitment to the mitigation hierarchy is also underlined in this policy document as offsetting is to only be considered when avoidance, reduction, and mitigation has been found to be not viable. The policy also requires that offsets be near impact sites and offsets be monitored for at least 5 years. Monitoring findings must be reported to the CVC and in the event of failing offsets, suitable changes must be made.

As highlighted by Ontario Nature (n.d. - c), none of the four wetland offsetting policies in Ontario acknowledges social, indigenous and cultural values in the development of their offsetting strategies or as part of policy goals. Additionally, these policies do not commit to ensuring meaningful and respectful engagement with Indigenous communities. With recent policy changes including the enactment of 'Bill 23', it is likely that social and cultural values will continue to be neglected at least at the level of conservation authority wetland offsetting policies. This is due to their role in the development permitting process now being limited to commenting solely on the potential impact of a project on the natural hazard mitigation functions of wetlands, such as flood and erosion control.

3.7 Limitations of Wetland Offsetting

Wetland offsetting, a subset of biodiversity offsetting, seeks to strike a balance between economic development and natural resource conservation by compensating for wetland loss by restoration, establishment, or improvement of alternative wetlands. While wetland offsetting provides a practical solution for balancing development and environmental protection, it has considerable limitations and obstacles. It is frequently defined as a high-risk endeavour that should be approached with caution and only as a last resort. Below are some commonly cited challenges to wetland offsetting.

3.7.1 Site Selection Challenges

An important consideration in biodiversity offsetting is the concept of 'equivalence' which refers to the need for the offset to provide the same or comparable ecological functions, services and values as the impacted natural resource (Bull et al., 2013). Effective offset policies are challenged by the need to ensure ecological equivalence between impacted sites and offsets (Maron et al., 2016; Quétier & Lavorel, 2011). However, ten Kate et al. (2004) posits that in some situations, it might be impossible or inappropriate to aim for perfect ecological equivalence especially in cases where the original impact site was ecologically sparse. They suggest that the goal then should be "conservation of complex systems rather than direct equivalence" (ten Kate et al., 2004 pp 61).

In the context of wetland offsetting, achieving ecological, geographic and socio-economic equivalence is particularly challenging due to the intricate linkages to site selection. Identifying a suitable site is challenging because of the unique requirements of each wetland type, such as specific parameters related to soil type, topography, and hydrology (Spence, 2021).

In addition, wetlands frequently support rare plant and animal species with habitat requirements that must be satisfied, which makes it much more difficult to locate a comparable location.

Furthermore, the issue is exacerbated in an area like Southern Ontario, where a booming economy and rapid growing human population, leads to limited affordable and open space (Ontario Nature, 2023). Due to this challenge, offset providers frequently select suboptimal sites or search for alternative areas that are further away from the affected sites. It is less likely that an offset will completely compensate for the range of ecological, social, and cultural impacts when it is located far from the affected area or on a site with less-than-ideal conditions (Yu et al., 2018). Moreover, given the absence of clear guidelines for the site selection procedures, an offset site may be selected more for practicality or financial reasons than for its ecological compatibility (Jacob & Dupras, 2021). The efficacy of offsetting efforts may be hampered by this lack of consistent standards, which may produce inconsistent results. Comprehensive, scientifically based rules that put long-term sustainability and ecological equivalency ahead of immediate financial gains are necessary for effective wetland offsetting.

3.7.2 Non-Compliance

Non-compliance with offset requirements and conditions has been identified as another major limitation to wetland offsetting. In ‘Compensating for Wetland losses under the Clean Water Act’, the National Research Council (2001) noted the lack of compliance with permit conditions by permit holders within the US wetlands compensation system. The report further highlights that limited attention to inspection and enforcement likely contributes to low observed permit violations.

The challenge of non-compliance can also include non-adherence to the mitigation hierarchy, where economic interests may take precedence over ecological preservation (Spence,

2021). A significant drawback of the mitigation hierarchy is that the initial and crucial stage, impact avoidance, can often be disregarded without any significant consequences (Clare et al., 2011). Clare et al. (2011) identified the inadequate enforcement of compensation requirements as one of the reasons why the 'avoidance' stage in the mitigation hierarchy is largely avoided.

Low compliance rates suggest a lack of regulatory enforcement of offset outcomes, which may imply a lack of institutional interest in the genuine offsetting outcomes and reduce the likelihood of positive outcomes (Walker et al., 2009). Moreover, seldom do laws provide for the imposition of monetary fines for noncompliance (Hahn & Richards, 2013) which further weakens enforcement.

Furthermore, studies by Mack & Micacchion (2006) and Matthews & Endress (2008) have shown that non-compliance has led to the partial or non-implementation of wetland offsets in the United States. Poulton & Bell (2017) posits that the success of wetland offsetting will depend amongst other things, on the political will and capacity to monitor and enforce compliance with offset permit conditions and performance standards. In addition, compliance necessitates strict enforcement, with regulators empowered to impose penalties when permits are violated (Gray & Shimshack, 2011).

However, it is noteworthy to mention that imperfect compliance with NNL policies does not automatically mean failure from an ecological perspective as additional compensatory measures beyond the required offset can mitigate the negative effects of non-compliance (Bull et al., 2017). Theis et al. (2019) in their review conclude that simply achieving compliance with permit criteria does not necessarily ensure that ecological goals of NNL policies are met, as the ecological functional performance of offsets fell short despite compliance with offset permit criteria.

In conclusion, strict enforcement, strong regulatory frameworks, and a sincere dedication to ecological results are necessary to overcome non-compliance in wetland offsetting. It is unlikely that wetland offsetting will reach its full potential without these.

3.7.3 Time Lags

Natural ecosystems do not generally grow and develop at the same rate as development activities. This means that if compensation projects and development activities begin simultaneously, the development activity and its associated ecosystem impact will occur long before the benefits provided by offset or compensation project (Poulton, 2014). This is a temporal loss to biodiversity. Therefore, while the loss of biodiversity is inevitable, the benefits could come later or not at all. In other words, the state of the restored ecosystem will become less predictable as time goes on (Bekessy et al., 2010). Even with active restoration, it can take a wetland ten to over one thousand years to recover from disturbance. This underscores the possibility of prolonged "temporary" losses resulting from the removal of wetlands for development that is predicated on offsetting (Pezzati et al., 2018). For in-lieu fee offset projects, this risk of "temporary" losses—often referred to as the "time lag"—is particularly noticeable because offsetting actions are frequently postponed until adequate financing is gathered (Stephenson & Tutko, 2018).

In theory and principle, it is recommended to have offset projects in operation before permitting development impacts to prevent temporal losses in ecosystem values. This is known as the ‘anticipatory approach’. However, Mckenney and Kiesecker (2010) postulate that this can disincentivize offsets development for two reasons. Firstly, if a like-for-like approach is to be used for offsets, it would be difficult for offsets developers to predict project impacts before they occur, especially for projects with complex and wide-ranging impacts. Secondly, with wetland

banking, where credits are created and sold, the anticipatory approach might restrict the ability to sell offset credits before the offset is fully operational and meets all performance standards. This can lead to significant upfront costs for wetland bankers as they will need to bear the costs of planning, establishing, managing and operating offsets before they can be used as compensation for environmental impacts.

The US wetland mitigation policy addresses this by tying credit releases to the achievement of specific milestones. Before any credits can be sold, a wetland bank or offset must have a secured location, an approved mitigation plan and other necessary assurances (McKenney & Kiesecker, 2010). Credits can then be gradually increased as the projects progresses to meet ecological and performance milestones such as construction, planting and the establishment of plant and animal communities (McKenney & Kiesecker, 2010). A considerable fraction of the credits is held until complete ecological performance standards are met. This advance credit mechanism is quite widespread for US wetland mitigation banking, and Environmental Law Institute (2002) estimates that around 90% of US wetland banks sell credits before meeting any performance standards.

3.7.4 Failure to achieve no net loss

Wetland offsetting Policies aims to achieve a No-net-loss in wetland area and function and if possible, a net gain. However, Walker et al. (2009) has described this goal as "administratively improbable and technically unrealistic”. Bürgin (2010) has further criticized this goal, arguing that it is figurative and rarely achieved. Studies have consistently demonstrated that wetland offsets differ significantly from natural wetlands in terms of biodiversity (Tillman et al., 2022) and ecological function (Theis, 2019). Overall, wetland offsetting practices have proven unsuccessful in achieving the goal of no-net-loss, even when the offset area matches the

size of the impacted ecosystem (Ontario Nature, 2023). Therefore, it is highly risky to assume that an offset project will deliver the same type and quality of ecological value as the natural ecosystem it is intended to replace.

In Canada, Quigley and Harper (2006) assessed the effectiveness of 16 habitat compensation projects in achieving no net loss of habitat productivity under the Fisheries act. Their study found that over 60 percent of these projects resulted in net losses of habitat productivity. However, 25 percent achieved NNL while 12 percent achieved a net gain in habitat productivity, and they conclude that there is a possibility to build on this success if issues of poor record keeping and low levels of compliance monitoring are addressed. In the aforementioned study, the probability of achieving NNL was also tied to the compensation ratio, and this is similar to zu Ermgassen (2019) global review of "no net loss" policies which identifies high offset ratio as a commonly cited reason for success in wetland offsets.

It is important to highlight that the stated goal of "no-net-loss" does not mean that every wetland ecosystem will be conserved in all mitigation efforts (Corps & EPA, 1990). This is what constitutes on-site compensation efforts, but this is not always feasible especially in highly urbanized areas with limited space to create or restore wetlands on-site. Mitigation banking, on the other hand, redistributes the compensation geographically, which means that while some specific wetlands may be lost or degraded without immediate on-site replacement, the overall quantity and quality of wetlands within a broader area are maintained or improved (Brown & Lant, 1999). However, this can lead to the loss of native plant species at the impact site as evident in research by Price at al. (2019) and Tillman (2022).

This raises the question of whether the preservation of taxonomic diversity is part of the offsetting goals, as the emphasis on the net conservation of wetlands has consequences for the

various types of wetland resources prioritised for compensation (Tillman, 2022). Although the fundamental purpose of wetland mitigation is to replace wetland function and area, it is critical to understand which wetland components are lost during wetland trades that are considered regulatory successes (Tillman, 2022). Therefore, the failure to achieve no net loss highlights the intricacies and problems inherent in wetland offsetting, as well as the need for more effective and nuanced conservation strategies.

3.8 Strong Wetland Offsetting Policy Criteria

Given the limitations and risks associated with wetland offsetting, it is 'risky business' and could be used to exacerbate wetland loss. Nonetheless, urban and industrial growth will continue to exert pressure on wetlands, despite the risks associated with wetland offsetting. Furthermore, recent changes to Ontario's government laws and policies are expected to accelerate the province's wetland loss and deterioration (Ontario Nature, 2023).Wetland offsetting offers a middle ground between the currently unfeasible goal of entirely stopping all development that negatively damages wetlands and the practice of permitting development without any compensation, which is common in the province (Poulton & Bell, 2017). Therefore, it is critical to approach wetland offsetting with utmost prudence and design offsetting rules that correspond to high standards.

The following is a list of 10 criteria for a strong wetland offsetting policy developed by Ontario Nature (2023) which reflects recommendations from other expert sources such as ten Kate (2018), The Wetland Conservation Strategy Advisory Panel (2018) and Poulton & Bell, (2017).

1. **Net Gain**: The stated policy goal should clearly be to achieve a net gain in wetland area, function, and values.

2. **Scope of Policy Goal**: The stated policy goal should include a list of explicitly defined and relevant ecological, social, cultural, and indigenous values to consider when developing offset requirements.
3. **Engagement with Indigenous Communities**: There should be genuine and respectful interaction with Indigenous communities on whose lands the impact and compensation would take place. This should be carried out in compliance with national, international, and inherent indigenous rights, including the right to Free, Prior, and Informed consent.
4. **The Mitigation Sequence**: The policy should require strict adherence to the mitigation sequence, with offsetting employed as a last resort to compensate for residual project impacts after exhausting all other options for avoiding, minimising, and mitigating those impacts.
5. **Limits to Offsetting**: A strong wetland offsetting policy would prohibit offsetting for all wetlands and explicitly identify wetlands ineligible for offsetting. Wetlands with high biodiversity, a long establishment time, and/or valuable indigenous cultural values should be off limits.
6. **Strategic Site Selection**: The policy would contain a clear, strategic approach for selecting offset sites based on proximity to impacts as well as the optimisation of physical and ecological circumstances such as the ability to achieve all desired social, cultural, and ecological benefits.
7. **Timing and Duration**: In order to minimise time lags between the impact's occurrence and provision of offset benefits, there should be rigorous deadlines for offset implementation. Offsets must be protected indefinitely or at least as long as impacts duration.

8. **Offset Monitoring and Management**: It is important to have a strategy for monitoring wetland offsets over an ecologically appropriate time span to establish the level of success. Furthermore, there should be management procedures on how offsets failures can be addressed and corrected when they happen.
9. **Metrics to Quantify Equivalence**: A strong wetland offsetting strategy would contain applicable measures and procedures for establishing baseline conditions (at the impacted and planned offset sites). The measurement of offset performance would serve as the foundation for establishing and measuring gains and losses.
10. **Transparency and Reporting**: Offset providers should be required to update the general public on the status of offset design and implementation.

3.9 Conclusion

Chapter 3 has provided a comprehensive examination of wetland offsetting policies across Canada, focusing on the frameworks established in Nova Scotia, New Brunswick, and Ontario. While these policies aim to balance economic development with the conservation of vital wetland ecosystems, significant limitations and challenges remain. Key issues such as site selection difficulties, non-compliance with offset requirements, time lags in ecosystem recovery, and the overarching failure to achieve no net loss illustrate the complexities inherent in wetland offsetting.

The evaluation of existing policies reveals that while they provide a foundation for wetland conservation, there is a pressing need for stronger, more rigorous criteria to enhance their effectiveness. The proposed ten criteria for a robust wetland offsetting policy underscore the importance of achieving net gains, engaging Indigenous communities, adhering strictly to the mitigation hierarchy, and ensuring transparency and accountability in offsetting practices.

Moving forward, it is critical for policymakers to adopt these recommendations to mitigate the risks associated with wetland offsetting. By prioritizing ecological integrity and long-term sustainability, it is possible to navigate the challenges posed by urban and industrial growth while safeguarding the invaluable services that wetlands provide to both the environment and society. Only through a commitment to these principles can wetland offsetting evolve from a risky compromise to a genuinely effective strategy for conservation and ecological restoration.

CHAPTER 4: METHODOLOGY

4.1 Introduction

This chapter discusses the selected methodology used to investigate the potential of wetland offsetting being a policy tool for sustainable wetland management in the Grand River watershed. The overall research approach selected for this study is the qualitative research approach and it employed a qualitative research design and a corresponding qualitative data collection method, analysis and interpretation.

4.2 Research Approach

This study employed the use of the qualitative research approach. This form of research approach has been defined by Creswell and Creswell (2018) as one that investigates and seeks to comprehend the meaning that individuals or groups assign to a human or societal issue. This research approach is useful when a concept has not been previously addressed with a particular sample or population group (Morse, 1991). In qualitative research, the study relies heavily on the views of the research participants than the direction the researcher has identified from the literature (Creswell, 2014).

In this case, the issue is whether wetland offsetting offers any potential benefits to the conservation and sustainable wetland management in the Grand River Watershed considering the recent policy changes that are anticipated to increase the rate of wetland loss in Southern Ontario.

A qualitative research approach is ideal for this study because it provides for a thorough and comprehensive examination of the complicated and nuanced perspectives of the different participants involved in wetland management and conservation. This research approach allows for a comprehensive understanding of the social, environmental, and regulatory settings driving

wetland offsetting activities, which is important for determining their potential as a sustainable management tool in the Grand River Watershed. This research approach offers rich, detailed data that can highlight the nuances of wetland offsetting policies and practices by focusing on the lived experiences and insights of stakeholders.

4.3 Research Design

Research designs are forms of inquiry that offer guidance for study procedures within a research approach (Creswell & Creswell, 2018). They have been described as ‘strategies of inquiry’ by Denzin and Lincoln (2011). Corresponding to the overall research approach, this study used a qualitative research design. Creswell and Creswell (2018) highlight five qualitative strategies of inquiry, drawing from previous studies. They include Narrative research, phenomenological research, grounded theory, ethnography, and Case Studies. This study used the case study research design to explore the potential for wetland offsetting as a policy tool for sustainable wetland management in the Grand River Watershed.

This is a design methodology that allows researchers to perform an in-depth analysis of complex issues within specific contexts (Creswell, 2009). It involves collecting and analysing information from a variety of sources, including focus groups, semi-structured interviews, and observations, to develop a full understanding of the topic being studied (Creswell and Creswell, 2018). This strategy of inquiry is particularly useful in the social science, nursing and education fields where examination of real-life situations is required to develop concepts and theories (Creswell, 2009). It allows for the learning of how people deal with specific circumstances and lived experiences (Crowe et al., 2011).

In this case, this study sought to understand other jurisdictions’ overall experience with the complexity of wetland offsetting and to determine if this wetland management strategy would

be applicable in the Grand River Watershed. Furthermore, the research sought to gain insights into the possible benefits and constraints of wetland offsetting by using a case study design that draws on a variety of perspectives and real-world applications. This technique provides a solid framework for evaluating the feasibility and effectiveness of implementing wetland offsetting policies in the Grand River Watershed, thereby contributing to the field of sustainable wetland management.

4.4 Data Collection

Data was collected for this research via semi-structured interviews with practitioners who have real-life experiences with wetland offsetting in policy and practice. These interviews offered comprehensive insights into the benefits and practical difficulties of wetland offsetting, as well as the viewpoints of individuals actively engaged in its implementation. This study involved the review of academic, governmental and non-governmental literature on wetland offsetting policies and practices which not only complemented the interviews, but also informed the development of the research questions, ensuring that they were based on current knowledge. Furthermore, it aided the identification of potential research participants or interviewees.

4.4.1 Recruitment

Fifteen participants were recruited for this study through a combination of identification from the literature review, LinkedIn search, and organizational website staff directory search. Purposive sampling was used to identify and select participants with relevant experience with wetland offsetting in policy and practice, as well as wetland management and conservation.

A recruitment email with an Information letter attachment describing the research purpose, interview design and confidentiality measures was sent to potential participants to request for their participation in this study. Participants were informed of the process being

voluntary and that the research had received ethics clearance from the University of Waterloo Research Ethics Board. Interviews were recorded after obtaining signed consent prior to the interview and verbal consent during the interview. Participants were recruited from the following organizations:

1. Grand River Conservation Authority
2. Toronto and Region Conservation Authority
3. Lake Simcoe Region Conservation Authority
4. Credit Valley Conservation Authority
5. Nottawasaga Valley Conservation Authority
6. Ducks Unlimited Canada
7. Alberta Land Institute
8. Fiera Biological Consulting
9. Alberta Environment and Protected Areas
10. City of Guelph
11. County of Brant

4.4.2 Semi-Structured Interviews

Semi-structured interviews allow researchers gather rich, detailed information that show participants' experiences, opinions, and attitudes towards a subject matter (Creswell, 2009), which in this case is wetland offsetting. It also provides the flexibility to adapt questions based on conversation flow, thereby revealing insights that could be missed by more rigid quantitative methods. Furthermore, it allows participants to express their opinions without being restricted or hindered by a rigid interview protocol and most often leads to trust-building between researchers and participants (Creswell, 2009).

The interviews were all conducted over Microsoft Teams, and they lasted between thirty minutes and one hour. Each interview was recorded (with participants' consent) and transcribed for accurate data analysis. The semi-structured interviews were instrumental in:

- Highlighting the lessons, experiences, successes, and complexities associated with wetland offsetting in different jurisdictions.
- Providing further insights on the impact of recent policy changes on the role conservation authorities and municipalities play in the development planning and permitting process.
- Identifying the extent to which non-environmental and non-economic values, such as social, indigenous, and cultural values are considered in wetland offsetting protocols and wetland conservation as a whole in different jurisdictions.

4.5 Data Analysis

The data analysis process started with the organization of the video recordings and transcripts from the interviews into structured files and folders. The audio transcripts were reviewed, with necessary corrections made while simultaneously reviewing the audio recordings to ensure accuracy of the transcripts. This dual-review process helped in getting a general sense of the ideas passed by participants as well as the depth and credibility of the provided information.

The next step in the process was the coding of the data which is an important step in qualitative research analysis. This is the process of differentiating the data into smaller chunks and using a singular word or phrase (code) to represent each category of data (Creswell & Creswell, 2018). This could either be done manually or with the use of sophisticated computer software programs such as NVivo. For this research, the coding process was done using the NVivo software as it is a less-laborious process in comparison to the manual coding process. It is

also generally a quicker and more efficient process than coding by hand (Creswell & Creswell, 2018).

The coding process was inductive as is common with qualitative research, and it involved the categorization of similar codes which further led to the identification of overarching themes that emerge from these categories (Creswell, 2014). Inductive coding was used to find trends and themes in participants' attitudes and experiences with wetland offsetting while **Deductive coding** was used to find data that supported predetermined concepts like 'collaborative governance.'

In summary, the utilisation of NVivo for coding the data not only improved the effectiveness of the analytical procedure but also guaranteed a comprehensive and methodical identification of crucial themes and insights. Subsequent chapters of this thesis include data and discussions that are based on these identified themes, which contributes to a thorough understanding of the potential of wetland offsetting as a policy instrument for sustainable wetland management in the Grand River Watershed.

4.6 Validity and Reliability

The validity, reliability and credibility of this research was ensured through two key strategies. Triangulation was achieved by combining data from the semi-structured interviews with participants with wetland offsetting expertise, a comprehensive literature review, and the analysis of relevant policy documents. Furthermore, member Checking was employed to validate the study findings. Creswell (2014) defines this qualitative validation procedure as reaching out to one or more study participants to verify that the findings from the qualitative data collection methods are accurately represented. In this study, participants had the opportunity to review and comment on the study's preliminary findings to ensure accurate representation of views.

4.7 Ethical Considerations

Silverman (2017) considers ethics as a foundation for conducting successful and relevant research. This study strictly adhered to the ethical guidelines for research involving human participants and received ethics clearance from the University of Waterloo Research Ethics Board (REB #45399). Furthermore, informed consent was obtained from all participants, ensuring they were fully aware of the study's purpose, procedures, and their rights to confidentiality as well as the ability to withdraw from the study at anytime. The recordings were anonymized to protect the identity of participants, and all records were securely stored to maintain privacy and confidentiality throughout the research process. These steps guaranteed that the study was carried out with utmost and strict adherence to ethical principles, ensuring the protection of participants' rights and privacy.

4.8 Conclusion

Chapter 4 described the analytical approach used to investigate the possibility of wetland offsetting as a policy instrument for sustainable wetland management in the Grand River Watershed. Using a qualitative research technique, this study sought rich, nuanced views from practitioners involved in wetland offsetting, thereby providing for a better understanding of the how complex wetland offsetting can be. The case study design allowed for a deep analysis of participants' experiences and opinions. Semi-structured interviews were used to collect data, which was supported by a thorough literature review to guarantee a comprehensive analysis of existing knowledge and practical applications. Triangulation and member checking were the key strategies used to ensure the research's validity and reliability. These measures increased the trustworthiness of the findings by ensuring that varied viewpoints were adequately represented.

Furthermore, the ethical concerns used throughout the study demonstrated a dedication to respecting participant rights and maintaining confidentiality. This ethical framework not only improved the integrity of the study process, but it also increased trust between I, the researcher and the participants.

In conclusion, the overall methodology described in this chapter provides a solid foundation for further analysis and discussion of wetland offsetting as a viable and potential tool for sustainable wetland management in the Grand River Watershed.

CHAPTER 5: DATA PRESENTATION, ANALYSIS, AND DISCUSSION

5.1 Introduction

This chapter presents the findings of this research, drawing on interviews with key stakeholders involved in wetland offsetting and management. These findings shed light on the state of wetlands, the implementation of wetland offsetting policies, and the challenges encountered in practice. Through the lens of multiple stakeholders including government agencies, conservation authorities, and municipalities, this chapter analyzes the practical realities of wetland conservation and offsetting initiatives within various watersheds or jurisdictions.

A major focus of the chapter is to explore the effectiveness of wetland offsetting in replicating the ecological functions and values of natural wetlands, particularly in a context where such projects are still relatively new. Additionally, the chapter delves into the key challenges faced during the implementation of these offset projects, including regulatory compliance, financial feasibility, and stakeholder engagement.

These findings are contextualized within the broader framework of wetland offsetting practices observed in other regions, notably the United States, where offsetting has a more established history. The chapter concludes by identifying potential improvements to enhance the success and sustainability of wetland offsetting in the region.

5.2 Interviewees’ General Perception on the State of Wetland

The interviewees' overall opinions indicate a shared concern about the deterioration of Ontario's wetlands, as well as the limitations of current wetland preservation and management rules. While efforts have been made to preserve these critical ecosystems, interviewees highlight

severe regulatory gaps, enforcement challenges, and rising development pressures that continue to damage wetlands.

1. State of the Wetlands

Most respondents agree that urbanization, infrastructural development, and agricultural growth pose a severe threat to Ontario's wetlands, especially in Southern Ontario. According to interviewee 4, agriculture has historically caused wetlands to suffer significant losses; in Southern Ontario, up to 80% of the natural wetlands have disappeared.

The vulnerability of smaller and isolated wetlands was highlighted by interviewees, despite the fact that provincially significant wetlands (PSWs) are given additional protection under existing legislation. These smaller wetlands are frequently excluded from consideration because they usually do not meet provincial significance standards, especially if they are thought to be low-value or degraded ecosystems. The most frequent candidates for wetland offsetting, according to interviewees 1, 2, and 3, are small, deteriorated wetlands. This means that even while these wetlands continue to fulfill vital biological and hydrological roles, they are more susceptible to disappearance.

Additionally, interviewees indicated that pressures from development still affect wetlands that have been classified as provincially significant. For instance, Interviewee 3 discussed how many PSWs may lose their status as a result of recent modifications to the Ontario Wetland Evaluation System (OWES), namely the removal of the wetland complex designation. Wetland loss is anticipated to rise as a result of this policy change throughout the province, especially in areas that are expanding quickly. Interviewee 8 highlighted that smaller or degraded wetlands are not protected by strong legislation. They, like others, voiced concern that these wetlands, while not generally seen as valuable, serve crucial biological functions that are often disregarded.

Interviewee 5 noted that, while wetland conservation efforts continue, present monitoring systems are insufficient, and wetlands are often evaluated based on presence-absence surveys rather than long-term scientific monitoring. This demonstrates a gap in recognizing the true health and state of wetlands.

The complexity of wetland systems, especially in highly urbanized regions, was highlighted by interviewee 10. They stressed that even though wetlands are still disappearing, more people are becoming aware of how important they are for biodiversity and flood management. Wetland loss is often linked to infrastructure projects, especially road construction and linear development, according to interviewees 11, 12, and 13. This is because wetlands are seen as barriers to growth. Wetlands are therefore frequently removed, usually on the pretext that they are small, remote, or damaged. Wetland loss happens gradually, according to interviewee 14, and although there may not be significant individual instances of loss and degradation, the cumulative effects are catastrophic for wetland ecosystems.

2. **Effectiveness of Wetland Policies**

Although there are several laws protecting wetlands, interviewees generally agree that, despite their good intentions, these laws are sometimes insufficient or improperly implemented to successfully stop the loss of wetlands. The Provincial Policy Statement (PPS) and other policies, according to Interviewee 1, are solid in theory but fall short in practice because of enforcement gaps and other flaws. Although Provincially Significant Wetlands (PSWs) are protected, they remain susceptible to the effects of infrastructure projects. Such projects frequently adhere to separate environmental assessment protocols and criteria compared to conventional development, especially when considered vital for public infrastructure. In such instances, infrastructure projects may obtain approval via a more flexible or accelerated

regulatory framework, notwithstanding their impact on wetlands. This may potentially bypass certain conservation measures.

Interviewees expressed a general dissatisfaction with the way policies like the PPS are being implemented. For instance, Interviewee 1 said that laws intended to prevent the loss of wetlands, such as the no-net loss idea, are not always fully followed, which permits wetlands to be lost as a result of small-scale development initiatives like road extensions or farming initiatives. Interviewees emphasized that the protection of wetlands has now been undermined by Ministerial Zoning Orders (MZOs), which facilitate the removal of wetlands for construction by avoiding local planning choices and conservation authority scrutiny.

Several interviewees also brought out variations in the methods used by conservation organizations to handle wetland offsetting. There is still no standard methodology for calculating offset ratios, especially when cash-in-lieu is involved, even though some conservation authorities, like the Credit Valley Conservation Authority (CVC) and the Toronto and Region Conservation Authority (TRCA), have put structured offsetting policies into place. Interviewee 1 discussed the challenges in valuing wetlands and achieving fair compensation, especially considering the variable nature of land values and the variety of ecological functions that wetlands provide.

Interviewee 9 highlights that by reducing the standards for wetland complexing and granting more development permissions, the recent PPS amendments and the enactment of Bill 23 had diminished the protection of wetlands. Many wetlands are now at risk due to this legislative change, especially in places where there is a demand to expand infrastructure and development. Interviewees 11 and 12 expressed frustrations about how different policies were

implemented in different places. For instance, whereas some conservation authorities have more stringent no-net-loss standards, others are more lenient when it comes to accepting wetland loss.

Interviewee 13 further pointed out that regulations like the PPS are often read too liberally, creating exceptions and loopholes that exacerbate the devastation of wetlands. They stressed that confusing terminology, including "where feasible," is often used in legislation, allowing development projects to evade more stringent environmental reviews.

The overall finding was that, although wetland regulations in Ontario offer some protection, development needs—particularly those related to housing and infrastructure—often compromise these regulations.

5.3 Emerging themes from the interviews

5.3.1 Challenges in Wetland Management and Conservation

The study revealed several significant challenges in wetland management and conservation, particularly in Southern Ontario. These challenges include difficulties in finding suitable land for offset projects, resource limitations, and increased workload due to recent regulatory changes. These findings align closely with existing literature, providing a comprehensive understanding of the issues at hand.

A major challenge identified from the interviews was the difficulty in finding suitable land for offset projects, especially in Southern Ontario where land is predominantly privately owned. Interviewees 2 and 7 highlighted this issue, noting that even when funds are available, the scarcity of appropriate land hampers the timely implementation of offset projects. Interviewee 1 noted that land availability and legal complexities, such as securing long-term protection for offset sites, can hinder successful implementation. "It's not just about finding the right site, but also ensuring that it remains protected in the long term, which is often easier said

than done" (Interviewee 1, 2024). This challenge of land availability is consistent with Sonter et al. (2020b), who found that land scarcity limits wetland restoration efforts. Race and Fonseca (1996) and Yu et al. (2018) also emphasize that securing land for offsetting can be difficult in high-development areas. Furthermore, in urban areas with limited land availability, stormwater management ponds are being used as a substitute for natural wetlands, although this approach is seen as less desirable than natural wetland restoration as highlighted by interviewee 9. They state that “while stormwater ponds can provide some ecological functions, they do not fully replicate the biodiversity and ecosystem services of natural wetlands” (Interview 9, 2024). Smaller wetlands are generally not afforded strong protections under the Ontario Wetland Evaluation System and provincial policies at large (Schulte-Hostedde et al., 2007) hence there is an increasing trend towards their replacement by stormwater management ponds as seen in Birch et al. (2022). Birch et al. (2022) investigated wetland degradation, the establishment of stormwater management (SWM) ponds, and land use trends across seven municipalities in southern Ontario, arguing that dependence on SWM ponds for wetland restoration is unsustainable and insufficient in providing essential ecosystem services crucial for biodiversity.

Resource limitations were another significant challenge highlighted by the interviewees. Both Interviewees 2 and 7 mentioned that even when funds are available, the lack of technical expertise and human resources delays the implementation of wetland conservation projects. Interviewee 4 further noted that "the GRCA currently lacks the resources to develop and implement a wetland compensation program, which has become increasingly challenging due to recent regulatory changes. Until recently, we were reviewing development applications to ensure compliance with GRCA, municipal, and Provincial Policies. The recent changes force us to focus on our own policies. Staff wages still do not reflect the volume and complexity of the projects

that we are reviewing. Developing and introducing a policy that would mandate compensation would be a complex undertaking and would create additional work for planners and ecologists in the long run" (Interviewee 4, 2024). This issue is echoed in the literature, where Clare et al. (2011) noted that the lack of expertise and resources is a major barrier to effective wetland policy implementation. Financial constraints further exacerbate this challenge as it can limit the scope of ecological designs, potentially leading to ecosystem degradation (Calvet et al., 2015; Spence, 2021). Sewell et al. (2016) similarly identified financing as one of the primary challenges in scaling up ecosystem restoration projects. Gevers et al. (2016) highlighted the constrained capacity of governmental and non-governmental organisations tasked with wetland management as a significant impediment to effective wetland protection and restoration, despite heightened awareness of the importance of wetland ecosystem services and a rise in the number of countries implementing policies to prevent wetland degradation and loss. Additionally, Quetier et al. (2014) and Bezombes et al. (2019) in their studies on the success of biodiversity offsetting in France, attribute the limited offsets data to insufficient human and financial capacity in environmental authorities.

Furthermore, the interviews revealed that recent regulatory changes, such as those introduced by Bill 23 and Ontario Regulation 41/24, have significantly increased the workload for municipalities. Interviewees 4, 5, 10, 11 and 15 mentioned that municipalities now have an added responsibility of reviewing development applications and assessing ecological functions (a role they historically relied on conservation authorities for) without the necessary expertise. This has therefore led to a reliance on external consultants and increased costs. Using the Grand River Watershed as a case study, Interviewee 10 expressed concern that many municipalities, especially the smaller ones might not be equipped to carry out this new role. “A large number of

municipalities do not have OWES certified staff…some of the bigger municipalities such as Waterloo region can adapt to these new changes" (Interviewee 10, 2024). Interviewee 11 added that while larger municipalities are trying to hire environmental planners, many still lack the technical expertise available at CAs: "I know a lot of municipalities are now trying to hire environmental planners, but at a conservation authority there's a planner and environmental engineer… that skill set is missing right now at probably most municipalities" (Interviewee 11, 2024). Interviewee 15 also noted that "smaller municipalities certainly will feel the change a lot more because they've got a lot more wetlands and a lot less expertise" (Interviewee 15, 2024). This finding aligns with Hettiarachchi et al. (2014), who discussed the challenges of urban wetland policy regimes and the application of ecological reference points. They highlight how new regulations often add to the responsibilities of local authorities, who may lack the necessary expertise, leading to increased reliance on external consultants and higher costs (Hettiarachchi et al., 2014).

In this context, Interviewee 12 from the Lake Simcoe Region Conservation Authority noted that while recent regulatory changes have shifted most of the Natural Heritage Reviews to municipalities, their CA remains somewhat unique due to the Lake Simcoe Protection Plan. "In a significant portion of our watershed, the Natural Heritage Review is now up to the municipality," they explained. However, they added, "we have the Lake Simcoe Protection Plan, which affords us some natural heritage review" (Interviewee 12, 2024). This distinction highlights the variability and differences in how different regions and conservation authorities are impacted by recent regulatory changes and underscores the importance of localized strategies in managing wetland conservation.

Despite these concerns, Interviewee 12 remained optimistic stating that municipalities “are dealing with the recent changes in the best way they can” (Interviewee 12, 2024). Furthermore, Interviewee 4 highlighted a potential ‘backdoor’ as conservation authorities can still comment on both the hazard control features and ecological functions of wetlands through sub-watershed studies. “The GRCA is involved in sub-watershed planning and these sub-watershed plans in many cases are funded by local municipalities. Sometimes they're jointly funded by the municipality and the GRCA and in other cases, they're funded by developers. These sub-watershed studies aim to characterize the biophysical features and functions of a small sub-watershed. They should also identify avoidance measures, mitigation measures and then future study requirements, so that when a development application is submitted to the local municipality, the developer must ensure that all the recommendations of the sub-watershed study are implemented” (Interviewee 4, 2024).

Interviewee 1 was critical of the effectiveness of wetland offsetting, particularly in terms of long-term ecological outcomes and identified several challenges. Firstly, Interviewee 1 emphasized that the process of creating or restoring wetlands that function equivalently to those lost can take decades. "There's a lot of literature out there that says offsetting just doesn't work, especially given the time it takes for a new wetland to develop the same functions as the one that was lost" (Interviewee 1, 2024). The interviewee further highlighted the variability in how different CAs calculate and implement offsetting, which can lead to inconsistencies in outcomes. This inconsistency extends to the use of cash-in-lieu arrangements, where developers pay for offsets instead of implementing them directly. "Each Conservation Authority has its own approach, and that leads to a lot of inconsistencies in how offsetting is applied" (Interviewee 1, 2024).

5.3.2 Minister’s Zoning Orders (MZOs)

A minister's zoning order (MZO) is a regulatory measure issued by the Minister of Municipal Affairs and Housing (MMAH) under the Planning Act to govern the use of land, buildings, and structures throughout Ontario. If a Ministerial Zoning Order (MZO) conflicts with a municipal zoning by-law, the MZO takes precedence (City of Toronto, n.d). Ministerial Zoning Orders (MZOs) essentially grant the Minister the authority to supersede local municipal zoning by-laws to determine land use, construction, and structure regulations throughout Ontario. So far, their implementation has generated controversy due to reservations about undermining local planning procedures and community participation (Mcintosh, 2023).

Interviewee 1 discussed the impact of MZOs, which allows the provincial government to override local planning decisions, including those related to wetland conservation. "MZOs essentially take away our ability to enforce local conservation policies, leaving us with limited options to protect wetlands" (Interviewee 1, 2024).

Interviewee 10 highlighted that MZOs often include provisions for wetland compensation, requiring developers to offset the loss of wetland functions through restoration or creation efforts elsewhere. However, the transparency and effectiveness of these compensation measures are subjects of concern. Interviewees 12 and 13 also acknowledged the existence of compensation measures but expressed concerns about their implementation and monitoring. They emphasized the need for clear guidelines on how compensation should be implemented and monitored under MZOs, aligning with broader criticisms from environmental groups. Environmental Defence (2020) and Ontario Nature (n.d. b) criticized the frequent use of MZOs, arguing that they undermine local planning and conservation efforts as well as sidestep public

consultations. Furthermore, they emphasize the need for public consultation and adherence to environmental regulations, echoing the concerns of Interviewees 12 and 13.

MZOs were originally intended for emergencies or significant provincial initiatives but they have now been increasingly used for routine development projects (Environmental Defence, 2020; Water Docs, 2021). This shift raises important questions about the balance between swift economic growth and the imperative to safeguard natural resources, including wetlands. Its frequent use has led to concerns about the potential for increased wetland loss and the need for stringent compensation and monitoring measures.

A recurring sub-theme emerged from the interviews and the literature which is the tension between rapid economic development and environmental conservation. While MZOs can expedite development projects, they pose significant risks to wetland conservation. The need for robust compensation measures and effective monitoring is a common concern among all interviewees, as the integrity of Ontario's wetland ecosystems could be compromised without these stringent compensation measures.

Effective environmental governance requires balancing economic development with the protection of natural resources and ensuring that compensation measures are transparent and adequately monitored (Narwhal, 2023). The issues expressed by Interviewees 12 and 13 about the circumvention of local conservation initiatives emphasise the need for MZOs to have not just strong compensation criteria but also mechanisms for public engagement and compliance with environmental standards. This would ensure that development projects do not undermine the long-term sustainability of Ontario's wetlands.

The use of MZOs in Ontario highlights the ongoing tension between development and conservation. Although MZOs offer a tool for fast-tracking projects, the potential for increased wetland loss is very significant. Ensuring that MZOs include robust compensation measures and that these measures are effectively monitored is essential for maintaining the integrity of Ontario's wetland ecosystems. The perspectives from the interviews, along with insights from other articles and policy documents, underscore the need for clear guidelines and public participation in the MZO process.

5.3.3 Evaluation and Monitoring of Wetland Offsetting Projects

Several interviewees highlighted significant gaps in the monitoring of wetland offsetting projects. The current lack of rigorous, long-term monitoring systems hinders the ability to assess whether offset projects are effectively compensating for the loss of wetland functions and values. For instance, Interviewee 8 mentioned that in Alberta, many wetlands offset projects rely on self-reporting by proponents, which often focuses on compliance rather than actual ecological outcomes (Interviewee 8, 2024). Similarly, Interviewee 9 discussed the challenges in monitoring peatland restoration efforts, which require specialized knowledge and long-term assessment to ensure success (Interviewee 9, 2024). This concern is echoed by Quigley and Harper (2006), who emphasize the need for rigorous and ongoing monitoring to ensure the ecological success of habitat compensation projects.

One of the critical gaps identified by Interviewee 1 is the lack of robust monitoring and compliance mechanisms for wetland offsetting projects. The interviewee notes that while Conservation Authorities (CAs) may approve offset strategies, the long-term monitoring and adaptive management of these projects are often inadequate (Interviewee 1, 2024). CVC and other CAs may struggle with ensuring that developers comply with the offsetting conditions after

a project is completed. "Oftentimes, we spend years reviewing and negotiating, but then we never get to see the finished product," noted Interviewee 1 (2024).

Interviewee 1 further acknowledged that adaptive management which is adjusting management strategies based on monitoring results, is a significant gap in current practices. This gap is exacerbated by recent policy changes, such as those introduced by Bill 23, which have diminished the regulatory authority of CAs. "There's a real challenge in ensuring that these offset projects continue to function as intended, especially with the reduced oversight we now have" (Interviewee 1, 2024).

Interviewee 15 expressed skepticism about the effectiveness of wetland offsetting, noting that it requires significant financial investment, time, and proper site selection. Interviewee 15 also emphasized the need for strong criteria, including the replacement of lost hydrological and ecological functions and the purchase of land for compensation. The interviewee questioned the net benefits of offsetting, particularly when it involves enhancing existing wetlands rather than creating new ones. They further acknowledged challenges in offsetting, including the availability of land and the effectiveness of planting adjacent to existing wetlands. They emphasized the need for robust criteria to ensure that offsetting compensates for lost wetlands adequately.

Interviewee 5 and Interviewee 8 both highlighted that current monitoring practices often rely on visual inspections, which focus on the presence or absence of species rather than detailed functional assessments. Interviewee 5 mentioned that “their monitoring approach is largely based on presence-absence surveys, which are relatively simple but may not capture the full range of ecological functions that wetlands provide” (Interview 5, 2024). This approach can miss critical indicators of wetland health and ecological function (Ontario Nature, n.d - d).

The significant time lags between wetland loss and compensation in Alberta, coupled with widespread non-compliance, have resulted in substantial net losses of wetlands. Interviewee 14 highlighted that more than 85% of wetland loss occurs illegally, which severely undermines the effectiveness of the offsetting policy. "More than 85% of the wetland loss in some parts of the province is illegal loss. We are only actually capturing about 10 or 15% of the wetland loss that's happening" (Interviewee 14, 2024).

While Interviewee 5 and 8 emphasized the need for functional assessments over visual inspections, Interviewee 9 focused more on the timing of evaluations and the challenges posed by time lags (Ontario Nature, n.d - d; Wetland Conservation Strategy Advisory Panel, 2018). They discussed the time lags between the implementation of offset projects and the ability to fully assess their success. In addition, they emphasized that “many offset projects are still in their infancy, making it difficult to assess their success in replicating lost wetland functions” (Interview 9, 2024). The issue of time lags in wetland compensation is well-documented, with studies showing that the delayed restoration of wetlands often leads to long-term ecological deficits (Maron et al., 2012).

Furthermore, interviewees expressed concerns about the effectiveness of monitoring efforts. Interviewee 3 mentioned that “…monitoring typically occurs for only 2-5 years, which may not be enough to determine the long-term success of recreated wetlands” (Interview 3, 2024). Interviewee 7 noted that “while funds are allocated for monitoring, the practical implementation is hampered by capacity constraints” (Interview 7, 2024). Hough and Robertson (2009) also underscore the importance of long-term monitoring in wetland mitigation projects, noting that inadequate monitoring often leads to failure in achieving the intended environmental benefits.

Interviewee 11 mentioned that “municipalities often lack the capacity and resources to conduct thorough monitoring, particularly now in the absence of support from conservation authorities” (Interviewee 11, 2024). They further discussed challenges in evaluating the effectiveness of wetland protection measures, specifically mentioning the reliance on pre-existing studies and the absence of a standardized monitoring framework. This theme reflects a broader concern across multiple jurisdictions about the inadequacy of follow-up and monitoring post-implementation. Without proper monitoring, it’s challenging to assess the effectiveness of wetland conservation efforts.

The TRCA (2023) report outlines the compensation program and its financials, but again, there is a noticeable absence of a detailed, standardized monitoring process to track the effectiveness of these compensation measures over time. The ecosystem compensation program, as detailed in their 2023 report, illustrates a well-funded initiative, but the absence of clear long-term monitoring data undermines confidence in the program’s sustainability and effectiveness (TRCA, 2023).

While Interviewee 8 focused on the reliance on self-reporting by proponents in Alberta, Interviewee 9 emphasized the specialized knowledge required for monitoring peatland restoration efforts. Interviewee 11 discussed the challenges in evaluating the effectiveness of wetland protection measures due to the absence of a standardized monitoring framework. These differences highlight the varied challenges faced in different regions and contexts.

While all interviewees recognized the potential of offsetting as a tool, they also acknowledged that it was not a perfect solution. Interviewees 2 and 3 were cautious about the ability of offset projects to fully replicate the ecological functions of lost wetlands, especially given the challenges in enforcing proper mitigation hierarchies and avoiding over-reliance on

compensation. This skepticism is supported by Quigley and Harper (2006), who discuss the limitations of habitat compensation and the need for rigorous monitoring to ensure ecological success.

The Ontario Nature's Wetland Offsetting Policy Evaluation document emphasizes the need for rigorous monitoring frameworks that can assess the ecological function of offset projects over time (Ontario Nature, n.d.- d). It aligns with the interviewees' concerns about the inadequacy of visual inspections and the need for functional assessments.

Furthermore, the Wetland Conservation Strategy Advisory Panel Report highlights the importance of timely and effective monitoring to ensure that offset projects achieve their intended outcomes (Wetland Conservation Strategy Advisory Panel, 2018). This supports Interviewee 9's concerns about time lags in evaluating offset projects.

The interviews highlight significant gaps in the current approach to monitoring wetland offsetting projects. The reliance on presence-absence surveys and the absence of detailed functional monitoring represents major challenges. Addressing these issues requires the development of more sophisticated monitoring frameworks that can assess the full suite of ecosystem services provided by wetlands over time. The perspectives from the interviews, along with insights from other articles and policy documents, underscore the need for effective monitoring to ensure that wetland offsetting achieves its intended outcomes.

5.3.4 Agricultural Activities and Wetland Conservation

Interviewee 4 highlighted a critical issue: agricultural activities, such as drainage are generally not subject to the same level of scrutiny as urban development projects. They further emphasised the regulatory gap, noting that the Provincial Policy Statement (PPS), does not aim to restrict current agricultural practices, even when situated within wetlands. This also includes

new agricultural activities as they are not addressed by the Planning Act or the Conservation Authorities Act. This issue exacerbates the existing pressures on wetlands, rendering agricultural areas especially susceptible to wetland loss and degradation.

Furthermore, Interviewee 2 emphasised the difficulties associated with voluntary conservation initiatives targeting farmers. Despite the design of these programs to promote wetland conservation, participation is limited due to economic constraints (the cost of agricultural land in Ontario is high) and lack of awareness among farmers. Similarly, interviewee 14 highlights that, despite increasing awareness of the ecological advantages of wetlands, numerous farmers still regard drained wetlands as economically beneficial, converting them into more productive land. This belief persists despite research, including a study by Clare et al. (2021), indicating that the financial advantages of wetland drainage are inconsistent and may lead to financial losses for certain producers. These enduring misconceptions constitute a substantial obstacle to advancing sustainable agricultural practices that safeguard wetlands.

The Ramsar Convention on Wetlands (n.d.) underscores the adverse impacts of agricultural practices, including drainage, nutrient overuse, and the use of toxic substances, on wetland ecosystems. Furthermore, Verhoeven and Setter (2010) demonstrate that although the conversion of wetlands for agricultural purposes may yield immediate advantages, it frequently results in enduring ecological deterioration. These studies corroborate the interviewees' assertions that contemporary agricultural practices lead to the continual degradation of wetlands.

A transition to sustainable agricultural practices is essential for harmonising agricultural productivity with wetland preservation. Research conducted by the USDA Agricultural Research Service (Cooper and Moore, 2003) highlight that sustainable agricultural practices are important for maintaining the delicate relationship that exists between agriculture and wetlands.

Policies that combine sustainable agriculture with wetland conservation would help address these gaps. Successful wetland conservation in agricultural landscapes requires both regulatory oversight and incentives that encourage farmers to implement practices conserving wetlands. The Ramsar Convention on Wetlands (n.d.) promotes comprehensive policies that tackle the distinct challenges presented by agriculture and foster the long-term sustainability of wetland ecosystems.

The insights from the interviews and relevant literature indicate that inadequate regulations and the economic challenges encountered by farmers are major barriers to wetland conservation in farming areas. Resolving these issues requires integrated policies that encourage sustainable agricultural practices, complemented by incentives and enhanced regulations to protect wetlands. A more holistic strategy for wetland conservation in agricultural landscapes is essential to reconcile the needs of farmers with the preservation of important wetland ecosystems.

5.3.5 Protection of Smaller Wetlands

Interviewees from two municipalities in the Grand River Watershed (i.e., Interviewees 11, and 15) highlighted the importance of strong local policies in protecting smaller wetlands, which are often more vulnerable to development pressures. Brant County, for instance, has implemented a countywide 30-meter buffer for all wetlands, a policy that has proven effective in safeguarding these ecosystems. However, challenges remain, especially with the limited protection offered under provincial policies like the Provincial Policy Statement (PPS). Interviewee 11, alongside previous research by Schulte-Hostedde et al. (2007) and the Environmental Commissioner of Ontario (2018), underlined the deficiencies of the Ontario

Wetland Evaluation System (OWES) and provincial policies in adequately safeguarding and protecting smaller wetlands.

The importance of protecting smaller wetlands is further emphasized in the literature. Small wetlands are important habitats for species like amphibians, water birds and rare plants (Kushlan, 1986; Porej and Hetherington, 2005; Richardson et al., 2015). They also play important roles in landscape hydrology (McLaughlin et al., 2014) and biogeochemical cycling (Marton et al., 2015) The World Wildlife Fund (WWF) further highlights the unique ecological functions of small and micro wetlands, which are often overlooked but play a crucial role in biodiversity and water purification (WWF, 20211). Additionally, the World Economic Forum underscores the need for increased knowledge and protection of wetlands, noting that smaller wetlands are particularly vulnerable to threats such as agricultural expansion and climate change (World Economic Forum, 2021).

5.3.6 Social and Cultural Considerations in Wetland Conservation

The integration of Indigenous Knowledge Systems (IKS) in natural resource management is crucial for sustainability, as noted by Tang Kai & Swatuk (2023). Indigenous communities possess a deep understanding of the ecosystems they have historically managed, and their inclusion in wetland conservation efforts ensures that traditional ecological knowledge is incorporated into modern management strategies. This integration is supported by various studies that highlight the success of collaborative efforts that involve Indigenous communities in wetland management, such as the governance of wetlands in Bolivia and Australia (Villarroel et al., 2014; Hemming et al., 2017).

Interviewees 8, and 11 emphasized the importance of consulting with Indigenous communities in the planning process, particularly when wetlands hold cultural or spiritual

significance. This inclusion is seen as essential for ensuring that wetland conservation efforts respect and incorporate diverse values. McGregor (2021) supports this view, highlighting the integration of Indigenous knowledge in environmental management. McGregor's work underscores the importance of Indigenous consultation in environmental governance, aligning with the interviewees' perspectives on the necessity of including Indigenous communities in wetland conservation efforts. Nonetheless, Indigenous Peoples' engagement in conservation concerns is sometimes limited, with governments and developers viewing it as a reluctant responsibility (Youdelis, 2016). This limited engagement can therefore hinder the full integration of Indigenous knowledge in wetland management, despite its recognized importance.

Nevertheless, the task of quantifying and integrating social values into the preservation of wetlands is substantial. Interviewee 3 emphasised the challenge of quantifying the social values associated with wetlands, stating that "It is a nuanced measurement... ultimately, the critical question is whether we can replicate and safeguard this wetland within the natural environment" (Interviewee 3, 2024). This challenge is evident in the Ontario Wetland Evaluation System (OWES), which incorporates standards for assessing the cultural importance of wetlands in order to determine their provincial significance. Notwithstanding this, the Grand River Conservation Authority (GRCA) and similar conservation agencies have faced limitations imposed by recent legislation. Ontario Regulation 41/24 prohibits conservation authorities from considering provincial significance in the development permitting process, therefore restricting their authority. Therefore, the task of taking into account social values in the protection of wetlands now rests with municipalities.

Interviewee 10 emphasised the shift in responsibility, stating that "Conservation authorities had 'Memorandum of Understandings' with municipalities under previous acts and

played a role in commenting on the social and biological values of wetlands. Within the scope of the new Act, municipalities are expected to serve this function, whilst the conservation authority is limited to tackling flooding, erosion, and feature protection" (Interview 10, 2024). Furthermore Interviewees 6 and 7 mentioned their inability to fully incorporate OWES into their policies and regulations: "we would be heavily scrutinised because we are reminded all the time that OWES is not within our purview, however municipalities have been identifying locally significant wetlands and it's a product of the OWES process" (Interviewee 6, 2024).

Interviewee 14 noted that while social and cultural values are technically included in the Alberta wetland evaluation process, they are not seriously considered in practice. The primary focus remains on ecological and hydrological functions. "Social and cultural values are pretty low on the list of considerations... The focus is more on ecological and hydrologic function" (Interviewee 14, 2024). Studies such as Leslie at al. (2018) and Reed (2008) have argued for the inclusion of social and cultural considerations as well as local knowledge in environmental management for the achievement of sustainable outcomes. Although the Alberta wetland policy includes requirements for consultation with Indigenous communities, these considerations are not part of the wetland assessment tool but are addressed during the application process. This approach reflects a broader trend in environmental management, where Indigenous values are increasingly recognized but not always systematically integrated into assessment tools as seen in Eckert et al. (2020) analysis of Canada’s Impact Assessment Act. McDermott and Bell (2017) in their research on Indigenous perspectives on conservation offsetting, highlight that conservation initiatives may overlook and marginalise indigenous values and perspectives. Gordon (Iñupiaq) et al. (2023) discuss the challenges and opportunities of linking traditional ecological knowledge with Western science, emphasizing the need for more inclusive and integrated approaches.

Burgos-Ayala et al. (2020) further argue that the integration of Indigenous Knowledge (IK) in environmental management can enhance human-nature interconnectedness, resulting in more effective conservation policies.

5.3.7 Policy Development and Evolution

Most interviewees emphasized the need for consistent and formalized policies to manage wetland offsetting. Interviewee 6 was directly involved in creating a policy for their organization, driven by the need to standardize compensation practices. This discussion was set against the backdrop of recent revisions to the Ontario Wetland Evaluation System (OWES) and the broader implications of Bill 23.

The revisions to OWES, including the removal of scoring for species at risk and the elimination of complexing, have weakened the ability of CAs to protect wetlands effectively. Interviewee 1 expressed concern that these changes may lead to a re-evaluation and potential downlisting of previously protected wetlands, making them more vulnerable to development. "The removal of species at risk from the OWES scoring is a significant blow to our ability to protect these vital ecosystems" (Interviewee 1, 2024).

Interviewee 3 further highlighted a critical issue with the re-evaluation process under the revised OWES. They pointed out that once a wetland is re-evaluated by an OWES-certified consultant, there is no clear mechanism to challenge or refute this decision. "If a consultant re-evaluates a wetland as no longer provincially significant, that assessment often stands without any formal way to contest it. Technically, another evaluation could be conducted to reassert its significance, but this could result in a cycle of back-and-forth reclassifications without a final resolution," (Interviewee 3, 2024). This ongoing uncertainty and potential for repeated re-evaluations weaken the consistency and effectiveness of wetland protection efforts.

This corresponds with the overarching concerns in Ontario's wetland management identified by Penfound (2023), who delineated various challenges, such as inadequate informed decision-making, fragmented jurisdiction, ambiguous enforcement protocols, and deficient inter-agency communication (Schulte-Hostedde et al., 2007). Environmental Commissioner of Ontario (2018) emphasised the inconsistency in the exercise of powers by conservation authorities, conflicting priorities among them, variable resource constraints, ambiguous terminology in their guidance, and a general lack of direction from the provincial government.

Interviewee 14 gave insight into the issues faced in Alberta, especially the apparent inability of regulators to deny licenses under the Water Act. This regulatory culture, combined with the possibility of appealing decisions, reduces the strict implementation of the mitigation hierarchy. "I think here in Alberta the issue is that we don't have a good system for saying no... if you have an offset policy that is governed by a piece of legislation that does not allow for the denial of a permit, then your mitigation policies are not gonna work" (Interviewee 14, 2024). They further emphasized that, while the mitigation hierarchy theoretically starts with avoidance, in practice, the process often skips to compensation. This tendency undermines the intended environmental benefits of the policy, as it encourages developers to bypass avoidance altogether, especially for smaller wetlands. "Compensation has become a routine decision-making practice. Regulators, developers, and consultants alike don't give due consideration to avoidance because there's the option to compensate" (Interviewee 14, 2024).

Interviewees 2 and 3 reflected on the broader policy landscape, noting that while past policies were not necessarily failures, they were often too broad and lacked the specificity needed for effective on-ground implementation. This need for formalized policies is echoed in

the literature, where clear and consistent guidelines are seen as essential for effective conservation efforts (Penfound, 2023).

Interviewee 15 talked about how the City of Guelph has integrated policies for the natural heritage system into its official plan, which is both tailored to local conditions and in line with provincial policy. "Key protections include prohibitions on development in wetlands, requirements for environmental assessments or official plan amendments, and maintaining hydrological cycles through stormwater infrastructure" (Interviewee 15 of 2024). Nevertheless, they also emphasised how Bill 23 has diminished the Grand River Conservation Authority's (GRCA) regulatory authority. Due to its established competence, Guelph has been able to sustain its environmental planning functions; smaller communities, however, may find it difficult to overcome their lack of resources and experience.

The recent changes in provincial regulations, particularly Bill 23, were a significant concern for all interviewees from Ontario. These changes have shifted the focus from a broader ecological perspective to a narrower hydrological focus, potentially undermining wetland protection efforts. Interviewees expressed concerns that these legislative changes could lead to reduced protection for wetlands, aligning with broader concerns about regulatory uncertainty and the need for ongoing policy adaptation (Hettiarachchi et al, 2014).

Interviewees 2 and 3 also explored the potential benefits and risks of a provincial offsetting framework. Although a standardized approach could help address inconsistencies, there is concern that it could also lead to the dilution of local efforts and ecological benefits if not carefully managed.

The ongoing revisions to conservation authority roles and the potential for more wetlands to lose protection under Bill 23 create uncertainty about the future of wetland conservation. Interviewee 6 emphasized the need for ongoing policy adaptation to ensure that wetlands continue to receive adequate protection despite these challenges. This concern is echoed by Love et al., (2018), who highlight the importance of adaptive management in ensuring the effectiveness of ecosystem restoration strategies.

5.3.8 Collaborative Governance and Stakeholder Engagement

The importance of collaborative governance is evident in Ontario's approach to wetland conservation, particularly through the work of Conservation Authorities (CAs), which represent a form of collaborative governance by aggregating municipalities on a watershed basis (Ontario Ministry of Natural Resources and Forestry, 2017).

Despite its potential benefits, collaborative governance in wetland management faces several challenges, such as the varying interests and power dynamics among stakeholders. For instance, as highlighted by Interviewee 1 (2024), the inclusion of local stakeholders in decision-making processes can be hampered by regulatory changes, such as those introduced by Bill 23, which limit the influence of conservation authorities (aggregates of different municipalities) and reduce their ability to enforce comprehensive wetland protection measures. Additionally, the success of collaborative governance often hinges on effective communication and trust-building among stakeholders, which can be difficult to achieve in practice (Rapp, 2020). Although dialogue with stakeholders can take some time and may not always result in agreement, stakeholder engagement is still required for the effective design and implementation of effective biodiversity offsetting schemes. According to Yu et al. (2019), this incorporation of stakeholder perspectives is necessary to strengthen the legitimacy and effectiveness of offsetting schemes.

Interviewees 8, 10, and 11 highlighted the challenges of engaging diverse stakeholders in wetland conservation efforts, particularly in the context of recent regulatory changes. The shifting roles of conservation authorities and municipalities have complicated the collaborative process, leading to confusion and tension among different stakeholders. This aligns with findings from Lockwood et al. (2010) and Megdal et al. (2017), who emphasize the importance of clear governance structures and roles to mitigate such confusion. Additionally, the complexity of water resources management and the difficulty of engaging diverse stakeholders are well-documented challenges (Zebardast et al., 2021).

Interviewee 1 discussed the role of various stakeholders in developing and implementing wetland offsetting policies, noting that key stakeholders include, municipalities, CAs, developers, and landowners. They emphasize that “achieving successful wetland offsetting often requires collaboration between multiple stakeholders, including CAs, municipalities, and developers” (Interview 1, 2024). This multi-stakeholder approach is essential for balancing development needs with conservation goals.

Interviewee 4 emphasized that it would be essential to approach wetland offsetting using a collaborative governance framework involving local CAs, municipalities, the Ontario Ministry of Natural Resources and Forestry (MNRF), NGOs such as Ducks Unlimited Canada (DUC), academics, consultants, and other key stakeholders. They noted that “conflicting stakeholder interests are a challenge now even in the absence of any compensation policies.” This sentiment was echoed by other interviewees who expressed concerns about the effectiveness of current collaborative efforts, particularly given recent legislative changes. They further noted that, despite some CAs accepting this challenge, "it’s unclear that their policies and guidelines are working effectively. Given the recent legislative changes, there is uncertainty about the level of

collaboration between local CAs and the MNRF", highlighting the need for a more structured and inclusive approach.

Incorporating wetland offsetting into a collaborative governance framework depends upon the framework itself, according to interviewees 12 and 13. They noted that numerous municipal policy documents, such as Official Plans, contain references to offsetting when features are planned to be eliminated, however wetlands are still being removed to accommodate development plans. They stressed that providing clear guidance on offsetting will ensure clarity in the process and effectively handle the expectations of the development community. However, they further expressed skepticism about whether a collaborative governance framework would be effective in planning discussions where streamlining processes are favored. This reflects the ongoing tension between development and conservation objectives.

Interviewees 12 and 13, also shared their experiences in engaging the development community during policy development. By involving developers early in the process, they were able to create policies that effectively balanced development needs with conservation goals, leading to more successful implementation and compliance. During the development of their ecological offsetting policy between 2016 and 2017, they conducted consultations with NGOs like Ducks Unlimited, consultants like Dillon Consulting, and the Building Industry and Land Development Association (BILD) working group. All stakeholders generally agreed with the conservation authority's ecosystem offsetting approach.

However, collaboration frequently faces considerable challenges, particularly in obtaining long-term commitments from landowners for offset projects. Interviewee 14 cited landowner cooperation as the most significant impediment to effective wetland restoration. They talked about a University of Alberta research initiative that aimed to develop market-based

incentives for private land restoration, such as a reverse auction. Despite economic theory predicting that financial incentives would encourage participation, the reality was more complex. According to interviewee 14, "even though there are landowners who are interested in that payment, there are additional barriers to doing restoration on private land." One big problem is that wetlands frequently traverse many properties, necessitating the agreement of multiple landowners. "You can have a single wetland that's on four different parcels of land, and while one or two landowners may be willing to participate, enrolling all of them is really difficult" (Interviewee 14, 2024). Furthermore, even when landowners are interested, accessing Alberta's wetland compensation and restoration fund can be a serious challenge. Interviewee 14 mentioned that "despite the fact that we have a wetland compensation and restoration fund, the steps involved in actually getting the money from the government to do that restoration is very complicated and not especially streamlined. There's not a lot of certainty and it takes a lot of time." Therefore, willing landowners often eventually lose interest due to the long and bureaucratic process, thereby leading to delays in wetland restoration.

The above insight is consistent with the challenges highlighted by Interviewees 1 and 2, who discussed the difficulties in convincing private landowners, especially farmers, to convert their land to wetlands. Interviewee 1 further noted that “collaboration can be challenging, particularly when it comes to securing long-term commitments from landowners for offset projects” (Interview 1, 2024). Interviewee 2 also added that “while partnerships with landowners can help, the economic implications for farmers often pose a barrier” (Interview 2, 2024). Establishing successful collaborations with landowners necessitates meticulous negotiation and suitable incentives to tackle these economic issues, as corroborated by Trenholm et al. (2017).

Another recurring theme in the interviews was the conflict between development interests and conservation objectives. Interviewee 3 expressed concern over the pressure from developers to move quickly to compensation rather than following the mitigation hierarchy. Interviewee 7 highlighted that the policy's strict eligibility criteria sometimes clash with the interests of developers, leading to tension in policy implementation. A lingering challenge in environmental governance is the continued effort at attempting to reconcile stringent conservation standards with the requirement for flexibility (Zebardast et al., 2021).

Interviewee 10 reflected on the GRCA's experience with collaborative governance, highlighting both the opportunities and challenges in managing wetlands across a diverse and growing watershed. The GRCA's work with various stakeholders, including municipalities, private landowners, and First Nations, underscores the importance of collaboration in wetland management. Successful projects often involve multistakeholder partnerships that bring together technical expertise, funding, and local knowledge (Zebardast et al., 2021). This approach is supported by other studies that emphasize the benefits of community-based conservation and restoration efforts (Moore & Kumble, 2024).

Finally, Interviewee 11 noted that "Brant County's official plan was developed through extensive consultation with various stakeholders, including conservation authorities, Indigenous communities, and the public" (Interview 11, 2024). However, the changing roles of these stakeholders under new regulations have complicated the collaborative process. Educational efforts to inform developers about the importance of wetland conservation and new requirements are crucial for fostering cooperation and compliance (Zebardast et al., 2021).

5.3.8.1 Case studies and examples

Some successful wetland restoration and collaborative efforts were highlighted by interviewees, particularly from the Grand River Conservation Authority (GRCA) and other organizations.

1. **Taquanyah Conservation Area**: As discussed by Interviewee 10, this project involved the restoration and enhancement of wetlands within the Taquanyah Conservation Area. The property spans 136 hectares and features a path network that traverses woodlands, wetlands, and the cold-water Mill Creek. By 2005, both a dam and a substantial reservoir had been decommissioned. Following that, the area underwent restoration with the incorporation of additional wetlands, ponds, and paths. Trees and shrubs were established. The initiative was a collaborative endeavour including the GRCA, Ducks Unlimited Canada, Six Nations of the Grand River, Habitat Haldimand, the Haldimand Stewardship Network, and other relevant organisations. The Grand River Conservation Foundation secured funding for the initiative. The Ontario Trillium Foundation and the Ron and Nancy Clark Foundation served as the primary sponsors (GRCA, n.d. - c). This project exemplifies the benefits of collaborative efforts in achieving successful conservation outcomes.
2. **Grimsby Wetlands**: Highlighted by Interviewee 10, the Grimsby Wetlands project transformed a neglected brownfield site (The Biggar Sewage Lagoons) into a thriving 29-acre wetland ecosystem, providing critical habitat for various species and enhancing biodiversity. Effective collaboration between the Hamilton Naturalists' Club, the Niagara Peninsula Conservation Authority, and the Town of Grimsby led to the success of the Grimsby Wetlands project, showcasing how combined efforts and innovative approaches can convert former industrial sites into valuable natural assets (Environment Journal,

2024). This project received recognition for its innovative approach to wetland restoration.



Figure 5.1: Grimsby Wetlands (Doors Open Ontario, n.d)

3. **Luther Marsh Compensation Project**: Interviewees 4 and 10, both GRCA staff, mentioned the Luther Marsh project as a key example of successful environmental mitigation. This project was part of Hydro One's "Biodiversity Initiative," which was designed to compensate for the expected and associated environmental impacts as a result of the twinning of an existing transmission line between the Bruce Power Plant and the Town of Milton. Interviewee 10 highlighted that the project focused on creating and expanding wildlife habitats within the Luther Marsh Wildlife Management Area to compensate for the natural areas impacted by the Hydro One construction project. Hydro One played a key role, hosting three workshops and being responsible for the environmental impact assessment as well as the administration of funding for the

restoration. The Grand River Conservation Authority (GRCA), in collaboration with the Ministry of Natural Resources and Forestry (MNRF) and the Department of Fisheries and Oceans (DFO), reviewed the construction project and were also involved in the initiative. Interviewee 10 further highlighted that funding from Hydro One was specifically used to restore wetlands, forests, and grassland habitats in the area, and this collaboration provided critical habitat for species such as the Loggerhead Shrike and the Short-Eared Owl. "This was a Hydro One project where they conducted an analysis to identify potential sites for offsetting and compensation. They selected the Luther Marsh Wildlife Management Area, located towards the north end of the watershed, as the ideal site. As a result, the GRCA received funding from Hydro One to restore wetlands and forest habitats at Luther Marsh. This restoration was intended to compensate for the environmental impacts along the transmission line, and it was completely voluntary on Hydro One's part" (Interviewee 4, 2024).

4. **Rural Water Quality Program:** Interviewees 4 and 10 highlighted the Grand River Conservation Authority's (GRCA) Rural Water Quality Program, emphasizing its role in supporting wetland conservation. Interviewee 4 described the program as “a cost-sharing initiative funded by municipalities,” while Interviewee 10 elaborated that “the GRCA partners with local municipalities to fund and deliver projects aimed at protecting, restoring, and enhancing wetlands on private properties through this program.” Interviewee 4 further noted that the program, which has been operational for over 20 years, allows for the restoration or enhancement of wetlands within the Grand River Watershed, provided there are willing landowners. Through this initiative, farmers can

access grants to support projects that improve water quality and bolster soil health (Grand River Conservation Authority, n.d. - d).

These examples demonstrate the importance of collaboration in achieving successful wetland conservation outcomes. Engaging a broad range of stakeholders, including local communities, indigenous groups, and developers, is crucial for designing and implementing offsetting projects that are more likely to succeed. Interviewee 4 emphasized that "collaboration and adequate funding made these projects successful," highlighting the need for both financial resources and cooperative efforts to ensure the effectiveness of conservation initiatives

5.3.9 Ecological Offsetting and Compensation

Ecological offsetting, particularly in the context of wetland conservation, emerged as a prominent theme across the interviews. The perspectives of various stakeholders, including environmental planners, conservation authority officials, and government representatives, revealed a complex and nuanced understanding of offsetting practices. This thematic analysis synthesizes the insights from the interviews, identifying key patterns, similarities, and differences in perspectives across participants.

Interviewee 1 discussed the Natural Heritage System (NHS) as an integral component of wetland conservation and offsetting efforts in the Credit Valley Watershed. The NHS is a framework that includes various natural features like significant woodlands, valleylands, watercourses, and wetlands. The NHS is designed to maintain ecological integrity within a given area and is guided by tools such as the "Natural Heritage Reference Manual" and the "How Much Habitat is Enough?" guidelines. These tools help quantify and assess the sufficiency of natural habitats in meeting ecological targets (Interviewee 1, 2024). Wetland offsetting often involves integrating newly created or enhanced wetlands into the NHS. This approach ensures

that these offsets contribute to broader ecological objectives and are protected within the system. Interviewee 1 emphasized, "Wetland offsetting is most effective when it's integrated into a broader natural heritage system, ensuring long-term ecological resilience" (Interviewee 1, 2024).

Most respondents, including Interviewees 5, 8, and 11, conceptualized ecological offsetting as a last-resort measure within the broader framework of the mitigation hierarchy. This hierarchy prioritizes avoidance and minimization of environmental impacts before resorting to offsetting (Interviewee 5, 2024). The concept was broadly understood as a mechanism to compensate for unavoidable losses, particularly when development projects result in the destruction of wetlands or other critical habitats. However, there were variations in how respondents viewed the effectiveness and ethical implications of offsetting.

Interviewee 8 expressed skepticism about the ability of offsetting to genuinely replicate the ecological functions of lost wetlands, highlighting the inherent challenges in ensuring that created or restored wetlands can provide the same ecosystem services as natural ones (Interviewee 8, 2024). In contrast, Interviewee 9 from Alberta took a more pragmatic approach, emphasizing the importance of offsetting in regions where wetland loss is significant and inevitable due to development pressures (Interviewee 9, 2024).

A pattern that emerged was the acknowledgment of offsetting as a necessary but imperfect tool. While there was consensus on its role within the mitigation hierarchy, the interviews revealed concerns about its application, varied depending on regional contexts. For example, Interviewee 5 and Interviewee 9 highlighted the difficulty of finding suitable land for offset projects, especially within the same watershed as the impacted wetland. This challenge was particularly pronounced in urban areas where real estate values are high, making it difficult to secure land for conservation purposes.

The interviews demonstrate that the efficiency of ecological offsetting, although acknowledged as a potential important tool in the conservation arsenal, depends on careful planning, continuous management, and an in-depth understanding of the regional context. The incorporation of offset programs into wider ecological frameworks such as the NHS is essential for their sustained effectiveness. Nevertheless, the ethical and practical obstacles linked to offsetting, such as the complexity of replicating natural ecosystems and the challenge of finding suitable land, emphasise the need for a careful and thoroughly deliberated approach. The ongoing evolution of policies and regulations requires a delicate balance between the demands of development and the urgent need to preserve our natural heritage.

5.4 Summary of the emerging themes

1. **Policy Gaps and Challenges**

The analysis revealed significant policy gaps, considering the context of recent legislative changes such as Bill 23 and the introduction of Ministerial Zoning Orders (MZOs). These changes have weakened conservation authorities' ability to protect wetlands, particularly by limiting their role in commenting on ecological functions and shifting responsibilities to municipalities that may lack the necessary expertise.

Furthermore, agricultural activities in wetland areas remain largely unregulated, creating additional challenges for wetland conservation efforts. Despite the presence of protective policies, enforcement and practical implementation remain inconsistent across different regions and municipalities.

2. **Monitoring and Evaluation Shortcomings**

The study identified that existing monitoring frameworks for wetland offsetting projects are generally inadequate. Most current monitoring practices rely on visual inspections and basic

presence/absence data rather than detailed functional assessments. This approach restricts the ability to fully evaluate the ecological success of offsetting projects, particularly in the long term.

A significant number of wetlands offsetting projects are relatively new, which means that comprehensive data on their effectiveness in replacing lost wetland functions is still lacking. This temporal limitation further complicates efforts to assess the success of these compensation projects.

3. Stakeholder Engagement and Collaborative Efforts

While there are some examples of successful collaborative efforts in wetland restoration, the analysis highlighted the need for more consistent and structured stakeholder engagement, particularly with Indigenous communities and local landowners. The data shows that conservation authorities and municipalities that engage in active collaboration tend to achieve better outcomes in wetland conservation.

The analysis also found that the introduction of ecological offsetting policies, such as those by the Lake Simcoe Region Conservation Authority, has been generally well-received when developed with stakeholder input, including the development community. However, the implementation of these policies remains uneven, with some areas struggling to enforce offsetting requirements effectively.

4. Ecological Offsetting and Compensation

The effectiveness of ecological offsetting as a conservation tool is still under debate. While offsetting provides a mechanism to compensate for wetland loss, it should only be treated as a last resort. The challenges of land availability, the high costs associated with offsetting, and the need for time-intensive monitoring are some of the challenges associated with wetland offsetting.

The data suggests that while offsetting can help mitigate some of the impacts of development, it should not be viewed as a substitute for direct wetland protection. Instead, it should be integrated into a broader framework that prioritizes wetland preservation and restoration.

5.5 Linking of findings to relevant literature

This section compares the interview findings with existing literature from regions practicing wetland offsetting for longer, such as the United States. The purpose is to assess whether the wetland offsetting challenges identified from the interviews are typical or unique.

5.5.1 Comparing Interviewees' Wetland Offsetting Experience with Literature

Monitoring Challenges: The literature underscores the difficulty of ensuring long-term functional monitoring. Race and Fonseca (1996) discuss the challenges of maintaining consistent and detailed monitoring over extended periods. In the US, wetland offsetting initiatives have a poor history of successful implementation and monitoring, frequently failing to achieve their intended objectives (Moreno-Mateos et al., 2012; ROBERTSON & HAYDEN, 2008). This lack of adequate monitoring has also been identified as a key challenge in Bull et al. (2013) review of wetland offsetting in theory and practice. Harper and Quigley (2005) discovered that in Canada, offsets associated with the fish habitat compensation program were monitored for an average of only 3.7 years following construction, resulting in insufficient data on outcomes. Rubec and Hanson (2009) analysed Canada's approach to wetland mitigation and compensation, concluding that the lack of a standardised framework for monitoring the ecological results of compensation projects has hindered the assessment of whether Canadian compensation policy objectives are being met.

This study's interviewees (which includes respondents from Ontario and Alberta) raised similar concerns, noting that monitoring is often short-term and superficial, relying more on

visual inspections than on detailed functional indicators. Therefore, it is evident that long-term ecological health of wetland offsets remains a critical challenge.

Lack of Suitable Land: The difficulty of obtaining appropriate land for wetland offsetting is especially evident in urban and agricultural areas. A significant challenge associated with offsetting activities, including the restoration of degraded areas or the conservation of existing biodiversity, is the substantial land requirement. Even minor impacts frequently require extensive areas for adequate offsetting. In many countries, the scarcity of accessible land hinders adequate compensation for the significant biodiversity losses anticipated from current and forthcoming development (Sonter et al., 2020b). In areas such as Southern Ontario, where rapid economic expansion and an increasing population have significantly restricted the availability of affordable, undeveloped land for conservation initiatives, this issue is particularly prominent (Ontario Nature, 2023). Yu et al. (2018) noted that rigorous in-kind biodiversity offsetting is progressively difficult in extensively altered landscapes due to a scarcity of spatial alternatives for offsets and the likelihood for potential offset sites to differ significantly from the habitats that originally existed on developed sites within these landscapes. This issue was repeatedly highlighted by participants in this study.

Time Lags: The literature on wetland offsetting and biodiversity offsetting at large has identified significant time lags between wetland creation and the replication of original wetland functions as a major challenge. Bekessy et al. (2010) expressed criticism towards the temporal aspect and time delays of these projects, arguing that they trade immediate habitat loss for future biodiversity benefits. Furthermore, Kihslinger (2008) notes that it can take years, if not decades, for newly created wetlands to develop the full range of ecological functions found in natural

wetlands. This concern about time lags was echoed by several interviewees from Ontario conservation authorities.

Interviewee 5 elaborated on the time lag, explaining that wetland offset projects can take 5-6 years before they even begin, due to the lengthy process of design, hiring contractors, and obtaining the appropriate approvals. They noted that, while the process is slow, they believe that projects will eventually catch up. However, finding suitable land for these projects presents an additional challenge. In cases where the land is unsuitable for wetlands, alternative projects such as grasslands or tree planting are considered to ensure ecological restoration fits the location.

Interviewee 1 highlighted the difficulty in immediately implementing offset projects after receiving funds. They explained that while the financial resources may be available, the actual wetland creation often faces delays, further extending the time lag between wetland loss and compensation.

Interviewees 6 and 7 discussed the challenges in tracking and executing offsetting measures. They noted that while the policy on paper aims for a one-to-one replacement of lost functions, in practice, tracking the funds and ensuring offset projects fulfill the intended ecological roles is difficult. The capacity issues within conservation authorities limit the ability to implement these projects promptly. This often results in money sitting in the bank, waiting for capacity to ramp up to execute the offset projects.

The experiences of these interviewees underscore a recurring theme: the disconnect between policy and implementation. Although the objective of wetland offsetting policies is to establish a system for compensation, the actual situation is that substantial delays, logistical obstacles, and capacity constraints impede the prompt restoration of ecological functions. The

delay poses a significant obstacle to the successful conservation of biodiversity, since the extension of time required for the implementation of offset projects increases the likelihood of incomplete compensation for the ecological loss.

5.5.2 Differences Between Ontario and the U.S.

Unlike the U.S., which has federal-level guidance and some established wetland banking systems, Canada is still navigating the provincial versus municipal roles in wetland conservation. The U.S. has a more centralized approach with the Clean Water Act providing a framework for wetland protection and offsetting (Environmental Law Institute, 2007). In contrast, Canada's approach is more fragmented, with recent legislative changes such as Bill 23 creating additional uncertainty about roles and responsibilities in wetland conservation (Ontario Nature, 2022).

5.6 Conclusion

Chapter 5 provided an in-depth analysis of the data obtained from key informant interviews related to Canada's wetland conservation and offsetting initiatives. The results offer crucial information about the condition of wetlands, the effectiveness of mitigation initiatives, and the problems that municipalities and conservation authorities face. Important topics including legislative gaps, monitoring limitations, stakeholder participation, and the role of ecological offsetting in wetland management were covered in this chapter.

The study discovered considerable policy gaps, particularly after recent legislative changes such as Bill 23 and the implementation of Ministerial Zoning Orders (MZOs). These developments have hampered conservation agencies' ability to maintain wetlands by delegating responsibilities to municipalities, many of which lack the competence required to properly manage ecological functions. Furthermore, the fact that nothing in the provincial policy statement is intended to limit existing or new agricultural activity on wetland areas exacerbates

the problem considering wetland drainage for agriculture is one of the biggest threats to wetland ecosystems.

The data revealed that monitoring frameworks for wetland offsetting projects are generally inadequate. Most offsetting projects are monitored using simple presence/absence surveys rather than detailed functional assessments, limiting the ability to assess the success of these projects over time. Furthermore, since many of offsetting projects from the participants in this study, are still relatively new, there is a lack of long-term data on their effectiveness, complicating efforts to evaluate whether they can fully replace lost wetland functions.

The analysis showed that stakeholder engagement plays a crucial role in the success of wetland conservation efforts. Conservation authorities and municipalities that foster strong collaborations with Indigenous communities, local landowners, and developers tend to achieve better outcomes. However, the lack of consistent and structured engagement frameworks, particularly in light of new legislative changes, remains a challenge. Ecological offsetting, while an important tool for mitigating the impacts of development, should be seen as a last resort rather than a proactive conservation strategy. The findings emphasize the need for offsetting to be integrated into broader frameworks such as the Natural Heritage System (NHS) to ensure long-term ecological resilience. However, challenges related to land availability, high costs, and insufficient monitoring make it difficult to implement offsetting effectively.

The findings from the interviews align with challenges observed in other regions practicing wetland offsetting, particularly in the U.S. Like Ontario, the U.S. has struggled with time lags between wetland creation and the full restoration of ecological functions, inadequate long-term monitoring, and land scarcity for offset projects. However, Ontario’s approach remains

fragmented, lacking the centralized federal or provincial level guidance and established wetland banking systems found in the U.S.

Finally, while wetland offsetting holds potential as a conservation tool, its success in the Grand River Watershed is uncertain due to several challenges, including policy gaps, insufficient monitoring, and the need for stronger collaboration between stakeholders. The chapter underscores the importance of a more integrated, evidence-based approach to wetland conservation, prioritizing preservation over offsetting whenever possible to ensure the long-term protection of these vital ecosystems.

CHAPTER 6: SUMMARY OF THE FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The final chapter of this thesis presents the summary of the findings, draws conclusions and offers recommendations. Table 6.1 below revisits the research questions presented in the introductory chapter and provides corresponding answers derived from the data collected and analysed during this study. Additionally, the table includes a column that connects the research questions and conclusions to relevant literature, so contextualising the study's outcomes within the broader academic discourse.

In addition, this chapter draws conclusions based on the data collected through the interviews and the literature review, examining the implications of existing wetland offsetting policies and practices in Ontario conservation authorities and Alberta. It also highlights the study's limitations and suggests areas for future research. Finally, it offers recommendations to improve the efficacy of wetland conservation efforts, addressing gaps in policy and monitoring, and stakeholder engagement towards ensuring more inclusive sustainable management approaches moving forward.

Table 6.1: Research question and Summary of the findings

Research Questions	Answers Based on Findings	Link to Literature
Has the wetland offsetting policy yielded its expected economic and environmental benefits in the watersheds where it has been implemented?	The findings indicated that it is too early to estimate the full economic and environmental advantages of the wetland offsetting programs in Ontario and Alberta. Interviewees highlighted that the wetland offsets were recently established and will require 3-5 years of monitoring to determine their success. Furthermore, functional monitoring is weak, with most assessments relying on visual inspections rather than in-depth ecological analyses.	The lack of a detailed monitoring assessment tool is consistent with the research on wetland offsetting on the US Wetland Mitigation Program (Moreno-Mateos et al., 2012; ROBERTSON & HAYDEN, 2008), Canada's Fish habitat compensation program (Harper & Quigley, 2005; Rubec & Hanson, 2009), and Bull (2013) review of wetland offsetting in theory and practice.
To what extent do conservation authorities incorporate non-economic wetland values, particularly Indigenous cultural values, into their wetland offsetting protocols, and what factors influence the inclusion or exclusion of these values?	The incorporation of Indigenous cultural values into wetland offsetting techniques is limited. Interviewees 8 and 11 emphasized the importance of collaboration with Indigenous populations, particularly when wetlands are culturally significant. However, Interviewee 3 mentioned the difficulty of quantifying social and cultural values in offset protocols, and Interviewees from Ontario CAs mentioned that Ontario Regulation 41/24 has shifted responsibility for considering these values from conservation authorities to municipalities, complicating matters further. While social and cultural considerations are part of the OWES	McGregor (2021) highlights the importance of integrating Indigenous knowledge into wetland conservation. Nonetheless, the practical constraints correspond with the conclusions of McDermott and Bell (2017) in their research on Indigenous perspectives on conservation offsetting based on five case studies from Ontario. They assert that conservation offsetting initiatives may overlook and marginalise Indigenous values, perspectives, consultation methods, and Traditional Ecological Knowledge. Indigenous Peoples' engagement in conservation concerns is sometimes limited, with governments and developers viewing

	process, Interviewees 6 & 7 mentioned their inability to fully incorporate OWES into their policies and regulations as they will face scrutiny. Interviewee 14 noted that while social and cultural values are technically included in the Alberta wetland evaluation process, they are not seriously considered in practice	it as a reluctant responsibility (Youdelis, 2016)
What logistical challenges have other conservation authorities encountered during the implementation of wetland offsetting policies, and what strategies have they employed to address these challenges?	Several logistical obstacles were encountered when adopting wetland offset regulations. Interviewees 4, 7, 10, and 11 identified land availability as a serious difficulty, particularly in urbanized regions where high real estate prices make securing land for wetland restoration challenging. Interviewee 14 mentioned that landowner cooperation is another difficulty, especially when wetlands encompass numerous properties. Furthermore, monitoring and technical expertise present substantial challenges—interviewees 4 and 5 stated that towns lack the capacity to conduct extensive functional assessments. Partnerships with non-governmental organizations (NGOs) such as Ducks Unlimited (Interviewee 10) and financial incentives for landowners (Interviewee 14) are two options for overcoming these challenges.	The challenge of land availability is consistent with Sonter et al. (2020b), who found that land scarcity limits wetland restoration efforts. Race and Fonseca (1996) and Yu et al. (2018) also emphasize that securing land for offsetting can be difficult in high-development areas. Race and Fonseca (1996) highlight how, in urbanized or highly fragmented areas, securing suitable land for on-site and in-kind restoration or mitigation can be difficult, and alternative solutions like mitigation banks may be necessary. Clare et al. (2011) noted that the reactive nature of wetland regulation in Alberta could be related to a lack of government capacity and resources. Additionally, insufficient financial resources and financing may result in constrained ecological designs and subsequent ecosystem degradation (Calvet et al., 2015; Spence, 2021). Furthermore, Sewell et al. (2016)

		identified financing as one of the primary challenges in scaling up ecosystem restoration projects.
Can a Wetland offsetting policy enhance collaborative wetland governance and management strategies in the Grand River Watershed?	Interviewees expressed cautious optimism regarding the possibility of wetland offsetting policies to improve collaborative governance. Interviewees 1, 4, and 10 suggested that offsetting may be used to foster collaboration among conservation agencies, municipalities, developers, and non-governmental organizations (NGOs). However, they also stated that offsetting alone will not achieve this goal; it must be part of a larger, multifaceted plan that involves stakeholder participation and public education. Interviewee 4 further highlighted how recent legislative changes may hamper collaboration between the Ministry of Natural Resources and Forestry and local conservation authorities. Interviewees 10 and 11 stressed the need of early engagement of stakeholders, notably developers, in policy talks. Interviewee 3 emphasized that the success of such collaborations is dependent on clear governance mechanisms and enough finance.	The potential of offsetting to foster collaboration is supported by Lockwood et al. (2010), who emphasize the role of collaborative governance in natural resource management. Zebardast et al. (2021) also discuss how multi-stakeholder approaches can improve wetland management outcomes. Megdal et al. (2017) highlight the need for effective stakeholder engagement. Clare et al. (2011) suggests long-term citizen-based monitoring of wetland restoration and offset projects as a measure to improve sustainable wetland management. This approach emphasises that collaborative governance frameworks encompass not just governmental and institutional parties but also local communities as active participants in wetland monitoring and conservation.

6.2 Conclusion

The study's findings indicate that wetland offsetting may serve as an effective mechanism for sustainable wetland management in the Grand River Watershed. However, beyond the Luther Marsh compensation project, no significant wetland offsetting initiatives have been established within the watershed and there has been no formal monitoring to determine if the wetland restoration efforts at Luther Marsh did in fact compensate for wetland loss in area and function. Furthermore, the GRCA is currently limited in resources (finances and technical capacity) for its current operations and hence there is a need for increased support and funding for the GRCA and other authorities tasked with environmental protection. While the GRCA has been part of 'successful' wetland restoration initiatives, adequate funding as well as collaboration is what made these projects succeed.

The data collected from this research originates from interviews in jurisdictions beyond the Grand River Watershed, where wetland offsetting regulations are implemented; nonetheless, projects in these areas remain in their initial stages. Therefore, it is premature to ascertain if these projects are fulfilling expectations about the restoration of the ecological services of natural wetlands. The insights derived from these places provide significant implications for prospective future implementation in the Grand River Watershed.

Recent changes in legislation, most notably the passage of Bill 23 and the introduction of Ontario regulation 41/24, have transferred important duties that Conservation Authorities had previously carried out to municipalities. The role of Conservation Authorities has been confined to tackling hydrological issues like flood and erosion control due to these changes, which also limit their power to comment on development proposals that may impact wetlands. Municipalities are now in charge of ecological issues, which used to be part of the mandate of conservation authorities. Wetland conservation is increasingly expected to be managed by many

municipalities, which presents serious challenges to effective wetland protection, particularly for the smaller municipalities with limited resources and technical expertise.

Further impeding their successful implementation are practical issues such the lack of suitable land, high costs, and limited capacity, which also lead to time lags—significant delays between the impact of approved developments and the creation of wetland offsets. The availability of sufficient land for offsetting continues to be a persistent and significant barrier in areas such as Southern Ontario, where land acquisition for conservation is both costly and challenging.

Moreover, the integration of non-economic values, such as social and cultural values, in offsetting protocols remains underdeveloped. While the Ontario Wetland Evaluation System (OWES), integrate cultural significance, these elements are often secondary to ecological and hydrological goals in wetland compensation programs and following Bill 23, a wetland's provincial significance is not a factor considered by conservation authorities in issuing or denying permits. Conservation authorities are also prevented from integrating OWES factors in their policies and processes as it is not within their purview. Therefore, Indigenous cultural values were not reflected in the offsetting policies and guidelines explored for this research, despite their importance in natural resources management.

Interviewees expressed concern about the lack of long-term monitoring of wetland offsets. Existing methods, including as presence/absence surveys and visual inspections, are insufficient to assess the long-term functional performance of wetlands. This is consistent with concerns raised in the literature, which states that wetland offsets may succeed or fail over time, depending on the outcomes of short-term monitoring. If offsetting is to be a useful conservation strategy, significant advances in monitoring techniques are required to ensure that programs

generate the desired ecological outcomes. Clare et al. (2011) recommends the establishment of long-term citizen-based monitoring to mitigate the monitoring gap in wetland conservation and management. As an example, citizens have been educated to recognise the functional and structural attributes of wetlands and to report these assessments consistently and reliably, at minimal expense to local institutions (Clare, 2011; Koontz & Thomas 2006). This program enables local individuals to assist in the monitoring and management of local wetlands. This program aims to motivate citizen scientists to document and submit data regarding local wetlands, thereby enhancing the comprehension of their status and health. Additionally, it seeks to empower citizens to participate in local stewardship and exert influence on politicians to advocate for wetland conservation and restoration.

Despite the challenges in designing a scientifically rigorous program for volunteer monitoring that yields valuable scientific data accessible to non-specialists, such initiatives can generate data for wetlands that may otherwise be economically unfeasible, enhance the volume of information available to decision-makers across all governmental tiers, raise awareness regarding wetland issues, and contribute to the prevention of wetland degradation (Stratford, 2018). This approach emphasises that collaborative governance frameworks encompass not just governmental and institutional parties but also local communities as active participants in wetland monitoring and conservation.

Collaborative governance was recognised as a viable answer to some of these challenges. Its efficacy, however, is contingent upon the availability of sufficient resources, adequate leadership, organised structures, and strong stakeholder involvement mechanisms. Initiatives such as the Grand River Watershed's Rural Water Quality Program, which has been in existence for over two decades, exemplify the efficacy of collaborative governance when stakeholders are

unified and dedicated. The initiative emphasises the importance of incentives in promoting collaboration between landowners and conservation authorities by providing grants to farmers for wetland restoration or enhancement. This long-term partnership underscores the significance of collaboration in attaining favourable conservation results. Additional notable collaborative wetland initiatives encompass the Taquanyah Conservation Area and the Grimsby Wetlands, which exemplify the advantages of multi-stakeholder involvement. Enhancing cooperation among conservation authorities, municipalities, developers, landowners, and non-governmental organizations while establishing clear and enforced laws for wetland offsetting, is crucial for future success. Nonetheless, the uncertainties arising from a changing regulatory landscape must be recognised. Modifications such as those enacted by Bill 23 persist in redefining stakeholder roles, thereby complicating the pursuit of successful, collaborative solutions.

6.3 Limitations and Future Research

This study encountered multiple constraints. The data primarily comprised interviewees from jurisdictions that had established wetland offsetting programs; however, many of these projects were still in the initial phases of implementation. As a result, interviewees were unable to really offer definitive and conclusive insights regarding the fulfilment of ecological and economic expectations by these compensation projects. The findings are preliminary; subsequent study should reassess these projects as they advance to offer a more thorough evaluation of their efficacy.

Additionally, the scope of the research was constrained by the limited number of interviewees from different municipalities in Grand River Watershed and other provinces, such as Nova Scotia and New Brunswick which have implemented wetland compensation policies. Although respondents from Alberta were included, the overall number of participants was

insufficient to make broad generalizations. Future studies should therefore aim to collect data from a broader range of jurisdictions to gather diverse real-life experiences with wetland offsetting. It is also important that future research strives to garner insights from ministries like the Ministry of Natural Resources and Forestry and the Ministry of Municipal Affairs and Housing, indigenous communities, the development community, the agricultural community and other relevant stakeholder groups.

Finally, subsequent research could examine the concept of 'Trust' in relation to collaborations in wetland offsetting and overall wetland management, analysing the influence of various dimensions of 'Trust' on wetland offsetting and management.

6.4 Recommendations

Although development is both inevitable and necessary, it is very important to ensure that economic growth does not come at the expense of valuable ecosystems like wetlands. While it is challenging to achieve a balance between development and environmental conservation, it is very essential, given the vital ecosystem services that wetlands provide. For example, peatlands in Northern Ontario have been estimated to annually sequester carbon that is equivalent to approximately one-third of the province’s total carbon emissions (Far North Science Advisory Panel, 2010). Additionally, Moudrak et al. (2017) asserts that preserving wetlands can lower flood-related financial expenditures by up to 38 percent. The Ontario government has acknowledged the importance of wetlands in reports such as the 2015 "Wetland Conservation in Ontario: A Discussion Paper" and the 2017 "Wetland Conservation Strategy for Ontario 2017–2030." These reports emphasize goals of no net loss and net gain, especially in areas that have already experienced considerable wetland loss. However, the recent policy changes could accelerate wetland loss and degradation. Yes, it is challenging to perfectly align development and

wetland preservation, however, I believe that wetland offsetting - despite its challenges and limitations – if carefully designed according to the highest standards as outlined in Chapter 3 of this study, holds potential to improve the wetland landscape in the Grand River Watershed and across Ontario. For this potential to be realized, the policy landscape must provide a supportive environment. Table 6.2 below outlines key policy documents that influence the success of wetland offsetting initiatives in the Grand River Watershed. It is followed by paragraph that summarizes the table and includes a suggestion for a provincial-wide offsetting policy with strict criteria to provide comprehensive provincial guidance.

Table 6.2: Key Ontario Wetland Policy Instruments and their impact on the success of Wetland Offsetting

Regulation/Policy Tool	**Impact on Wetland Offsetting in the Grand River Watershed**	**Explanation**
Ontario Wetland Evaluation System (OWES)	Negative	The changes associated with the passing of Bill 23 may increase the number of wetlands requiring offsetting as there is a potential for wetlands previously classified as provincially significant to lose their provincial status, thereby putting them at the risk of development pressures. This generates additional offsetting opportunities, and at the same time heightens the demands on appropriate site selection and the success of offsetting projects, as compensating for lost ecological functions and values becomes increasingly complex.
Provincial Policy Statement	Negative	The Provincial Policy Statement (PPS) is issued under section 3 of the planning act. Nothing in the Provincial Policy Statement restricts agricultural activities, the largest contributor to wetland loss in

		Ontario (Walters & Shrubsole, 2003). The Environmental Commissioner of Ontario (2018) found that the Ontario Ministry of Agriculture, Food, and Rural Affairs does not monitor wetland loss due to agricultural drainage and cannot provide adequate data on its rate and extent (Penfound, 2023). This can hinder the success of wetland offsetting and compensation efforts, if the goal remains to ensure that the wetland landscape and function of the watershed and Ontario as a whole remains healthy.
Conservation Authorities Act	Negative	The changes made to the conservation authorities act under Bill 23 impedes the collaborative environment required for the success of wetland offsetting. It puts pressure on municipalities (especially smaller municipalities with limited staffing and resources) to play roles they had historically relied on conservation authorities for. Furthermore, smaller municipalities are often focused on development and growth, and this interest may conflict with wetland preservation. In the absence of provincial guidance on wetland offsetting, conservation authorities have developed their own offsetting policies and guidelines. However, It is unclear to what extent they would be able to enforce their policies in the face of the changing regulatory landscape.
Natural Heritage Reference Manual & the Natural Heritage System	Positive	This is a key guidance document produced by the Ontario Ministry of Natural Resources and Forestry which provides direction for implementing the Provincial Policy Statement (PPS) regarding the preservation of Ontario's natural heritage, encompassing wetlands, forests, and other notable natural features. It includes steps for the identification and evaluation of these features and recommends best practices for their protection in land-use planning. These features

		form part of the 'Natural Heritage System (NHS)'. Wetlands are among the ecologically significant areas that the NHS works to connect and protect. By offering recommendations on where restoration or compensation projects should be prioritised in order to improve ecological networks and preserve biodiversity, it promotes wetland offsetting. This strategy is currently being utilised by one of the conservation authorities in this study. Alongside utilising this system to pinpoint potential compensation and offset projects, they incorporate any offset site into the Natural Heritage System, provided it was not previously included. However, its efficiency relies on consistent enforcement and integration with developmental planning processes.

From the above table and this study as a whole, it is apparent that changes to the wetland regulatory landscape in support of Bill 23 has negative implications for the success of wetland offsetting projects. These changes restrict the collaborative environment essential for potential wetland offsetting success. For example, modifications to the Ontario Wetland Evaluation System puts many wetlands at the risk of potential development impacts, thereby increasing the need for wetland offsetting and compensation, along with its inherent risks and limitations. Some interviewees in this study expressed interest in the development of a provincial-wide offsetting policy. This policy at the provincial level would provide provincial guidance and increases the probability of success by ensuring that all stakeholders including the development community, the agricultural community, Indigenous peoples, Non-Governmental Organizations, Conservation authorities, Municipalities and other relevant stakeholders are involved in the process. Furthermore, the Provincial Government would be better equipped to enforce

compliance with offset requirements - a consistent challenge identified from the literature. As an alternative, they can empower municipalities and conservation authorities alike with the authority to enforce compliance and impose fines for offset requirement violations where necessary. The province would also be able to provide the required support in terms of funding, human resources, and technical expertise that many conservation authorities currently struggle to secure in their efforts to implement effective wetland offsetting. In recognition of the Natural Heritage System, a provincial wetland offsetting policy that emphasizes strategic planning and ecological connectivity, could encourage offsets to be situated in areas that will effectively preserve or improve wetland connectivity and ecological function in the province. This could potentially prevent the piecemeal approach that results in isolated or less effective restoration efforts and invariably address site selection challenges.

The following are other recommendations drawn from this study.

1. Develop and implement more robust monitoring frameworks that go beyond visual inspections and presence/absence data. These frameworks should include detailed functional assessments that can provide a clearer picture of the ecological success of wetland offsetting projects. Increase the duration and frequency of monitoring efforts, particularly for newer offsetting projects, to ensure that they are functioning as intended over the long term. Long-term citizen-based monitoring of wetlands, suggested by Clare et al. (2011), could help in addressing the monitoring gap, while also encouraging general public participation in wetland management and conservation.
2. There is a need to incorporate social and accounting valuations in the planning and permitting process.

3. Efforts should be made to expand collaborations with private landowners. For instance, providing compensation to landowners for the protection or restoration of wetlands can serve as an incentive for conservation efforts (Hansen et al., 2015). Furthermore, there is a need to explore the use of market-based instruments, such as reverse auctions (a promising tool currently employed in Australia and Alberta) to encourage landowners' participation in wetland restoration efforts. It is important that this tool be meticulously designed with the involvement of all relevant stakeholders to avert implementation challenges.
4. Develop specific regulations for agricultural activities in wetland areas to prevent further degradation and loss of wetland ecosystems.
5. Encourage more structured and consistent engagement with Indigenous communities, local landowners, and other stakeholders in the development and implementation of wetland conservation policies. This can help ensure that diverse perspectives are considered and that policies are more likely to be effective in practice.
6. Foster partnerships between conservation authorities, municipalities, and the development community to create more effective and sustainable wetland offsetting projects.
7. Studies on economic valuation have shown that a lack of awareness among stakeholders regarding the ecosystem services that wetlands provide can result in the degradation of these ecosystems (Aziz & Cappellen, 2021; Gustavson & Kennedy, 2010). Therefore, effective communication and education about the economic advantages of wetlands would be crucial to garner public support for conservation efforts.

8. Encourage municipalities and conservation authorities to adopt stronger policies that protect smaller wetlands, which are often at greater risk of being lost due to development pressures.
9. Identify strategies to address the funding and capacity limitations in the GRCA and other environmental authorities.
10. Prioritize Preservation Over Offsetting: Wherever possible, wetland preservation should be prioritized over offsetting to prevent further losses. Legislation should support stricter regulations around wetland degradation, particularly for smaller or isolated wetlands that may not meet provincial significance but still offer essential ecological functions.

REFERENCES

Adaman, F., Hakyemez, S., & Özkaynak, B. (2009). The political ecology of a Ramsar site conservation failure: the case of Burdur Lake, Turkey. Environment and Planning C: Government and Policy, 27(5), 783-800.

Adekola, O., & Mitchell, G. (2011). The Niger Delta wetlands: Threats to ecosystem services, their importance to dependent communities and possible management measures. International Journal of Biodiversity Science, Ecosystem Services & Management, 7(1), 50–68. https://doi.org/10.1080/21513732.2011.603138

Amano, T., Székely, T., Sandel, B., Nagy, S., Mundkur, T., Langendoen, T., ... & Sutherland, W. J. (2018). Successful conservation of global waterbird populations depends on effective governance. Nature, 553(7687), 199-202.

Artelle, K. A., Zurba, M., Bhattacharyya, J., Chan, D. E., Brown, K., Housty, J., & Moola, F. (2020). Supporting resurgent Indigenous-led governance: A nascent mechanism for just and effective conservation. Biological Conservation, 240, 108284.

Attridge, I. (Editor). (1996). Biodiversity Law and Policy in Canada: Review and Recommendations. Canadian Institute for Environmental Law and Policy. Toronto, Ontario. 534 p.

Austen, E., & Hanson, A. (2007). An Analysis of Wetland Policy in Atlantic Canada. Canadian Water Resources Journal (Vol. 32). Retrieved from https://journals-scholarsportalinfo.proxy.lib.uwaterloo.ca/pdf/07011784/v32i0003/163_aaowpiac.xml

Aziz, T., & Van Cappellen, P. (2021). Economic valuation of suspended sediment and phosphorus filtration services by four different wetland types: A preliminary assessment for southern Ontario, Canada. Hydrological Processes, 35(12), e14442. https://doi.org/10.1002/hyp.14442

Balmford A, Bruner A, Cooper P, Costanza R, Farber S, Green RE, Jenkins M, Jefferiss P, Jessamy V, Madden J, Munro K, Myers N, Naeem S, Paavola J, Rayment M, Rosendo S, Roughgarden J, Trumper K, Turner RK (2002) Economic reasons for conserving wild nature. Science 297:950–953

Barbier, E. B. (2011). Wetlands as natural assets. Hydrological Sciences Journal, 56(8), 1360-1373.

Bangalang, N., Nadji, J., Nayinggul, A., Nadji, S., Nayinggul, A., Dempsey, S., Mangiru, K., Dempsey, J., McCartney, S., Mairi Macdonald, J., & Robinson, C. J. (2022). Understanding Indigenous values and priorities for wetlands to guide weed management actions: Lessons from the Nardab floodplain in northern Australia's Kakadu National Park. ECOLOGICAL MANAGEMENT & RESTORATION, 23, 105–116. https://doi.org/10.1111/emr.12542

Bean, M. J., & Dwyer, L. E. (2000). Mitigation Banking as an Endangered Species Conservation Tool. Environmental Law Reporter News & Analysis, 30(7), 10537–10556.

Bennett, G. (2018). Environmental Impact Assessment: Wetland Mitigation Banking. In C. M. Finlayson, M. Everard, K. Irvine, R. J. McInnes, B. A. Middleton, A. A. van Dam, & N. C. Davidson (Eds.), The Wetland Book: I: Structure

and Function, Management, and Methods (pp. 2053–2058). Springer Netherlands. https://doi.org/10.1007/978-90-481-9659-3_260

Bennett, G., Gallant, M., & ten Kate, K. (2017). State of biodiversity mitigation 2017: Markets and compensation for global infrastructure development. Washington, DC: Forest Trends' Ecosystem Marketplace

Berkes, F., J. Colding, and C. Folke. (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10(5):1251-1262. http://dx.doi. org/10.2307/2641280

Bezombes, L., Kerbiriou, C., & Spiegelberger, T. (2019). Do biodiversity offsets achieve No Net Loss? An evaluation of offsets in a French department. *Biological Conservation*, *231*, 24–29. https://doi.org/10.1016/j.biocon.2019.01.004

Brown, P. H., & Lant, C. L. (1999). The effect of wetland mitigation banking on the achievement of no-net-loss. Environmental Management, 23, 333–345. https://doi.org/10.1007/s002679900190

Birch, W. S., Drescher, M., Pittman, J., & Rooney, R. C. (2022). Trends and predictors of wetland conversion in urbanizing environments. Journal of Environmental Management, 310(Complete). https://doi.org/10.1016/j.jenvman.2022.114723

Bradford A. (2016). Averting degradation of southern Ontario wetlands due to hydrologic alterations associated with development. Can Water Resour J 41(4):543–553. https://doi.org/10.108 0/07011784.2015.1119061

Business and Biodiversity Offsets Programme (BBOP). (2018). Glossary. BBOP, Washington, D.C. 3 rd updated edition. Available from https://www.foresttrends.org/bbop_pubs/glossary_2018

Bull, J. W., Lloyd, S. P., & Strange, N. (2017). Implementation Gap between the Theory and Practice of Biodiversity Offset Multipliers. Conservation Letters, 10(6), Article 6. https://doi.org/10.1111/conl.12335

Bull, J. W., Suttle, K. B., Gordon, A., Singh, N. J., & Milner-Gulland, E. J. (2013). Biodiversity offsets in theory and practice. Oryx, 47(3), 369–380. https://doi.org/10.1017/S003060531200172X

Bureau, R. C. (2001). Wetlands values and functions. In *Ramsar Convention Bureau: Gland, Switzerland*.

Burgin, S. (2010). 'Mitigation banks' for wetland conservation: a major success or an unmitigated disaster?. *Wetlands Ecology and Management*, *18*, 49-55.

Burgos-Ayala, A., Jiménez-Aceituno, A., Torres-Torres, A. M., Rozas-Vásquez, D., & Lam, D. P. M. (2020). Indigenous and local knowledge in environmental management for human-nature connectedness: A leverage points perspective. Ecosystems and People, 16(1), 290–303. https://doi.org/10.1080/26395916.2020.1817152

Byun E, Finkelstein SA, Cowling SA, Badiou P. (2018). Potential carbon loss associated with post-settlement wetland conversion in Southern Ontario, Canada. Carbon Balance Manag 13(6):1–12. https://doi.org/10.1186/s13021-018-0094-4

Calvet, C., Napoléone, C., & Salles, J.-M. (2015). The Biodiversity Offsetting Dilemma: Between Economic Rationales and Ecological Dynamics. Sustainability, 7(6), Article 6. https://doi.org/10.3390/su7067357

Carr Kelman, C., Brady, U., Raschke, B. A., & Schoon, M. L. (2023). A systematic review of key factors of effective collaborative governance of social-ecological systems. Society & Natural Resources, 36(11), 1452-1470.

Carr Kelman, D., Emmerson, D., & Thomas, C. (2023). Collaborative governance in natural resource management. Journal of Environmental Management, 297, 113460.

Canadian Wildlife Service. (2019). Wetland conservation in Canada. Environment and Climate Change Canada.

Cheng, R. & Lee, P. (2008). Urban Sprawl and Other Major Land Use Conversions in Ontario's Greenbelt From 1993 to 2007: A Change Analysis Project Using Satellite Imagery. Edmonton, Alberta.

City of Toronto. (n.d.). Ministerial Zoning Orders. https://www.toronto.ca/city-government/planning-development/zoning-by-law-preliminary-zoning-reviews/zoning-in-toronto/ministerial-zoning-orders/

Clare, S., Krogman, N., Foote, L., & Lemphers, N. (2011). Where is the avoidance in the implementation of wetland law and policy? Wetlands Ecology and Management, 19(2), 165–182. https://doi.org/10.1007/s11273-011-9209-3

Condon, John. (2020). Biodiversity offsetting and the English planning system: a regulatory analysis. J. Environ. Law 32, 529–557. https://doi.org/10.1093/jel/eqaa018.

Conservation Ontario. (n.d). Conservation Authorities Act. Retrieved from Conservation Authorities Act - Section 28 Regulations // Conservation Ontario

Convention on Biological Diversity. (2022, October). Kunming-Montreal global biodiversity framework. In Conference of the Parties to the Convention on Biological Diversity. Montreal, Canada: UN Environment Programme.

Convention on Wetlands. (2021). Global Wetland Outlook: Special Edition 2021. Gland, Switzerland: Secretariat of the Convention on Wetlands.

Cooper, C.M., & Moore, M.T. (2003). Chapter 10 Wetlands and Agriculture. Retrieved from https://www.ars.usda.gov/ARSUserFiles/3938/Ch10%20%28221-236%29.pdf

Corps [US Army Corps of Engineers], & EPA [US Environmental Protection Agency]. (1990). Memorandum of agreement between the Department of the Army and the Environmental Protection Agency: The determination of mitigation under the clean water act section 404(b)(1) guidelines.

Costanza, R., De Groot, R., Sutton, P., Van Der Ploeg, S., Anderson, S. J., Kubiszewski, I., Farber, S., & Turner, R. K. (2014). Changes in the global value of ecosystem services. Global Environmental Change, 26, 152–158. https://doi.org/10.1016/j.gloenvcha.2014.04.002

Cowardin, L. M., Carter, V., Golet, F. C. & LaRoe, E. T. (1979). Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS 79/31.

Coyle, D. (2020). Wetland Management in Ontario: A Social Multi-Criteria Evaluation of Niagara Falls' Slough Forests [Master Thesis, University of Waterloo]. https://uwspace.uwaterloo.ca/handle/10012/16003

Credit Valley Conservation (CVC). (2020). Ecosystem Offsetting Guidelines. Ecosystem Offsetting Guidelines - Credit Valley Conservation (cvc.ca)

Creswell, & Creswell, D. (2018). Research Design_ Qualitative Quantitative and Mixed Methods Approaches (5th ed.). SAGE Publications, Inc

Creswell, J. W. (2009). Research design: Qualitative, quantitative, and mixed methods approaches (3rd ed). Sage Publications.

Creswell, J.W. (2014). Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research.

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. BMC Medical Research Methodology, 11(1), 1–9

Crowl, T. A., Crist, T. O., Parmenter, R. R., Belovsky, G., & Lugo, A. E. (2008). The spread of invasive species and infectious disease as drivers of ecosystem change. Frontiers in Ecology and the Environment, 6(5), 238-246.

Cugusi B, Piccarozzi M. (2009). Environmental change and human mobility. A thematic literature and organisational review. Paper presented at: International Conference: Towards the G8 Summit Climate Change and Human Mobility in Africa Dialogue for a Strategic Cooperation Between Italy and Africa; 2009 Apr 21; Rome, Italy

Dahl, T. E., & Fish, U. S. (n.d.). Status and Trends of Wetlands in the Conterminous United States 1998 to 2004.

Davidson, N. (2014). How much wetland has the world lost? Long-term and recent trends in global wetland area. Marine and Freshwater Research, 65, 936–941. https://doi.org/10.1071/MF14173

Davidson NC, Van Dam AA, Finlayson CM, McInnes RJ. (2019). Worth of wetlands: revised global monetary values of coastal and inland wetland ecosystem services. Marine Freshwater Research 70(8): 1189. https://doi.org/10.1071/mf18391

Dawson, N. M., Coolsaet, B., Sterling, E. J., Loveridge, R., Gross-Camp, N. D., Wongbusarakum, S., ... & Rosado-May, F. J. (2021). The role of Indigenous peoples and local communities in effective and equitable conservation.

de Groot, D., Brander, L., & Max Finlayson, C. (2018). Wetland ecosystem services. In C. M. Finlayson, M. Everard, K. Irvine, R. J. McInnes, B. A. Middleton, A. A. van Dam, & N. C. Davidson (Eds.), The Wetland Book (Vol. 1, pp. 323–333). Springer Netherlands. https://doi.org/10.1007/978-90-481-9659-3_66

de Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L. C., ten Brink, P., & van Beukering, P. (2012). Global estimates of the value of ecosystems and their services in monetary units. Ecosystem Services, 1(1), 50–61. https://doi.org/10.1016/j.ecoser.2012.07.005

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). The SAGE handbook of qualitative research (4th ed.). Thousand Oaks, CA: Sage

Department of Environment and Local Government. (2020). Wetland Compensation and General Guidance. Wetland Compensation General Guidance (gnb.ca)

Dinneen, J. (2020, January 27). Indigenous-led governance and conservation: A complex relationship. Mongabay. https://www.mongabay.com/article/indigenous-led-governance-and-conservation-a-complex-relationship

Doyle, M.W., Lave, R., Robertson, M.M., Ferguson, J. (2013). River federalism. Ann. Assoc. Am. Geogr. 103, 290–298. https://doi.org/10.1080/00045608.2013.754686.

Ducks Unlimited Canada (DUC). (2010). Southern Ontario wetland conversion analysis: final report. Ducks Unlimited Canada, Barrie, ON

Ducks Unlimited Canada. (2021). Wetland conservation and policy. Retrieved from https://www.ducks.ca/our-work/wetland-conservation-policy/

Dupont, L.M., Jahns S, Marret, F., Ning S. (2000). Vegetation change in equatorial West Africa: time-slices for the last 150 ka. Palaeogeogr Palaeoclimatol Palaeoecol. 155: 95–122

Droste, N., Alkan Olsson, J., Hanson, H., Knaggård, Å., Lima, G., Lundmark, L., Thoni, T., & Zelli, F. (2022). A global overview of biodiversity offsetting governance. Journal of Environmental Management, 316, 115231. https://doi.org/10.1016/j.jenvman.2022.115231

Eckert, L. E., Claxton, N. X., Owens, C., Johnston, A., Ban, N. C., Moola, F., & Darimont, C. T. (2020). Indigenous knowledge and federal environmental assessments in Canada: Applying past lessons to the 2019 impact assessment act. FACETS, 5(1), 67–90. https://doi.org/10.1139/facets-2019-0039

EEA. (2015). European environment — state and outlook 2015: Assessment of global megatrends. Copenhagen: European Environment Agency.

Emerson, K., Nabatchi, T., & Balogh, S. (2011). An integrative framework for collaborative governance. Journal of Public Administration Research and Theory, 22(1), 1-29. https://doi.org/10.1093/jopart/mur011

Enríquez-de-Salamanca, A., Martín-Aranda, R.M., Diaz-Sierra, R. (2017). Towards an integrated environmental compensation scheme in Spain: linking biodiversity and carbon offsets. J. Environ. Assess. Pol. Manag. 19, 1750006 https://doi.org/

Ens, E. J., P. Pert, P. A. Clarke, M. Budden, L. Clubb, B. Doran, C. Douras, J. Gaikwad, B. Gott, S. Leonard, J. Locke, J. Packer, G. Turpin, and S. Wason. (2015). Indigenous biocultural knowledge in ecosystem science and management: review and insight from Australia. Biological Conservation 181:133-149. http://dx.doi.org/10.1016/j.biocon.2014.11.008

Environmental Commissioner of Ontario. (2018). Environmental protection report. Retrieved from https://docs.assets.eco.on.ca/reports/environmental-protection/2018/Back-to-BasicsVolume4-Ch1.pdf

Environmental Defence. (2020). You may have never heard of a Minister's Zoning Order and that used to be ok - but not anymore. Retrieved from https://environmentaldefence.ca/2020/08/28/may-never-heard-ministers-zoning-order-used-ok-not-anymore/

Environmental Law Institute. (2002). Banks and fees: the status of offsite wetland mitigation in the United States. Washington, DC, 202 pp

Environment and Climate Change Canada. (2016). Canadian Wetland Conservation Framework. Government of Canada.

Environment and Climate Change Canada. (2021). Canada's Natural Heritage: Protecting our Nature and Biodiversity. Government of Canada.

Environment and Climate Change Canada. (2024). Canada's Natural Heritage Conservation Plan. Government of Canada.

Environment and Climate Change Canada (2021, August 12). Government of Canada announces $340 million to support Indigenous-led conservation. Www.canada.ca. https://www.canada.ca/en/environment-climate-change/news/2021/08/government-of-canada-announces-340-million-to-support-indigenous-led-conservation.html

Environment and Climate Change Canada. (2024, March 11). Canada and Ontario commit to significant collaboration on shared nature conservation goals. Canada.ca. https://www.canada.ca/en/environment-climate-change/news/2024/03/canada-and-ontario-commit-to-significant-collaboration-on-shared-nature-conservation-goals.html

Environment Journal. (2024, August 6th). From neglected brownfield to vibrant biodiversity: The award-winning Grimsby wetlands. https://environmentjournal.ca/from-neglected-brownfield-to-vibrant-biodiversity-the-award-winning-grimsby-wetlands/

EPA. (n.d.-a). Compensatory Mitigation Factsheet under CWA Section 404. Compensatory Mitigation Factsheet under CWA Section 404 | US EPA

EPA. (n.d.-b). Mitigation Banks under CWA Section 404. Mitigation Banks under CWA Section 404 | US EPA

FAO. (2020). The State of World Fisheries and Aquaculture 2020. FAO, Rome

Farrier, D., & Tucker, L. (2000). Wise use of Wetlands Under the Ramsar Convention: A Challange for Meaningful Implementation of International Law. Environmental Law, 12(1). Retrieved from http://iucn.org/themes/ramsar/w.n.html

Far North Science Advisory Panel (Ont.). (2010). *Science for a Changing Far North: The Report of the Far North Advisory Panel*. Far North Branch, Ministry of Natural Resources.

Faulkner, S. (2004). Urbanization impacts on the structure and function of forested wetlands. Urban Ecosystems, 7(2), 89-106.

Federal Interagency Mitigation Workgroup. (2004). Draft Federal Guidance on the Use of Off-Site and Out-of-Kind Compensatory Mitigation Under Section 404 of the Clean Water Act. April 7, 2004

Federal, Provincial and Territorial Governments of Canada. (2010). Canadian Biodiversity: Ecosystem Status and Trends 2010. Canadian Councils of Resource Ministers. Ottawa, ON. vi + 142 p

Fianko, J. R., & Dodd, H. (2018). Sustainable Management of Wetlands: A case study of the Songor Ramsar and UNESCO Man and Biosphere Reserve in Ghana. Journal of Wetlands Environmental Management, 6, 45. https://doi.org/10.20527/jwem.v6i1.173

Fisheries and Oceans Canada. (2019). Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act. Applicants Guide Supporting the "Authorizations concerning fish and fish habitat protection regulations" (dfo-mpo.gc.ca)

Finlayson 1, C. M., Davidson 2, N., Pritchard 3, D., Milton 4, G. R., & MacKay 5, H. (2011). The Ramsar Convention and Ecosystem-Based Approaches to the Wise Use and Sustainable Development of Wetlands. Journal of International Wildlife Law and Policy, 14(3–4), 176–198. https://doi.org/10.1080/13880292.2011.626704

Finlayson, C. M., & van der Valk, A. G. (1995). Wetland classification and inventory: A summary. Vegetatio, 118(1), 185–192. https://doi.org/10.1007/BF00045199

Freyfogle, E. T. (2011). Natural Resources Law: A Global Point of Reference.

Gallardo, B., Clavero, M., Sánchez, M. I., & Vilà, M. (2016). Global ecological impacts of invasive species in aquatic ecosystems. Global change biology, 22(1), 151-163.

Gardner, R. C., & Finlayson, C. (2018). Global Wetland Outlook: State of the World's Wetlands and Their Services to People (SSRN Scholarly Paper 3261606). https://papers.ssrn.com/abstract=3261606

Gell, P. A., Davidson, N. C., & Finlayson, M. (2023). Ramsar Wetlands: Values, Assessment, Management. Elsevier. https://doi.org/10.1016/C2018-0-02282-3

Gerbeaux, P., Finlayson, C. M., & Dam, A. V. (2018). Wetland Classification: Overview. In C. M. Finlayson, M. Everard, K. Irvine, R. J. McInnes, B. A. Middleton, A. A. van Dam, & N. C. Davidson (Eds.), The Wetland book I (Vol. 1, pp. 1461–1468). Springer. https://doi.org/10.1007/978-90-481-9659-3_329

Gevers, G., Koopmanschap, E., Irvine, K., Finlayson, C., & Dam, A. (2016). Capacity development for wetland management., 1-8. https://doi.org/10.1007/978-94-007-6172-8_274-1

Global Inventory of Biodiversity Offset Policies (GIBOP). (2019) International Union for Conservation of Nature. The Biodiversity Consultancy, Durell Institute of Conservation & Ecology [WWW Document]. URL. https://portals.iucn.org/offsetpolicy/.

Gordon (Iñupiaq), H. S. J., Ross, J. A., Cheryl Bauer-Armstrong, Moreno, M., Byington (Choctaw), R., & Bowman (Lunaape/Mohican), N. (2023). Integrating Indigenous Traditional Ecological Knowledge of land into land management through Indigenous-academic partnerships. Land Use Policy, 125, 106469. https://doi.org/10.1016/j.landusepol.2022.106469

Government of Alberta. (2013). Alberta Wetland Policy. Alberta Wetland Policy

Government of Alberta. (2015). Alberta Wetland Mitigation Directive. Water Policy Branch, Alberta Environment and Parks. Edmonton . aep.alberta.ca/water/programs andservices/wetlands/documents/AlbertaWetlandMitigationDirective-Feb2017.pdf.

Government of Canada. (1991). The Federal Policy on Wetland Conservation. P.5. Federal policy on wetland conservation : CW66-116/1991E-IN - Government of Canada Publications - Canada.ca

Government of Canada. (1999). Canadian Environmental Protection Act. Ottawa: Government of Canada.

Government of Nova Scotia. (2011). Nova Scotia Wetland Conservation Policy. Nova.Scotia.Wetland.Conservation.Policy.pdf (novascotia.ca)

Government of Ontario. (2023). Environmental Registry of Ontario. Retrieved from https://ero.ontario.ca/

Grand River Conservation Authority (GRCA). (n.d. – a) Wetlands. Wetlands - Grand River Conservation Authority . Accessed November 28, 2023.

Grand River Conservation Authority. (2008). Grand River Watershed Characterization Report.

Grand river Conservation Authority. (n.d. – b) Restoration. Restoration - Grand River Conservation Authority

Grand River Conservation Authority (GRCA). (n.d. - c). Taquanyah Conservation Area. https://www.grandriver.ca/en/outdoor-recreation/Taquanyah.aspx#gsc.tab=0

Grand River Conservation Authority. (n.d. - d). Rural Water Quality Program. Grand River Conservation Authority. https://www.grandriver.ca/en/our-watershed/Rural-Water-Quality-Program.aspx#gsc.tab=0

Grand River Conservation Authority. (2015). Policies for the Administration of the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation…

Grand River Conservation Authority. (2023). Watershed Report Card. Watershed Report Card - Grand River Conservation Authority

Grand River Conservation Authority. (2024a). Policies for the Administration of the Prohibited Activities, Exemptions and Permits Regulation 41/24

Grand River Conservation Authority. (2024b). GRCA Policies for the Administration of Ontario Regulation 150/06 Revisions, January 2024

Gray, W. B., & Shimshack, J. P. (2011). The effectiveness of environmental monitoring and enforcement: A review of the empirical evidence. Review of Environmental Economics and Policy, 5, 3–24.

Gustavson, K. and Kennedy, E. (2010). Approaching wetland valuation in canada. Wetlands, 30(6), 1065-1076. https://doi.org/10.1007/s13157-010-0112-0

Hahn, R., & Richards, K. (2013). Understanding the effectiveness of environmental offset policies. Journal of Regulatory Economics, 44, 103–119

Hansen, L., Hellerstein, D., Ribaudo, M., Williamson, J., Nulph, D., Loesch, C., & Crumpton, W. (2015). Targeting investments to cost effectively restore and protect wetland ecosystems: some economic insights. *Economic Research Service ERR-183, February*.

Harper, D. J., & Quigley, J. T. (2005). No Net Loss of Fish Habitat: A Review and Analysis of Habitat Compensation in Canada. Environmental Management, 36(3), 343–355. https://doi.org/10.1007/s00267-004-0114-x

HELCOM. (2017). First version of the 'State of the Baltic Sea' report June 2017. Available at: http://stateofthebalticsea.helcom.fi

Hemming, S., Rigney, D., Muller, S. L., Rigney, G., & Campbell, I. (2017). A new direction for water management? Indigenous nation building as a strategy for river health. Ecology and Society, 22(2). https://www.jstor.org/stable/26270083

Hernandez, M. E., Marín-Muñiz, J. L., Moreno-Casasola, P., & Vázquez, V. (2015). Comparing soil carbon pools and carbon gas fluxes in coastal forested wetlands and flooded grasslands in Veracruz, Mexico. International Journal of Biodiversity Science, Ecosystem Services & Management, 11(1), 5-16.

Hettiarachchi, M., McAlpine, C., & Morrison, T. H. (2014). Governing the urban wetlands: A multiple case-study of policy, institutions and reference points. Environmental Conservation, 41(3), 276-289. https://doi.org/10.1017/S0376892913000519

Hobbs, M. (2024). What makes a wetland significant? An examination of changes made to the Ontario Wetland Evaluation System.

Horvat, K. P. and Smrekar, A. (2021). The wetland contract as a tool for successful wetland governance: a case study of ljubljansko barje nature park, slovenia. Sustainability, 13(1), 425. https://doi.org/10.3390/su13010425

Hossu, C. A., Ioja, I. C., Susskind, L. E., Badiu, D. L., & Hersperger, A. M. (2018). Factors driving collaboration in natural resource conflict management: Evidence from Romania. Ambio, 47(7), 816–830. https://doi.org/10.1007/s13280-018-1016-0

Hossu, C., Ioja, I. C., Onose, D. A., Nita, M. R., & Badiu, D. L. (2018). The importance of collaborative governance in the sustainable management of natural resources. Environmental Science and Policy, 89, 154-162.

Hough, P., & Robertson, M. (2009). Mitigation under Section 404 of the Clean Water Act: Where it comes from, what it means. Wetlands Ecology and Management, 17(1), 15-33. https://doi.org/10.1007/s11273-008-9121-7

Hu, S., Niu, Z., Chen, Y., Li, L., & Zhang, H. (2017). Global wetlands: Potential distribution, wetland loss, and status. The Science of the Total Environment, 586, 319–327. https://doi.org/10.1016/j.scitotenv.2017.02.001

Institute for Sustainable Finance. (2024). The Wealth of Wetlands: Measuring the Economic Value of Two Critical Ecosystem Services in Canada. Smith School of Business – Queens University. report-wetlands.pdf (queensu.ca)

IPCC. (2021): Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C. et al. (eds.). Cambridge University Press

Jacob, C., & Dupras, J. (2021). Institutional bricolage and the application of the No Net Loss policy in Quebec: Can we really engender 'social fit' for more sustainable land use planning? Journal of Environmental Policy & Planning, 23(1), 114–129. https://doi.org/10.1080/1523908X.2020.1814129

Junk, W. J., An, S., Finlayson, C. M., Gopal, B., Květ, J., Mitchell, S. A., Mitsch, W. J., & Robarts, R. D. (2013). Current state of knowledge regarding the world's wetlands and their future under global climate change: A synthesis. Aquatic Sciences, 75(1), 151–167. https://doi.org/10.1007/s00027-012-0278-z

Kennedy, G., & Mayer, T. (2002). Natural and Constructed Wetlands in Canada: An Overview. Water Quality Research Journal, 37(2), 295–325. https://doi.org/10.2166/wqrj.2002.020

Kernan, M. (2015). Climate change and the impact of invasive species on aquatic ecosystems. Aquatic Ecosystem Health & Management, 18(3), 321-333.

Khan, S. M. M. H., & Haque, C. (2010). Wetland resource management in Bangladesh: Implications for marginalization and vulnerability of local harvesters. Environmental Hazards, 9(1), 54–73. https://doi.org/10.3763/ehaz.2010.SI08

Kibria, G., & Yousuf Haroon, A. K. (2017). Climate Change Impacts on Wetlands of Bangladesh, its Biodiversity and Ecology, and Actions and Programs to Reduce Risks. In B. A. K. Prusty, R. Chandra, & P. A. Azeez (Eds.), Wetland Science: Perspectives From South Asia (pp. 189–204). Springer India. https://doi.org/10.1007/978-81-322-3715-0_10

Kihslinger, R. (2008). Success of wetland mitigation projects. National Wetlands Newsletter, 30, 14–16.

Koontz, T. M., & Thomas, C. W. (2006). What do we know and need to know about the environmental outcomes of collaborative management?. *Public administration review*, *66*, 111-121.

Kushlan, J.A. (1986). The management of wetlands for aquatic birds. Colon. Waterbirds 246–248. https://doi.org/10.2307/1521220

Lake Simcoe Region Conservation Authority (LSRCA). 2021. Ecological Offsetting Policy. Ecological Offsetting Policy (lsrca.on.ca)

Lake Simcoe Region Conservation Authority. (2023). Annual report. Lake Simcoe Region Conservation Authority.

Lang, M.W., Ingebritsen, J.C., Griffin, R.K. (2024). Status and Trends of Wetlands in the Conterminous United States 2009 to 2019. U.S. Department of the Interior; Fish and Wildlife Service, Washington, D.C. 43 pp.

Laurance, W. F., Peletier-Jellema, A., Geenen, B., Koster, H., Verweij, P., Van Dijck, P., Lovejoy, T. E., Schleicher, J., & Van Kuijk, M. (2015). Reducing the global environmental impacts of rapid infrastructure expansion. Current Biology, 25(7), R259–R262. https://doi.org/10.1016/j.cub.2015.02.050

Lave, R. (2014). Neoliberal confluences: the turbulent evolution of stream mitigation banking in the US. In: Frickel, S., Hess, D.J. (Eds.), Political Power and Social Theory. Emerald Group Publishing Limited, pp. 59–88. https://doi.org/10.1108/ S0198-871920140000027010

Lee, J. (2015). The governance of wetland ecosystems and the promotion of transboundary water cooperation – opportunities presented by the Ramsar Convention. Water International, 40(1), 33–47. https://doi.org/10.1080/02508060.2014.989681

Leslie, M., Nguyen, S. T., Nguyen, T. K. D., Pham, T. T., Cao, T. T. N., Le, T. Q., Dang, T. T., Nguyen, T. H. T., Nguyen, T. B. N., Le, H. N., Tran, T. T., Bui, T. C. T., Tran, N. A., Natascha, M.-H., & Chris, Y. (2018). Bringing social and cultural considerations into environmental management for vulnerable coastal communities: Responses to environmental change in Xuan Thuy National Park, Nam Dinh Province, Vietnam. Ocean & Coastal Management, 158, 32–44. https://doi.org/10.1016/j.ocecoaman.2018.03.022

Lockwood, M., Davidson, J., Curtis, A., Stratford, E., & Griffith, R. (2010). Governance principles for natural resource management. Society & Natural Resources, 23(10), 986-1001.

Love, M., Baldera, A., Robbins C. (2018). The benefits of adaptive management: Three case studies from ecosystem restoration programs around the U.S. Austin, TX: Ocean Conservancy

Lukman, M., Sari, R., & Fahrudin, A. (2023). Collaborative governance in natural resource conflict resolution. Journal of Natural Resource Policy Research, 15(1), 1-20.

Lukman, T., Yahaya, A., & N-yelkabo Tuu, G. (2023). External stakeholders in the collaborative governance of natural resources in Ghana: Experiences from the wa west district. Environmental Challenges, 13, 100769. https://doi.org/10.1016/j.envc.2023.100769

Lynch-Stewart, P., Kessel-Taylor, I., & Rubec, C. D. A. (1999). Wetlands and government: Policy and legislation for wetland conservation in Canada. North American Wetlands Conservation Council.

MACK, J.J. & MICACCHION, M. (2006) An Ecological Assessment of Ohio Mitigation Banks: Vegetation, Amphibians, Hydrology, and Soils. Technical Report no. WET/2006–1. Ohio Environmental Protection Agency, Columbus, USA.

Maron, M., Hobbs, R. J., Moilanen, A., Matthews, J. W., Christie, K., Gardner, T. A., Keith, D. A., Lindenmayer, D. B., & McAlpine, C. A. (2012). Faustian bargains? Restoration realities in the context of biodiversity offset policies. *Biological Conservation*, *155*, 141–148. https://doi.org/10.1016/j.biocon.2012.06.003

Maron, M., Ives, C. D., Kujala, H., Bull, J. W., Maseyk, F. J. F., Bekessy, S., Gordon, A., Watson, J. E. M., Lentini, P. E., Gibbons, P., Possingham, H. P., Hobbs, R. J., Keith, D. A., Wintle, B. A., & Evans, M. C. (2016). Taming a wicked problem: Resolving controversies in biodiversity offsetting. Bioscience, 66, 489–498. https://doi.org/10.1093/biosci/biw038

Mann Lawyers. (2023). Ontario proceeds with changes to wetland evaluation. Ontario Proceeds with Changes to Wetland Evaluation - Mann Lawyers

Marton, J.M., Creed, I.F., Lewis, D.B., Lane, C.R., Basu, N.B., Cohen, M.J., Craft, C.B. (2015). Geographically isolated wetlands are important biogeochemical reactors on the landscape. Bioscience 65 (4), 408–418. https://doi.org/10.1093/biosci/biv009.

MATTHEWS, J.W. & ENDRESS, A.G. (2008) Performance criteria, compliance success, and vegetation development in compensatory mitigation wetlands. Environmental Management, 41, 130–141.

McCartney, M. P., Rebelo, L. M., & Sellamuttu, S. S. (2015). Wetlands, livelihoods and human health. Wetlands and human health, 123-148.

McDermott, Larry, and Anne Bell. (2017) Indigenous Perspectives on Conservation Offsetting: Five Case Studies from Ontario, Canada, Toronto: Ontario Nature, Plenty Canada and the Indigenous Environmental Studies and Sciences Program at Trent University. ontarionature.org/protect/habitat/PDFs/Indigenous%20Perspectives%20on%20Conservation%20Offsetting%20final_796kb.pdf.

McGregor, D. (2021). Indigenous Knowledge Systems in Environmental Governance in Canada. KULA: Knowledge Creation, Dissemination, and Preservation Studies, 5(1), 1–10. https://doi.org/10.18357/kula.148

McInnes RJ. (2013). Recognizing ecosystem services from wetlands of international importance: an example from Sussex, UK. Wetlands. 33:1001–1017. doi:10.1007/s13157-013-0458-1

McIntosh, E. (2023). What's an MZO, anyway? Ontario's obscure land zoning stirs controversy in Durham Region. Retrieved from What's an MZO? Ontario's zoning power move, explained | The Narwhal

McKenney, B. (2005). Environmental offset policies, principles, and methods: a review of selected legislative frameworks. Amherst (NH): Biodiversity Neutral Initiative.

McKenney, B. A., & Kiesecker, J. M. (2010). Policy Development for Biodiversity Offsets: A Review of Offset Frameworks. Environmental Management, 45(1), 165–176. https://doi.org/10.1007/s00267-009-9396-3

MEA. (2005). Millennium Ecosystem Assessment: Ecosystems and Human Well-being. https://www.wri.org/research/millennium-ecosystem-assessment-ecosystems-and-human-well-being

Megdal, S., Eden, S., & Shamir, E. (2017). Water Governance, Stakeholder Engagement, and Sustainable Water Resources Management. Water, 9(3), 190. https://doi.org/10.3390/w9030190

Mitra, S., Wassmann, R., & Vlek, P. L. (2003). Global inventory of wetlands and their role in the carbon cycle.

Mitsch WJ, Gosselink JG. (2000). The value of wetlands: importance of scale and landscape setting. Ecol Econom. 35:2533. doi:10.1016/S0921-8009(00)00165-8

Mitsch, W., & Gosselink, J. (2015). Wetlands, 5th edition.

Mitsch, W. J., Bernal, B., & Hernandez, M. E. (2015). Ecosystem services of wetlands. International Journal of Biodiversity Science, Ecosystem Services & Management, 11(1), 1–4. https://doi.org/10.1080/21513732.2015.1006250

Mitsch, W. J. (with Gosselink, J. G.). (2015). Wetlands (Fifth edition.). Wiley.

Mitsch, W. J., & Gosselink, J. G. (2023). Wetlands. John Wiley & Sons.

Mitsch, W. J., & Hernandez, M. E. (2013). Landscape and climate change threats to wetlands of North and Central America. Aquatic Sciences, 75(1), 133–149. https://doi.org/10.1007/s00027-012-0262-7

Moomaw, W., Chmura, G., Davies, G., Finlayson, M., Middleton, B., Natali, S., Perry, J., Roulet, N., & Sutton-Grier, A. (2018). Wetlands In a Changing Climate: Science, Policy and Management. Wetlands, 38, 1–23. https://doi.org/10.1007/s13157-018-1023-8

Moore, A. C., & Kumble, S. (2024). Community-based conservation and restoration in coastal wetlands: A review. Wetlands, 44, 62. https://doi.org/10.1007/s13157-024-01818-3

Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. Nursing Research, 40(1), 120–123.

Moudrak, N., Hutter, A. M., & Feltmate, B. (2017). When the big storms hit: the role of wetlands to limit urban and rural flood damage. Intact Centre on Climate Adaptation.

Moreno-Mateos, D., Power, M. E., Comín, F. A., & Yockteng, R. (2012). Structural and Functional Loss in Restored Wetland Ecosystems. PLOS Biology, 10(1), e1001247. https://doi.org/10.1371/journal.pbio.1001247

National Farmers Union. (2022). Joint Response to Proposed Changes to Ontario Wetland Evaluation System (ERO 019-6160). Joint Response to Proposed Changes to Ontario Wetland Evaluation System (ERO 019-6160) | NFU-O National Farmers Union of Ontario (nfuontario.ca)

National Wetlands Working Group. (1997). The Canadian Wetland Classification System, 2nd Edition. Warner, B.G. and C.D.A. Rubec (eds.), Wetlands Research Centre, University of Waterloo, Waterloo, ON, Canada. 68 p.

New Brunswick Natural Resources and Energy & New Brunswick Environment and Local Government. (2002). New Brunswick Wetland Conservation Policy. DRAFT (gnb.ca)

North American Waterfowl Management Plan Committee. (2018). North American Waterfowl Management Plan (NAWMP) Update: Connecting People, Waterfowl, and Wetlands. Canadian Wildlife Service, US Fish & Wildlife Service, and Secretaria de Medio Ambiente y Recursos Naturales.

Nottawasaga Valley Conservation Authority (NVCA). (2021). Achieving Net Gains through ecological offsetting. *NVCA_Net_Gains_Guidelines-FINAL-September-2021_rev.pdf

Nunes, A.L., Douthwaite, R.J., Tyser, B., Measey, G.J. & Weyl, O.L.F. (2016). Invasive crayfish threaten Okavango Delta. Frontiers in Ecology and the Environment. doi:10.1002/fee.1287

Olvera-Garcia, J., & Neil, S. (2020). Examining how collaborative governance facilitates the implementation of natural resource planning policies: A water planning policy case from the Great Barrier Reef. Environmental Policy and Governance, 30(3), 115-127.

Ontario Biodiversity Council (OBC). (2015). State of Ontario's Biodiversity 2015. A Report of the Ontario Biodiversity Council, Peterborough, ON

Ontario Biodiversity Council. (2021). State of Ontario's Biodiversity [web application]. Ontario Biodiversity Council, Peterborough, Ontario. [Available at: http://ontariobiodiversitycouncil.ca/sobr

Ontario Housing Affordability Task Force. (2022). Report of the Ontario Housing Affordability Task Force. Report of the Ontario Housing Affordability Task Force

Ontario Ministry of Finance. (2014). Ontario Population Projections Fall 2014: Based on the 2011 Census. http://dx.doi.org/10.1016/S0022-3913(12)00047-9. Toronto, Ontario

Ontario Ministry of Natural Resources and Forestry (MNRF). (2015). Wetland Conservation in Ontario: A Discussion Paper. ontla.on.ca/library/repository/mon/29007/331299.pdf

Ontario Ministry of Natural Resources and Forestry. (2022). Ontario Wetland Evaluation System Southern Manual 4th Edition 2022.

Ontario Ministry of Natural Resources and Forestry. (2017). Ontario wetland evaluation system. Ontario Ministry of Natural Resources and Forestry.

Ontario Ministry of Natural Resources and Forestry. (2017). A Wetland Conservation Strategy for Ontario 2017–2030. Queen's Printer for Ontario. Toronto, ON. 52 pp.

Ontario Nature. (2022). Bill 23 Backgrounder. Bill 23 Backgrounder - November 2022 - Page 1 (publitas.com)

Ontario Nature. (2023). Wetland Offsetting Policies for Local Planning Authorities: A review of wise practices in Ontario.

Ontario Nature. (n.d – a). An Introduction to Wetland Offsetting. An Introduction to Wetland Offsetting - Ontario Nature

Ontario Nature. (n.d. – b). Bill 23. Bill 23 - Ontario Nature Accessed June 21st

Ontario Nature. (n.d. - c). Wetland Offsetting Policy Evaluation. Retrieved from https://ontarionature.org/campaigns/wetlands/wetland-offsetting-policy-evaluation/

Ontario Nature. (n.d. - d). Wetland Offsetting Policy Evaluation. Retrieved from https://ontarionature.org/campaigns/wetlands/wetland-offsetting-policy-evaluation/

Ontario. (2020). Provincial Policy Statement, 2020. Provincial Policy Statement, 2020 - Under the Planning Act (ontario.ca)

Patino, J.E. & Estupinan-Suarez, L.M. (2016). Hotspots of wetland area loss in Colombia. Wetlands, 36, 935-943.

Penfound, E. (2023). Ontario Wetland Policy Analysis. In E. Vaz (Ed.), Regional and Urban Change and Geographical Information Systems and Science: An Analysis of Ontario, Canada (pp. 181–194). Springer International Publishing. https://doi.org/10.1007/978-3-031-24731-6_7

Penfound, E., & Vaz, E. (2022). Analysis of 200 years of change in ontario wetland systems. Applied Geography, 138, 102625. https://doi.org/10.1016/j.apgeog.2021.102625

Pezzati, L., Verones, F., Curran, M., Baustert, P., & Hellweg, S. (2018). Biodiversity Recovery and Transformation Impacts for Wetland Biodiversity. Environmental Science & Technology, 52(15), 8479–8487. https://doi.org/10.1021/acs.est.8b01501

Polajnar Horvat, K., Gašperič, P., Leban, K., Tičar, J., & Smrekar, A. (2022a). A participatory approach to wetland governance: The case of the memorandum of understanding of the Sečovlje Salina Nature Park. Sustainability, 14(16), 9920. https://doi.org/10.3390/su14169920

Polajnar Horvat, K., Mladenović, V., & Černoga, M. (2022b). Participatory management of wetlands in the Secvije Salina Nature Park: A case study. Wetlands Ecology and Management, 30(4), 637-654.

Porej, D., Hetherington, T.E. (2005). Designing Wetlands for Amphibians: The Importance of Predatory Fish and Shallow Littoral Zones in Structuring of Amphibian Communities. Wetl. Ecol. Manage. 13, 445–455. https://doi.org/10.1007/s11273004-0522-y

Poulton, D. (2021). Biodiversity Offsetting in Canada: A Brief Review of Policies. Alberta Land Institute, University of Alberta.

Poulton, D., & Bell, A. (2017). Navigating the Swamp: Lessons on Wetland Offsetting for Ontario (SSRN Scholarly Paper 3066226). https://doi.org/10.2139/ssrn.3066226

Poulton, D. W. (2014). Conservation Offset Policy for Alberta: A Comparative Legal Analysis. Graduate Studies. https://doi.org/10.11575/PRISM/25424

Price, J. S., Branfireun, B. A., Michael Waddington, J., & Devito, K. J. (2005). Advances in Canadian wetland hydrology, 1999–2003. Hydrological Processes, 19(1), 201–214. https://doi.org/10.1002/hyp.5774

Price, Edward P. F., Greg Spyreas, and Jeffrey W. Matthews. (2019). "Wetland compensation and its impacts on β-diversity." Ecological Applications 29 (1): e01827. https://doi.org/10.1002/eap.1827

Pyke, M. L., Toussaint, S., Close, P. G., Dobbs, R. J., Davey, I., George, K. J., Oades, D., Sibosado, D., McCarthy, P., Tigan, C., Angus, B., Riley, E., Cox, D., Cox, Z., Smith, B., Cox, P., Wiggan, A., & Clifton, J. (2018). Wetlands need people: A framework for understanding and promoting Australian indigenous wetland management. Ecology and Society, 23(3). https://www.jstor.org/stable/26799161

Quétier, F., & Lavorel, S. (2011). Assessing ecological equivalence in biodiversity offset schemes: Key issues and solutions. Biological Conservation, 144, 2991–2999. https://doi.org/10.1016/j.biocon.2011.09.002

Quétier, F., Regnery, B., & Levrel, H. (2014). No net loss of biodiversity or paper offsets? A critical review of the French no net loss policy. *Environmental Science & Policy*, *38*, 120–131. https://doi.org/10.1016/j.envsci.2013.11.009

Quigley, J. T., & Harper, D. J. (2006). Effectiveness of Fish Habitat Compensation in Canada in Achieving No Net Loss. Environmental Management, 37(3), 351–366. https://doi.org/10.1007/s00267-004-0263-y

Race, M. S., & Fonseca, M. S. (1996). Fixing Compensatory Mitigation: What Will it Take? Ecological Applications, 6(1), 94–101. https://doi.org/10.2307/2269556

Rai, R. (2007). Community engagement in natural resource management: The role of traditional ecological knowledge. Ecological Applications, 17(5), 1239-1248.

Rai, S. C. (2007). Traditional ecological knowledge and community-based natural resource management in northeast India. Journal of Mountain Science, 4(3), 248–258. https://doi.org/10.1007/s11629-007-0248-4

Ramsar Convention on Wetlands. (n.d.). Wetlands and agriculture: impacts of farming practices and pathways to sustainability. Retrieved from https://www.ramsar.org/sites/default/files/documents/library/bn13_agriculture_e.pdf

Ramsar Convention on Wetlands. (2018). Global Wetland Outlook: State of the World's Wetlands and their Services to People. Gland, Switzerland: Ramsar Convention Secretariat

Ramsar Convention. (1971). The Convention on Wetlands text, as originally adopted in 1971. Available at https://www.ramsar.org/document/the-convention-on-wetlands-text-as-originally-adopted-in-1971

Ramsar Convention Secretariat. (2013). The Ramsar Convention Manual: a guide to the Convention on Wetlands (Ramsar, Iran, 1971), 6th ed. Ramsar Convention Secretariat, Gland, Switzerland.

Ramsar Convention Secretariat. (2016). An Introduction to the Convention on Wetlands (previously The Ramsar Convention Manual). Ramsar Convention Secretariat, Gland, Switzerland. https://www. ramsar.org/sites/default/files/documents/library/handbook1_5ed_ introductiontoconvention_e.pdf.

Rapp, C. (2020). Hypothesis and theory: Collaborative governance, natural resource management, and the trust environment. Frontiers in Communication, 5. https://doi.org/10.3389/fcomm.2020.00028

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. Biological Conservation, 141(10), 2417–2431. https://doi.org/10.1016/j.biocon.2008.07.014

Richardson, S.J., Clayton, R., Rance, B.D., Broadbent, H., McGlone, M.S., Wilmshurst, J. M. (2015). Small wetlands are critical for safeguarding rare and threatened plant species. Appl. Veg. Sci. 18 (2), 230 –241. https://doi.org/10.1111/avsc.12144.

Robertson, H.A., Ausseil, A.G., Rance, B., Betts, H. & Pomeroy, E. (2019). Loss of wetlands since 1990 in Southland, New Zealand. New Zealand Journal of Ecology, 43, 3355

ROBERTSON, M., & HAYDEN, N. (2008). Evaluation of a Market in Wetland Credits: Entrepreneurial Wetland Banking in Chicago. Conservation Biology, 22(3), 636–646. https://doi.org/10.1111/j.1523-1739.2008.00963.x

Robertson, M.M. (2004). The neoliberalization of ecosystem services: wetland mitigation banking and problems in environmental governance. Geoforum 35 (3), 361–373. https://doi.org/10.1016/j.geoforum.2003.06.002.

Rojas, C., Munizaga, J., Rojas, O., Martínez, C., & Pino, J. (2019). Urban development versus wetland loss in a coastal Latin American city: Lessons for sustainable land use planning. Land use policy, 80, 47-56.

Ross, Kristi and Marun-Batista, Jonathan. (2024). Ontario Advances Changes to Conservation Authorities Act for Safer Development. Ontario Advances Changes to Conservation Authorities Act for Safer Development (airdberlis.com)

Rubec, C., & Hanson, A. (2009). Wetland mitigation and compensation: Canadian experience. Wetlands Ecology and Management, 17(1), 3–14. https://doi.org/10.1007/s11273-008-9078-6

Rubec, C., & Lynch-Stewart, P. (1998). REGULATORY AND NON-REGULATORY APPROACHES FOR WETLAND CONSERVATION IN CANADA.

Salimi, S., Almuktar, S. A. A. A. N., & Scholz, M. (2021). Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management, 286, 112160. https://doi.org/10.1016/j.jenvman.2021.112160

Schulte-Hostedde, B., Walters, D., Powell, C., & Shrubsole, D. (2007). Wetland management: An analysis of past practice and recent policy changes in Ontario. Journal of Environmental Management, 82(1), 83–94. https://doi.org/10.1016/j.jenvman.2005.12.007

Scott, D. A., & Jones, T. A. (1995). Classification and inventory of wetlands: A global overview. Vegetatio, 118(1), 3–16. https://doi.org/10.1007/BF00045186

Sewell, A., Bouma, J., & van der Esch, S. (2016). Investigating the challenges and opportunities for scaling up ecosystem restoration. The Hague, The Netherlands: PBL Netherlands Environmental Assessment Agency

Smrekar, A., Horvat, K. P., & Ribeiro, D. (2019). Stakeholder analysis for (mediterranean) wetland governance: the case of ljubljansko barje nature park, slovenia. The Urban Book Series, 169-184. https://doi.org/10.1007/978-3-030-28014-7_11

Snell, E. A. (1987). Wetland distribution and conversion in southern Ontario.

Sonter, L. J., Gordon, A., Archibald, C., Simmonds, J. S., Ward, M., Metzger, J. P., Rhodes, J. R., & Maron, M. (2020a). Offsetting impacts of development on biodiversity and ecosystem services. Ambio, 49(8), 892-902.

Sonter, L., Simmonds, J., Watson, J., & Maron, M. (2020b, April 15). Biodiversity offsetting requires lots of land. International Union for Conservation of Nature (IUCN). https://iucn.org/news/business-and-biodiversity/202004/biodiversity-offsetting-requires-lots-land

Spence, R. (2021). Wetland Offsetting: Emergent Protocols and Techniques for Prioritizing Site-Specific Wetland Services [M.A., Trent University (Canada)]. https://www.proquest.com/docview/2573043865/abstract/7517A38B5EE54084PQ/1

Stadel, A., Evans, M., Kuiper, L., Mojgani, S., Weber, S., White, A., & Mulamoottil, G. (1993). Wetlands on trial : Ontario Municipal Board decisions affecting wetlands, 1980-1993. Canadian Public Administration, 38(2), 222–241.

Stephenson, K., & Tutko, B. (2018). The Role of in Lieu Fee Programs in Wetland/Stream Mitigation Credit Trading: Illustrations from Virginia and Georgia. Wetlands, 38(6), 1211–1221. https://doi.org/10.1007/s13157-018-1057-y

Stratford, C.J. (2018). Monitoring of Wetlands: Overview. In: Finlayson, C.M., et al. The Wetland Book. Springer, Dordrecht. https://doi.org/10.1007/978-90-481-9659-3_289

Tang Kai, N., & Swatuk, L. (2023). The Path Forward. In N. Tang Kai & L. Swatuk (Eds.), Prioritizing the Environment in Urban Sustainability Planning: Policies and Practices of Canadian Cities (pp. 107–117). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-46522-2_7

ten Brink, P, Russi D, Farmer A, Badura T, Coates D, Fo ̈rster J, Kumar R, Davidson N. (2013). The economics of ecosystems and biodiversity for water and wetlands. Executive summary. Available online: http://img.teebweb.org/wpcontent/uploads/2013/04/TEEB_WaterWetlands_ ExecSum_2013.pdf.

ten Kate, Kerry. (2018). Improving the Implementation of the Mitigation Hierarchy through Policy: Benchmark for Review of Policy Measures. Business and Biodiversity Offsets Programme (BBOP). Forest Trends, 2018, Washington, D.C

ten Kate, K., Bishop, J., & Bayon, R. (2004). *Biodiversity offsets: Views, experience, and the business case*. IUCN--The World Conservation Union.

The Wetland Conservation Strategy Advisory Panel. (2018). Considerations for the development of a wetland offsetting policy for Ontario

Theis, S., Ruppert, J. L., Roberts, K. N., Minns, C. K., Koops, M., & Poesch, M. S. (2019). Compliance with and ecosystem function of biodiversity offsets in North American and European freshwaters. Conservation Biology. https://doi.org/10.1111/cobi.13343

Tilman, D., Balzer, C., Hill, J., & Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture. *Proceedings of the national academy of sciences*, *108*(50), 20260-20264.

Tillman, S. C., Spyreas, G., Olnas, A., & Matthews, J. W. (2022). Plant communities in wetland mitigation banks surpass the quality of those in the most degraded, naturally occurring wetlands, but fall short of high-quality wetlands. Ecological Engineering, 176, 106526. https://doi.org/10.1016/j.ecoleng.2021.106526

Tolentino, A.M. (2013). Cultural values of wetlands. Environmental Policy and Law, 43, 87-90.

Torres, A., Jaeger, J. A. G., & Alonso, J. C. (2016). Assessing large-scale wildlife responses to human infrastructure development. Proceedings of the National Academy of Sciences, 113(30), 8472–8477. https://doi.org/10.1073/pnas.1522488113

Toronto and Region Conservation Authority (TRCA). 2023. Guideline for determining Ecosystem compensation.

Toronto and Region Conservation Authority. (2018). Guidelines for ecosystem compensation. Toronto and Region Conservation Authority.

TRCA. n.d. Ecosystem Compensation. Ecosystem Compensation - Toronto and Region Conservation Authority (TRCA).

Trenholm, R., Haider, W., Lantz, V., Knowler, D., & Haegeli, P. (2017). Landowner preferences for wetlands conservation programs in two Southern Ontario watersheds. *Journal of Environmental Management*, *200*, 6-21.

Troy, A., & Bagstad, K. (2009). Estimating ecosystem services in Southern Ontario. Spatial Informatics Group, LLC, 3248.

Turner, R. K., Van Den Bergh, J. C. J. M., Sö Derqvist D, T., Barendregt, A., Van Der Straaten, J., Maltby, E., & Van Ierland, E. C. (2000). Ecological-economic analysis of wetlands: scientific integration for management and policy. Ecological Economics, 35, 7–23. Retrieved from www.elsevier.com/locate/ecolecon

UN. (2015). World Urbanization Prospects: The 2014 Revision. ST/ESA/ SER.A/366. United Nations, Department of Economic and Social

Verhoeven, J. T. A., & Setter, T. L. (2010). Agricultural use of wetlands: opportunities and limitations. Annals of Botany, 105, 155–163. https://doi.org/10.1093/aob/mcp172

Villa JA, Mitsch WJ. (2015). Carbon sequestration in different wetland plant communities in Southwest Florida. Int J Biodivers Sci, Ecosyst Serv Manag. 11:17–28.

Villarroya, A., Persson, J., Puig, J. (2014). Ecological compensation: from general guidance and expertise to specific proposals for road developments. Environ. Impact Assess. Rev. 45, 54–62. https://doi.org/10.1016/j.eiar.2013.12.003.

Villarroel, E. K., Mollinedo, P. L. P., Domic, A. I., Capriles, J. M., & Espinoza, C. (2014). Local management of Andean wetlands in Sajama National Park, Bolivia: Persistence of the collective system in increasingly family-oriented arrangements. Mountain Research and Development, 34(4), 356–369. https://doi.org/10.1659/MRD-JOURNAL-D-14-00024.1

Walker, S., Brower, A. L., Stephens, R., & Lee, W. G. (2009). Why bartering biodiversity fails. Conservation Letters, 2, 149–157.

Walters, D., Shrubsole, D. (2003). Agricultural drainage and wetland management in Ontario. Journal of Environmental Management 69, 369–379.

Water Docs. (2021). What are MZOs? And why are they everywhere lately?. Retrieved from https://www.waterdocs.ca/water-talk/2021/4/12/what-are-mzos

Wende, W., Albrecht, J., Darbi, M., Herbert, M., May, A., Schumacher, J., Szaramowicz, M. (2018). Germany. In: Wende, W., Tucker, G.-M., Que´tier, F., Rayment, M., Darbi, M. (Eds.), Biodiversity Offsets. Springer International Publishing, Cham, pp. 123–156. https://doi.org/10.1007/978-3-319-72581-9_8.

Wetlands International. (2024). Scaling up wetland conservation and restoration to deliver the Kunming-Montreal Global Biodiversity Framework. Retrieved from https://www.wetlands.org/publication/scaling-up-wetland-conservation-and-restoration-to-deliver-the-kunming-montreal-global-biodiversity-framework/

Whipps, N. (2014). What happens when species move but reserves do not: creating climate adaptive solutions to climate change. Hastings Law J. 66, 557.

Wilson, S. J. (2008). Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services', David Suzuki Foundation, Vancouver. URL: www. davidsuzuki. org/publications/downloads/2008/DSF-Greenbelt-web. pdf.

World Economic Forum. (2021, February 2). *Why wetlands are so important for the environment*. World Economic Forum. https://www.weforum.org/agenda/2021/02/wetlands-environmental-protection-ecsystem-biodiversity/

World Wildlife Fund. (2021, February 2). *World must not forget small wetlands*. WWF News. https://wwf.panda.org/wwf_news/?1350416/World-must-not-forget-small-wetlands

Xi, Y., Peng, S., Ciais, P., & Chen, Y. (2021). Future impacts of climate change on inland Ramsar wetlands. Nature Climate Change, 11(1), Article 1. https://doi.org/10.1038/s41558-020-00942-2

Xu, X., Chen, M., Yang, G., Jiang, B., & Zhang, J. (2020). Wetland ecosystem services research: A critical review. Global Ecology and Conservation, 22, e01027. https://doi.org/10.1016/j.gecco.2020.e01027

Yang W, Liu Y, Ou C, Gabor S. (2016). Examining water quality effects of riparian wetland loss and restoration scenarios in a Southern Ontario watershed. J Environ Manag 174:26–34. https://doi. org/10.1016/j.jenvman.2016.03.001

Youdelis, M. (2016). "They could take you out for coffee and call it consultation!": The colonial antipolitics of Indigenous consultation in Jasper National Park. Environment and Planning A: Economy and Space, 48(7), 1374–1392. https://doi.org/10.1177/0308518X16640530

Yu, S., Cui, B., & Gibbons, P. (2018). A method for identifying suitable biodiversity offset sites and its application to reclamation of coastal wetlands in China. Biological Conservation, 227, 284–291. https://doi.org/10.1016/j.biocon.2018.09.030

Yu, S., Cui, B., Xie, C., Ma, X., & Ning, Z. (2019). Ecological offsetting in china's coastal wetlands: existing challenges and strategies for future improvement. Chinese Geographical Science, 29(2), 202-213. https://doi.org/10.1007/s11769-019-1024-4

Zebardast, L., Akbarpour, S., Jafari, H. R., & Bagherzadeh Karimi, M. (2021). Sustainable wetland management through bridging the communication gap between conservation projects and local communities. Environment, Development and Sustainability, 23(7), 11098–11119. https://doi.org/10.1007/s10668-020-01082-5

Zedler, J.B. & Kercher, S. (2004). Causes and consequences of invasive plants in wetlands: opportunities, opportunists, and outcomes. Critical Reviews in Plant Sciences, 23(5), 431-452.

Zedler, J. B., & Kercher, S. (2005). WETLAND RESOURCES: Status, Trends, Ecosystem Services, and Restorability. Annual Review of Environment and Resources, 30(Volume 30, 2005), 39–74. https://doi.org/10.1146/annurev.energy.30.050504.144248

Zou, Y., Wang, L., Xue, Z., Mingju, E., Jiang, M. et al. (2018). Impacts of agricultural and reclamation practices on wetlands in the Amur River Basin, Northeastern China. Wetlands, 38, 383-389.

Zhang, Z., Bortolotti, L. E., Li, Z., Armstrong, L. M., Bell, T. W., & Li, Y. (2021). Heterogeneous Changes to Wetlands in the Canadian Prairies Under Future Climate. Water Resources Research, 57(7), e2020WR028727. https://doi.org/10.1029/2020WR028727

Zu Ermgassen, S. O. S. E., Utamiputri, P., Bennun, L., Edwards, S., & Bull, J. W. (2019). The Role of "No Net Loss" Policies in Conserving Biodiversity Threatened by the Global Infrastructure Boom. One Earth, 1(3), 305–315. https://doi.org/10.1016/j.oneear.2019.10.019

Appendix A: Ethics Clearance Form

UNIVERSITY OF WATERLOO

Notification of Ethics Clearance to Conduct Research with Human Participants

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Principal Investigator: Larry Swatuk

Student investigator: Ejiro Movoria

File #: 45399

Title: Wetland Offsetting: A Policy tool for Sustainable Wetland Management in the Grand River Watershed

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The Human Research Ethics Board is pleased to inform you this study has been reviewed and given ethics clearance.

Initial Approval Date: 05/07/24 (m/d/y)

University of Waterloo Research Ethics Boards are composed in accordance with, and carry out their functions and operate in a manner consistent with, the institution's guidelines for research with human participants, the Tri-Council Policy Statement for the Ethical Conduct for Research Involving Humans (TCPS2 2022), the Ontario Personal Health Information Protection Act (PHIPA), and all laws and regulations of the province of Ontario (as applicable). Additionally, CREB operates in a manner consistent with the International Conference for Harmonization of Technical Requirements for Pharmaceuticals for Human Use (ICH) Guidance E6(R2): Good Clinical Practice , the International Organization for Standardization of Good Clinical Practices (GCP) as set out by ISO 14155 - Clinical investigation of medical devices for human subjects, Part C, Division 5 of the Food and Drug Regulations, Part 4 of the Natural Health Products Regulations, Part 3 of the Medical Devices Regulations. Both Boards are registered with the U.S. Department of Health and Human Services under the Federal Wide Assurance, FWA00021410, and IRB registration number IRB00002419 (HREB) and IRB00007409 (CREB).

Expiry Date: 05/08/25 (m/d/y)

Multi-year research must be renewed at least once every 12 months unless a more frequent review has otherwise been specified. Studies will only be renewed if the renewal report is received and approved

before the expiry date. Failure to submit renewal reports will result in the investigators being notified ethics clearance has been suspended and Research Finance being notified the ethics clearance is no longer valid.

Level of review: Delegated Review

Signed on behalf of the Human Research Ethics Board



Karen Pieters, Manager, Research Ethics

This above-named study is to be conducted in accordance with the submitted application and the most recently approved versions of all supporting materials.

Documents reviewed and received ethics clearance for use in the study and/or received for information:

file: tcps2_core_certificate2022.pdf

file: Email Script_Version1_20240406.docx

file: written_consent_form_Version1_20240406.docx

file: Interview Consent Letter_Version1_20240406.docx

file: verbalconsentscript_Version 1_20240506.docx

file: Thank You Email_Version1_20240409.docx

file: INTERVIEW RESEARCH QUESTIONS_VERSION2_20240506.docx

Approved Protocol Version 2 in Research Ethics System

This is an official document. Retain for your files.

You are responsible for obtaining any additional institutional approvals that might be required to complete this study.

Appendix B: Written Consent Form

WRITTEN CONSENT FORM

Study Title: ***Wetland Offsetting: A Policy tool for Sustainable Wetland Management in the Grand River Watershed***

By providing your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented in the information letter about the study being conducted by Professor Larry Swatuk and Ejiro Movoria from the School of Environment, Enterprise, and Development at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses.

I am also aware that sections from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous.

I was informed that I may withdraw my consent at any time without penalty by advising the researcher. Data cannot be withdrawn after results have been published.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB #45399). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

For all other questions contact **Ejiro Movoria by email at **********.**

( )YES ( )NO I agree, of my own free will, to participate in this study.

( )YES ( )NO I agree to have my interview audio recorded.

( )YES ( )NO I agree to the use of anonymous quotations in any paper or publication that comes from this research.

( )YES ( )NO I would like to review and approve my quotations before they are used as study results.

( )YES ( )NO As a participant in this study, if the interview is over a video conferencing platform, I agree to having the session recorded for accurate data collection and analysis.

Participant Name: _____ (Please print)

Participant Signature: _____

Date: _____

Appendix C: Verbal Consent Form and Documentation

Verbal Consent Script and Documentation Form

Have you had a chance to read the information letter? Do you have any questions?

As a reminder, participation is voluntary, and you may end the interview session by advising me of your decision at any time. If you have questions for the Research Ethics Board, contact information for the Office of Research Ethics is listed on the information letter that you received prior to this session. For all other questions about the study, you may contact me at **********.

Do you consent to participating in the interview?

[ ] YES [ ] NO

Do you give permission for your interview to be audio-recorded?

[ ] YES [ ] NO

Do you agree to the use of anonymous quotations in any paper or publication resulting from this research?

[ ] YES [ ] NO

Participant's name: _____
Researcher's signature: _____
Date: _____

Appendix D: Information Letter

UNIVERSITY OF WATERLOO | SCHOOL OF ENVIRONMENT, ENTERPRISE AND DEVELOPMENT

Date:

Project Title - ***Wetland Offsetting: A policy tool for Sustainable Wetland Management in the Grand River Watershed***

Principal Investigator (or Faculty Supervisor):

Name: *Larry Swatuk*

Department: School of Environment, Enterprise, and Development

Email: **********

Phone: **********

Student Investigator(s):

Name: *Ejiro Movoria*

Department: School of Environment, Enterprise, and Development

Email: **********

This letter explains what the study is about, what participation involves, possible risks and benefits, and your rights as a research participant. You may print/save a copy for your records. If you do not understand something in the letter, please ask one of the investigators before consenting to participate.

Land conversion for industrial, residential and farmland development have historically and continued to threaten Ontario Wetlands. It is estimated that over 85% of pre-settlement wetlands in southwestern Ontario have been lost because of land conversion. In the Grand River Watershed, 65% of historical wetlands within the basin have been lost. With recent revisions to the Ontario Wetland evaluation system in support of 'Bill 23: More Homes Built Faster Act, 2022', it is anticipated that a lot of wetlands would be at risk of development. To address the continued wetland loss in the province, some conversation authorities have developed detailed wetland offsetting policies and the Government of Ontario is considering developing one for the province. This study is being conducted as a master's level thesis project within the University of Waterloo Sustainability Management (water) graduate studies program. The purpose is to perform a complete evaluation of a wetland offsetting policy as a viable tool for promoting sustainable wetland management and conservation in the Grand River Watershed and possibly inform the development of a potential Ontario wetland offsetting policy. This inquiry will focus on the experiences and practices of four Ontario conservation authorities as well as Provinces such as Nova Scotia and Alberta that have implemented detailed wetland offsetting policies, with the goal of assessing their efficacy, identifying obstacles, and exploring potential to improve present wetland management

measures. Furthermore, similar insights will be drawn from Ducks Unlimited Canada and the Ministry of Natural Resources and Forestry.

This study would involve a comprehensive literature review of academic and grey literature on wetland offsetting and ecosystem compensation. Furthermore, it would comprise of a series of semi-structured interviews with representatives from the four Ontario Conservation Authorities with detailed wetland offsetting policies (Toronto and Region conservation authority, Lake Simcoe region conservation authority, Nottawasaga valley conservation authority, and Credit valley conservation authority), Ducks Unlimited Canada, Municipalities in the Grand River Watershed, and Ministry of Environment and Protected Areas Alberta. Therefore, with your organization being one of the organizations to be included in this study, I would like to invite you to participate in my study. I believe that you have been directly involved with wetland offsetting projects and would therefore be able to share valuable insights on this topic.

Participation in this study is voluntary. It will involve an interview of approximately **1 hour** in length to take place in-person or via a video conferencing platform. You may decline to answer any of the interview questions if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by advising the researcher. If you wish to withdraw your study data after participating, please contact the researchers. You can request your data be removed from the study up until **December 2025,** as it is not possible to withdraw your data once papers and publications have been submitted to publishers.

With your permission, the interview will be recorded to facilitate the collection of information, and later transcribed for analysis. Shortly after the interview has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points that you wish.

Your identity will be confidential. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. Data collected during this study will be retained for at least **1 year** to which only researchers associated with this project will have access. The digital recordings would be stored on the student investigator's personal computer with a backup file on an external hard drive. For the protection of privacy and confidentiality, the data would be encrypted, and password protected using standard encryption protocols. This encryption would prevent unauthorized access as one would require an encryption key to decipher the contents. To ensure best practices in data privacy, the original data would be split into two data sets; a de-identified data set and an identity-only data set. There are no known or anticipated risks to you as a participant in this study.

The interview will be conducted over an online platform, Microsoft Teams. Microsoft Teams has implemented technical, administrative, and physical safeguards to protect the information provided via the Services from loss, misuse, and unauthorized access, disclosure, alteration, or destruction. However, no Internet transmission is ever fully secure or error free.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board [REB ***#45399]*** If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

For all other questions or if you would like additional information to assist you in reaching a decision about participation, please contact me by email at ****************. You can also contact my supervisor, **Professor Larry Swatuk**.

I hope that the results of my study will be of benefit to those organizations directly involved in the study, other organizations not directly involved in the study, as well as to the broader research community.

I very much look forward to speaking with you and thank you in advance for your assistance with this project.

Yours Sincerely,

Ejiro Movoria

Appendix E: Interview Questions (TRCA, CVC, LSRCA, NVCA)

INTERVIEW RESEARCH QUESTIONS

Thank you very much for agreeing to participate in this research project titled, "Wetland Offsetting: A Policy tool for Sustainable Wetland Management in the Grand River Watershed".

Kindly note that you are not obligated to answer each question as you can pass on any questions you do not feel entirely comfortable answering. Furthermore, you can contact either the principal or student investigator at any time post-interview to provide further insights.

1. What experience do you have with wetland offsetting practice or policy?
2. Overall, what influenced the decision to develop and implement a wetland offsetting policy for your conservation area despite the policies, programs and partnerships that have been in place for the province? What is the connection between the offsetting policy and policies such as the greenbelt act? What kind of projects have generally gone through the mitigation sequence hierarchy to eventually requiring offsetting?
3. Has the wetland offsetting policy yielded its expected economic and environmental benefits in your watershed?
    - Can you provide some examples of specific economic benefits that have been observed because of the implementation of this policy?
    - In your opinion, have the anticipated environmental benefits been realized? Can you shed light on some of these benefits?
    - How do you quantify environmental and economic benefits?
    - Have there been any unforeseen outcomes associated with the implementation of this policy?
    - What would you consider to be an appropriate offset ratio and why?
4. To what extent does your organization incorporate non-economic wetland values, particularly indigenous cultural values in your offsetting protocols?
    - How does your organization approach the incorporation of non-economic wetland values such as social and indigenous cultural values into wetland offsetting protocols?
    - Can you provide examples of specific efforts made to incorporate these non-economic wetland values?
    - What factors influence the inclusion or exclusion of non-economic wetland values in your wetland offsetting protocols?
5. To what extent has this policy led to the loss of original wetlands?
6. To what degree are created or rehabilitated wetlands able to compensate for lost wetland value, function, and area?
7. Research have identified time lags, site-selection challenges, and historical failure to achieve no-net loss as challenges to the Wetland offsetting concept. Would you say these are challenges your organization have also encountered with this conservation strategy?
    - What other logistical challenges have your organization encountered during the implementation of wetland offsetting policies?
    - Can you describe any specific strategies or approaches that have been employed to either mitigate or address these challenges?
    - In your opinion, which of these strategies have been the most effective?

8 What are the implications of ‘Bill 23: More Homes built faster act’ and the associated revision to the Ontario Wetland Evaluation system for current wetland conservation efforts in your jurisdiction?
    - What are the impacts of the Ministerial Zoning Order on your wetland conservation efforts?
9 Who is responsible for the adaptive monitoring of wetland offset projects and/or ensuring compliance to offset permit requirements? Has this been a challenge?
10 What is the current approach to wetland offsetting in your jurisdiction – Proponent-led offsets? In lieu? Mitigation Banking? In combination? What influences the option, and which one has been most feasible?
11 Collaborative Governance
    - Who are the stakeholders involved in the policy development and decisions around wetland management and conservation in the Grand River Watershed?
    - Are there any examples of successful multistakeholder collaborations over wetland or natural heritage conservation that you know or have been part of and what made it successful?
    - What challenges have you encountered when collaborating with diverse stakeholders on wetland management issues and how were they addressed?
    - Do you think wetland offsetting can be integrated into a collaborative governance framework to address conflicting stakeholder interests?
12 Please share any additional information you wish to add and believe would be relevant for this study?

Appendix F: Interview Questions (GRCA)

Thank you very much for agreeing to participate in this research project titled, "Wetland Offsetting: A Policy tool for Sustainable Wetland Management in the Grand River Watershed".

Kindly note that you are not obligated to answer each question as you can pass on any questions you do not feel entirely comfortable answering. Furthermore, you can contact either the principal or student investigator at any time post-interview to provide further insights.

1. What's you experience with wetland management and conservation in the Grand River Watershed
2. What are the key governance and management arrangements currently in place for the Grand River Watershed Wetlands and how do these arrangements impact the health and sustainability of these ecosystems?
    a. What would you say is the biggest threat to the Grand River Wetlands today?
    b. How are decisions regarding wetland management and conservation typically made within the watershed? Are there other entities or organizations directly involved in this decision-making process?
    c. In your opinion, how do these governance and management arrangements impact the health and sustainability of wetland ecosystems?
    d. Are there any policies that have been particularly effective in ensuring the sustainability of wetland ecosystems?
    e. Has your wetlands policy of 2003 been repealed?
    f. With Ontario regulation 41/24, development will only be prohibited in wetlands if it interferes with its hydrologic function or its ability to impact flooding or erosion. There is no mention of other ecosystem services or non-economic values. Is there an instrument in place for the protection of these other values?
3. What are the implications of 'Bill 23: More Homes built faster act' and the associated revision to the Ontario Wetland Evaluation system for current wetland conservation efforts in the GRCA?
4. Is there a tracking of wetlands loss in the watershed? Would you say there has been loss to even Provincially significant wetlands?
5. Can a Wetland offsetting policy align with and potentially enhance current wetland management strategies in the Grand River Watershed?
    a. Does the GRCA currently employ any form of ecosystem compensation in their sustainable management of biodiversity?
    b. In your opinion, are there ways a wetland offsetting policy could align with or complement current wetland management strategies?
    c. What are the potential barriers or challenges you anticipate?
    d. Do you think wetland offsetting would offer any added benefits to current wetland management strategies in the watershed? If not, what do you suggest?
6. What does the revoking of the Ontario regulation 150/06 imply?
7. Collaborative Governance
    a. Who are the stakeholders involved in the policy development and decisions around wetland management and conservation in the Grand River Watershed?

b. Are there any examples of successful multistakeholder collaborations over wetland or natural heritage conservation that you know or have been part of and what made it successful?
c. What challenges have you encountered when collaborating with diverse stakeholders on wetland management issues and how were they addressed?
d. Do you think wetland offsetting can be integrated into a collaborative governance framework to address conflicting stakeholder interests?

8. Kindly share any additional information you wish to provide and believe would be beneficial to this study?

Appendix G: Interview Questions (Municipalities)

1. Kindly share your experience with planning as it relates to wetland management in your municipality and the Grand River watershed.
2. Please describe the steps in the development planning and permitting process and what role do municipalities play in this process?
3. What are the key governance and management arrangements currently in place for wetlands and how do these arrangements impact the health and sustainability of these ecosystems.
    a. Are there any policies that have been particularly effective?
4. Who are the stakeholders involved in the policy development and decisions around wetland management and conservation in your municipality?
5. In your experience, are wetland social, cultural or indigenous values considered in the permitting process or is there more emphasis on its ecological and economic benefits?
6. Kindly share insights on the implications of Bill 23 on municipalities' role in wetland management and conservation.
7. Do you have any experience with wetland offsetting?
8. In the light of recent policy changes, do you think wetland offsetting can offer any benefit to municipalities or the watershed as a whole?
9. **Collaborative Governance**
    a. Are there any examples of successful multistakeholder collaborations over wetland or natural heritage conservation that you know or have been part of and what made it successful?
    b. What challenges have you encountered when collaborating with diverse stakeholders on wetland management issues and how were they addressed?
    c. Do you think wetland offsetting can be integrated into a collaborative governance framework to address conflicting stakeholder interests?
10. Kindly share any additional information you wish to provide and believe would be beneficial to this study?

Appendix H: Interview Questions (Ducks Unlimited Canada)

1. What experience do you have with wetland offsetting practice or policy?
2. What framework guides Ducks Unlimited Canada's approach to wetland and/or ecosystem compensation?
3. Has the wetland offsetting practise yielded its expected economic and environmental benefits? How do you quantify these economic and environmental benefits?
4. To what extent does your organization incorporate non-economic wetland values, particularly indigenous cultural values in your offsetting protocols?
    - What factors influences the inclusion or exclusion of these values?
5. To what extent has the wetland offsetting concept led to the loss of original wetlands?
6. To what degree are created or rehabilitated wetlands able to compensate for lost wetland value, function, and area?
7. Research has identified time lags, site-selection challenges, and historical failure to achieve no-net loss as challenges to the Wetland offsetting concept. Would you say these are challenges your organization have also encountered with this conservation strategy?
8. What are the implications of 'Bill 23: More Homes built faster act' and the associated revision to the Ontario Wetland Evaluation system for your current wetland conservation efforts?
9. In your experience, what is ideally the best approach to wetland offsetting – Proponent-led offsets? In lieu? Mitigation Banking? In combination? What influences the option, and which one has been most feasible?
10. Please share any additional information you wish to add and believe would be relevant for this study?