Hidden Currents

Exploring understandings and planning potential of Montreal's lost waterways

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ABSTRACT

Over the past 190 years, approximately 82% of Montreal's waterways have been canalized or buried. This trend mirrors broader water management strategies in other North American cities over the same period and has had environmental, economic, and social consequences. Existing research has primarily focused on historical mapping and the factors that led to canalization. Less attention has been given to how lost waterways are understood by residents and planners. This research addresses that gap by exploring Montreal's lost waterways through examining current planning practices and residents' lived experiences focusing on three research questions: (1) How are lost waterways understood by residents and planners in Montreal? (2) What is currently being done to address challenges related to lost waterways in the context of climate change? (3) What are policy recommendations for approaching challenges related to lost waterways in Montreal?

The research uses a mixed-methods approach, combining a literature review, policy analysis, interviews, and a survey of grey literature to capture both institutional and community-level perspectives on lost waterways in Montreal. The research finds that lost waterways are largely overlooked in Montreal's planning practice, with little knowledge or engagement found across policy and interviews. When they are considered, it is mainly through the lens of water management and flood risk assessment driven by the increasing impacts of climate change and interests in nature-based solutions. While some community groups have shown interest in the cultural, environmental, and educational value of lost waterways, public awareness remains low. Based on these findings, this report makes five recommendations: (1) Consider access to water in planning; (2) Continue to focus on green infrastructure; (3) Consider the inclusion of more permanent water features with nature-based solutions; (4) Improve awareness of lost waterways through climate vulnerability maps; (5) Explore opportunities for cultural daylighting.

RÉSUMÉ

Au cours des 190 dernières années, environ 82% des cours d'eau de Montréal ont été canalisés ou enterrés. Cette tendance reflète les stratégies plus générales de gestion de l'eau dans d'autres villes nord-américaines au cours de la même période et a eu des conséquences environnementales, économiques et sociales. Les études existantes se sont principalement concentrées sur la cartographie historique et les facteurs qui ont contribué à la canalisation. Une moindre attention a été accordée à la façon dont les cours d'eau perdus sont compris par les résidents et les urbanistes. Cette recherche répond à cette lacune en explorant les cours d'eau perdus de Montréal à travers l'examen des pratiques de planification courantes et les expériences vécues des résidents en se concentrant sur trois questions de recherche: (1) Comment les cours d'eau perdus sont-ils compris par les résidents et les urbanistes de Montréal? (2) Quelles sont les mesures prises à présent pour répondre aux défis liés aux cours d'eau perdus dans le contexte du changement climatique? (3) Quelles sont des recommandations politiques pour répondre aux défis liés aux cours d'eau perdus à Montréal?

La recherche utilise une méthode mixte, combinant une revue de la littérature, une analyse des politiques, des entretiens et une étude de la littérature grise pour saisir les perspectives institutionnelles et communautaires sur les cours d'eau perdus à Montréal. L'étude montre que les cours d'eau perdus sont largement négligés dans les pratiques de planification de Montréal, avec peu de connaissances ou d'engagement trouvés dans les politiques et les entrevues. Lorsqu'elles sont prises en compte, c'est principalement dans le cadre de la gestion de l'eau et de l'évaluation des risques d'inondation, sous l'influence des impacts croissants du changement climatique et de l'intérêt des solutions fondées sur la nature. Bien que certains groupes communautaires aient montré de l'intérêt pour la valeur culturelle, environnementale et éducative des cours d'eau perdus, la sensibilisation du public reste limitée. Sur la base de ces résultats, ce rapport formule cinq recommandations: (1) prendre en compte l'accès à l'eau dans la planification; (2) continuer à se concentrer sur l'infrastructure verte; (3) envisager l'inclusion d'éléments hydriques plus permanents avec les solutions fondées sur la nature; (4) améliorer la sensibilisation aux cours d'eau perdus en utilisant des cartes de vulnérabilité climatique; (5) explorer les possibilités de « renaturation culturelle » (cultural daylighting) des cours d'eau.

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Introduction

Most major cities in North America once had more waterways within their boundaries than they do today. Through periods of industrialization and urban growth, however, many of these waterways were filled in, merged with municipal sewer systems, or canalized—diverted into underground tunnels or culverts. In Montreal, it is estimated that 82% of the island's original waterways have been buried or canalized (Mahaut, 2016). This research project defines lost waterways as former streams or rivers that have either disappeared or been diverted underground. In the context of climate change, where water management and ecological protection are becoming increasingly important topics, conversations about whether lost waterways can be leveraged as assets by cities are beginning to take place. Cities like Seoul and Vancouver have restored formerly lost streams (H. Kim & Jung, 2019; City of Vancouver, 2024), while others like Paris and Zurich have integrated them into stormwater management strategies by separating them from sewage networks (Val de Bièvre, n.d.; Conradin & Buchli, 2004). These actions demonstrate that lost waterways can contribute to modern day city planning.

In Montreal, climate change has contributed to more frequent and intense rainfall, flooding, heat waves, and other challenges in recent years (Rocha, 2017). It does not appear, however, that actions which leverage lost waterways—particularly in the face of climate threats—have yet been meaningfully pursued. While other cities have reintroduced lost waterways into public spaces or integrated them into stormwater management systems, Montreal has not yet taken similar steps. This research examines how lost waterways are understood by planners and residents in Montreal to identify how these waterways are considered in the city's planning decisions, and whether there

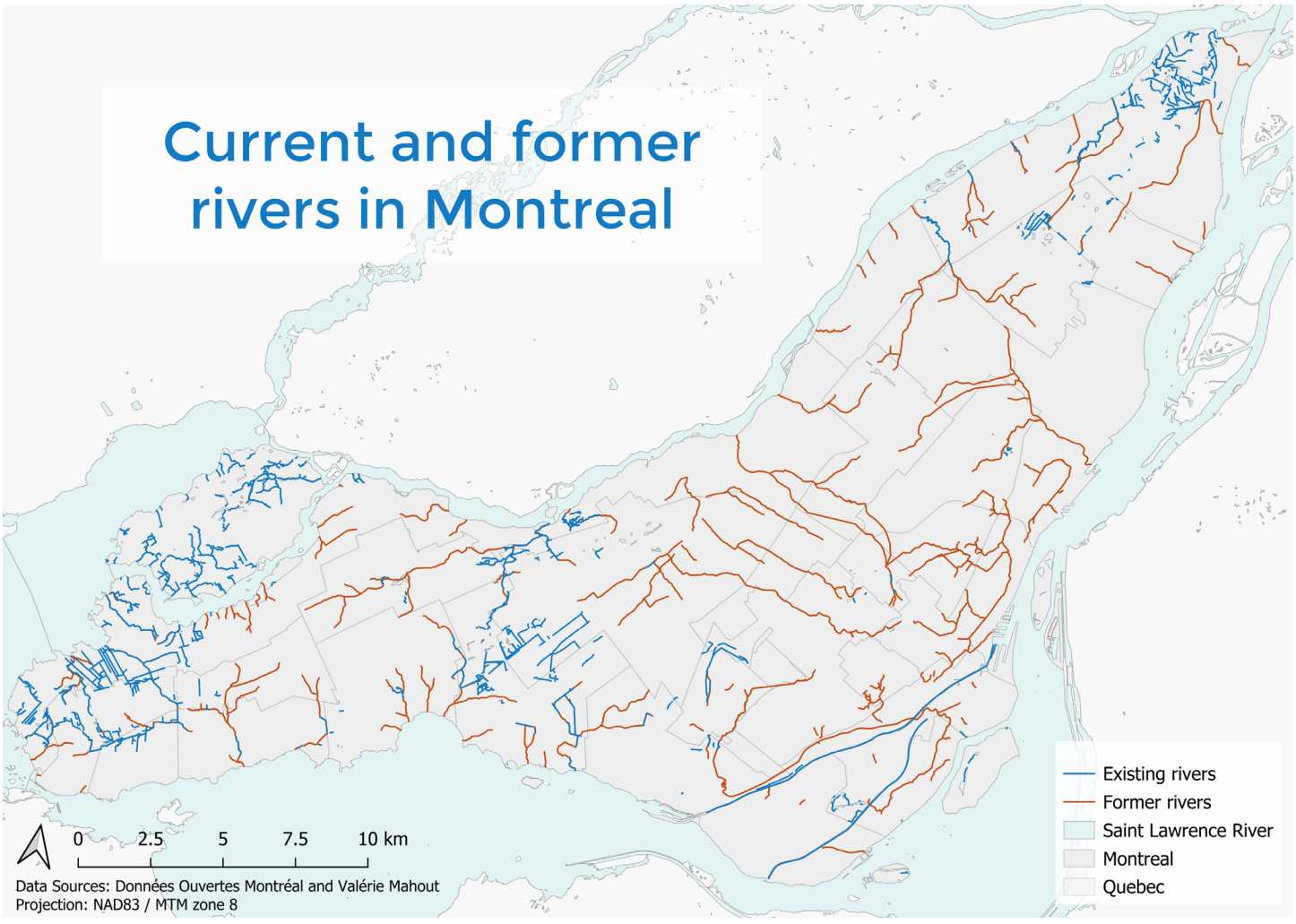

Figure 1: Current and Former Rivers in Montreal

are alignments or differences in the ways they are understood by planning professionals and citizens. The research aims to identify whether there are opportunities for greater integration of lost waterways into planning decisions and strategies.

Existing research on lost waterways in Montreal has primarily focused on historical mapping and the tracing of factors and processes that led to their removal from the urban landscape through canalization or other means. While historical work has provided valuable insights into how lost waterways have shaped historical planning and development in Montreal, there has been less academic research that looks at their contemporary role in the city and the ways they are understood by residents and planners. This research aims to address that gap by exploring Montreal's lost waterways in terms of current planning practices and residents' lived experiences. A better understanding of these perspectives and current planning directions could inform future planning strategies that are more responsive to the environmental, social, and economic impacts of lost waterways.

Based on these research objectives, this project is guided by the three following research questions. (1) How are lost waterways understood by residents and planners in Montreal? (2) What is currently being done to address challenges related to lost waterways in the context of climate change? (3) What are policy recommendations for approaching challenges related to lost waterways in Montreal? To address these questions, the research uses a mixed-methods approach that combines interviews, document analysis, and a literature review which is outlined in the following chapter.

Chapter 2

Methodology

This research project uses a mixed-methods approach to examine how planners and residents understand lost waterways in Montreal. Planners are given particular attention to reveal how lost waterways are incorporated into planning decisions. The research also identifies where gaps and opportunities related to these waterways may exist in the Montreal planning context. Understanding the relationship between residents and lost waterways can reveal tensions or alignments between planners' and residents' understandings. Relevant academic literature and Montreal's historic context are looked at to situate the research within broader academic and local discussions around the role of former and present urban waterways in planning. Interviews with professional planners and a review of relevant city policy documents are used to inform findings on the understandings of planners, while a survey of available grey literature and one community group interview are used to inform findings on the understandings of residents. The results from the analysis and data collected are used to formulate the report's final conclusions and recommendations.

2.1 Literature Review and Montreal Historical Context

To situate the research project within broader academic discussions, a literature review of relevant research was conducted. This review examines the motivations for and impacts of river canalization, the growing interest in river daylighting as a response to these challenges—along with its limitations—and how discussions about restoring canalized rivers fit into the wider topic of nature-based solutions. Montreal's historical context traces the role of rivers on the island and approaches to managing them across three eras: pre-industrialization, the industrial era, and the 1970s to the present. This historical context section situates the findings of the report within longer historic trends in planning and attitudes toward water in the city.

2.2 Policy Review

To add to the findings from interviews highlighted in chapter 6, a policy review of four Montreal planning documents was conducted. This review looked at how flooding and waterways were discussed in city strategies. Attention was given to mentions of waterways, integrations of green infrastructure, and strategies for flood mitigation. This analysis was compared with interview findings to see where official documents aligned or differed from the interview findings. Since city strategies and policy documents shape how planning is done in practice, this review helps situate the interviews within broader Montreal planning discussions and strengthens the findings. As with the interviews, the findings of the policy review are presented through themes and key takeaways. Quotes from French documents used in this report have been translated into English by the researcher and in-text citations clearly mark them as such.

2.3 Interviews and Grey Literature

This project received ethics approval (McGill University REB #24-12-011) to conduct interviews with planners and members of community groups on the topics of flooding and water management in Montreal. For the project, a total of six semi-structured interviews were conducted to assess risks and responses to flooding, as well as understandings of lost waterways. Five of these interviews were conducted with planning professionals from two boroughs, working in a variety of municipal planning-related positions. These interviews were partially informed by insights from the literature review and Montreal historical context sections of the report.

One interview was conducted with a member of a community group to understand relationships between residents and waterways in their community—both former and present—as well as community challenges related to flooding. To complement the community group interview, a review of grey literature was also conducted to capture a wider range of perspectives. This review focused on news articles, podcasts, and

community group websites containing interviews or quotes from residents related to flooding, water management, or lost waterways.

All interviews were conducted via Microsoft Teams video calls. Initial transcriptions were generated using the built-in transcription capabilities of the Teams application. Quotes used in the final report were also manually reviewed and cleaned by the researcher. Transcribed interviews were then coded into key themes using an offline version of Taguette. Identifying information was removed from transcripts prior to them being uploaded to the Taguette software. Interviews were conducted in both English and French. Quotes from French interviews used in this report have been translated into English by the researcher. In these cases, the in-text citation clearly indicates that the quote has been translated. Findings from interviews and grey literature are presented through themes and key takeaways.

2.4 Summary of Methodology

The methods used in this research combine to capture both institutional and community-level perspectives on lost waterways in Montreal. These approaches also situate these perspectives within the city's historic context and the relevant academic literature. The following chapters present a review of the academic literature and provide a historical overview of how perspectives of Montreal's waterways have shifted over time to contextualize the interviews and policy analysis.

Chapter 3

Literature Review

This chapter reviews key academic debates on lost waterways and urban waterway management more generally. The chapter first looks at the processes and discussions that led to river canalization in cities and what the long-term consequences of canalization have been. The chapter then looks at recent literature addressing lost waterways with particular attention given to literature on daylighting, including arguments in favour of daylighting, notable case studies, and its limitations. Daylighting and discussions around the management of lost waterways are then linked to broader academic discussions around nature-based solutions in planning.

3.1 The Industrialization and Transformation of Urban Rivers

Urban rivers served as important resources in the early development of cities, with many being founded alongside waterways to take advantage of the freshwater, fertile soil, fishing grounds, and connections to water-based transportation networks they provided. The relationship between North American cities and their urban waterways, however, shifted with the rise of industrialization in the 19th-century. Rising industrial activities and growing urban populations led to increased pollution which was often dumped into rivers and other waterways (Usher et al., 2020, p. 1490). This led to rivers frequently being used as de facto open sewers, often leading to complaints from residents about their smell and water quality (Wantzen et al., 2022, p. 22).

An 1832 journal entry written by author Catharine Parr Traill on a visit to Montreal highlights the deplorable state of urban waterways in this era. "We were struck by the dirty, narrow, ill-paved streets of the suburbs, and overpowered by the noisome vapour arising from a deep open fosse that ran along the street behind the wharf. This ditch seemed the receptacle for every abomination, and sufficient in itself to infect a whole town with malignant fevers" (Traill, 2006, p. 31). In addition to the polluted conditions of waterways, Traill's quote touches on another challenge frequently associated with urban rivers in the early 1800s—the spread of disease. Across North American cities, heavily polluted water caused many sanitary risks including the spread of water-borne diseases such as cholera, typhoid, and yellow fever, which occurred through contact between residents and polluted water (McGlinn, 2003, p. 129).

While industrialization and urban growth were negatively impacting water quality, urban waterways also became seen as a barrier to the continued growth of industry and land development. For cities that were trading hubs like Montreal, goods being moved around the city constantly needed to cross urban rivers. This made them inconvenient obstacles for growing industrial activities (Fougères, 2007, p. 124).

A final challenge posed by urban waterways was their proneness to flooding. With unpredictable weather and flooding patterns causing damage to homes and infrastructure, waterways could be seen as a liability (Delibas & Tezer, 2017, p. 21). Still, in the early 1800s, technical expertise and scientific knowledge were limited when it came to devising solutions for these issues. Though straightening, dredging, and diverting of waterways occurred in some cases, major infrastructure projects related to urban rivers remained infeasible until several decades into the 1800s (Fougères, 2007, pp. 102-103).

By the 1840s, advancements in engineering and construction techniques advanced making it more feasible for cities to build large underground tunnels capable of containing streams and rivers (Fougères, 2007, p. 103). These advancements led to a period of widespread river canalizations that continued in North American well into the 20th-century (Delibas & Tezer, 2017, p. 21). These canalizations were motivated by a desire to bring order to cities through planning, and to relieve cities of issues related to urban rivers, including pollution, sanitation, navigation, and flooding (Delibas & Tezer, 2017, p. 21).

In this same period, advancements in automotives and rail transport were making inland

travel by water "inefficient and obsolete," making decisions to bury waterways easier (Nienhuis, 2008, p. 111). As an added benefit, this process also created developable land for growing cities. Today many buildings and facilities are constructed directly above canalized rivers (Wantzen et al., 2022, p. 4). Oftentimes, canalization occurred alongside the development of stormwater and wastewater infrastructure. As a result, some cities decided to save money by combining these underground water systems, meaning that storm runoff, wastewater, and waterways became mixed together in culverts or pipes (Toso et al., 2020, p. 5). In Montreal, it has been estimated that 70% of the sewer system is combined, meaning canalized waterways or stormwater systems share infrastructure with sewage systems (Bernstien & Chung, 2024). Because of these decisions, the distinction between canalized rivers and other water management systems can be murky.

Figure 2: A section of Montreal's St. Pierre River in 1956 (Poirier, 1956)

Through the period of widespread canalization, urban waterways went from an everyday part of urban life to absent from the experiences of residents in areas where waterways were completely lost (Fougères, 2007, p. 101-102). In addition to Montreal which has lost 82% of its inland waterways (Mahaut, 2016), other cities from around the world have similarly seen their waterways disappear. In Switzerland, it is estimated 20% of all waterways in the country have been canalized, while in Denmark the estimate is 15% (Wild et al., 2011, p. 412). Some scholars have argued that this wide-scale canalization can be seen as part of a larger urban water management trend in the industrial period and beyond, where water has gone from an "artisanal to an industrial product" (Bakker, 2003, p. 42). These scholars argue that water is increasingly managed by "large-scale, technological structures and processes" (Usher et al., 2020, p. 1490).

In any case, the historic river landscapes of many major North American cities would likely be unrecognizable to their modern counterparts. Still, while this massive transformation may have provided benefits to cities in their early industrial periods, they have not come without their consequences in the present day.

3.2 Consequences of River Canalization

Negative consequences of river canalization can be broadly classified into three categories: environmental, economic, and social. Much of the discussion on these consequences comes from academic literature on river daylighting—the process of restoring surface flows of previously canalized rivers. As such, these discussions are often presented alongside arguments in favour of daylighting projects.

When it comes to environmental consequences, the most significant impacts covered in literature are loss of biodiversity and harm to urban ecology. Rivers are among the most essential ecological systems in cities and losing them can be detrimental to urban ecosystems (Delibas & Tezer, 2017, p. 19). Even when confined to limited space, rivers and streams can host diverse and dynamic plant and animal life (Wantzen et al., 2022, p. 3).

Canalized rivers, on the other hand, generally have low ecological integrity because of low light levels, disconnection from the wider ecological landscape, and higher levels of pollution when combined with wastewater and sewage systems (Wild et al., 2011, p. 412). Because of these impacts on ecology, river canalization also contributes to what scholars call urban stream syndrome, a term that describes the contributions of urbanization to the general degradation of water quality and ecology in urban water systems (Kominkova, 2012, p. 24).

In terms of economic consequences, two of the major costs as they pertain to municipal agencies are infrastructure costs and water treatment costs. Pipes and tunnels where canalized rivers flow often require frequent maintenance (Wild et al., 2011, p. 413). With waterways typically being buried deep underground, maintenance can be challenging and costly (Wantzen et al., 2022, p. 26). In addition to maintaining infrastructure, culverts can also be prone to blockages that lead to flooding, creating another maintenance liability (Wild et al., 2011, p. 413). As many North American cities have been cutting public spending since the late 20th-century, funding this maintenance has become more challenging (Usher et al., 2020, p. 1491). In situations where canalized rivers exist in combined systems, it also increases water treatment costs. This is because in systems where waterways are combined with stormwater or wastewater, all water must be treated as if it were the latter since it is all mixed together. This can significantly increase water treatment outlays (Wild et al., 2011, p. 413).

Social consequences of canalization primarily relate to the loss of waterways as a resource for recreation and enjoyment. In the literature, social consequences tend to refer broadly to impacts on quality of life, well-being, and community engagement for residents. The most obvious consequence in this regard is the loss of access to natural environments. Urban waterways can serve as public spaces that provide opportunities to relax or be active near nature in cities (Wild et al., 2011, p. 413). Absence of access to water, therefore, means fewer public recreational amenities. This impact extends beyond physical health, as access to urban green spaces has also been linked to improved mental health and psychological well-being, specifically regarding sense of place and quality of life (Wantzen et al., 2022, p. 4). Finally, waterways provide residents with chances to view and interact with water cycles, local ecology and wildlife. When waterways are only present underground, therefore, educational opportunities where residents can learn about and gain appreciation for local ecology and water cycles are lost (Wild et al., 2011, p. 413).

A final consequence affecting all three categories is increased flood risk from canalization. Although one of the motivations for canalization in the early 19th-century was flood management, canalization often has the effect of causing more flooding. Rivers and other waterways can serve as natural flood preventers with vegetation in riparian zones collecting excess water during heavy rainfalls and releasing it during prolonged dry periods (Wantzen et al., 2022, p. 4). When waterways are replaced with concrete roadways, or other materials that cannot absorb water, water instead pools and causes flooding in those areas (Stevenson, 2024). This flooding can then collect surface pollutants found in cities—like chemicals, oil, and debris—and transport it to larger waterways or bodies of water, deteriorating their water quality (Müller et al., 2020, p. 2). Economically, flooding also causes damage to properties which can be costly to repair (Yanez-Leyton, 2024). Finally, residents in areas affected by major floods can experience stress or anxiety related to experiences of flooding and expectations that they may reoccur (Bruemmer, 2023). With major rain events happening more frequently due to climate change, the impacts of flooding are likely to continue to worsen.

3.3 Daylighting as a Response to River Canalization

The most extensively discussed response to the consequences of river canalization in the academic literature is stream daylighting. This literature often discusses the history and consequences

of canalization, assesses the feasibility of these daylighting projects, or looks at the level of success of these projects at meeting goals in different areas. Discussions on the feasibility or success of daylighting projects generally fall into the same three categories as the consequences—environmental, economic, and social. Literature on daylighting can help us understand what the motivations of existing projects have been for municipal decision-makers and why this practice has attracted significant academic attention.

Studies highlighting the environmental benefits of daylighting have focused on the potential for projects to improve biodiversity and to create or restore green spaces. Successful daylighting projects have been shown to revitalize local ecosystems and improve water quality and soil health, benefiting both urban residents and wildlife (Delibas & Tezer, 2017, p. 21). Reduced flooding from strengthened riparian zones also prevents the issue of rainwater runoff polluting other water bodies (Wantzen et al., 2022, p. 4). In addition to ecological benefits, research has also highlighted that surface waterways can mitigate the urban heat island effect by serving as "cooling corridors," especially when lined with vegetation or tree canopy covers (Wantzen et al., 2022, p. 28). In the context of climate change and more frequent severe weather events, restoration of waterways and the natural plant life that surrounds them could play a role in building climate resilience.

Concerns about pollution and the spread of waterborne diseases, which were among the primary environmental motivators for canalization, have become less pressing with modern wastewater treatment methods and infrastructure (Wantzen et al., 2022, p. 20). This reduces the risks associated with surface streams. Daylighting can, therefore, respond to various environmental objectives for municipalities including contributions to urban ecology, flood prevention, and urban heat island mitigation.

While daylighting projects can have high upfront costs, several arguments still suggest long-term benefits could make these projects worthwhile economically. Firstly, with surface streams typically requiring less maintenance than canalized ones, daylighting is often a more cost-effective long-term solution to managing waterways (Wild et al., 2011, p. 413). Secondly, daylighting can play a role in flood prevention while being more cost-efficient than other more traditional flood prevention engineering projects (Wantzen et al., 2022, p. 5). Finally, a key economic incentive is the anticipated increase in land value. Scholars have noted that daylighted streams can result in increases to the value of nearby real estate and attract new investments and businesses to the area (Pinkham, 2000, p. 7).

With place-based municipal actors being incentivized to push for growth in local property value—which is an observed impact of daylighting—and the potential for reduced maintenance costs for culvert infrastructure, it is clear strong economic motivators exist for daylighting. The possibility of cost savings on maintenance is perhaps more poignant in the Canadian context where cities are prohibited from running operating deficits.

Studies on the social benefits of daylighting highlight that successful projects lead to improvements in quality of life, well-being, and community engagement. One example of a social benefit is the recreational value added from creating new aesthetically pleasing public spaces, where footpaths and park areas can be added to facilitate a variety of uses (Wild et al., 2011, p. 416). These public spaces are also often framed as educational environments which provide opportunities to interact with nature and wildlife (Delibas & Tezer, 2017, p. 22). In this way, daylighted streams can teach children and other groups about local ecology and habitats. Finally, social benefits extend to the concept of creating healthy cities since access to green spaces has been linked to improvements in mental and physical health (Wantzen et al., 2022, p. 4). When viewed from a social lens, therefore, daylighting can align with multiple municipal strategies focused on creating recreational

spaces, educational opportunities, and healthy environments for residents.

When daylighting projects are successful, they can provide environmental, economic, and social advantages to cities making them attractive to decision-makers. With famous examples of successful projects being found across multiple continents, more attention has been drawn to daylighting as a possible solution to the consequences of river canalization. This has led to a large body of literature developing on the subject and more projects being considered in cities across Canada and other countries.

3.4 Examples of Daylighting Projects

One of the most extensively researched examples of daylighting from the international context is Cheonggyecheon Stream in Seoul, South Korea. The stream, which crosses a northern portion of the city, was buried between 1958 and 1977 as a response to water pollution and flooding (Y. Kim & Yang, 2023, p. 3). The stream was replaced with a ten-lane elevated highway that stood until 2003, when work on daylighting commenced (Lee et al., 2020, p. 3). Overall, the project—which restored nearly 6-kilometres of the stream—took 28 months to complete and was financed primarily by the Seoul Metropolitan Government (H. Kim & Jung, 2019, p. 59). Though this project does not technically meet the definition of daylighting, as water for the new stream was pumped from other nearby bodies of water and not released from a culvert (Khirfan et al., 2020, p. 2), the literature largely describes it as daylighting and evaluates its impacts the same way.

The project was designed for the stream to accommodate 200-year flood events, bolstering resilient infrastructure in the area, and has been observed to reduce the urban heat island effect in its immediate surroundings, creating a cooling corridor (Richards & Edwards, 2017, p. 495). The stream has also been found to reduce air pollution and increase plant and animal populations (Snell, 2018, p. 14). When considering the economic impacts of the project, scholars largely agree that daylighting Cheonggyecheon increased nearby property values and has become a flagship project in Seoul's economic strategy by improving the "economic competitiveness and global appeal of the city," developing the South Korean capital as a creative city, and revitalizing former industrial areas for commerce and recreation (H. Kim & Jung, 2019, p. 64). Findings on social impacts have been mixed. Positive studies mention increased access to green space and recreational opportunities, while critical studies discuss gentrification and a lack of public engagement in the daylighting process (H. Kim & Jung, 2019, p. 65).

Figure 3: Cheonggyecheon Stream in Seoul, South Korea

Another heavily researched example of daylighting is the policy of daylighting rivers in Zurich, Switzerland. During the 19th and 20th-centuries, Zurich canalized approximately 100 kilometres of its urban waterways. This widespread canalization across the city led to

consequences including increased water treatment costs from combined systems, loss of public space, and ecological degradation (Conradin & Buchli, 2004, p. 277). Responding to these impacts, in 1986 Zurich implemented a policy known as Bachkonzept where the city would daylight rivers wherever possible. This program has since resulted in the daylighting of 25 kilometres of waterways (Khirfan, 2020, p. 179).

The Bachkonzept program was implemented with the goal of achieving three objectives: (1) "to improve the recreational qualities of urban neighbourhoods and thus make them more attractive," (2) "to restore lost habitat for plants, insects and small animals, enhancing the relationship between city residents and their natural environment," and (3) "to reduce the amount of clean water flowing through the wastewater treatment plants and thus improve the quality and the efficiency of treatment process" (Conradin & Buchli, 2004, p. 280). Studies on the impacts of Zurich's daylighting policy have largely confirmed that daylighting projects have been successful at meeting these three objectives overall, with reduced cost of water treatment being written about particularly positively (Conradin & Buchli, 2004, p. 277).

In Canada, several daylighting projects have already taken place across the country. The leader in these projects to date has been Vancouver, which successfully daylighted several waterways including Canyon Creek, and Still Creek among others (City of Vancouver, 2024). Daylighting projects from other parts of the country include Sawmill Creek in Dartmouth, Nova Scotia (Laroche, 2024), and an unnamed stream in Caledon, Ontario (Town of Caledon, 2021, p. 56). As of 2025, there have been no major daylighting projects in Quebec. When reviewing municipal documents on Canadian daylighting projects, it seems that environmental considerations have been the most central motivation mentioned in project framing, followed by economic and social motivations.

In Montreal, the most extensive feasibility analysis of river daylighting opportunities was conducted by the Quebec branch of WWF-Canada with funding from the Federation of Canadian Municipalities and Interact Insurance (Léveillé, 2019). This 2017 project, titled *Bleue Montréal*, looked at five boroughs in Montreal to determine if opportunities for daylighting existed. The boroughs studied were Villeray-Saint-Michel-Parc-Extension, Rosemont-La Petite-Patrie, Mercier-Hochelaga-Maisonneuve, Ville-Marie, and Le Sud-Ouest (WWF-Canada, 2017). In the end, the project selected three sites for more extensive feasibility analyses. These included the section of the canalized Saint-Martin stream that passes through Parc des Faubourgs, a project at the base of the Falaise Saint-Jacques near the Turcot Interchange where a body of water known as Lac à la Loutres previously existed, and finally the creation of a new waterway through Parc Jarry following a route similar to that of the buried Provost Creek (Léveillé, 2019).

As of 2025, it seems that only one of these detailed feasibility analyses has been conducted for the project in Ville-Marie. As with existing daylighting literature, this report framed the benefits of daylighting in Ville-Marie in the three categories of environmental, economic, and social (WWF-Canada, 2019, pp. 73–79). Challenges to the project identified in the report included soil contamination, cost and financial availability, difficulties related to dismantling and reinstalling existing water infrastructure in the area, and separation of sewage water from river and storm water in the existing system (WWF-Canada, 2019, pp. 97–99).

In the community consultation summary for the PPU des Faubourgs produced by the City of Montreal in 2021, the *participants' concerns, expectations and opinions* section acknowledged the feasibility report by WWF-Canada stating that WWF wishes to see rivers like the Saint-Martin and Saint-Pierre reintegrated into the urban environment (OCPM, 2021, p. 44). The final version of the PPU published later that

year, however, includes no plans for daylighting (Arrondissement Ville-Marie, 2021). It thus seems unlikely any daylighting projects will occur in Montreal in the near future.

3.5 Limitations to Daylighting

While daylighting projects have become more popular in recent decades, there are many cases where daylighting is not feasible for canalized waterways. One survey of daylighting case studies found seven key conditions that tended to be present where daylighting took place. These included: (1) high costs of water treatment from combined systems, (2) high costs of maintenance for culvert infrastructure, (3) risks to urban hydrology caused by climate change, (4) housing in project areas could be torn down and rebuilt, (5) support was present from neighbourhood groups and/or sponsors, (6) many stakeholders had interest in the project, and (7) projects could boost the local economy, especially in city centres (Wantzen et al., 2022, pp. 23-25). If few of these conditions are present at the site of a canalized river—or if there are other obstacles to projects such as lack of funding or local opposition—then daylighting may not be feasible. In these cases, other measures will likely need to be taken to address any challenges caused or exacerbated by river canalization.

Though daylighting was not explicitly part of interview guides for this project, the topic still arose in several interviews with planners. During these discussions, planners identified several obstacles to such projects in Montreal. A major barrier that was mentioned particularly for central boroughs in Montreal was the high density of the built environment and issues related to control of land (interview 1). The trajectory of all major canalized rivers passes under existing buildings, most of which are privately owned. This makes daylighting in these areas infeasible since it would require the city to obtain privately held land and to demolish existing structures.

Another concern was the separation of storm and sewage water (interview 6). Much of the sewer system in Montreal, particularly in older areas, is made up of combined sewers, meaning water from all sources is collected into the same system. To daylight rivers, sewage and storm water systems would need to be completely separated to ensure sewage water is not present in daylighted streams. This work would need to be done for the entire system upstream from a daylighted section of river—a process that would be very costly and involve disruptions of transportation networks during the construction phase. This process would be further complicated by the crowdedness of underground infrastructure in dense areas of the city where it would be challenging to find space for two water systems to run in parallel (interview 6).

These considerations demonstrate that while daylighting has been shown to provide many benefits to areas around previously canalized rivers, it is unlikely that these projects can be extensively realized in Montreal. Planning considerations in Montreal that consider historic waterways, therefore, must go beyond simply looking for opportunities to daylight these streams.

3.6 Nature-Based Solutions in Environmental Urban Planning

Discussions around river daylighting are part of a wider trend in urban environmental planning towards implementing nature-based solutions in cities. As evidenced by the growth of organizations like the Resilient City Network—of which four Canadian cities are members (Resilient Cities Network, 2022)—there has been a clear rise in interest towards building urban resilience over the past two decades (Croese et al., 2020, p. 2). Urban resilience is broadly defined as the ability of cities to withstand "acute shocks" of which extreme weather events brought on by climate change are a large consideration (Resilient Cities Network, 2022).

Within this context, projects incorporating nature-based solutions have risen in popularity and this trend seems poised to continue (Pineda-Pinto et al., 2021, p. 167). Nature-based solutions can be defined as interventions that "are inspired by

nature, use nature and/or are supported by nature" (Frantzeskaki, 2019, p. 101). These solutions have grown out of the worsening environmental, social, and economic conditions that cities are experiencing from both sudden and sustained impacts of climate change (Bush & Doyon, 2019, p. 1). Through incorporating solutions that either restore, support, or artificially mimic natural environments and processes in cities at various scales, environmental planners hope that networks of green infrastructure can be developed that respond to challenges caused by climate change (Bush & Doyon, 2019, p. 3).

Though environmental considerations are inherently central to these projects, nature-based solutions often respond to non-environmental urban issues as well. Job creation, improvements to citizen health and well-being, improvements to social cohesion, and place-making are all co-benefits that are often found in projects incorporating nature-based solutions (Albert et al., 2020, p. 1148; Pineda-Pinto et al., 2021, p. 167). The multifunctional element of many nature-based projects sets the practice apart from grey infrastructure projects that tend to be more centralized and inflexible (Bush & Doyon, 2019, p. 3; Pineda-Pinto et al., 2021, p. 167).

Within the wide scope of building resiliency and responding to the adverse effects of climate change, there are several subsets of nature-based solutions that aim for different outcomes, including carbon sequestration, heat-island reduction, or restoring ecosystems. When considering water management, nature-based solutions most frequently focus on biodiversity conservation or restoration and flood management (Boelee et al., 2017, p. 831). Some examples of initiatives with these objectives include constructing or restoring natural features to protect coastal communities against storms—like dunes, marshes, islands, or reefs—strengthening riparian zones in forested areas to improve water quality and reduce flooding downstream, and developing features like permeable pavement, rain gardens, or vegetated zones to absorb stormwater (Nelson et al., 2020, p. 49; Martín Muñoz et al., 2024, p. 10). If implemented effectively, water-oriented nature-based solutions can support the development of freshwater ecosystems that perform multiple functions for cities by improving water quality, natural habitats, and flood resilience.

In Canada, several cities have developed major projects grounded in the practice of nature-based solutions. The Toronto Port Lands Flood Protection project includes naturalizing the mouth of the Don River—a major river east of the city's downtown—where it meets Lake Ontario and creating a natural greenway to promote wetland diversity and habitats in the area (City of Toronto, 2018, p. 95). Montreal has already developed several sponge parks—green spaces that retain stormwater onsite by allowing it to soak into the ground instead of flowing into city sewers—and plans to construct 30 in total by 2025 (Bongiorno, 2023). In 2013, Calgary implemented its Riparian Action Program, a ten-year plan targeted at stabilizing riverbanks, supporting wildlife, improving water quality, managing flood risk, and improving public space around the city's rivers through bioengineering that adds vegetation and natural materials to riparian zones (City of Calgary, 2019, p. 102). As Canadian cities continue to incorporate nature-based solutions into resiliency strategies, it seems likely that discussions around using solutions informed by nature for urban water management will become more common.

As nature-based solutions have gained more attention, several challenges to their implementation have emerged. These challenges are primarily related to financing and governance of projects. Because the externalities of these projects are diffuse and often only fully realized over long time frames, funding can be difficult to obtain. This is because benefits to any one party are often marginal. Since both private and public sectors are incentivized to focus on short-term benefits, this makes persuading organizations to provide funding more difficult (Seddon et al., 2020, p. 8). Governance of projects is also often complex and requires support from multiple stakeholders. Projects that involve water management can be particularly challenging as governance of water is

Figure 4: Place des Fleurs-de-Macadam in Montreal (Bongiorno, 2023)

already complex. Water governance often involves many competing interests and decision-making powers that can be dispersed across multiple levels of government from municipal to federal (Seddon et al., 2020, p. 8). Projects also generally involve coordination in sectors beyond water management to be fully integrated into the urban and ecological fabrics, further complicating implementation and governance (Boelee et al., 2017, p. 832).

Several criticisms of nature-based solutions have emerged covering various aspects of these projects. One major criticism has been the difficulty of measuring the impacts of projects. This is due to the context-specific nature of projects, the complexity of devising metrics for evaluating social or ecological impacts, and the difficulties of comparing projects across scales (Seddon et al., 2020, p. 7). Related to this criticism are concerns that nature-based solutions can be used as a form of greenwashing, where projects are praised for their positive outcomes when the extent of those outcomes is unclear (Alva, 2022, p. 2). In this regard, some have argued that the term 'nature-based solution' has been "misappropriated, co-opted or corrupted" by organizations that apply it to projects with little, or even negative, environmental value (Alva, 2022, p. 2). Projects are also often described as being top-down technocratic processes that do not leave enough opportunities for public participation (Usher et al., 2020, p. 1493). Technocratic processes have also drawn criticism for excluding Indigenous communities, thus perpetuating the dispossession of Indigenous lands (Alva, 2022, p. 2).

3.7 Summary of Literature Review

This chapter has outlined the primary processes and discussions that led to the canalization of waterways in many cities across the world and the long-term consequences of these transformations. It also provided an overview of the key discussions and debates around lost waterways in the academic

literature. Once vital resources that influenced settlement, urban development, and transportation patterns, urban waterways became seen as nuisances as industrialization and urbanization intensified due to high levels of pollution, the barriers they created to land development, and their proneness to flooding. Widespread canalization, driven by shifting perceptions of urban waterways, led to longstanding impacts on their surrounding urban areas including environmental, economic, and social consequences.

The most discussed response to waterway canalization in academic literature has been stream daylighting which has been seen to provide environmental, economic, and social benefits. Several daylighting projects have already taken place across multiple countries and continents, including Canada—although none have yet occurred in Montreal or Quebec. Despite advantages and successful projects, daylighting is often not feasible in dense urban areas and generally requires a specific set of conditions to succeed. Discussions of river daylighting are part of a broader shift in urban planning towards nature-based solutions. These solutions have been found to improve climate resilience while also offering economic and social benefits. They have been criticized, however, for contributing to greenwashing, having results that are difficult to measure, and excluding participation from Indigenous groups and the public more generally.

Overall, academic literature on lost waterways focuses overwhelmingly on daylighting despite the fact that these projects can only be applied in a narrow set of circumstances. For many cities where the majority of urban waterways have been canalized, but widespread daylighting is infeasible—like Montreal—it would be useful for academic literature to address alternative practices that can respond to challenges caused by widespread canalization. Water-oriented nature-based solutions, which have already been implemented in several Canadian cities, may offer more realistic solutions to addressing challenges associated with canalization without requiring fully uncovering waterways in contexts like Montreal. There is an opportunity to consider how these non-daylighting nature-based solutions can be framed around lost waterways more directly rather than as responses to more general climate and resiliency concerns in cities.

The following chapter will look at historic perceptions and waterway management strategies in Montreal to understand the specific role that waterways have played in the development and character of the city. This will provide context for the policy review and interviews, and help ground the conclusions and recommendations of this research paper into Montreal's historic context.

Chapter 4

Montreal Historical Context

As an island, water has played a significant role in Montreal's development, economy, and character throughout its history. The city has been shaped not only by its proximity to the St. Lawrence River—which connected it to both the interior of North America and to transatlantic trade routes—but also by the island's interior waterways. This chapter focuses on the role that these interior waterways have played in the city's history and how their management and perceptions have shifted over time. The chapter organizes this history into three distinct eras: pre-industrial history, which looks at uses by Indigenous peoples and early European settlers; industrialization and canalization, where waterways began being seen as nuisances and canalization became the preferred strategy for managing them; and 1970 to the present, where policy shifted toward preserving and restoring the island's inland waterways.

4.1 Pre-Industrial History

For thousands of years prior to the arrival of European settlers in Quebec, rivers played a vital role in the lives of Indigenous peoples. It is widely believed by archaeologists that the first humans settled in Quebec approximately 12,000 years ago with the earliest evidence of human activity on the Island of Montreal thus far discovered from 5,000 years ago (Tremblay, 2016). The presence of Indigenous peoples in Montreal has continued uninterrupted from the first arrivals approximately 5,000 years ago (Tremblay, 2016). For Indigenous peoples in the areas around Montreal, rivers have served as important resources for many aspects of life including navigation, hunting, and as a source of water for agricultural activities (Duhamel, 2021). Jacques Cartier, on his 1535 visit to Hochelaga, described Indigenous peoples using rivers for fishing and canoeing (Tremblay, 2016). In his 1890 Pen and Ink Sketches, John Fraser described Iroquois travellers navigating the now canalized St. Pierre River in Montreal by canoe (Toso et al., 2020, pp. 6–7).

Unlike early European settlers, who used water primarily as a navigational and developmental tool, Indigenous communities understand water as a "sacred life force" (Duhamel, 2021). Water is seen as a gift from nature with waterways representing the veins of the Earth. Water is also seen as a relative to humans that must be protected and cared for and who, in turn, offers protection and care for people (Duhamel, 2021). This view highlights the important role that rivers play both culturally and in the day-to-day lives of Indigenous peoples.

Montreal's rivers also played a significant role in the way the island was first settled by Europeans. In 1611, when selecting a location for the settlement of what would become Montreal, Samuel de Champlain described a river near the chosen location that was "abundant" with fish, surrounded by ideal lands for agriculture and animals that could be hunted, and which could be a safe harbour for the settlers (de Champlain, 1959, pp. 203–204). This description provides insight into the importance of rivers to early European settlers and how these rivers would have been used—as strategic locations for settlement and as areas that supported hunting and agriculture. Rivers also played an important role in the fur trade, which was a major economic driver for early colonists. Ville St. Pierre, described as a "node on the fur trade route," was located strategically near the former St. Pierre River and Lac à la Loutre with tanneries being found at the other side of the lake (Toso et al., 2020, p. 5). Patterns of European settlement along rivers in Montreal can still be seen today in certain administrative boundaries. Portions of the boundaries between Côte-des-Neiges and Mount Royal as well as Notre-Dame-de-Grâce, Hampstead, Côte Saint-Luc, and Montréal-Ouest closely mirror the locations of former rivers.

A map of Montreal drawn by Louis Charland in 1801 shows several waterways crossing through the old city of Montreal and its suburbs (Charland, 1801). At this time, urban rivers would have been a ubiquitous feature of life in Montreal. While these waterways provided many benefits, they could also be a nuisance at times even in the early days of settlement. Without a sewage system, waste was often dumped into waterways, with the earliest

Figure 5: An 1801 map of Montreal created by Louis Charland showing the presence of rivers in the city (Charland, 1801)

laws against dumping in rivers being passed in the 1810s (Fougères, 2007, p. 106). Waterways also constricted movement across the city, necessitating the construction and maintenance of bridges to cross them. It is estimated that between 1800 and 1840 the city had over 60 bridges, which could be up to 17 metres long (Fougères, 2007, pp. 103–104). These concerns around movement and pollution would only worsen in the 1820s and beyond as industrial activities increased on the island.

4.2 Industrialization and Canalization

As with other cities around the world, concerns around pollution, public health, and restrictions to the movement of people and goods across the city were the primary motivators for river canalization in Montreal. As industrial activities increased on the island in the early 1800s, water quality deteriorated to the point that the city began regulating the locations of tanneries, abattoirs, and other industrial polluters away from the city centre, indicating pollution had become a serious issue (D. Dagenais, 2020). Beginning in 1796, planning acts in the city had also taken on the directive of "producing order" which included drafting more complete city plans, linking Montreal to its suburbs, and connecting the street grid (Fougères, 2007, pp. 105–106). Urban rivers proved to be barriers to these objectives.

Still, it was health concerns that led to the final push towards canalizing rivers. In 1832 and

1834, Montreal experienced two cholera outbreaks that led to thousands of deaths. The spread of these epidemics was partially attributed to urban waterways, which generated support for river canalization (Fougères, 2007, p. 108). By 1832, increased tax revenues from the incorporation of Montreal as a city and advancements in engineering made canalization more feasible (Fougères, 2007, p. 99). This led to a section of the St. Pierre River becoming the first in the city to be canalized, with work being completed between 1832 and 1838 (D. Dagenais, 2020). Even before the project was completed, the city had formed a committee to create plans for the canalization of another stream, the St. Martin, and soon canalization became the preferred method for managing streams on built-up parts of the island (Fougères, 2007, pp. 109-110).

One debate that took place in the initial considerations about canalizing rivers, which had important consequences for the city later, was whether to combine canalized rivers with the sewer network that was being developed around the same time as early canalization projects. The first canalization of the St. Pierre River was integrated into the city's first collector sewer, known as the William Collector. By 1857, however, city road inspector and engineer John P. Doyle was tasked with creating a more comprehensive sewer plan for the city (M. Dagenais, 2011, p. 108). In his plans, Doyle recommended creating separate systems for wastewater and stormwater, effectively separating future canalized rivers from the city's sewer system. The city, however, did not follow Doyle's recommendation on this matter, instead choosing to pursue the cheaper option of combining sewer and stormwater systems (M. Dagenais, 2011, p. 112). While wastewater at the time was routed

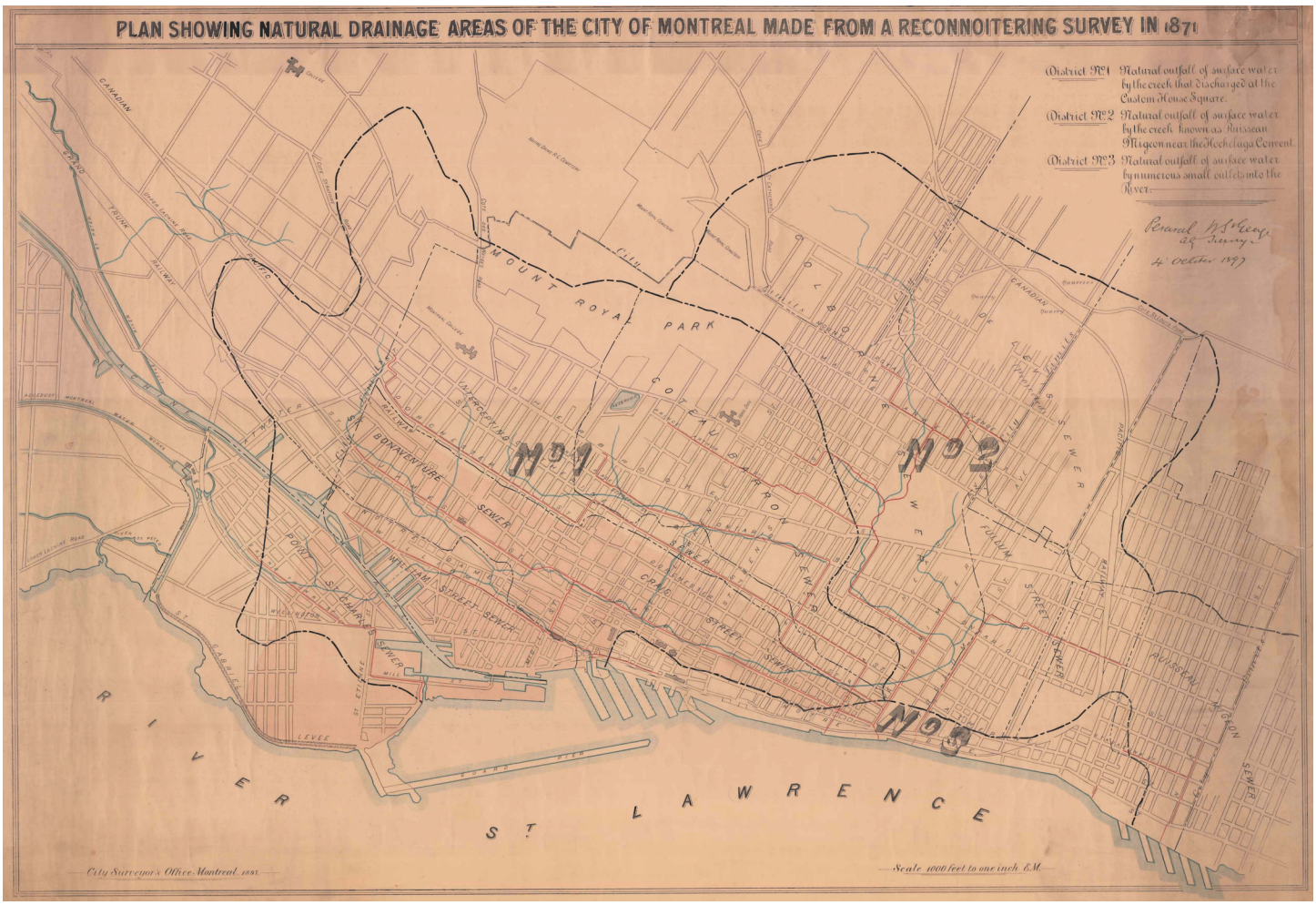

Figure 6: A 1897 map showing the location of major collector sewers (red) and the locations of waterways from an 1871 survey (blue). (St-George, 1897)

directly into the St. Lawrence River without being treated, the choice to use a combined system for much of the city means that in the present day, both stormwater and wastewater must be processed by treatment plants. This increases the quantity of water that must be treated and the associated costs of running the treatment plants. The preference for river canalization as an approach to managing urban waterways persisted in Montreal until approximately the 1960s, after which river canalization became much less frequent (D. Dagenais, 2020). Despite this, canalization does still occasionally occur with a 200m section of the St. Pierre River located on the Meadowbrook Golf Club being canalized as recently as 2022 (Bernstien & Chung, 2024).

4.3 1970 to Present Day

While most of Montreal's rivers disappeared between the 1830s and the 1960s, from the 1970s onward, new policies and strategies have emerged for managing the island's remaining waterways. The basis for this new approach to waterways started in 1970 when Montreal introduced the *Réseau de suivi du milieu aquatique (RSMA)* (Ville de Montréal, 2024b, p. 7). RSMA is a water sampling network that assesses the water quality of key waterways across the island—today the network has over 500 sampling stations (Ville de Montréal, n.d.-a). Whereas previously the preferred method for handling waterways was canalization, the emergence of the RSMA network represented an early step in moving towards new policies that sought to monitor, protect, and gradually improve the ecological health of Montreal's waterways rather than treating them as nuisances.

The first more comprehensive plan for managing Montreal's waters without a heavy focus on canalization came with the government of Quebec's *Projet Archipel*, launched in 1980. This project sought to find solutions to various water-related issues on the Hochelaga Archipelago—which includes Montreal and surrounding islands. This project differed from previous water management strategies in the city because it went beyond simply looking for ways to control water, and instead also looked at how to connect citizens with water while also gaving some attention to improving water quality (Secrétariat Archipel, 1980, p. 1). The project explicitly noted that human interventions had caused waterways in the Hochelaga Archipelago to deteriorate and lose their natural qualities. "The archipelago's waters have lost their 'natural state' quality. Over the last three and a half centuries, human intervention has profoundly altered the archipelago's natural environment [...] The result was a more habitable environment, more suited to the archipelago's development needs. Nevertheless, the urbanization and industrialization of the Montreal region, especially in the post-war period, has led to a deterioration in some of the uses we derive from water" (Secrétariat Archipel, 1980, p. 8, translated). This project marked a departure from a relationship with water led by engineered human interventions, and towards one that recognized the social and environmental importance of water.

In 2006, *Le réseau bleu – Montréal vers une culture de l'eau* was released, constituting the city of Montreal's first concrete plan to develop the banks of the St. Lawrence River and the Rivière des Prairies for socio-recreational purposes (Ville de Montréal, 2024b, p. 7). This plan aimed to improve access to riverfront lands, improve the quality of public riverfront areas, and to increase participation in outdoor activities on and alongside Montreal's surrounding rivers (Ville de Montréal, 2006, p. 7). The project noted that loss of accessibility to riverbanks and deterioration of water quality since the 1950s and 60s had led to fewer recreational activities alongside the water (Ville de Montréal, 2006, p. 1). Reanimating activities along the water, therefore, represented an opportunity to fully realize the potential of Montreal's large surrounding rivers in contributing to the health, economy, and quality of life of the city and its residents (Ville de Montréal, 2006, p. 25). Though not dealing directly with inland waterways, this policy demonstrated a recognition of the social and economic benefits that water resources can contribute to the city, and

a recognition that lack of planning around water access leads to a deterioration of these benefits.

The 2012 *Trame verte et bleue*, published by the Communauté métropolitaine de Montréal (CMM), built on some of the objectives around environmental conservation and development of recreational amenities laid out in *réseau bleu* plan, but expanded the focus to other natural environments in and around Montreal (CMM, 2012). The plan sets out to develop a network of natural environments that can be used for recreational, and tourist purposes and includes attention to wetlands, beaches, riverbanks, and floodplains among other areas of interest (CMM, 2012, p. 7). The document also highlights that, through its integration of natural environments and infrastructure, the plan will help "build a greener, more resilient region powered by sustainable active transport, where citizens can enjoy easily accessible spaces for leisure and relaxation close to where they live" (CMM, 2012, p. 11, translated). Though not explicitly mentioned, this language demonstrates a closer attention to the role that developing green networks plays in responding to growing climate concerns.

The most recent plan informing Montreal's strategy on managing its waterways is the *Plan nature et sport* released in 2020. This plan includes a section titled *Bleue Montréal* which aims at protecting and restoring water resources in Montreal, making the island more resilient to climate change, and improving the accessibility of the island's water to residents (Ville de Montréal, 2020, p. 33). This latest plan recognizes that water is central to the identity of Montreal and sets out the clear objective of protecting the island's waterways and shorelines while also making them more accessible to Montreal residents (Ville de Montréal, 2020, p. 33). In this way the plan continues the city's transition away from eliminating urban waterways and towards protecting them and recognizing their economic, environmental, and social potential.

4.4 Summary of Historic Context

Over the past 190 years, Montreal has gone from an island where water was a ubiquitous part of life to one where most urban waterways have been lost. Shifts in treatment of urban rivers in Montreal are reflective of more evolving relationships between humans, nature, and infrastructure more broadly. In the early European settlement period and prior to the arrival of Europeans in Montreal, rivers were a vital resource for those living on and around the island. They provided the island's population with hunting grounds, lands that supported agriculture, and parts of transportation networks that facilitated trade and movement. As such, early European settlement of the island took place primarily alongside rivers.

In the early 19th-century, however, as the island industrialized, attitudes towards water shifted. High levels of pollution, the spread of disease, and a desire to bring order to the city through connecting on island road networks made rivers seem like more of a nuisance than a resource. Cholera outbreaks in 1832 and 1834 were health crises that motivated a shift in the city's approach to rivers towards one which sought to eliminate them from the urban landscape through canalization.

Since the 1970s, however, attitudes towards water in the city have once again shifted with the preservation and restoration becoming priorities. This has coincided with growing recognition of a climate crisis leading to a greater focus overall on working with nature rather than against it. Policy in Montreal now recognizes the environmental, economic, and recreation benefits of water in the city and this has been reflected in more efforts to protect water environments, and to make them more accessible to the island's population. The next chapter will look more closely at present policy documents to understand how waterways are discussed in official city strategies today.

Chapter 5

Policy Review

5.1 Findings - Policy Review

To complement the interviews with planners, a policy review was conducted to understand how flooding and river management is discussed in official documents. The main documents analyzed for this review were the *2050 Land Use and Mobility Plan*, the *2020-2030 Climate Plan*, the *2030 Citywide Strategic Plan*, and the *2030 Nature and Sports Plan*. Below, themes on how these plans engage with rivers and flood management are presented before a brief discussion of key takeaways from the policy review is provided.

Figures 7, 8, 9 & 10: Montreal policy documents surveyed

Theme 1: Need for the city and residents to have better understanding of flood vulnerability

Flooding was consistently seen as one of the most pressing threats to the city across the surveyed documents. Of the seven climate change adaptation measures mentioned in the Land Use and Mobility Plan, four directly reference water retention or flooding (Ville de Montréal, 2024d, p. 10). In response to this, documents set objectives of better identifying areas vulnerable to flooding. This more detailed understanding of vulnerable areas is framed as a way to ensure interventions can be prioritized in the areas where they will have the greatest impact.

Two objectives in the Land Use and Mobility Plan touch on this theme. In the description of objective 6.2, it is noted that the city should "carry out a cartographic analysis of public spaces to identify rainwater retention areas and prioritize the interventions to be carried out based on their retention and/or infiltration potential" (Ville de Montréal, 2024c, p. 45, translated). Similarly, objective 9.2 seeks to "refine knowledge on areas vulnerable to surface flooding to guide additional interventions in public and private areas and thus reduce the risks of flooding to buildings" (Ville de Montréal, 2024c, p. 56, translated). This objective also seeks to "develop information, raise awareness and offer support measures for the various publics concerning the adaptation of buildings and land to climate change" (Ville de Montréal, 2024c, p. 56, translated). This demonstrates that the city has placed an emphasis on having higher quality information on flood vulnerability available to guide decisions in both the public and private sectors.

Theme 2: Nature-based solution seen as a priority in addressing flooding

Just like with the planner interviews, nature-based solutions were a common part of the flood mitigation strategy laid out in the various documents. The description for objective 5.3 in the Land Use and Mobility Plan outlines why this has become a central part of the city's strategy, highlighting limitations of engineered approaches and economic advantages of nature-based solutions. "With climate change, rainfall will increase considerably in intensity and recurrence. Traditional engineering solutions based on underground infrastructure alone are no longer sufficient to collect all this

water. It is therefore necessary to manage part of the surface water runoff as other leading cities in the world do in this area (e.g. New York, Rotterdam, Copenhagen, Vancouver, Portland, Philadelphia, etc.). Surface developments, both in private and public areas, prove to be more economical and efficient, especially when planned in conjunction with underground infrastructure" (Ville de Montréal, 2024a, p. 110, translated). The plan, therefore, states that more green spaces designed to store water must be added to the city. The plan specifically outlines that "these infrastructures must be distributed throughout the territory, and projects to rebuild streets or build new ones must systematically aim to integrate 10% green drainage infrastructures" (Ville de Montréal, 2024a, p. 109, translated). Objective 6.2 also outlines other benefits of green infrastructure projects, highlighting their ability to contribute to strategic goals beyond flood prevention (Ville de Montréal, 2024a, pp. 129-130).

Another consideration of nature-based solutions is that they direct water away from the wastewater system and towards absorption into soil and the natural water table. This has the benefit of reducing water treatment costs and GHG emissions. The Montreal Climate Action Plan demonstrates that wastewater treatment accounted for 40% of municipal GHG emissions in 2015, making it the largest contributor source of GHGs emitted by the city (Ville de Montréal, 2020, p. 88). Since much of Montreal uses combined sewers—meaning rainwater is treated with wastewater—reducing the amount of rain entering combined sewers will reduce costs and emissions associated with water treatment.

Theme 3: Attention given to the protection of wetlands

Considering the environmental elements of waterways, the greatest attention for protection of inland water-ecosystems is given to wetlands. The Montreal Land Use and Mobility Plan sets the target of having 459 hectares, or 4.59km2, of wetlands on the island protected by 2050 (Ville de Montréal, 2024a, p. 171). The Nature and Sports Plan includes a component title *Montréal bleue* which includes the objective of "restoring wetlands and water environments" (Ville de Montréal, 2021, p. 34). This component outlines objectives, concerns, and courses of action for supporting wetlands, waterways, and riverbanks in the city. Looking at the plan, however, it seems that while there are targeted actions for wetland and riverbank restoration and preservation, there are no specific initiatives for inland waterways. It appears that when considering inland water features, wetlands are prioritized for conservation efforts over the island's remaining waterways.

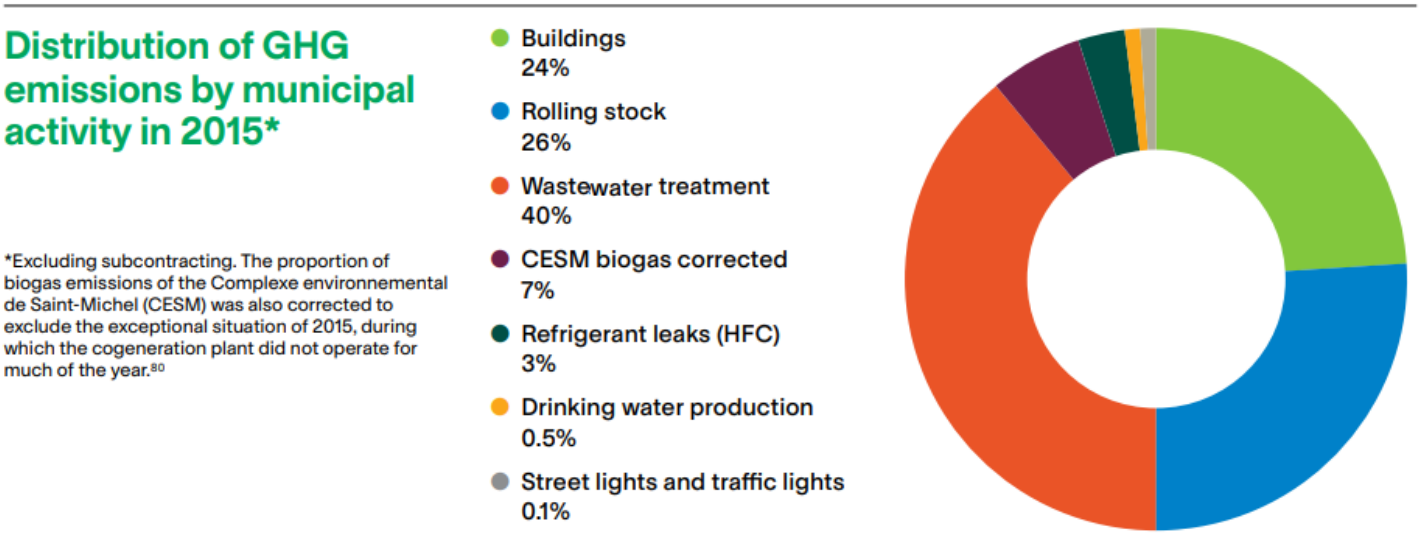

Figure 11: Distribution of GHG emissions by municipal activity in 2015 (Ville de Montréal, 2020, p. 88)

Theme 4: Access to water is a goal, but the focus is mostly on the St. Lawrence River and Rivière des Prairies

The documents highlight that water is a defining part of the character and identity of Montreal and that creating opportunities for residents to access water is one of the city's objectives. The Land Use and Mobility Plan lists the Montreal group of islands and waterways as one of four iconic areas in the city (Ville de Montréal, 2024d, p. 30) and the Nature and Sports Plan states that "Montréal's rivers, islands and wetlands are part of its identity. This is why, in this plan, the city has set out a clear vision that aims to sustain and protect waterways and shorelines while making shores more accessible" (Ville de Montréal, 2022). Several specific actions are laid out across the various documents to improve access to water, however nearly all of these focus on improving access to the St. Lawrence River and the Rivière des Prairies.

For example, objective 7.1 of the Land Use and Mobility Plan outlines commitments by the city to restore and improve access to 10km of riverbanks by 2032 and to create new public spaces along the St. Lawrence and Rivière des Prairies (Ville de Montréal, 2024c, p. 48). The *Montréal bleue* section of the Nature and Sports Plan similarly places a strong focus on creating and restoring parks along riverbanks to improve "visual and physical accessibility" to the St. Lawrence River and Rivière des Prairies, but almost no attention is given to improving access to inland water other than a few references to improving access to wetlands in big parks. While the policy documents clearly identify improving access to surface water as an important part of the city's planning objectives, an overwhelming emphasis is placed on improving access to the St. Lawrence River and Rivière des Prairies while little attention is given to inland surface water.

Theme 5: Little direct engagement with lost waterways

A final finding in the policy documents is that there is little direct engagement with lost waterways. The only document that refers to these waterways is the Land Use and Mobility Plan. Under Objective 5.3, there is a sub-section titled "sustainable surface water management to complement underground infrastructures" which states that "re-opening buried watercourses could also be considered where technically and financially feasible" (Ville de Montréal, 2024a, p. 110, translated). Under section 8.2 when discussing ecological restoration projects, the document also states, "opportunities are particularly available for the redevelopment or restoration of inland waterways, some of which are buried, as part of urban planning and development projects" (Ville de Montréal, 2024a, p. 168, translated). These quotes suggest that there have been at the very least preliminary discussions within the city about river daylighting even if no projects have materialized to this point. It is also telling that of the two quotes, the more specific reference to daylighting was in a discussion related to water management.

Interviews with planners suggested that lost waterways were primarily considered in flood risk assessments. The fact that daylighting was mentioned in the context of its water management capabilities reinforces the finding that the main way lost waterways are considered in Montreal planning is in relation to flooding—either in terms of their contributions to flood risk or their abilities to reduce risk if daylighted. Policy documents engaged to varying extents with environmental and social elements of water; however, this focused primarily on wetlands and the St. Lawrence and Prairies rivers. Social and environmental elements of inland waterways, both past and present, were not given significant attention on the other hand, outside of one brief reference to opportunities to redevelop or restore inland waterways including buried ones.

5.2 Key Takeaways - Policy Review

Overall, the five themes reveal how the surveyed documents engaged with rivers and flood management. First, it was found that the city has made it a priority to improve information available

on areas vulnerable to flooding to better guide public and private interventions that address flooding. Planner interviews, which will be discussed in the next chapter, supported this finding by revealing that new maps created by the water department have been incorporated into by-laws regulating the issuance of building permits in recent years. Also consistent with planner interviews was a focus on nature-based solutions as a response to more frequent flooding events.

In terms of environmental considerations of inland surface water, attention was mostly given to protection of wetlands with less of a focus on waterways. Inland waterways were similarly given little attention when it came to increasing access to blue spaces on the island. The documents recognized the importance of water to the identity and character of Montreal, but they focused primarily on improving access to the St. Lawrence and Prairies rivers and not inland waterways.

Finally, there were very few direct references to lost waterways across the documents. The only two references to these waterways were framed around their potential to manage stormwater if daylighted and their potential to be part of larger ecological restoration efforts. As the next chapter will show, this is in line with planner interviews that revealed the primary way in which lost waterways are thought of is in terms of their impacts on flood risk. Less attention is given to the social and environmental potential of planning around lost waterways. The following chapter builds on the policy review by presenting insights from planner interviews demonstrating how these policies impact planning in practice.

Chapter 6

Interviews

This chapter presents the key findings from interviews and grey literature analysis conducted with planners and with residents and community groups. The interviews focused primarily on two areas. First, what knowledge interviewees had of lost waterways in their communities or areas of work, and how this factored into their job or understandings of their community. If interviewees showed little knowledge of lost waterways, questions focused more generally on water management strategies used by professionals or on any surface water that did exist in the community. The second focus of interviews was on flooding and heavy rain events that have occurred in recent years and how this has impacted communities, approaches to urban planning, and understandings of the city.

The chapter is divided into two parts with the first looking at planners and the second at residents and community groups. These two sections, combined with the policy analysis from the previous chapter, develop an understanding of how lost waterways are understood by residents and planners in Montreal and what is currently being done to address challenges related to lost waterways—particularly in the context of more extreme climate events.

6.1 Interview Findings - Planners

For the research, five semi-structured interviews were conducted with planners in various positions. Interviewees included planners from the urban planning departments of Ville-Marie and Côte-Des-Neiges—Notre-Dame-De-Grâce (CDN-NDG), a heritage planner, a planner in the public works department, and a planner who worked on a recent PPU project. From analysis of the coded interviews transcripts, several key themes were identified and are presented below.

Theme 1: Lost waterways are primarily considered in flood risk assessments

When asked about the role that lost waterways play in planning decisions, most planners responded that it did not factor into their jobs and some even mentioned they did not know of any information available on lost waterways. "Sometimes we can guess [where they are], but we don't have tools that allow us to locate ancient rivers, so we don't take them into account in our work" (interview 4, translated). Two planners, however, did give examples of the city considering the locations of lost waterways in planning decisions. In both cases it was noted that the lost waterways were used as part of evaluations of flood risks. "The historic underground network is an input to our multi-criteria analysis for the management of the most abundant risks" (interview 3, translated). "I know that in our thinking about risk management; that's part of it. The question of risk criteria in the background, the presence or not of a depression or a historic river" (interview 3, translated).

The other planner noted that maps of historic waterways have been considered more recently in recent planning work than they had been in the past. When talking about how a 2021 PPU project in Ville-Marie addressed flooding they said "it wasn't that much of an issue at the time. You know, we were starting to talk about it, but we didn't have the big floods that came afterwards. By 2023, you know, we knew there were rivers. We even pulled out some historical maps. Maybe there was even a heritage study done, and I think the historical maps showed the rivers in particular" (interview 5, translated).

Theme 2: Recent heavy rain events have accelerated regulatory changes

Related to the final quote from the first theme, multiple interviews showed that recent heavy rain events have led to a greater focus on regulatory changes that address flood risks. The same planner who commented on recent attention to lost waterways outlined some regulatory changes that passed recently in Ville-Marie. "We made a zoning amendment in 2024 that basically says that a building being built is not allowed to construct an underground floor, unless it's more of a resilient space, or a parking lot or something like that, but not a habitable space, so a habitable space can't

be built underground. On the other hand, if they absolutely want to build underground, they have the right to do so, but they'll have to make certain demonstrations. The first of these is that there is no basin." (interview 5, translated).

Another planner from Ville-Marie further detailed these changes "So for us, you know, there was absolutely nothing in our urban planning regulations that analyzed requests in terms of flooding. So, seeing that it's a phenomenon that happens, that recurs several times a summer, especially in this case, we decided that we had to modify the regulations to ensure that buildings were no longer vulnerable, especially for underground users. There was nothing to prevent a use, be it housing or a business, from setting up in a basement, so we wanted to put a stop to that, and that's why, among other things, we made a regulatory change" (interview 4, translated). This planner specifically linked these changes to flooding that occurred in recent years. "You know, we're not in a flood zone, in Ville-Marie, so it's more a case of, I'd say, over the past three summers, we've seen this phenomenon grow in scope and seriously affect the quality of life of our citizens" (interview 4, translated).

These recent regulatory changes also include studies to improve information on areas vulnerable to flooding. As one planner notes, "the water department is also confronted with this problem, and has developed a map of basins. On the territory, before 2023, we didn't have this kind of information in the boroughs, so it's a map that the water department has developed and even put online [...] We've incorporated this map into our by-laws. So, it's probably going to be a map that changes over the years" (interview 4, translated). Overlaying the map of basins (called secteurs

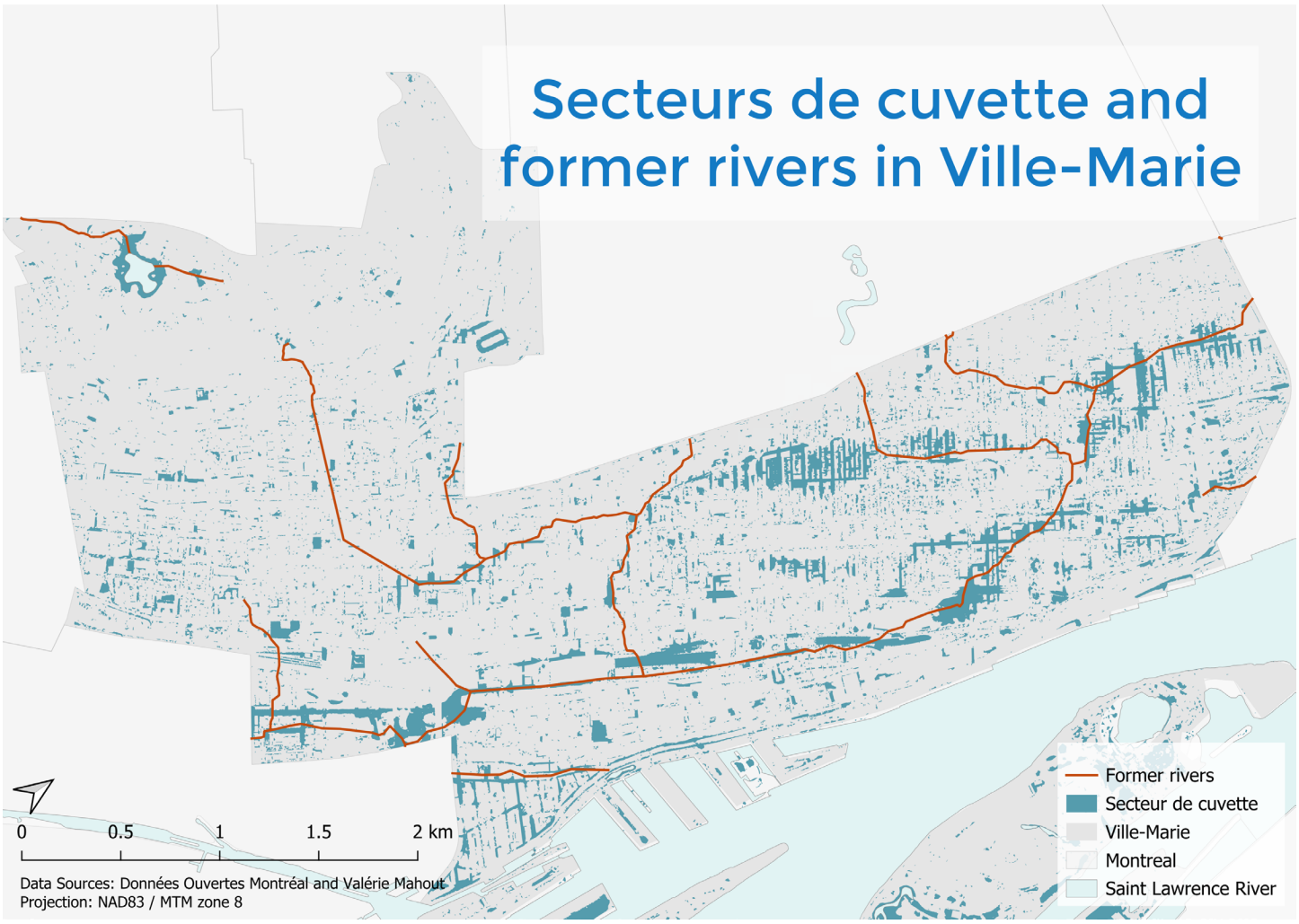

Figure 12: A map comparing the locations of former waterways to Montreal's *secteurs de cuvette* map

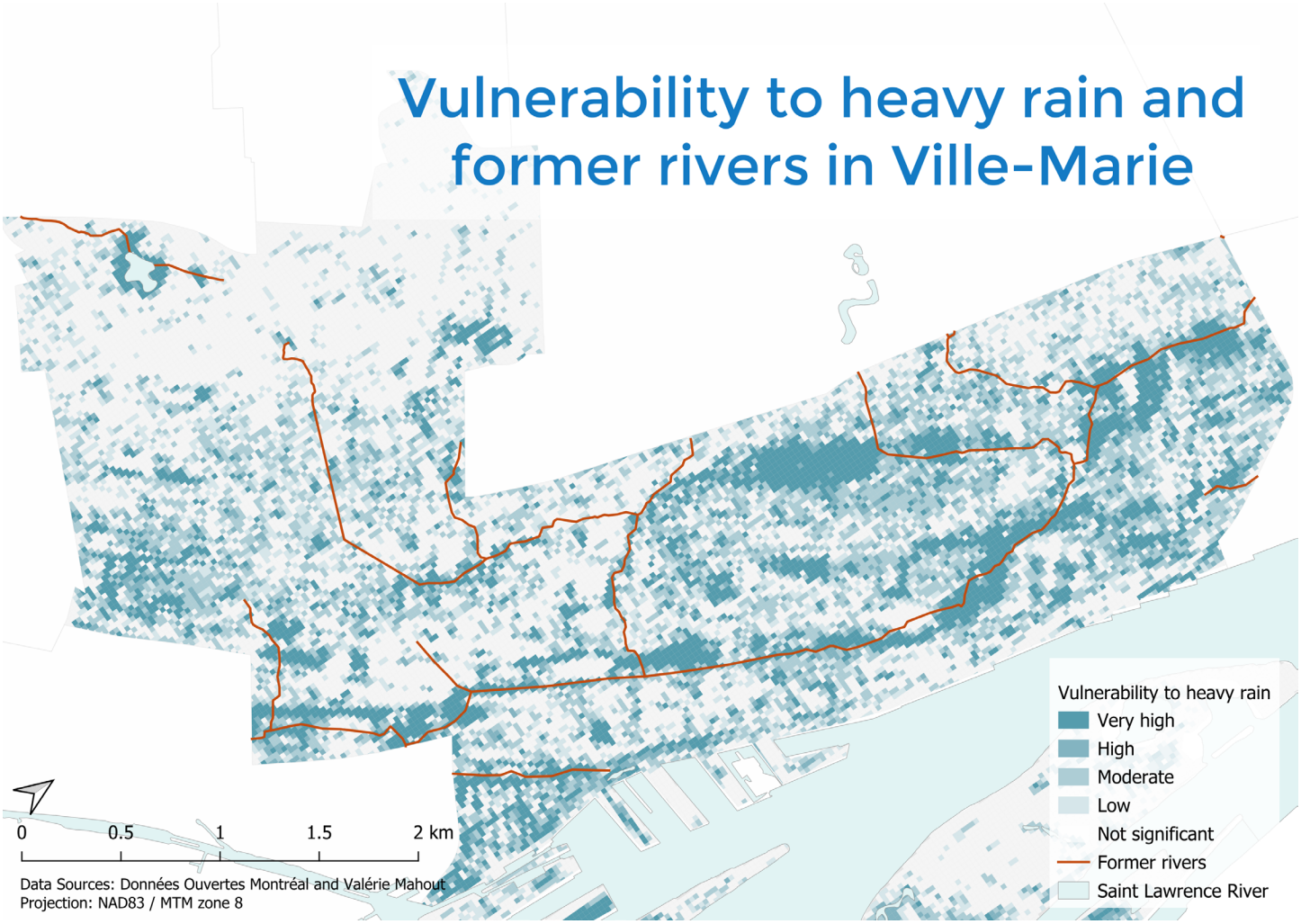

Figure 13: A map comparing the locations of former waterways to Montreal's *vulnerability to heavy rain* map

de cuvettes in French) with lost waterways in Ville-Marie indicates significant overlap. This demonstrates that by using these maps, which are partially informed by the locations of lost waterways, planners in Ville-Marie indirectly consider lost waterways in planning decisions even if they are not always aware of this.

Theme 3: Interest in nature-based solutions to flooding

In addition to regulatory changes, the theme of using nature-based solutions as part of Montreal's solution to flooding came up in all planner interviews. One planner noted that nature-based solutions might be able to address some of the limitations of more engineered flooding solutions. "I've watched a few conferences on the subject, and I know that there are approaches in France, for example, where rather than operating in a totally watertight way, we try to accept the excesses that are going to occur. [...] I get the impression that we're always trying to protect. I have the impression that we're going to go against nature, and then maybe we need to start asking ourselves the question, maybe there's a way of ensuring that if you can't beat them [nature], you join them" (interview 4, translated).

Of the nature-based solutions being used in the city, sponge parks were mentioned the most frequently. One planner in Côte-Des-Neiges, for example, identified a sponge park project that was being considered because of its location in an area that was prone to flooding due to its topography. "We've still got some [projects] in the pipeline, we've got some sponge street parks in the pipeline too, and I'll give you an example [...] There's the nearby Parc Jean-Brillant, where we're talking about a widening of Parc Jean-Brillant across the street, with a sponge park-style layout. We're also

talking about this area because of the downward-sloping topography" (interview 3, translated).

Another planner in Ville-Marie, when shown a map of former waterways, identified an area along a former waterway that was prone to flooding and mentioned that a sponge park would be going in as part of a response to this flooding. "Here, the water flows through a lot, so you can feel that the topography is much the same as when there was no construction, when the rivers existed. Now that it's built up, that there are streets, the topography, or rather the water, has to infiltrate a lot through the streets there [...] There, it flows, and then it flows a lot onto rue de Larivière, and then there's a project there. A sponge street parquet" (interview 4, translated). The heritage planner that was interviewed linked sponge parks to replicating the role that lost waterways might have historically played in rainwater management. "That's often the thing that we're trying now to do. Like putting in sponge parks is a bit… you're trying to like daylight that notion of when it rains" (interview 1).

Another nature-based solution that came up in interviews was the implementation of *saillies drainantes* or *saillies de trottoirs*. These are curb extensions that include greening and allow for water to drain into the soil during rain events. "The saillie de trottoir, is the simplest, smallest type of landscaping that retains a little water and has the advantage of beautifying the town. It allows you to put in a bit of greenery, plant a tree, and we've improved them over time [...] It's a bit late now, but we need to return water to the ground. One good way of doing this is to make openings in the urban space and let the water down to raise the water table. But then, what it also does for us in terms of service is that it retains and reduces the quantity of water we send to the sewage system as a whole. In other words, the amount of water you send to the sewer reduces its intensity, so when you get to a site, you reduce the risk of flooding" (interview 6, translated). This quote also demonstrates that some of the interest in nature-based solutions goes beyond flood risk. There is also interest in using sponge parks and saillies de trottoirs to make spaces more pleasant by adding greenery which has social benefits and adding water back into the soil which has environmental benefits.

Theme 4: Skepticism of the impact of nature-based solutions

Although there was a demonstrated interest in nature-based solutions, several planners also expressed skepticism about how much of an impact these solutions could have on their own. One planner in Ville-Marie noted concerns both about time frames and the size of the incoming sponge park project at Larivière. "It's going to get results, but not right away. You know how long it's going to take all these big [projects]? I'm talking about the park on Rue de Larivière. You know it's a project that lasts what? A year? Two years? Then, it's a very small park, you know. The water comes from the north of the city. We're the last in Ville-Marie down the topography to receive [it]. All this means that the other boroughs also have to do this kind of work" (interview 4, translated).

Another planner noted that while there are many parks in the city, not all of them would be impactful as sponge parks, limiting the extent to which flooding mitigation strategies can be built around them. "But if your park isn't at a low point or in a flood-prone area, it's a bit of a waste of time, you know, it's a bit of a waste of money to come up with a high-performance concept when you don't have 20 cubic metres of water coming in. So that's it, it's a technical choice that has to be made, and it's important not to play politics with it, otherwise we're wasting our money" (interview 6, translated).

The cost to impact ratio of nature-based projects was also noted as a more general concern for saillies de trottoirs. As one planner noted "It's really about 3, 4, 5, 10 cubic metres. And then, when you have a flood of 10,000 cubic metres, you might as well not talk about it [...] if the saillie costs even $100,000, let's say around that, then you will capture 3, 4 cubic metres there" (interview 6, translated). Financial concerns also played a role

in the final two themes identified in interviews with planners.

Theme 5: Responses to flooding can conflict with other planning goals

Several planners noted that with the city facing multiple challenges at the same time, sometimes addressing one challenge meant not addressing others. One way this was expressed was in terms of the financial constraints and limited resources at the city. As one planner mentioned when talking about flooding, "it's just one of the problems. We have more to adapt to in relation to climate change, I'm thinking of heat islands, ice storms, you know, there are so many crises at the same time that I think the city is doing a lot, is very aware of the issues, and is tackling them seriously. Afterwards, it's a question of money" (interview 3, translated). Another planner similarly mentioned that the city must be careful in terms of how it uses what resources it has, "let's face it, there's no money you know. Funding is limited when it comes to rebuilding infrastructure, so it's hard to know what's worth doing and what will have negative consequences down the road?" (interview 5, translated).

A similar theme that came up frequently was how regulations on construction that made buildings more resilient or limited basement units in flood-prone areas also raised building construction costs. This directly conflicted with city objectives of building more units to address the housing crisis. When talking about restrictions on basement units in flood-prone areas, one planner noted "with the climate crisis, we also have a housing crisis and a housing affordability crisis. Of course, basement housing is affordable housing in and of itself, so there's a bit of a conflict of objectives here, which means that there has to be a certain degree of arbitration and nuance in all of this" (interview 3, translated). Another planner speaking about the same regulations mirrored this sentiment, "We have to allow a certain amount of flexibility, because there may be sectors or cases where [basement units are] permissible. But that's where we come in, to bring flexibility to the regulations so that each case can be considered, because we mustn't forget that, yes, we're in a climate crisis, but we're also in a housing crisis." (interview 4, translated). A third planner commented on the tight position competing crises puts the city in. "Then there's the housing crisis, which means we can't afford to eliminate existing housing either, so we're in a situation of extreme vulnerability" (interview 5, translated).

The quote of a final planner demonstrates how overwhelmed the city is in the face of multiple challenges at the same time. "There are limits, we need help, you know. We will do the maximum, but we have an old city and limited capacity. It's worse, we have climate change that doesn't help us" (interview 6, translated). Overall, planners seemed to agree that the city was making a strong effort with the resources they have available, but also that it would be challenging for the city alone to solve all ongoing challenges.

Theme 6: More action needed from homeowners

Considering some of the limitations noted by planners, several planners mentioned that there was also a need for homeowners to be more proactive in addressing flooding as well. One planner suggested that to address this, the city could focus on informing citizens of how to take action as part of its strategy. "I think one thing we might not be doing enough of is education. If you support private initiatives, it's not up to the state to solve everything. So, it's going to be necessary for society to take charge of itself, and not just shovel things into the administration's backyard all the time." (interview 3, translated).

Another planner expressed a similar opinion but also noted that if the city is going to ask citizens to contribute, it needs to demonstrate that it is also doing everything it can to mitigate flooding. "As an approach, I understand it. But because of the nature of the boroughs, because we're closer to the population, we respond to citizens' requests, we're close to the citizens, we meet them in the street,

it's a bit difficult for us to say that. 'Listen, protect yourselves because the city is doing its utmost, and we won't be able to solve everything in 3 years.' It's a bit tricky to say that [...] [But] if we manage to play on the margins on all possible fronts, we could reduce [flooding] by perhaps 30-40%. We're not going to make the flooding disappear, but we are going to reduce it by 30-40%. Then, when you reduce it by 30-40%, 350 houses [at risk] will perhaps become 150 houses that will be at risk. Then, we tell them that the borough is making a big effort. We've invested a lot of money, we've done our part, so we're asking you. It's easier to ask residents to make an effort later on" (interview 6, translated).

Overall, planners seemed to acknowledge that while the city's resources might be limited, the same is often also true for residents so the city must be realistic about what it can ask citizens to contribute. As one planner put it, "I think there are limits to what citizens can do to solve the water problem, but I think we can ask them. Still, it's not all super-rich people who can afford to do everything" (interview 5, translated). Another planner talking about new building regulations in Ville-Marie similarly noted that expenses to citizens might limit new regulations' effectiveness. "If I come back to the question of the private domain. Of course, yes, you have regulations for the citizens. If they want to improve their building, they can, the regulations now allow them to. But it's still a major expense. They've already been flooded and had to do work to correct it. Just cleaning up, redoing the walls, that costs money. Now, if they want to transform the unit to prevent water damage from happening again, it's an expense" (interview 4, translated).

6.2 Key takeaways - Planners

Overall, interviews with planners revealed lost waterways are primarily considered in relation to flood risk. The locations of former waterways are used to create vulnerability maps, which inform decisions by planners at various levels. This has gained more relevance in recent years as more frequent heavy rain events have accelerated regulatory changes and led to more detailed flood mapping. An example of this is the *secteur de cuvette map*, introduced in 2024, which is now used in the permit approval process in some boroughs to assess what resiliency measures are needed for buildings. Planners also showed an interest in working with nature as part of the response to flooding through nature-based solutions, though it was also clearly expressed that there are capacity limitations to this approach. Finally, balancing response to climate challenges with other priorities was difficult given the city's financial constraints. As such, planners felt that greater investment from the private sector in flood mitigation is needed, although it was acknowledged that often the private sector also has limited resources.

6.3 Findings - Residents and Community Groups

For findings on residents and community groups, the focus of research was primarily on grey literature. For this review, an extensive online search of news articles, news videos, podcasts, community group webpages, blog posts, and NGOs operating in Montreal was conducted. In particular, materials that discussed flooding events or made specific references to lost waterways were examined. One interview was also conducted with a member of a community group in CDN-NDG to complement the analysis of grey literature. From the interview and the literature consulted, key themes were identified which are presented below.

Theme 1 - Limited access to surface water in parts of the island

A first finding is that several areas on the island do not have easy access to natural surface water. This can be easily seen on a simple map of the island with surface water highlighted, but it was also confirmed in the interview with a CDN-NDG community member. When asked where people in NDG might go to be near water, the interviewee stated "Well, the closest one definitely would be the Lachine Canal. And speaking about the Falaise and the Lachine Canal, there is the plan for a footbridge to traverse the cliffs, the highway and

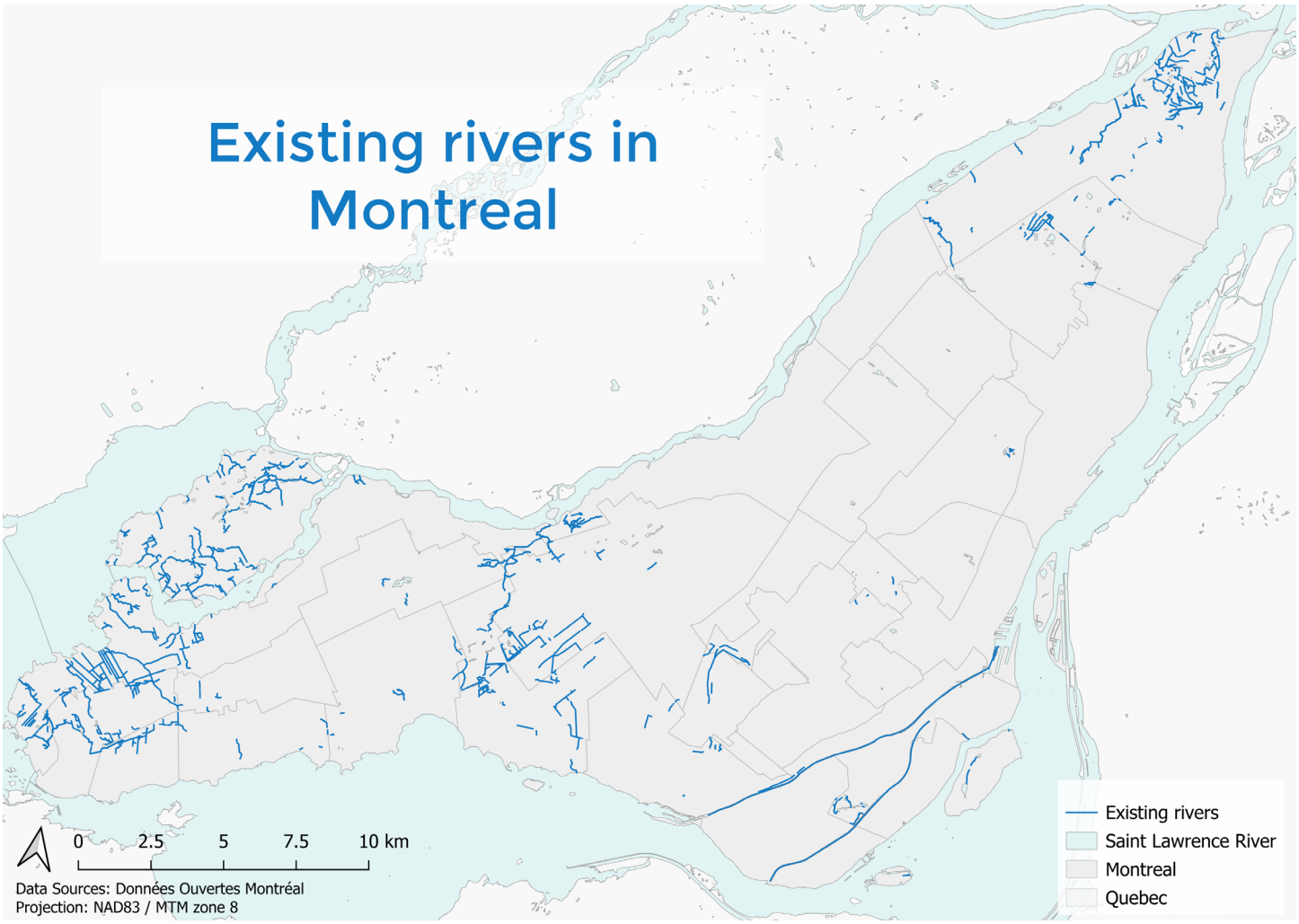

Figure 14: Map of existing waterways in Montreal

end up on the canal. However, because that's not there, going to the canal from NDG, it's really a detour and you can't really do it. I think it's really tough to do it without the car because you have to cross the highway. And yeah, that's the closest body of water. Or actually Beaver Lake on the mountain, Mont-Royal. So yeah, you don't really have any close options" (interview 2). This finding is somewhat surprising given how important water, and rivers in particular, have been to the development of Montreal and how prevalent rivers once were on the island.

Theme 2 - Major flooding events have caused significant property damage and challenges with obtaining insurance in flood-prone areas

The primary focus of lost waterways when reported in the media was their relation to present day flooding events. Unsurprisingly, this corresponded with the main way that residents seemed to consider lost waterways—as something that led to flooding in their communities and caused property damage. In one interview conducted on the *This is Montreal* podcast, a resident in a flood-prone area of Saint-Laurent explained the causes of flooding on his street with the following quote, "there was a creek here before, years ago. And you shouldn't play around with Mother Nature. So, this is what happens" (This is Montreal, 2024). In another CBC article covering flooding in Kirkland on Highway 40, one resident stuck on the flooded highway was quoted as saying "I'm just curious if I'm — if I'm in a river" (Stevenson, 2024). In both cases, maps confirmed residents' beliefs that they were near or above the trajectories of former waterways. This suggests that brief but often destructive re-emergences of water during flooding events are the main way that most residents connect with these waterways.

The impacts for residents, however, go beyond damages during flooding events. In some areas that are particularly flood-prone, residents can have difficulties getting insurance for their properties. In a news report by Radio-Canada, residents from a building in east Ville-Marie that had flooded nine times in 16 years reported that they had to pay approximately $750,000 in combined damages for flood repairs out of pocket because it was no longer insurable (Radio-Canada Info, 2024). When shown a map of the former Saint-Martin stream that ran near the location of the building until 1870, one resident remarked "I didn't know it was that close. We're really on the corner here" (Radio-Canada Info, 2024).

The community group member interviewed in CDN-NDG also noted that costs to landlords are often passed down to tenants of buildings. "I know in terms of the effects, again from outreach and door to door that, a lot of these basements were converted into housing for rent and a lot of people were mentioning how their landlord increased their rent, many times illegally above like the allowed threshold in, you know, with the excuse of they have to cover the losses and the expenses for the damaged garages and basements" (interview 2).

Theme 3 - There is interest in more education and information on lost waterways

A third and final theme identified for residents and community groups was an interest in more education and information on lost waterways. Part of this motivation was related to better equipping residents to understand and deal with flooding in their communities. As the community group member from CDN-NDG mentioned, "maybe this should be more accessible for the average resident who doesn't really follow other things for work or for fun, so it will definitely help a lot. Same with, for example, recently we were arguing about the urban heat island effect in some neighbourhoods. Once you overlay that with the existing canopy. It explains a lot and I think it gives some power to the people. Once they have information easily available, they know what to ask for at least" (interview 2).

Beyond interest in information on lost waterways for flood preparedness, there also appears to be a more general interest in learning about the history of former rivers on the island. Often this is with the goal of understanding whether there is a possibility of daylight rivers. One community group in CDN-NDG called Les Amis du parc Meadowbrook has made several posts to their website about the history of the now canalized Saint-Pierre River and including some promoting the idea of daylighting the river (Les Amis du Parc Meadowbrook, 2018). There are also several residents who have visited canalized rivers and posted their photos and articles about it online like Andrew Emond who posted a series of articles visiting the St. Pierre River among others (Emond, 2009). Lost waterways on the island have also been the subject of art installations, including a 2012 Nuit Blanche exhibit titled *River Flow, Sewer Flow, Street Flow* that aimed to artistically daylight the St. Pierre River by projecting videos of water with accompanying recordings of water from the city's sewer system along a portion of the canalized river in downtown Montreal (Sawchuk & Thulin, 2012). Existing interest in lost waterways among residents indicates that there is a foundation for community engagement around climate resilience and urban ecology issues tied to urban waterways.

6.4 Key Takeaways - Residents and Community Groups

Overall, review of grey literature for residents and community groups revealed that despite the role that waterways have played in the development and history of Montreal, today there are several parts of the island that do not have easy access to natural surface water features like rivers or ponds. This is surprising given that the idea of Montreal being an island, and thus surrounded by water, is an important part of the city's identity. When looking at the relationship between residents and lost waterways, it appeared that the main way residents thought about these waterways in their

communities was as a factor that increased the risk of flooding. Flooding around lost waterways impacted homeowners through property damage and difficulties getting insurance, while it impacted renters through rent increases justified by high costs of repairing properties. Still, though brief re-emergences of waterways during flood events are often damaging, there is still evidence that some residents connect with lost waterways in more positive ways. The emergence of community groups that share the history of these waterways, urban explorers who visit river culverts, and art pieces dedicated to lost waterways show that curiosity about these waterways exist and that they still hold cultural value.

6.5 Summary of Interviews

Overall, there was limited engagement with, and knowledge of, lost waterways demonstrated across the three data streams (policy documents, planner interviews, and residents / community groups). When lost waterways did come up, it was clear that they were primarily thought of in terms of water management and flood risk assessment. Some community groups looked at lost waterways more in terms of their cultural, environmental, and educational value, though overall knowledge of these waterways appears to be low among the public. Nonetheless, it is apparent that there is interest in more information being available on lost waterways.

All three data streams also emphasized that there is a need for more detailed understandings of flood vulnerability which might explain in part why flood vulnerability is the main way in which planning presently engages with lost waterways. More extreme weather events due to climate change have clearly driven this focus on water management and flood mitigation. In recent years, there has been an increased focus on regulatory

Theme	Policy Documents	Planner Interviews	Residents / Community Groups
Need for better understanding of flood vulnerability	✓ Emphasizes improved mapping and information for public and private actors	✓ Highlighted importance of updated maps and regulatory tools	✓ Desire for more public information so that residents can better prepare and know what help to ask for from the city
Focus on Nature-Based Solutions	✓ Prioritized as a flood mitigation strategy	✓ Interest in these solutions, but also skepticism about impact and feasibility	— Not mentioned
Attention to surface water / blue space access	✓ Focus on St. Lawrence River and Rivière des Prairies; inland waterways less emphasized	— Not mentioned	✓ Limited access to water in many parts of the island; many do not have easy access to surface water / blue spaces
Attention to lost waterways	× Few references; focus on water management	× Little engagement with lost rivers; when considered, seen mainly through a flood risk lens	× Little knowledge of lost waterways demonstrated; evidence of interest in more information for cultural, environmental, and educational purposes
Comments on possibility of daylighting	× Only one mention of daylighting; commented on its potential to contribute to surface water management	— Not mentioned	✓ At least one community group has made explicit calls for river daylighting; art installations have also occurred that aim at cultural daylighting
Climate-driven regulatory change / response to extreme weather	✓ Directly frames Nature-Based Solutions and improved rainwater management as necessary responses to climate change	✓ Regulatory changes accelerated due to recent heavy rain events	— Implied interest in climate resilience, but the interview and media surveyed did not directly focus on this area
Role of homeowners / individuals in managing flood risk	— Implied through need for better information dissemination	✓ Noted need for more homeowner action	— Some residents felt underinformed or unsupported in addressing flood vulnerability

Legend
✓ = Theme is clearly present
× = Minimal or no engagement
— = Not mentioned or indirectly present

Figure 15: Table comparing themes from the three data streams

changes and nature-based solutions. Planners noted that though the city is investing in addressing flooding, there is a need for more investment from private citizens as well. Still, it seems that private citizens feel uninformed and under-supported when it comes to taking action to address flooding.

Finally, despite calls from some community groups, there have not been any serious discussions of daylighting within the city. Although policy documents do note a need for better access to water on the island, this focuses on access to the St. Lawrence and Prairies rivers and not inland water. This is despite the fact that some parts of the island have little access to surface water or blue spaces.

The findings of this chapter show that while climate resilience and nature-based solutions are gaining more attention in Montreal, lost waterways remain a dimension of the island's environment and history that is relatively underexplored both in professional planning documents and in the planning practice. There may be opportunities to consider how lost waterways could contribute to future planning decisions that build towards a more resilient, sustainable, and inclusive city.

Chapter 7

Conclusion and Recommendations

7.1 Conclusion

This research project has looked at how lost waterways are understood by planners and residents in Montreal and what is currently being done to address challenges related to these waterways, particularly in the context of more frequent extreme weather events related to climate change. Historically, Montreal has gone from an island where rivers and streams were a ubiquitous part of life, to one where most of the island's waterways have disappeared or been canalized. Since the 1970s, policy has shifted towards a greater recognition of the environmental, economic, and recreation benefits of water and greater efforts have been made to protect existing water environments. This has created a planning environment where there might be opportunities for greater integration of lost waterways into planning decisions and strategies.

Despite this, interviews with planners revealed that current planning practices primarily consider lost waterways only as a factor in assessing flood risk. The policy review found a similarly heavy focus on flood prevention measures and improving the identification of areas vulnerable to flooding. Overall, it was found that planning primarily addressed the economic impacts of lost waterways and gave less attention to social and environmental impacts. Like planners, residents showed a concern for flood risks caused by lost waterways. Interest in these waterways, however, was not exclusive to flooding as it was also observed that there was a more general interest in the history and potential educational benefits of natural surface water on the island, both past and present.

Overall, this research suggests that greater opportunities exist to consider lost waterways in the Montreal planning context. Based on the findings and conclusions of this research project, five recommendations for how to better integrate waterways into planning in ways that address economic, environmental, and social aspects of water. These recommendations are intended to be actionable, however no specific design interventions are suggested as assessing the economic and technical feasibility of individual projects escapes the scope of this research project.

7.2 Recommendations

Recommendation 1: Consider access to water beyond the St. Lawrence River and Rivière des Prairies

The policy review found that while there is attention being given to improving access to the riverbanks of the St. Lawrence River and the Rivière des Prairies, less attention is being given to inland water environments like rivers or wetlands. As mapping of existing rivers on the island demonstrated, there are parts of Montreal that do not have easy access to natural surface water. Policy documents recognized the role that water plays in the history and identity of Montreal as well as its benefits to public health and quality of life.

Improving quality and access to public spaces along riverbanks is a positive step in connecting citizens with water; however more attention should also be given to connecting citizens with inland waterways, especially for parts of the island that are not close to one of the major rivers. While some of these areas might have swimming pools or park fountains, artificial and natural water spaces have different qualities and offer different experiences. One paper on participatory daylighting found that educational benefits—like interactions with nature and water cycles—were among the most desirable aspects of daylighting projects for residents (Usher et al., 2020, pp. 1497-1499). These educational benefits are not as present with artificial water features like pools or fountains, demonstrating the importance of providing access to natural water alongside more artificial water bodies like swimming pools or fountains.

Recommendation 2: Continue to focus on green infrastructure

While there was some skepticism among planners of the flood retention capabilities of nature-based solutions like sponge parks and

saillies drainantes, the city should continue to pursue these solutions where possible. Because much of Montreal uses a combined sewer system, rainwater that would otherwise not need to be treated is mixed with wastewater and sent to water treatment plants. Because of this water treatment costs to the city are raised. As water treatment is also the largest municipal source of GHG emissions, this raises the city's carbon footprint. Water absorbed into the ground and the island's water table reduces the quantity of water that needs to be treated and thus reduces both costs and GHG emissions associated with water treatment.

Green infrastructure projects are also multifunctional and can provide both environmental and social benefits. Given the findings that the city's current engagement with lost waterways focuses primarily on their economic impacts, green infrastructure projects provide an opportunity to respond to some of the environmental and social impacts of losing waterways. To maximize the benefits of these projects, considering the locations of lost waterways more directly in green infrastructure planning might be worthwhile.

Recommendation 3: Consider the inclusion of more permanent water features with nature-based solutions

Considering the city is already making an effort to implement green infrastructure, and to improve existing green spaces, it is recommended that greater consideration be made towards including permanent water features in new and existing green spaces. Nature-based solutions being implemented on the island right now focus on rainwater retention, but few plans have been made to add permanent water to new or existing spaces. Adding new blue spaces to the city can support the island's water-based ecology and riparian ecosystems while also providing residents with new opportunities to engage with water and helping to support resilience against heavy rains and flooding.

One possible way to accomplish this might be through daylighting rivers. There have already been some preliminary plans to daylight portions of the island's rivers, though none of the plans have yet been realized. For example, plans existed to daylight a portion of the St. Pierre River that runs through the Falaise Saint-Jacques before a pedestrian trail was installed instead (Ville de Montréal, 2018). One planner from CDN-NDG also expressed interest in daylighting when interviewed. "I dream of the day when we'll take the rivers out of the underground and put them back above ground. We've been working hard at the borough with the Université de Montréal for years to create the Darlington ecological corridor, then eventually link it up to the Hippodrome site, which is the head of the Saint-Pierre. […] And we're dreaming that water features will be part of this too, that it won't just be green on the surface, but that we'll also be able to recreate some water environments through all this, so let's hope for the future" (interview 3, translated).

Still, given the barriers to daylighting in Montreal, the city should also explore other ways to add blue spaces to the island. In this regard, ponds or lakes might be another possibility. Following the maps of lost waterways, it can be seen that a river used to flow through Parc La Fontaine. Today the park has a pond that remains where the river once was which is a popular destination for residents and visitors to the area. Looking at maps of lost waterways across the wider island might reveal other parks or locations where ponds or lakes can be revived or created.

Anjou-sur-le-Lac is another example of a water retention area constructed at the site of a former river. This man-made lake was built by the city in the 1980s as a retention basin to prevent flooding in surrounding areas. In addition to its water management function, the stream has also become an area that supports a variety of biodiversity and has over a kilometre surrounding visitors can see the animals and plants that inhabit the area (Ville de Montréal, n.d.-b). Instead of being sent to a water treatment plant, water that enters the lake passes through the Ruisseau De Montigny before flowing into the Rivière des Prairies. This is a great example of a project that creates a surface water

feature which retains water, invites residents to visit, and provides ecological value.

Figure 16: Anjou-sur-le-Lac (Promenades de Jane, 2025)

Water features need not strictly follow the locations of lost waterways, however. Anyplace where ponds or lakes might provide climate resiliency, social benefits, or environmental benefits should be considered. It is important to remember that rivers and lakes often transform and shift over long timeframes, so although lost waterways might help inform which areas have the most potential to collect and retain water based on the island's topography and water tables, other areas may also be able to fulfill these functions.

Recommendation 4: Improve awareness of lost waterways through climate vulnerability maps

One place where planner and resident interest seemed to align was on a desire for more information to be available to the public on lost waterways. As explained in the interview findings, part of the motivation for this from both planners' and residents' perspectives was to give the public more understanding of factors that influence flood risk in their communities. Maps of lost waterways are already available through the city's *Vulnérabilité aux aléas climatiques de l'agglomération de Montréal* interactive website (Ville de Montréal, n.d.-c), however, this information does not seem to be well known even among planners. Two planners noted in interviews that they were not aware that information on lost rivers was available with one stating that "we don't have tools that allow us to locate ancient rivers" (interview 4, translated), and another saying "I didn't know it was online [...] I'd seen the climatic hazards, I hadn't seen the original rivers" (interview 5, translated) when being shown the city's virtual portal displaying lost waterway locations.

Knowing there is interest from both residents and planners in increasing knowledge of lost waterways, the city should do more to promote its already developed climate vulnerability map. Additionally, the climate vulnerability map includes several data points beyond lost waterways that influence flooding or climate resiliency more generally—like secteurs de cuvettes, tree canopy cover, and urban heat islands—however no explanation is provided of how these factors influence resiliency, or lack thereof. To provide residents with a full understanding of the vulnerabilities in their communities, explanations of what this data represents and how it influences climate resilience in their neighbourhoods should be provided either within the interactive climate vulnerability map itself, or on a companion page that is clearly marked and easy to access through the map page. It should not be assumed that every resident will understand what secteurs de cuvettes or tree canopy cover represents and how it influences their neighbourhood.

Recommendation 5: Explore opportunities for cultural daylighting

As residents also demonstrated an interest in engaging with lost waterways beyond understanding their contributions to flood vulnerability, a final recommendation would be exploring opportunities for the cultural daylighting of lost waterways. Cultural daylighting is the process of "restoring [rivers] in people's imaginations by drawing upon the stories, folklore, and history flowing through it" (Shute, 2024, p. 613). This can be done through a combination of art projects, informative landmarks and plaques, and educational events

or tours. If successful, this process can allow a wider audience to engage with lost waterways and their history, and to form new connections with buried rivers (Shute, 2024, p. 614). Cultural daylighting can increase knowledge and awareness of waterways and create opportunities for residents to envision how these streams should be managed in the future. In this regard, cultural daylighting can support other recommendations of improving awareness of lost waterways, encouraging the inclusion of permanent water features in future green infrastructure projects, and improving access to inland water on the island—though in this case it would be former waterways, not physical water.

One example of cultural daylighting in practice is the Tank Stream in Sydney, Australia. The Tank Stream was a waterway that passed through the centre of Sydney and was canalized in 1858 (Sydney Water, n.d., p. 2). Today, Sydney Water operates guided tours of the Tank Stream that allow visitors to enter the underground tunnels where the stream still flows (Hoh, 2016). Several public art pieces have also been installed along the route of the stream to bring attention to the underground waterway including a fountain and pavement markers (City of Sydney, n.d.-a; City of Sydney, n.d.-b). Sydney has made an effort to recognize the heritage value and historic importance of the Tank Stream and uses art and public tours to ensure that it remains in the collective imagination of its citizens, maintaining its cultural importance.

In Montreal, the Pointe-à-Callière Museum already has an exhibit titled *Memory Collector* where a section of the William Collector that contained the St. Pierre River until 1989 can be visited (Musée Pointe-à-Callière, n.d.). Though not explicitly related to lost waterways, *la Société québécoise de spéléologie* has also been offering education tours of the Caverne de St-Léonard located underneath Parc Pie-XII since 1981, connecting residents to the island's natural heritage (Spéléo Québec, n.d.). These existing attractions could provide a foundation for a greater effort to culturally daylight lost waterways across the island.

Still, cultural daylighting must be approached thoughtfully. If it is pursued, the city must be careful to ensure that it is done meaningfully and

Figure 17: The *Memory Collector* exhibit at the Pointe-à-Callière Museum (Musée Pointe-à-Callière, n.d.)

not simply as a way to avoid addressing the more significant economic, social, and environmental impacts that have resulted from canalizing the majority of the island's waterways. When asked about the idea of culturally daylighting rivers, a heritage planner stated, "I think that the trap is that you don't do the actual work that you can, and you say, 'Oh well, that's good enough.' That's always a trap because it's cheap and fast, and it's showy [...] It's interesting when it's telling you a story on the ground of something that's happening below ground, but just this used to be the place of a historic river can be kind of meaningless I guess if there's nothing else there" (interview 2).

The planner expressed that cultural daylighting should be done in concert with other interventions, or with the objective of advocating for particular actions to be more meaningful. "I think it could [be meaningful]. If it's combined with other [actions]. If it's just that by itself it can be kind of hollow, whereas if it's actually expressing something that's going on or expressing something that's incoming it could be [meaningful]. Let's say a bunch of people in a neighbourhood want to go and paint the roads blue in an area where it's prone to flooding, and where there was a historic stream. That could be a political way to leverage and put pressure" (interview 2). Given this reflection, cultural daylighting should only be pursued if it accompanies actions that work towards accomplishing other recommendations or municipal objectives and not for the sake of cultural daylighting in and of itself.

7.3 Limitations

Although this research project grounds its conclusions and recommendations in the literature review, Montreal's historical context, interviews, grey literature, and policy review, there are limitations to the research that must be noted.

First, interviews with planners represent a small sample and might not capture the full range of opinions within the planning field. Planners in only two Montreal boroughs were interviewed. It is possible that the views of planners in these boroughs differ from those in other boroughs. Interviews with planners from other parts of Montreal might have revealed additional challenges, tensions, and opportunities.

Findings from residents have similar limitations. In this case, only one interview was conducted, and this was accompanied by a survey of grey literature. Since special attention was given to grey literature that included discussions on lost waterways, opinions expressed in these sources likely privileged the voices of residents who had greater prior knowledge of these waterways than the average resident. Because of this, opinions and views expressed might not have been representative of the wider population's understanding of the topics discussed. Consideration to this was given when developing themes in the section on resident findings, and as such fewer themes were presented for the resident group.

Finally, it should also be noted that the data used for the mapping of lost waterways has known imprecisions and limitations. Shapefiles of lost waterways used for this research come from a project conducted in the Faculty of Planning at the University of Montreal (Mahaut, 2018). One planner interviewed for this research worked on this project and noted that although major streams on the island were mapped, there were also smaller streams that were omitted from the final project either because they were seasonal or non-permanent, or because of uncertainty around their existence or trajectory (interview 1). The width and depth of streams was also difficult to assess and so all streams are presented at the same size when this would not have been the case in reality. Historical maps presented in this research should, therefore, be used as rough guides to where rivers once were and not treated as absolute fact.

7.4 Future Research Recommendations

Future research in Montreal could focus on interviewing a wider group of residents and planners or on design and feasibility studies for specific water features or cultural daylighting projects. Interviews with planners and residents from more boroughs across different parts of Montreal could

reveal more perspectives and uncover whether differences in borough topography, flood-risk, and planning priorities elicit different understandings of lost waterways. Research focusing on designs and locations of specific interventions that could have the greatest impact on managing water, improving citizen access to blue spaces, and contributing positively to ecological objectives, could establish priority sectors for future interventions on the island. Design workshops or charrettes with residents and planners on possible project designs and desired outcomes could also be valuable for determining objectives of future projects and policy directions. Research in any of these areas would contribute to better understandings of how lost waterways can be integrated into Montreal's planning policies and strategies in ways that support social, environmental, and economic objectives.

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McGill University
Research Ethics Board Office
www.mcgill.ca/research/research/human

CERTIFICATE OF ETHICS APPROVAL

REB File Number:	24-12-011
Project Title:	Assessing Impacts of Climate Change on Understandings of Underground Urban Rivers
Student Principal Investigator:	Jack Campbell
Department:	Urban Planning, School of
Supervisor Name:	Professor Lisa Bornstein
Sponsor/Funding Agency (if applicable):	

Research Team (if applicable):

Name	Affiliation

Approval Period:

FROM	TO
30-Jan-2025	29-Jan-2026

The *REB-1* reviewed and approved this project by review in accordance with the requirements of the McGill University Policy on the Ethical Conduct of Research Involving Human Participants and the Tri-Council Policy Statement: Ethical Conduct For Research Involving Humans.

* Approval is granted only for the research and purposes described.
* The PI must inform the REB if there is a termination or interruption of their affiliation with the University. The McGill REB approval is no longer valid once the PI is no longer a student or employee.
* An **Amendment** form must be used to submit any proposed modifications to the approved research. Modifications to the approved research must be reviewed and approved by the REB before they can be implemented. Changes to funding or adding new funding to a previously unfunded study must be submitted as an Amendment.
* A **Continuing Review** form must be submitted before the above expiry date. Research cannot be conducted without a current ethics approval. Submit 2-3 weeks ahead of the expiry date.
A total of 5 renewals are permitted after which time a new application will need to be submitted.
* A **Termination** form must be submitted to inform the REB when a project has been completed or terminated.
* A **Reportable New Information** form must be submitted to report any unanticipated issues that may increase the risk level to participants or that may have other ethical implications or to report any protocol deviations that did not receive prior REB approval.
* The REB must be promptly notified of any new information that may affect the welfare or consent of participants.
* The REB must be notified of any suspension or cancellation imposed by a funding agency or regulatory body that is related to this study.
* The REB must be notified of any findings that may have ethical implications or may affect the decision of the REB.