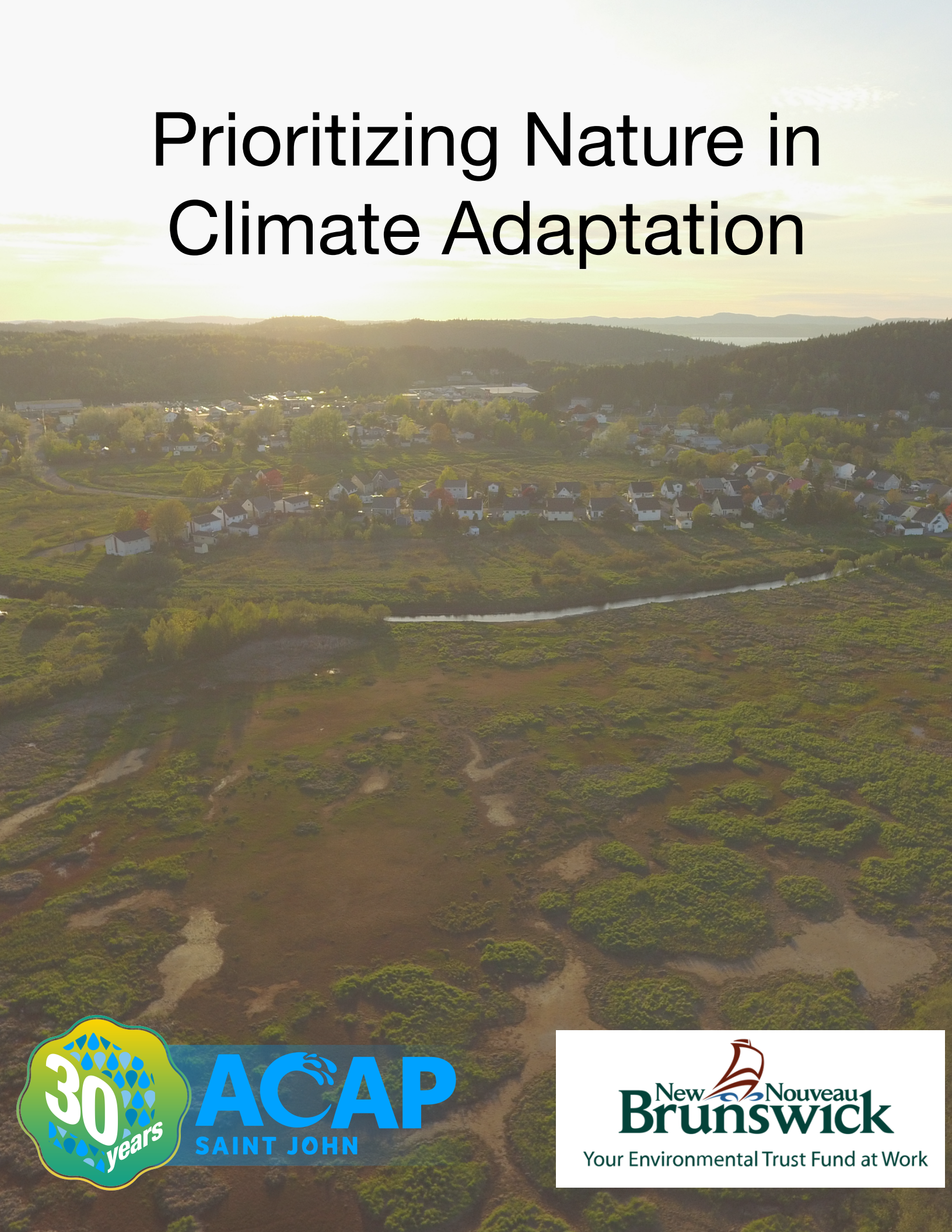
Prioritizing Nature in Climate Adaptation



30 years

ACAP SAINT JOHN

New Nouveau Brunswick

Your Environmental Trust Fund at Work

Prioritizing Nature in Climate Adaptation

ETF Project number: 220057

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Introduction

The City of Saint John, (hereafter referred to as "the City") is known for its location on the Bay of Fundy, where the world's highest tides meet the Wolastoq. The vast coastline, forests, and freshwater ecosystems that make up the City provide ecosystem services that make Saint John a beautiful and resilient place to live. These services can be advantageous to the municipality for their role in managing water levels, mitigating temperature, and creating habitat and biodiversity. As our climate changes, the City of Saint John is faced with challenges like sea level rise and increased storm events, increasing the vulnerability of communities and infrastructure along the coast. This project will explore the impacts of changing climate on the natural environment by identifying and evaluating existing natural assets and developing a strategy to protect, enhance, and restore the function of these assets in the future.

ACAP Saint John has successfully led the development of the City of Saint John's Climate Change Adaptation Plan (2020) and is eager to provide resources and materials to the City and community during the implementation of the plan. This project falls into Objective 2 of the Adaptation Plan, to reduce shoreline erosion and promote natural infrastructure, most notably, Action 2-12, to include natural assets in the City's Asset Management Plan. This process will help the City to identify the ecosystem services provided by existing assets and contribute to the development of a framework to manage natural resources in Saint John. As the City faces extreme precipitation events, higher intensity storms, and sea level rise, the role of these natural assets and modern management strategies are increasingly critical.

Natural Assets

Natural assets are a type of green infrastructure that can be used to adapt to climate change and include forests, wetlands, parks, waterbodies, shorelines, and riparian areas (Figure 1; Green Infrastructure Coalition Ontario, 2021). Other categories of green infrastructure include enhanced assets (rain gardens, bioswales, etc.) and engineered assets (permeable pavement, rain barrels). All these types of green infrastructure support conventional, or grey infrastructure in its function and longevity. Natural assets, for example, can help to reduce the amount of stormwater that will eventually enter the stormwater system or can slow storm surge that could cause erosion to built infrastructure.

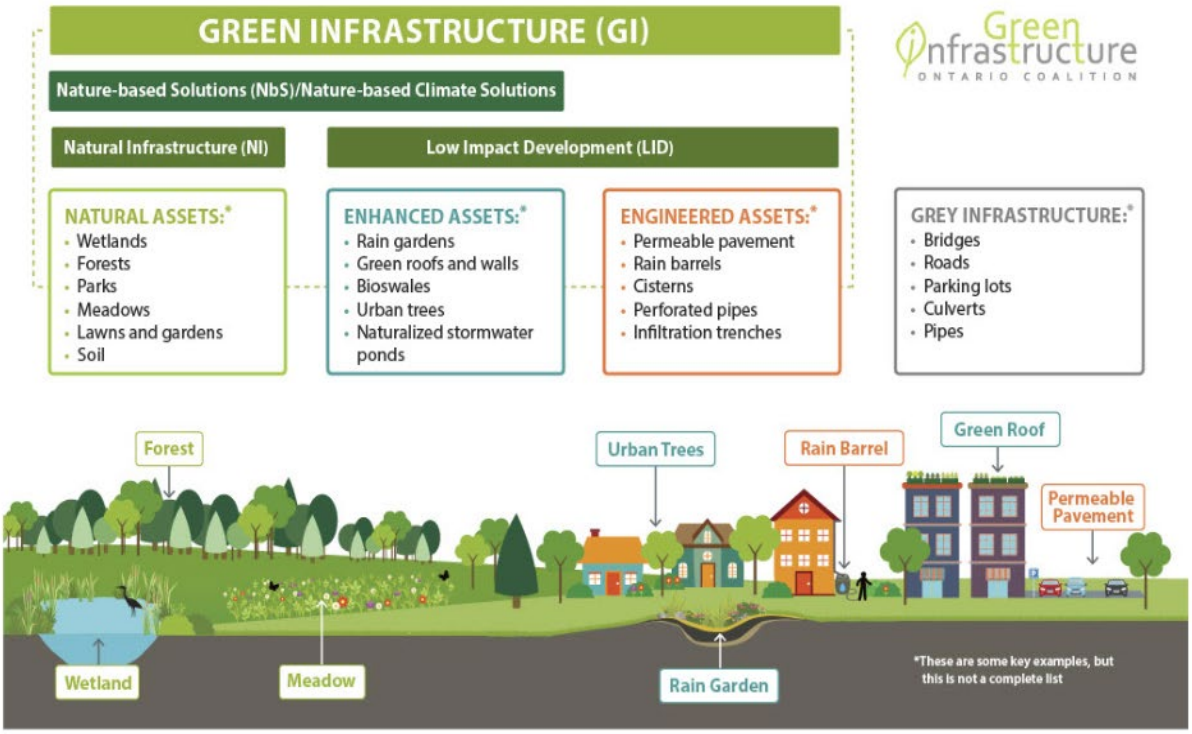

Figure 1: Types of green infrastructure in municipalities (Green Infrastructure Ontario Coalition, 2021).

Natural assets can reduce the costs delivering municipal services through:

- Reducing upfront costs of engineered infrastructure. Managing natural assets may reduce the need for conventional infrastructure to complete similar functions.
- Providing services to the community at no cost (i.e., wetlands improve stormwater attenuation).
- Improving adaptive capacity to climate change. Natural assets appreciate over time and can adapt to changing climate conditions, as conventional infrastructure will remain static and/or decline over time.
- Natural asset integration can provide higher levels of service than conventional infrastructure systems (Asset Management BC, 2019a).

Natural asset management can also have important benefits for the community and can support biodiversity, recreation, health, and social inclusion.

We can look to other municipalities in Canada and New Brunswick to see how natural asset management works in practice. Gibsons, BC was the first municipality in North America to include natural spaces as an asset class in their asset management system and in annual financial statements. This approach recognizes nature as an asset that provides municipal services to Gibsons to protect the town's groundwater aquifer. This has created opportunities for projects on managing stormwater, studying coastal infrastructure, and urban forest planning. One of these projects, *Managing Natural Assets to Coastal Resilience,* involved the Town of Gibsons as well as Pointe-du-Chêne, NB.

The Southeast Regional Service Commission of New Brunswick partnered with the Municipal Natural Assets Initiative (MNAI) to assess the benefits of natural coastal infrastructure in Pointe-du-Chêne. A modelling tool (Coastal Toolbox) was used to compare natural asset solutions to storm surge flooding and coastal erosion (Figure 2). This approach determined that natural assets can have an impact on reducing coastal erosion, but are less effective for managing flood impacts, which will require managed retreat. Flood protection benefits ranged in a cost savings of approximately $1.4 – $7.6 million. Erosion protection benefits ranged depending on the type of natural infrastructure used in protection but offered a cost savings of approximately $8 - $11 million (MNAI, 2021).

Figure 2: Flood map of Pointe-du-Chêne, New Brunswick developed using the Coastal Toolbox (MNAI, 2021).

Asset Management in the City of Saint John

The City of Saint John has a well-established asset management system that includes an asset management policy (2021), asset management strategy (2018), and asset management work plan (roadmap) (2017) to guide the management of infrastructure in the municipality. The asset management policy is continually updated on a 3-year basis.

This project aligns with the City's objectives in the Asset Management Policy:

- "Facilitate the leveraging of partnerships and infrastructure funding from external sources.
- Improve the reliability of customer service by maintaining clearly defined levels of service.
- Improve the decisions related to the management of the City's assets.

- Improve the transparency and accountability of community investments in the management of the City's assets.
- Improve the management of the City's exposure to risks of reduced service delivery." (City of Saint John, 2022a).

As part of the City's asset management process, a State of the Infrastructure report is completed on a regular basis to update infrastructure conditions and risks to assets managed by the City. While these initiatives have been effective in guiding asset management processes in the City, they do not include considerations for natural assets. The City of Saint John already has a robust system to manage conventional infrastructure, and this project will begin the process of integrating natural assets within this system.

Natural asset management goals:

1. Fulfill Climate Change Adaptation Plan Objective 2.12: "Include natural assets (i.e. forests, wetlands, stormwater retention areas) in the Asset Management Plan. Identify & inventory natural assets using GIS".
2. Manage natural assets in a way that supports the City of Saint John infrastructure and operations.
3. Consider natural asset management a mechanism that can be used to adapt to climate change and reduce strain on conventional assets.

The City of Saint John follows the BC Framework for Asset Management, *Asset Management for Sustainable Service Delivery* (2019) outlined by Asset Management BC (Figure 3). This framework is based on international best practices and considers natural assets as part of a municipalities infrastructure makeup and outlines how they can be integrated. The companion document, *Integrating Natural Assets into Asset Management* (2019) was used to guide this project. This project will work within the "assess" category, to assess the natural assets present in the City of Saint John and to review current asset management practices and identify where natural assets could be integrated.

Figure 3: Integrating natural assets with the BC Asset Management Framework (Asset Management BC, 2019b).

Natural Asset Roadmap

ACAP Saint John, along with representatives from the City of Saint John worked with the Municipal Natural Assets Initiative (MNAI) to develop a Natural Asset Management Roadmap for the City. Participants included: Samir Yammine (Manager of Asset and Energy Management), Barb Crawford (Public Works and Transportation Services), Marc Dionne (Director of Parking, Parks, and Recreation Facilities), Steve Bishop (Superintendent of Parks and Recreation Facilities), Yves Legere (Geographic Information Systems Manager), and Bill Neal (Corporate Asset Management Coordinator).

This process consisted of attending three workshops to learn how natural assets can be integrated into asset management systems, completing a worksheet, and finally completing a Natural Asset Management Roadmap to guide the implementation of natural asset management in the City of Saint John. This roadmap resulted in 21 actions that will guide the City in managing natural assets across various sectors (Appendix A).

Natural Asset Inventory

To develop the natural asset inventory, a compilation of natural assets on municipally owned properties were divided into service areas based on the 2022 State of the Infrastructure (SOTI) Report (City of Saint John, 2022b). These service areas include:

- Saint John Water: Drinking Water Natural Assets
- Transportation & Public Works Services:
    - Stormwater Natural Assets
    - Parks and Public Spaces Natural Assets
    - Transportation Natural Assets

Drinking water natural assets are located within the watersheds that provide drinking water to the City (including the Spruce Lake and Loch Lomond watersheds). Natural assets that fall into the Transportation and Public Works service area include "stormwater natural assets" which are natural assets that are not within the boundaries of any municipally owned park, or with the drinking water watersheds, and are likely to provide a majority of ecosystem services to the stormwater service area. The "parks and public spaces assets" are those found within City-owned parks and public areas. Lastly, the "transportation assets" category refers to natural assets that are most likely to provide protection for roadways and transportation networks.

ACAP Saint John completed a desktop analysis using geographic information system (GIS) software and compared municipal properties and infrastructure with mapped forests, waterbodies, watercourses, wetlands, riparian areas (30 m buffer around a watercourse, waterbody, or wetland), parks, shorelines, and enhanced assets (rain gardens, stormwater detention areas, ditches, and street trees). A summary of natural assets found in the City of Saint John can be found in Table 1. The total area of each asset was catalogued, and a percentage of each asset was calculated compared to all the catalogued assets of that type. This information has also been developed into a GIS database that will be provided to the City of Saint John.

Overall, the majority of the City's natural assets are located within the drinking water service area. Forests could not be categorized using the City's canopy cover data in the drinking water service area since the data only extended to the municipal boundary. In these areas, the Government of New Brunswick's GeoNB forest layer was used and therefore was not compared to the other service areas. This is seen as a gap in the inventory, and it is recommended that the forest canopy cover layer be extended to include the Loch Lomond Watershed. Although these properties are outside of the City's boundary, they were included in the inventory since the City owns a substantial amount of land in this area and they provide important ecosystem services to help provide high quality drinking water to the residents of Saint John. Two detention ponds were identified at the City's Drinking Water Treatment Facility on Latimore Lake Road. This property is categorized as a park (Little River Reservoir) on the City's GIS system, so these detention ponds were listed under the parks and public spaces service area.

Table 1: Natural Assets in Saint John divided by service area. Percent total describes the percentage of natural assets in each service area relative to the total amount of assets within the City. Preliminary risk scores are based off the City of Saint John Climate Change Adaptation Plan risk and vulnerability assessment (2020). Note: risk scores only include climate change risks to asset failure.
** Enhanced Assets*
*** Based off the Saint John Climate Change Vulnerability Assessment (RVA, 2020).*

Service Area	Unit of Measurement	Quantification of Asset	Percent Total	Preliminary Risk Score
Saint John Water				
Drinking Water Natural Assets				
Properties	ha	7915.10	79%	N/A
Forests (GNB Forests)	ha	6543.89	N/A	Medium
Waterbodies (lakes)	ha	1819.67	94%	Medium
Wetlands	ha	1161.49	79%	Medium
Watercourses	km	68.37	67%	Medium
Riparian Areas	ha	1597.69	75%	Medium
Transportation & Public Works Services				
Stormwater Natural Assets				
Stormwater Properties	ha	1117.55	11%	N/A
Forests (CSJ Tree Canopy)	ha	499.41	43%	Medium
Waterbodies (lakes)	ha	44.77	2%	Medium-High
Wetlands	ha	243.53	17%	Medium
Watercourses	km	25.03	24%	Medium-High
Riparian Areas	ha	334.32	16%	Medium
Detention Ponds*	Number	7	78%	Medium-High** (High – future)**
Rain Gardens*	Number	1	33%	N/A
Parks and Public Spaces Natural Assets				
Properties (Parks)	ha	934.08	9%	Medium-High
Forests (CSJ Tree Canopy)	ha	674.12	57%	Medium
Waterbodies (lakes)	ha	76.96	4%	Low
Wetlands	ha	66.13	4%	Low
Watercourses	km	8.81	9%	Low
Riparian Areas	ha	207.03	9%	Low
Detention Ponds*	Number	2	22%	Medium-High** (High – future)**
Rain Gardens*	Number	2	67%	N/A
Transportation Natural Assets				
Shoreline Properties	Number	73	1%	Very-High
Shoreline Riparian Area	ha	64.60	3%	Very-High
Street Trees*	Number	4815	100%	Medium-High
Ditches*	km	19.24	100%	N/A

It is important to note that the natural assets assessed during this project were only on City-owned properties, which does not give a true scale of the ecosystem services that natural assets will provide to the municipality and residents in the City of Saint John. For example, the City does not own many properties along the shoreline, and therefore a small percentage of shoreline assets were captured in the inventory. This inventory is intended to be a preliminary assessment of the natural assets that the City is responsible for during future asset management practices.

Risks

A preliminary risk rating score was attributed to natural assets during the inventory (Table 1) using information from the City of Saint John Climate Change Adaptation Plan (2020) climate risk assessment and the Saint John Vulnerability Assessment (RVA, 2020). These risks are described as natural asset service risks, as they are susceptible to failure due to climate impacts and will directly affect service delivery. Other possible risks to natural assets such as development pressure and impacts due to lack of maintenance are listed in Table 2 but were not applied to this assessment. Further risk assessments of natural assets could include these categories. Enhanced assets such as rain gardens and ditches were not assessed in the Climate Change Adaptation Plan or Vulnerability Assessment, so these were not included in the preliminary risk assessment.

Table 2: Types of risks that can affect natural asset service delivery. Adapted from MNAI Risk Identification Approach (MNAI, n.d.).

TYPE	EXPLANATION	EXAMPLES
Natural asset service risk	The risks of asset failure that directly affects service delivery.	• ACAP Saint John able to complete a more detailed analysis using climate change risk assessment. • Aquifer contamination that results in a lack of safe drinking water.
Strategic risk	The risk of an event occurring that impacts the ability of achieving organizational goals.	• Development pressure. • A change in federal or provincial grant programs that reduces the availability of funding to your municipality.
Operations and maintenance risk	The risks related to poor asset controls and oversight, which can lead to poor record-keeping and poor monitoring of asset performance.	• Flooding due to poor maintenance of water retention areas (i.e., Enhanced assets). • Sediment buildup resulting in decreased functionality, ex. Flooding due to improperly maintained culverts.

Stormwater natural assets were rated as medium-high risk under the waterbodies, watercourses, and detention ponds categories. These areas experience more urban development than the parks and drinking water categories and will deal with climate change impacts such as sea level rise, heavy rainfall and increased temperatures.

Major's Brook, a tributary of Marsh Creek, is a natural asset on the City's East Side that receives stormwater inputs from surrounding commercial areas (Figure 4). Major's Brook was assessed during the vulnerability assessment completed by RV Anderson and Associates Limited (RVA) in 2020 and was assessed to be at medium-high risk under current climate conditions, and high risk

under future climate conditions (Table 1). The high-risk rating is attributed to wildfire impacts, as this would cause significant damage. This asset performs well under heavy rainfall conditions but received a medium-high risk rating after multi-day rainfall conditions (RVA, 2020). Major's Brook and Marsh Creek are also at risk of flooding from sea level rise. The City has an identified detention area on the East Side and more work should be done in this area to increase the storage capacity of these watercourses.

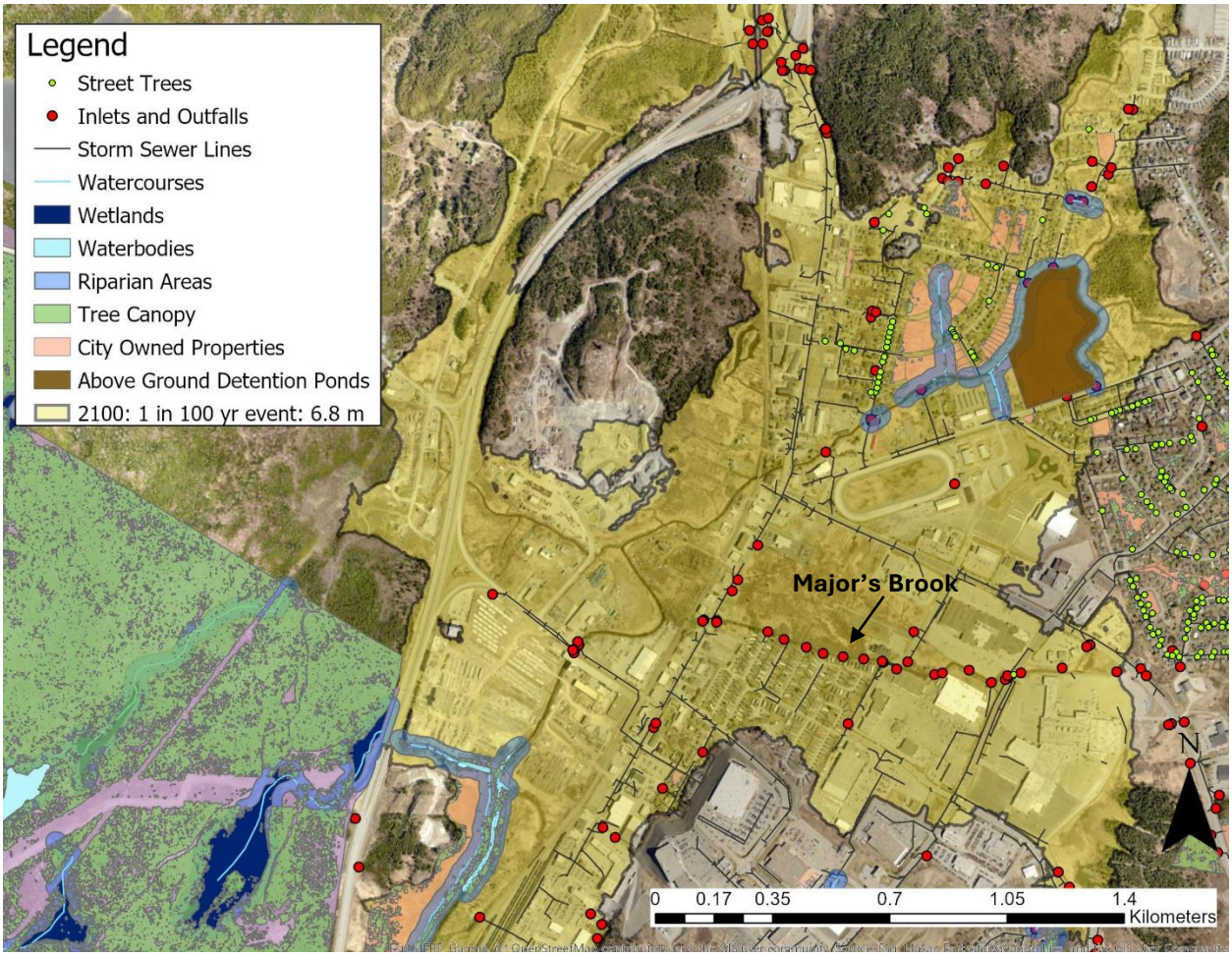

Figure 4: Flood risk areas in the City's East Side. Major's Brook is noted to be at medium-high to high risk of climate change impacts.

Many of Saint John's parks are located inland, have a large amount of forested area, are protected from development, and are maintained by the City. These areas are noted to be at low risk of climate impacts aside from a few properties (i.e., Shamrock Park, Mispec Beach) and two detention ponds which are at medium-high risk. Shamrock Park is a natural asset that has seen flooding impacts in the past during spring freshet events (Figure 5). This area is used seasonally and can act as a holding area until floodwaters recede. Newman's Brook is the primary watercourse in Shamrock Park and is piped underground limiting the services such as flood attenuation and water filtration that would be provided if this natural asset was available. Work to restore watercourses in this area can help increase the functionality of the floodplain.

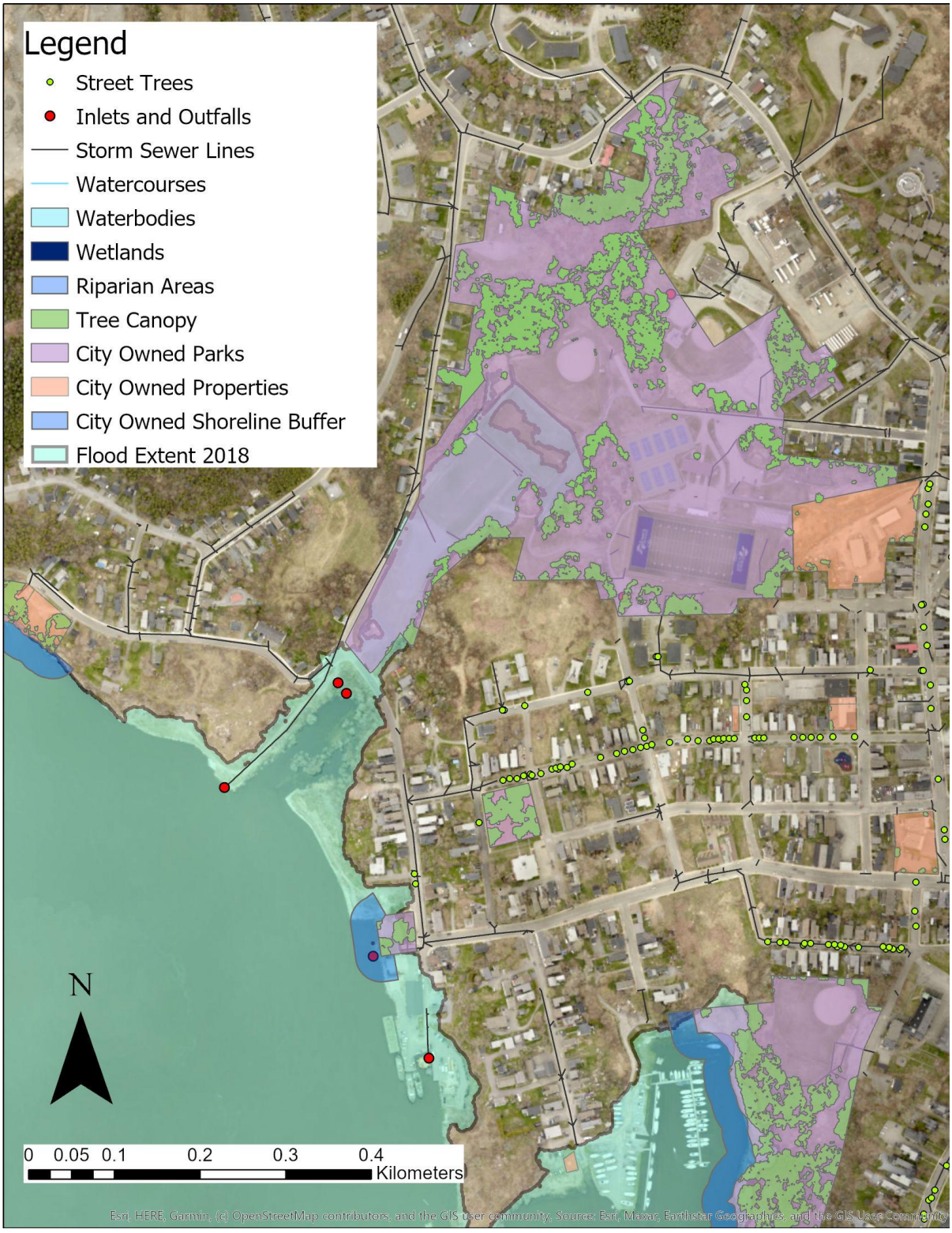

Figure 5: Shamrock Park during spring freshet flooding in 2018.

Transportation natural assets such as the shoreline and shoreline riparian areas were rated to be at very-high risk due to the impacts of sea level rise. Many of these natural assets protect municipal properties and roadways by buffering infrastructure from wave action that would otherwise cause

erosion and flooding. Marsh Creek and the Courtenay Bay Forebay are an example of where natural assets are providing conventional infrastructure with ecosystem services (Figure 6). The Forebay itself is a provincially significant wetland and will help manage sea level rise by providing stormwater services along Crown Street and Rothesay Avenue.

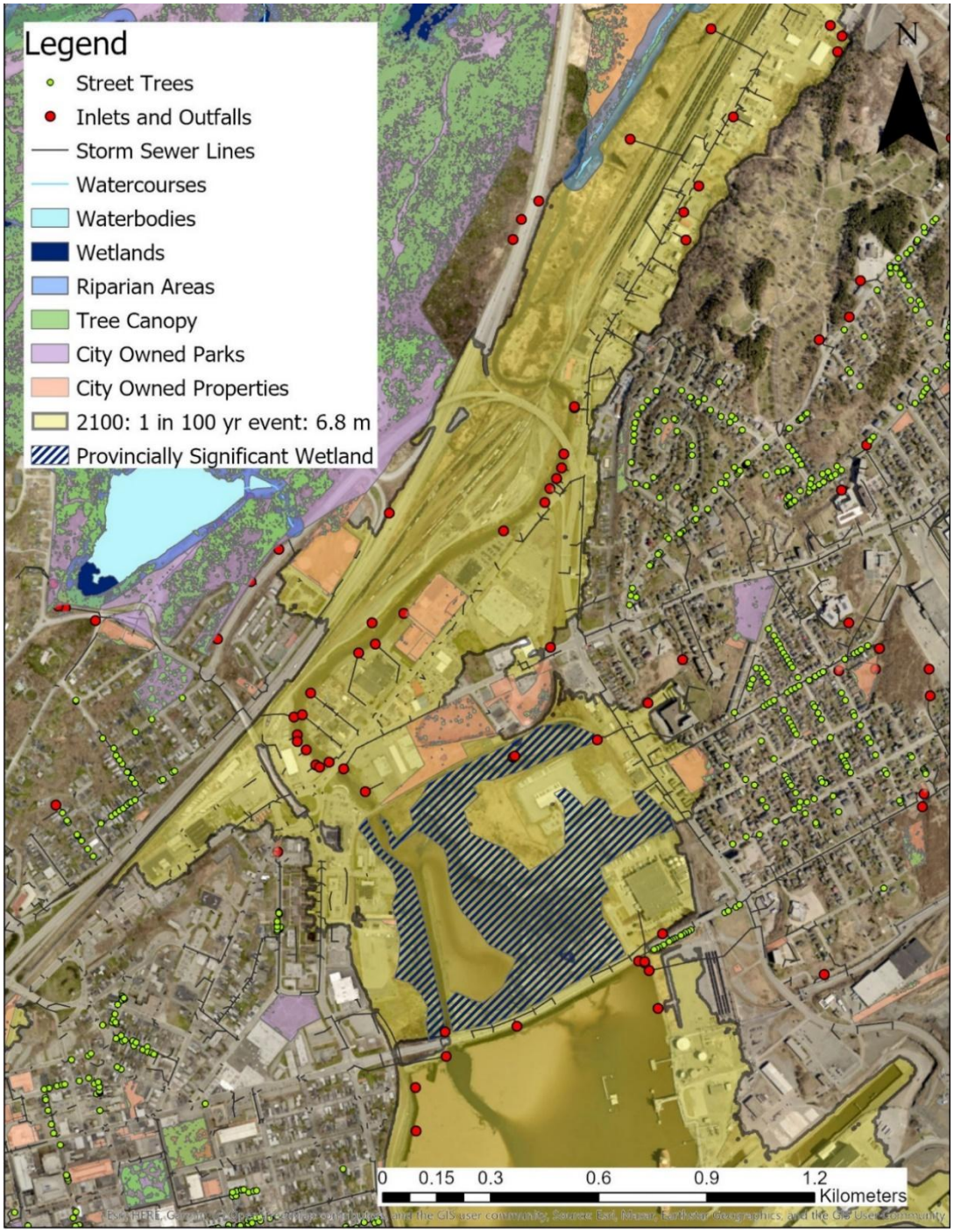

Figure 6: Marsh Creek and Courtenay Bay Forebay. The yellow demonstrates the extent of sea level rise flooding in 2100 without any adaptation efforts in place.

Gaps/Opportunities

Following the inventory exercise, ACAP Saint John completed a scan of natural assets in Saint John to identify areas where natural assets and conventional infrastructure interact, areas that are providing the City with a large number of services, and any gaps or opportunities to expand natural assets.

ACAP Saint John identified nine stormwater detention ponds during the inventory. Stormwater detention ponds temporarily store water and allow for water to either evaporate, infiltrate, or move downstream. Other environmental benefits associated with stormwater detention ponds include sediment/pollutant removal, nutrient inputs, providing wildlife habitat, and can provide esthetic and recreational opportunities (City of Surrey, 2023). Six of these ponds were not mapped in the City of Saint John GIS layers, and shapefiles were created to include them in the inventory. The detention pond layer provided by the City included underground stormwater detention tanks, therefore a new layer was created and termed “above-ground detention ponds” to include only stormwater detention ponds.

The Caledonia Brook stormwater detention pond near Boars Head Road was assessed during the vulnerability assessment completed by RVA in 2020 (Figure 7). Under current climate conditions this asset had an aggregate score of medium-high risk and under future climate conditions could be at high risk. The higher risk score is attributed to wildfire risks. The stormwater detention pond does well under heavy rainfall, hurricane, and spring freshet impacts, and is under medium-high risk (under both timelines) during multi-day rainfall events.

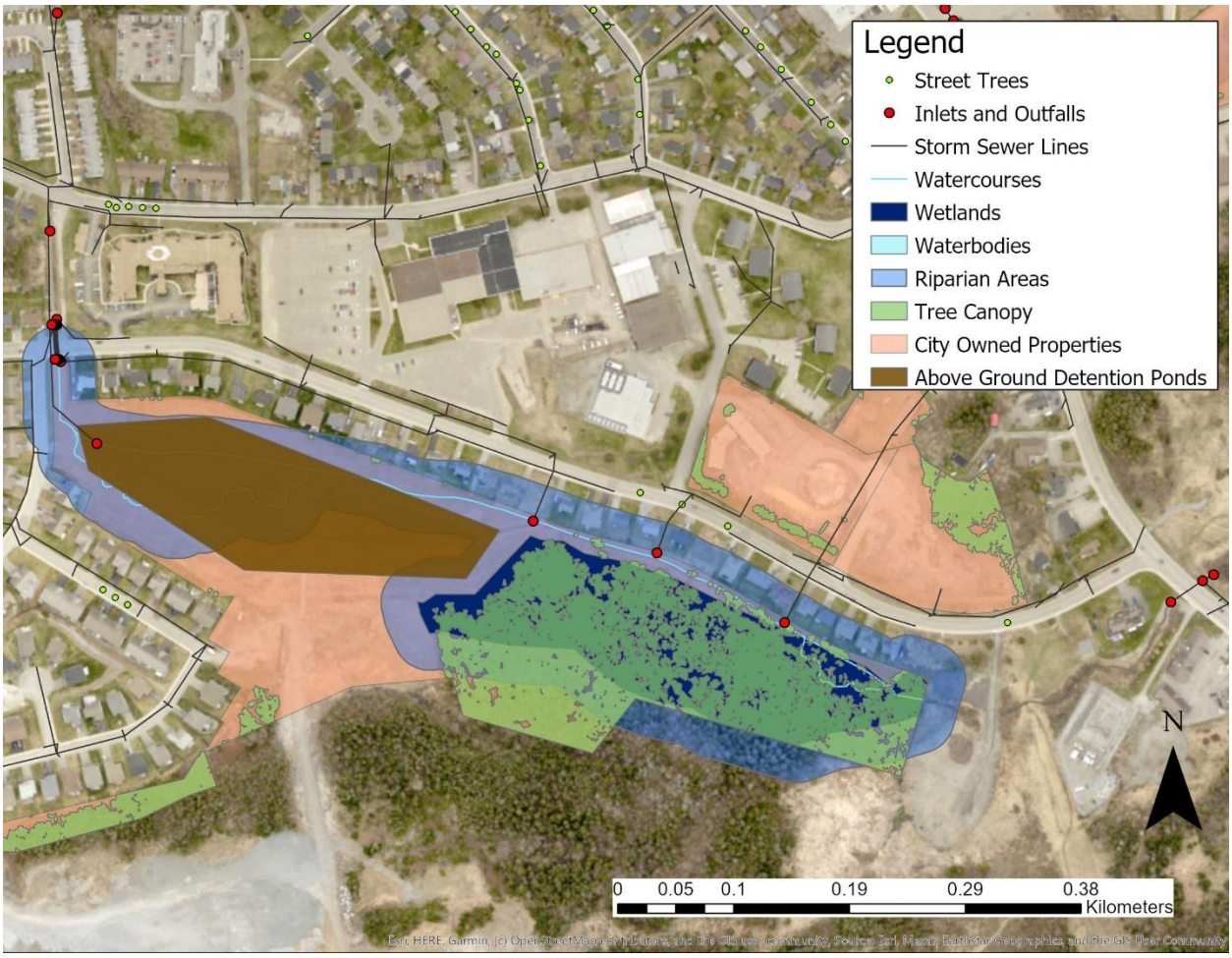

Figure 7: Caledonia Brook Stormwater Pond off Boars Head Road.

As stated above, three of the stormwater detention ponds in the City have already been included in the asset management framework; this is an opportunity to recognize these areas as natural assets that provide more than just stormwater management services. When implementing a zero-increase covenant (where new developments are required to manage runoff on-site) the City will likely see more stormwater management ponds being constructed during subdivision development and this inventory will continue to grow. As the climate changes, stormwater detention ponds can be a cost-effective adaptation to manage increasing rainfall and proper management will be important. Stormwater detention ponds may be a good starting point for integrating natural and constructed assets.

During the inventory scan, City-owned properties that were lacking in natural assets were noted as areas with potential for future work. One area of note is located between Champlain Drive, Loch Lomond Road, and Hickey Road (Figure 9). Little River runs through the northern portion of this property and then crosses underneath Champlain Drive to a pump station. The southern portion of this property has some bare ground areas and could be a potential tree planting site. This property is located between three residential communities as well as some commercial properties and has the capacity to manage a large volume of stormwater from the surrounding area.

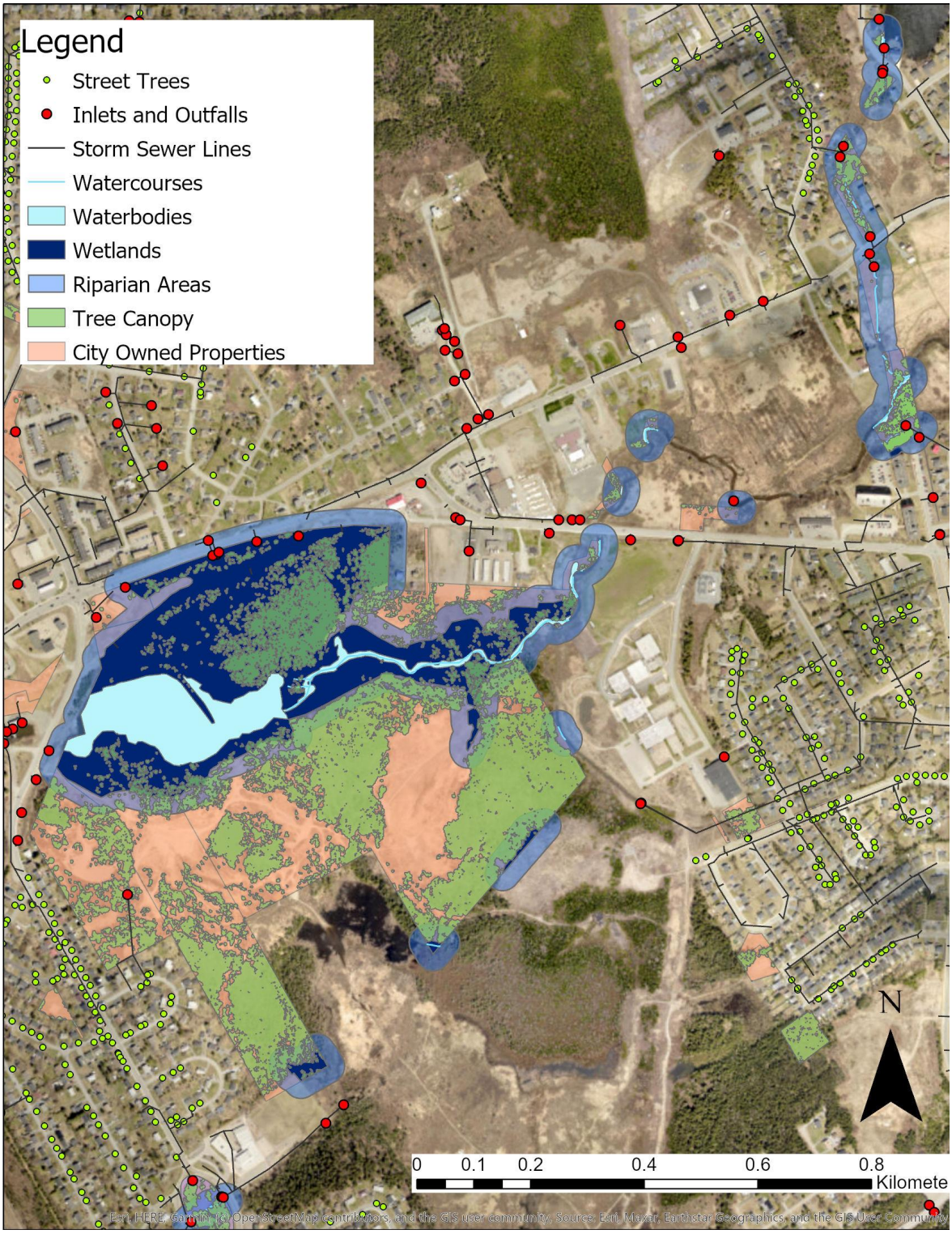

Figure 8: City property located between Champlain Drive (West), Loch Lomond Road (North), and Hickey Road (Northeast).

A parcel of City-owned land between Samuel Davis Drive and Sandy Point Road near the edge of Rockwood Park is another area to note that could be a potential site for restoration (Figure 10). The property has some open spots in the tree canopy where tree planting could be beneficial. There have

also been stormwater runoff issues along Sandy Point Road and the City is considering using enhanced assets (green wall) to manage erosion in 2023.

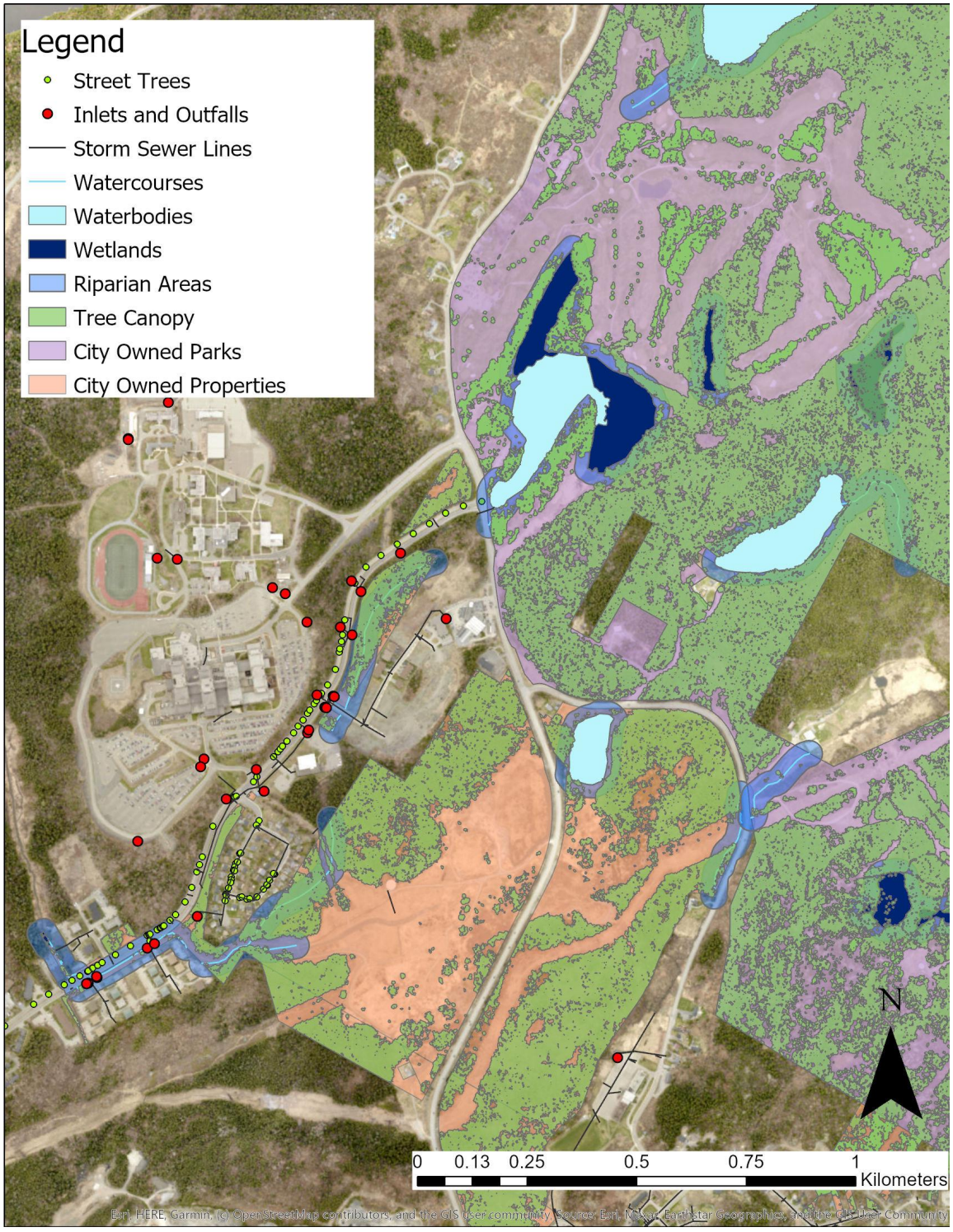

Figure 9: Rockwood Park and City-owned property along Sandy Point Road and Samuel Davis Drive.

Ecosystem Services

Natural assets can benefit municipalities by providing a multitude of ecosystem services including, but not limited to, carbon sequestration and storage, pollutant removal, stormwater management, wildlife habitat, storm surge interception, temperature regulation, and aesthetic appeal. Determining the values can be a challenging process, but there are tools available to help quantify the ecosystem services available in the City of Saint John. The following methods to estimate ecosystem services included all natural assets in the City, as they were not able to differentiate municipally owned property.

i-Tree Canopy

i-Tree Canopy is a tool developed by the United States Department of Agriculture (USDA) Forest Service that estimates cover classes to determine ecosystem services such as carbon storage, air pollution removal and stormwater retention within a specified boundary. This is done through a random point analysis of aerial images (Google Earth) and the user assigns cover type (i.e., trees, grass, buildings, roads, etc.) for each point generated. The City of Saint John (to the municipal boundary) was analyzed using this tool and approximately 62% of the City is composed of tree cover, 9% is composed of impervious surfaces, and 16% is covered by wetlands or water bodies (Figure 11).

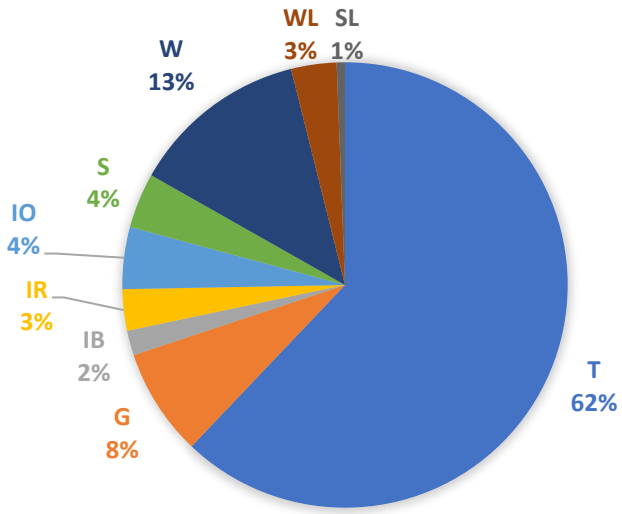

Figure 10: Cover class types in the City of Saint John using i-Tree Canopy software (USDA Forest Service, 2023). Legend: T= Tree, G= Grass, IB= Impervious Buildings, IR= Impervious Roadways, IO= Impervious Other, S= Soil/bare ground, W= Water, WL= Wetland, and SL= Shoreline.

The value of ecosystem services was calculated based on the area of tree cover in the City. A total of $453,094,162 was calculated based on the amount of carbon storage, pollutant removal, and stormwater management (Table 3). The largest contribution (over 95%) of this total is from carbon storage in trees supporting the importance of maintaining tree canopy in the City and limiting deforestation activities.

*Table 3: Ecosystem services gained from tree cover in the City of Saint John. *Note: Amount stored in trees is not an annual rate.*

Tree Benefit	Unit (kt = kilotonne; t = tonne; Ml = megalitre)	Amount	Value (CAD)
Sequestered annually in trees	kt	50.21	$12,656,626
Stored in trees*	kt	1,745.88	$440,107,452
Carbon monoxide removed annually	t	8.25	$298
Nitrogen dioxide removed annually	t	45.45	$134
Ozone removed annually	t	1,196.81	$43,727
Sulfur dioxide removed annually	t	11.08	$12
Particulate matter (less than 2.5 microns) removed annually	t	41.2	$51,567
Particulate matter (greater than 2.5 microns) removed annually	t	94.29	$15,967
Avoided runoff	Ml	68.99	$218,379
Evaporation	Ml	16,161.39	N/A
Interception	Ml	16,171.69	N/A
Transpiration	Ml	13212.91	N/A
Potential Evaporation	Ml	103350	N/A
Potential Evapotranspiration	Ml	83588.77	N/A
Total			**$453,094,162**

InVEST Model

The Natural Capital Project, led by Stanford University, has developed the Integrated Valuation of Ecosystem Services and Trade-offs model (InVEST), a free suite of tools that quantifies and maps ecosystem services. ACAP Saint John utilized the Urban Flood Risk Mitigation Model from InVEST to identify areas that have a higher risk of flooding due to heavy rainfall in Saint John. This process analyzes local land use and land cover, soil types, and rainfall intensity to determine areas where stormwater runoff will be high and map infiltration capacities throughout the area. This tool can help to visualize where natural assets may be lacking throughout the City and where land managers can focus future greening efforts.

The InVEST tool was used to model a 1 in 5 year storm (a storm that has a 20% probability) of 115.2 mm in the City of Saint John. This model identified areas where runoff is produced in mm (Figure 12) and areas of higher runoff retention (Figure 13). An analysis of the runoff retention was divided throughout watersheds in Saint John and is expressed as a percentage of the average runoff retention value per watershed. Areas that showed higher stormwater runoff and lower stormwater retention were more heavily developed areas in the Lower West, Central Peninsula, and the East Side of the City. This tool may be more useful during the analysis of flood risk areas such as Marsh Creek, where areas can be analyzed on a subwatershed basis, or during specific neighbourhood planning exercises rather than looking at it from a whole city view. These files will be provided to the City of Saint John along with the Natural Asset Inventory.

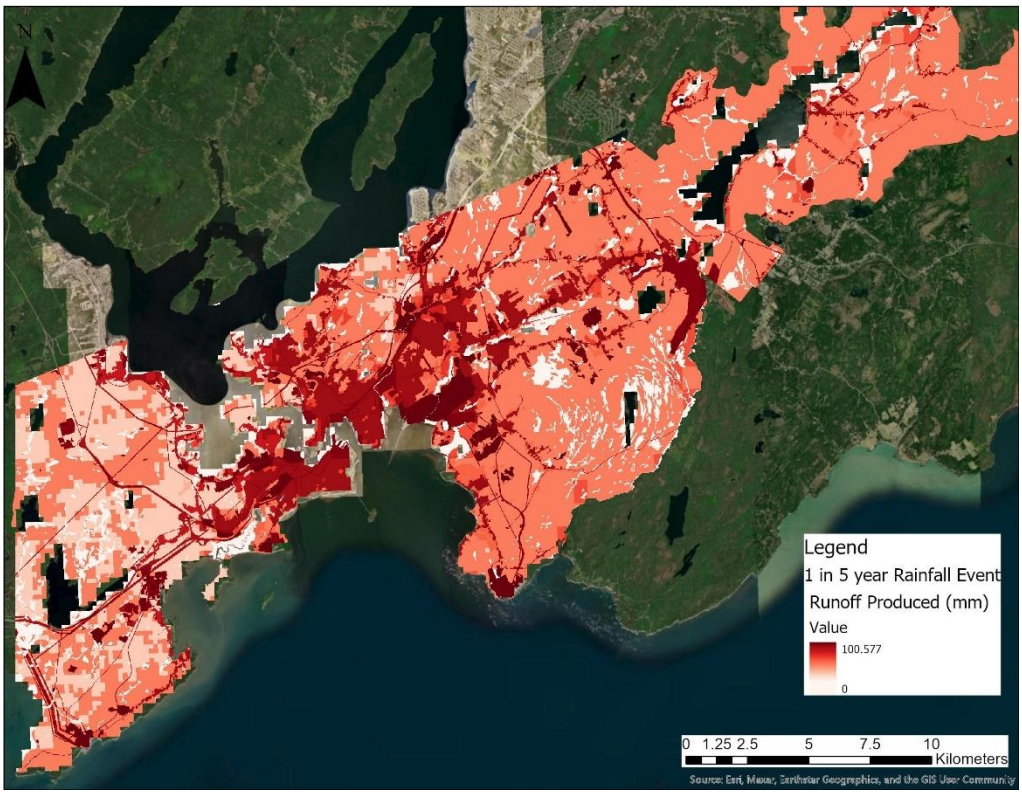

Figure 11: Runoff produced after a 1 in 5 year rainfall event (115.2 mm). Lighter colours indicate lower runoff and darker colours indicate higher runoff areas.

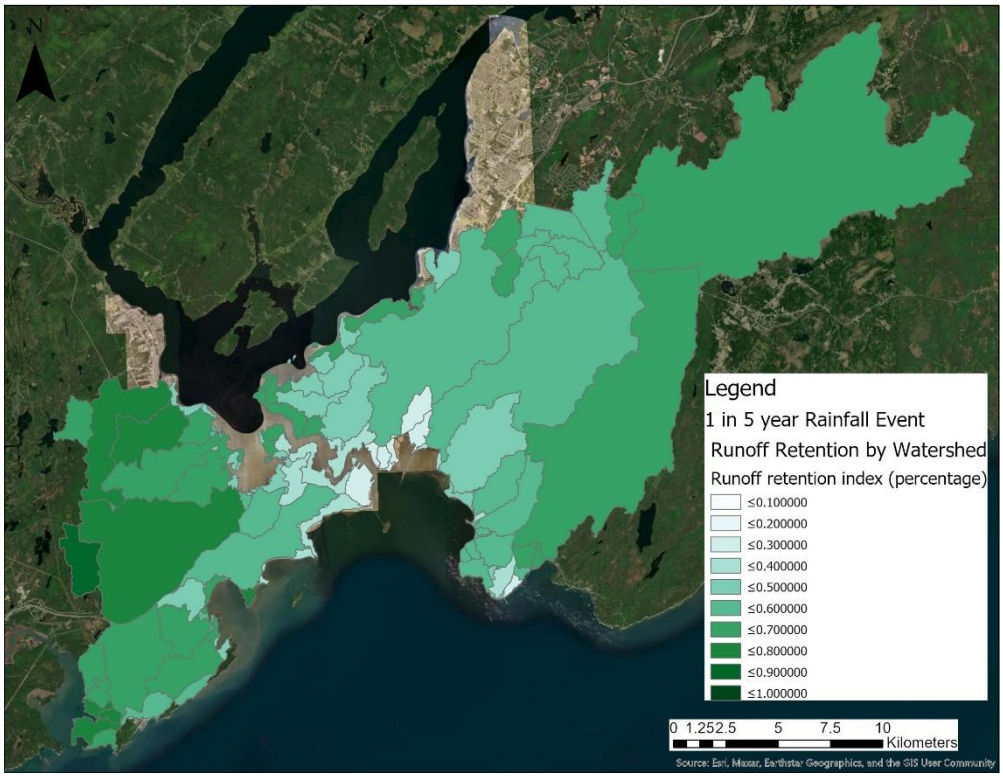

Figure 12: Runoff retention by watershed ranging from 0% (lighter colours) to 100% (darker colours).

WESP-AC

The Wetland Ecosystem Services Protocol for Atlantic Canada (WESP-AC) is an approach to compare and prioritize wetlands and assess wetland function and ecosystem services. ACAP Saint John and the Nature Conservancy of Canada worked to complete WESP-AC assessments at thirteen sites in Saint John from 2018-2020. Three of these sites were assessed near City owned properties (Table 4). Sites are rated based on a normalised score (from 0-10) of wetlands in the Province of New Brunswick and are given a rating of either lower, moderate, or higher when compared to other wetlands in New Brunswick.

Table 4: A selection of WESP-AC Sites and parameters assessed in Saint John from 2018-2020 by NCC (Nature Conservancy of Canada, Patrick, A., & Noel, P., 2021). Note: The results for Marsh Creek at Hanover have not yet been received.

		Randolph Island	Red Head	Little River	Marsh Creek at Hanover
Adjacent to City Property?		Y	Y	N	Y
Storm Surge Interception	**Score**	5.87	6.61	5.58	
	Rating	Higher	Higher	Higher	
Water Purification	**Score**	5.27	6.36	4.00	
	Rating	Moderate	Higher	Moderate	
Organic Nutrient Export	**Score**	8.27	9.48	6.79	
	Rating	Higher	Higher	Higher	
Wetland Stability	**Score**	4.71	7.75	7.65	
	Rating	Moderate	Higher	Higher	
Public Use & Recognition	**Score**	4.55	10.00	4.55	
	Rating	Higher	Higher	Higher	

The wetland around Randolph Island experiences spring freshet flooding (Figure 13). This wetland can help to manage floodwater during spring freshet and heavy rainfall and reduce flooding that can inundate the road that accesses the island. The Randolph Island wetland site located on the eastern and southern side of the causeway performs higher than average for storm surge interception, organic nutrient export, and public use and recognition. This site was also rated “moderate” for water purification and wetland stability (ability to adapt to sea level rise) (Table 4).

Figure 13: Randolph Island WESP-AC site (yellow) off Green Head Road.

Red Head Marsh is an area that provides a multitude of services to the City as it lies between Red Head Road and the East Side Wastewater Treatment Facility (Figure 14). The City only owns a portion of the marsh and the remainder is owned by the Government of New Brunswick. As sea levels rise, this wetland can help to protect the wastewater treatment facility from flooding impacts while also

capturing stormwater runoff from the industrial park and residential areas. Red Head Marsh was assessed to perform better than average when compared to other wetlands in New Brunswick in storm surge interception, water purification, organic nutrient export, wetland stability and public use and recognition (Table 4).

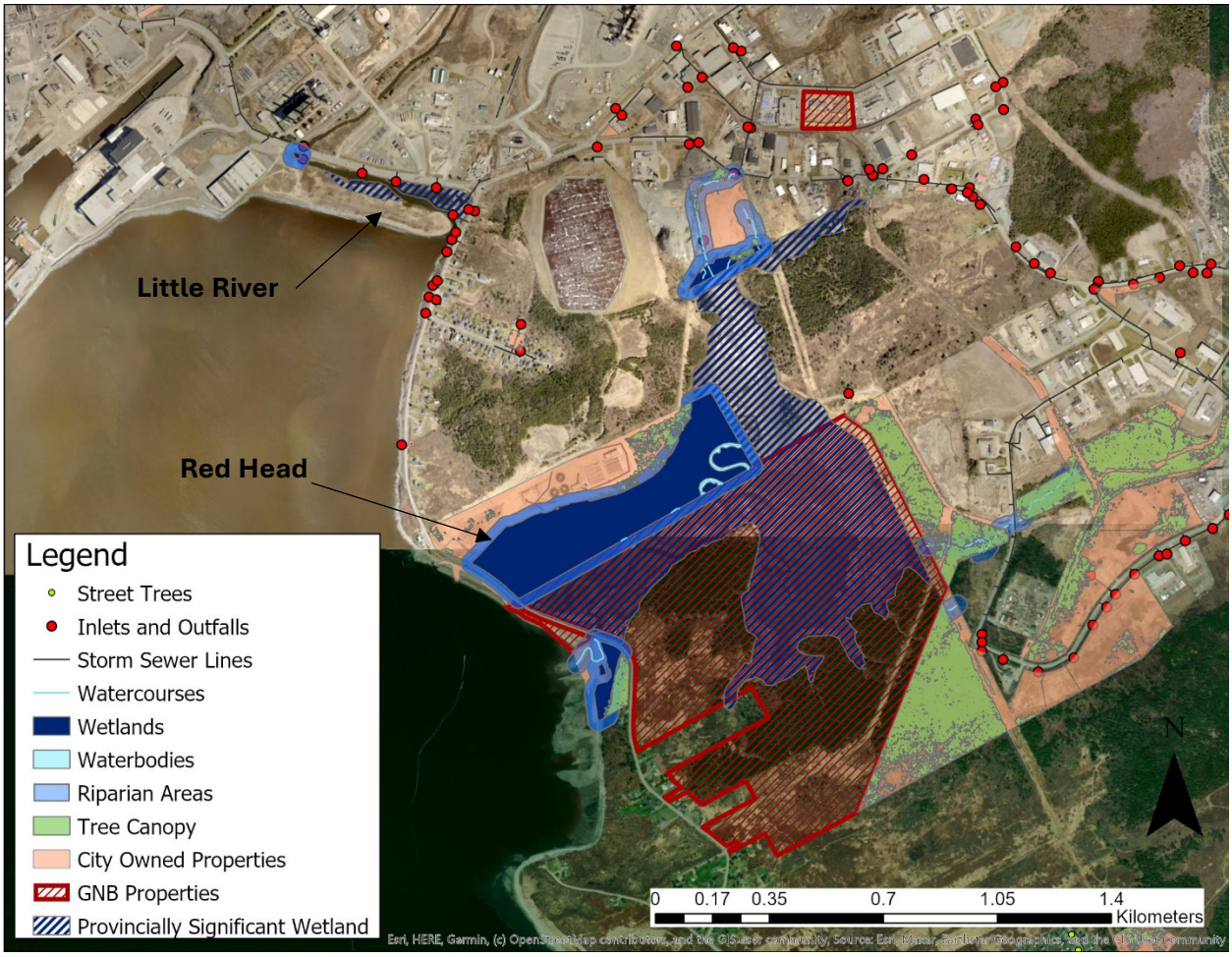

Figure 14: Red Head Marsh (east) and the wastewater treatment facility located on Red Head Road. Little River wetland to the north.

Little River is also noted to be a Provincially significant wetland on the east side of Saint John that interacts with multiple stormwater outfalls (Figure 14). Although this area is not on City-owned property, it was included due to its proximity to roadways and stormwater infrastructure. The Little River wetland performs higher than average at storm surge interception, organic nutrient export, wetland stability and public use and recognition (Table 4). This wetland was ranked “moderate” for water purification; this ecosystem service is essential for this wetland, as this area is highly contaminated from stormwater inputs and overflows from heavy industry.

The data for the WESP-AC assessment of Marsh Creek at Hanover Street has not yet been made available at the time of this report. This will be included in the final report to the City of Saint John when it has been completed. This site provides a large amount of ecosystem services to the City of Saint John as shown in Figure 6 and the *Risks* section of this report.

Condition of Natural Assets

Assessing the condition of natural assets in the City of Saint John is outside the scope of this project but can be useful in the future to better manage natural assets. Condition assessments can be completed by using available data collected by ACAP Saint John, the Government of New Brunswick, the University of New Brunswick, and other environmental consultants/researchers. Atlantic Data Stream and the St. Lawrence Global Observatory are open access data platforms that can provide data sources for natural asset conditions in Saint John. ACAP Saint John also completes annual water quality monitoring in Saint John. Another report that may be useful in determining the condition of shoreline assets is *Living Coastal: Exploring Coastline Changes in Saint John, NB,* completed by ACAP Saint John in 2022.

Recommendations

This project has been the initial step in embracing natural assets as part of asset management in the City of Saint John. By identifying where natural assets are located in the City and how they are providing valuable ecosystem services, we can move forward to better manage and protect these essential ecosystems. The following recommendations will strengthen natural asset management in the City of Saint John for years to come:

- Follow the actions included in the Asset Management Roadmap to continue integrating natural assets into the City of Saint John Asset Management structure.
- Add the natural asset inventory GIS layers to the City's data structure.
- Update forest canopy cover layer to include the Loch Lomond Watershed.
- Expand the natural asset risk assessment to include strategic and operational risks.
- Update the stormwater detention pond GIS layer to include newly identified natural assets.
- Recognize stormwater detention ponds as natural assets.
- Assess the feasibility of planting trees at the Champlain Drive and Sandy Point Road properties.
- Engage with other municipalities in New Brunswick that are completing natural asset management for guidance.

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Appendix A: Natural Asset Management Roadmap

Priority: High (H), Medium (M), Low (L)

Timing: Short-term (S-T) 1-3 years, Medium-term (M-T) 3-6 years, Long-term (L-T) 6+ years. Timing may change based on available resources.

Recommended Actions:	Priority H, M, L	Timing (S-T or M-T)	Responsible (bold) Involved (not bold)	Council Approval (Y/N)
COMPETENCY 1: POLICY AND GOVERNANCE				
1.1 Policy and Objectives Outcome Area				
● Update asset management (AM) policy to include natural asset management goals	M	S-T	**Utilities & Infrastructure**, Public Works & Transportation	Y
1.2 Asset Management Strategy and Roadmap Outcome Area				
● Develop natural asset management (NAM) roadmap to identify immediate priorities and begin identifying resources and opportunities	H (in progress)	S-T	**ACAPSJ**, NAM Team	N
● Refer to actions in the *Saint John Climate Change Adaptation Plan* for natural asset related goals (i.e., Stormwater Management Plan, Urban Forest Management Plan)	M	M-T	**Public Works & Transportation,** Parks, Utilities & Infrastructure, ACAPSJ	N
1.3 Measurement and Monitoring Outcome Area				
● Use levels of service to develop KPI to measure progress on implementation of NAM – linked to 3.1	M	M-T	**Utilities & Infrastructure**, Public Works & Transportation	N
COMPETENCY 2: PEOPLE AND LEADERSHIP				
2.1 Cross-functional Representation Outcome Area				
● Formalize an established NAM team (within Climate Change Committee) and champion within the City ● Ensure responsibilities for incorporating NAM are included in the terms of references for the Climate Change Committee	H	S-T	**City of Saint John,** Community input	Y (already approved)
2.2 Accountability Outcome Area				

● Formalize specific responsibilities for NAM through inclusion in job descriptions (i.e., Parks Department) ● Connect identified staff with AM team	H	M-T	**Utilities & Infrastructure**, Public Works & Transportation, Human resources (HR)	N (HR/Union)
2.3 Resourcing and Commitment Outcome Area				
● Complete natural asset inventory and gap analysis to identify priority assets	H (In progress)	S-T	**ACAPSJ,** GIS	N
● Identify funding opportunities for natural asset management work	M	M-T	**Utilities & Infrastructure**, Public Works & Transportation, ACAPSJ	N
COMPETENCY 3: DATA AND INFORMATION				
3.1 Asset Data Outcome Area				
● Update GIS data based on recommendations from natural asset inventory ● Incorporate natural asset data into asset registry during AM data system update; strategize approach to a combined system with a consistent format	M	L-T Working on centralizing data system	**Utilities and Infrastructure**, Public Works & Transportation, **GIS**, summer student	N
● Identify ecosystem services from natural assets and goals on what levels of service are a priority to achieve from natural assets – linked to 1.3	H	M-T	**Utilities and Infrastructure**, Public Works & Transportation, GIS, ACAPSJ	N
● Create a list of maintenance requirements for natural assets	M	M-T	Utilities and Infrastructure, Public Works & Transportation **(Parks),** GIS, ACAPSJ	N
● Refer to Risk Rating Manual to evaluate risks to natural assets	M	M-T	**Utilities and Infrastructure**, Public Works & Transportation, GIS	N
3.2 Performance Data Outcome Area				

● Consider field assessments and modelling to assess future performance of priority natural assets (pilot project)	M	M-T	Utilities and Infrastructure, **Public Works & Transportation**, ACAPSJ, Consultant	N
3.3 Financial Data Outcome Area				
● Pull information on current capital and operating expenses of natural assets (ex: cost of tree planting as part of street construction) – linked to 4.3	H	S-T	Utilities and Infrastructure, Public Works & Transportation, Parks	N
● Identify cost savings based on ecosystem services offered by natural assets	L	M-T	Utilities and Infrastructure, Public Works & Transportation, Consultant	N
COMPETENCY 4: PLANNING AND DECISION-MAKING				
4.1 Documentation and Standardization Outcome Area				
● Set goals for natural assets in future development planning	M	M-T	Utilities and Infrastructure **(Engineering)**, Public Works & Transportation, Planning, Parks	Y
4.2 Asset Investment Plans Outcome Area				
● Include objectives to manage natural assets during the next update to AM roadmap (can be included as a section within)	L	M-T	Utilities and Infrastructure (**Asset Management)**	N
4.3 Budget Outcome Area				
● needs assessment based on the outcomes of action 3.3. ● Begin incorporating needs into the budget process; develop capital investment planning	M	M-T	Utilities and Infrastructure, Public Works & Transportation, Parks, Consultant	Y
COMPETENCY 5: CONTRIBUTION TO ASSET MANAGEMENT PRACTICE				
5.1 Training and Development				
● Consider allocating resources for formal training for staff/council in relation to NAM goals; follow up on opportunities through FCM, Royal Roads (Internal, ongoing)	M	S-T	Human resources, Utilities and Infrastructure, Public Works & Transportation, Parks	N

5.2 Internal Communications and Knowledge Sharing Outcome Area				
● Communicate the benefits and opportunities of NAM to staff and Council; the first step could be presenting the results of the roadmap	H	S-T (ongoing)	Utilities and Infrastructure, Public Works & Transportation, Parks	N
5.3 External Communications and Knowledge Sharing Outcome Area				
● Present the conclusions of the NAM roadmap and other NAM projects (e.g., ACAP restoration projects) at conferences, public events, or community media spaces (ongoing)	L	M-T	**Utilities and Infrastructure**, Public Works & Transportation, **ACAPSJ**, Communications	N