6.1 Linear Engineered Assets

Most risks related to Linear Assets are caused by an increase in extreme precipitation that may overwhelm stormwater systems leading to localized flooding and erosion of stormwater channels and roadsides. Actions for this asset category focus on improving the resilience of the stormwater system to both extreme precipitation and drought events. Actions are also directed at improving road maintenance and operations to manage increasing degradation from shifting temperatures and extreme events (Table 9).

Table 9: Adaptation actions for Linear Engineered Assets (Roads and Stormwater)

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
L-1	Apply Low Impact Development (LID) and other "At-source" or "lot level control" strategies aimed at reducing and delaying conveyance system loading.	LID and other source controls can reduce the volume of water entering the linear storm system, improving water quality by capturing and treating rainfall where it lands. This will also reduce the risk of overwhelming the storm systems' capacity during heavy rainfalls, avoiding flooding and erosion.	25	Short	10+ (Considering city-wide improvements)	$$	Development Planning, Policy Planning, Engineering

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
L-2	Review maintenance procedures to reduce storm and sanitary system blockages and improve levels of service.	Increased extreme precipitation events may exceed the capacities of the stormwater and sanitary networks. Increasing the frequency of stormwater inspections following storm events is a relatively low-cost option to identify potential problem areas and undertake preventative maintenance measures where needed. Similarly, preventative inspections and maintenance prior to large storm events to clear out blockages can reduce flooding impacts.	25	Short	< 1	$	Operational Services
L-3	Increase the resilience of assets identified as vulnerable in the Tannery Creek Flood Study and maintain the asset Management system to prioritize and track resilience actions. Consider expanding floodplain studies to include all Town infrastructure and future climate projections.	Increased extreme precipitation events may exceed the capacities of the stormwater and sanitary networks. A floodplain analysis was conducted to identify areas of concern within the original developed area of the town. This study can guide preliminary actions to improve flood resilience. Further studies may be required to account for projected increases in precipitation. These should aim to identify the value of assets at risk, and how risk may change in the future at each location. This information should be maintained in an asset management system that is updated as resilience actions are completed.	20	Short	< 1	$$	Engineering

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
L-4	Increase the resilience of erosion-prone areas of the stormwater network in association with the Stream Management Master Plan and LSRCA inspections.	Enhancements such as increased rip rap and other protections against erosion at high flow locations such as headwalls may reduce impacts associated with extreme precipitation and flooding. Improvements should be in line with the Asset Management Plan, the Stream Management Master Plan, and existing work completed in partnership with the LSRCA. Costs may be higher if many improvements are required.	20	Medium	5 years	$$	Operational Services
L-5	Enhance stormwater management wet pond protections for drought and heatwaves.	Plant trees and other drought-resistant vegetation around stormwater management wet ponds to provide shading and reduce evaporation in high temperatures, heatwaves, and/or periods of drought. This may also contribute to increased urban biodiversity.	16	Medium	5 years	$$	Operational Services
L-6	Increase stormwater management wet pond maintenance during drought and heatwaves.	Increase wet pond inspections and add water as required to maintain adequate levels during drought and heatwave events where drawdown is a problem. Remove organics if odour becomes a problem during these events, and/or where there are concerns about water quality of future runoff.	16	Short	As required	$	Operational Services

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
L-7	Increase the resilience of erosion-prone areas of the pedestrian paths and road network.	Enhancements such as increased rip rap and other protections against erosion at vulnerable locations may prevent damages to roads and pathways associated with extreme precipitation and flooding. Improvements should be in line with the Asset Management Plan, targeting potentially vulnerable areas first due to age, condition, or potential for erosion. Costs may be higher if many improvements are required.	20	Medium	5 years	$$	Operational Services
L-8	Conduct a frost heave mitigation program.	Freeze-thaw cycles are projected to increase in concentration in the winter and decrease annually, which may require adjustments to maintenance schedules to respond to frost heave damages. Accept that sidewalk heave will occur and institute an inspection program to grind the lips smooth at heave locations to remove the trip hazards and associated liability. Should frost heave damage become a significant issue, investment into preventative measures such as replacement of base course, regrading, ditching, and crack sealing may reduce damages, however, requires significant upfront capital.	12	Long	10 years	$$	Operational Services

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
L-9	Conduct a high visibility signage replacement program.	Replacement and/or conversion of all safety signage to High-Intensity Prismatic (HIP) or Diamond Grade sheeting would maximize retro reflectivity which may be important for visibility during freezing rain or poor visibility events. Diamond grade sheeting also has the longest service life of available sheeting alternatives. The Town can monitor for visibility issues (accidents) and implement upgrades as needed.	12	Long	5 years	$$$	Operational Services
L-10	Prepare temporary signage for traffic signals during power failures.	Ensure traffic signals have temporary battery backups so these may continue to operate in power outages. Consider installing temporary folding stop signs at critical intersections as a low-cost, quickly deployable solution for extended periods of power outages, or having some prepared for deployment when needed.	24	Short	2 years	$$	Operational Services

$:<$10,000
$$: $10,000-$100,000
$$$: $100,000-$1M
$$$$: $1M+

Some roads and stormwater assets are located within floodplain areas (Figure 6) and may be impacted by flooding during extreme precipitation events. The Regional and 100-year Tannery Creek floodplain profiles were mapped as part of the 2019 Town of Aurora Stream Management Master Plan and Tannery Creek Flood Relief Study (Aquafor Beech Ltd., 2019). The map below shows the intersection between this floodplain and the Town's linear infrastructure. This does not represent all linear assets that may be affected by extreme precipitation and pluvial (overland) flooding but shows areas at risk of riverine flooding as assessed in 2019. More detailed information in the Tannery Creek Flood Study should be consulted in prioritizing flood adaptation actions. Precipitation associated with future climate conditions has not been modeled, so at-risk assets are likely to include more than what is shown on the map below and in the recent flood study.

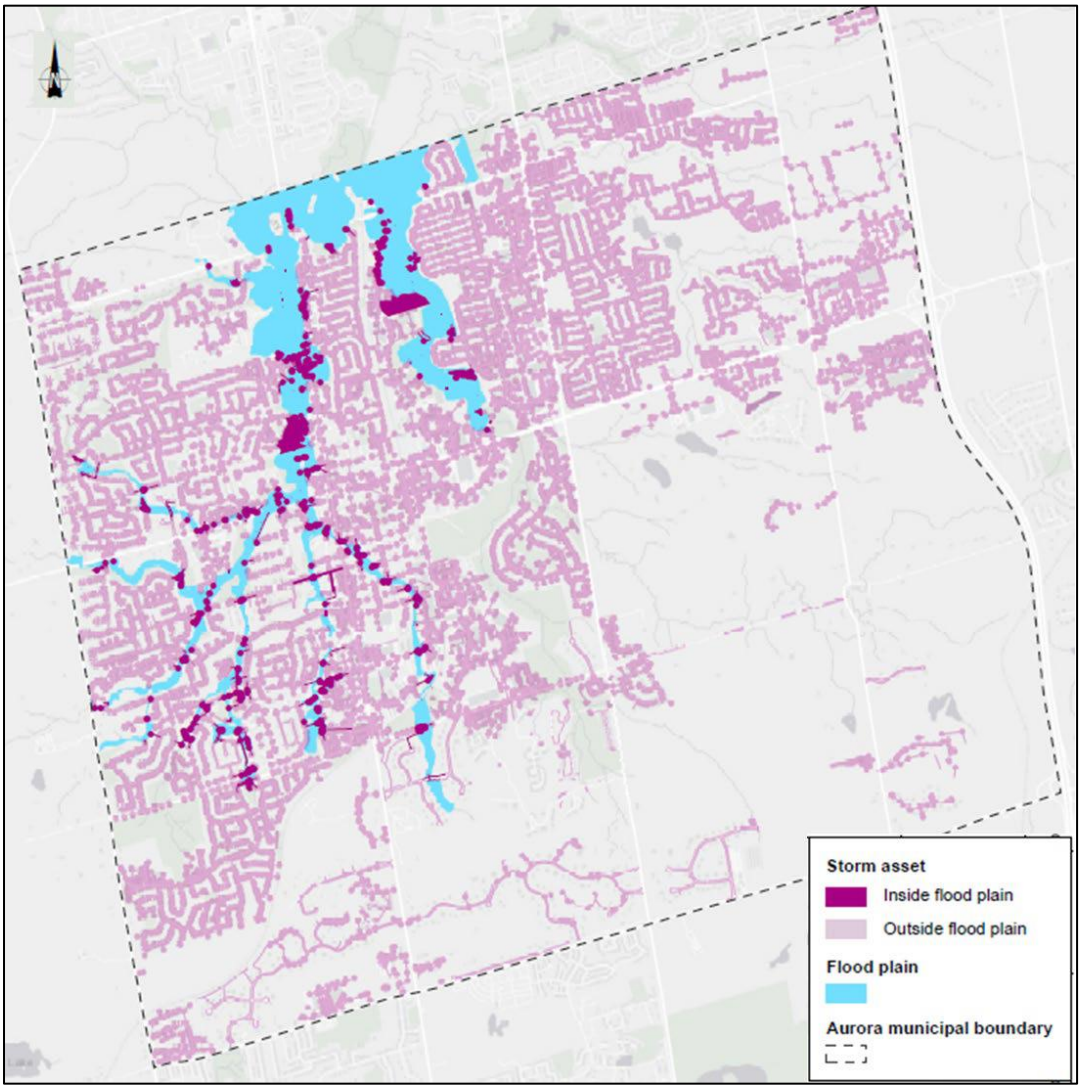

Figure 5: Map of Stormwater infrastructure located in floodplain areas.

6.2 Water Infrastructure Assets

The highest rated moderate risks to the water and sanitary networks relate to increasing precipitation and flooding during extreme events. Actions for this asset category focus on understanding the capacity and vulnerability of water and sanitary networks to manage risk related to heavy precipitation and severe weather events that may damage components, overload systems capacity or cause indirect issues like power outages (Table 10).

Table 10: Adaptation Actions for Water Infrastructure Assets (Water and Sanitary Networks)

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
W-1	Support landowners to protect their property from sanitary backups through education and incentive programs.	Many issues related to sanitary backups can be addressed at the property level by ensuring new construction is properly graded and that owners of new and existing properties have backflow protection installed within their property or building plumbing system. Public outreach can ensure property owners understand the risk of sewer backups and how they can protect their property. Incentives that offset the cost of backup valve installation can increase public uptake, saving property owners and the municipality money in the long term. Community outreach is required to raise awareness and trigger inquiries from landowners. Building Services (inspectors) and the Operational Services team may also be required to provide input or assessments for certain sites. Associated costs include staff time and subsidies.	25	Medium	5-10 years	As low as $ per year, $$ over 5 years, $$$ over 10 years	Development Planning, Policy Planning, Engineering, Building Services, Operational Services

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
W-2	Conduct a system-wide study to understand the age, conditions, and capacity of all storm and sanitary components.	This is a large-scale project that would help to prioritize long-term planning for infrastructure construction and maintenance. The study should address both sanitary and storm systems and include hydrologic modeling to understand system loading issues and future climate risk. This information should be maintained up to date in an asset management system that is updated as resilience actions are completed.	25	Medium to long	5-10 years	$$$	Engineering, GIS / IT
W-3	Continue to develop and Practice emergency response plans as part of the Drinking Water Quality Management System to protect and restore critical water system infrastructure in the event of damage from severe storms or natural disasters.	Storms and extreme precipitation events are projected to increase in the future, and these may impact the water and wastewater systems in the Town. Aside from the actions recommended to preventor reduce these impacts, response planning is also important to recover quickly from disruptions. Moderate costs are associated with updating and practicing emergency response plans, but this can save costs in the long-term by reducing the consequence of and disruption to services associated with asset failures.	15	Short	2-5 years	$$	Operational Services

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
W-4	Implement flood monitoring systems at water booster stations and sanitary lift stations to identify issues early before damage to infrastructure or loss of power occurs.	An increase in extreme precipitation events may lead to flooding, which could impact infrastructure at booster stations and interrupt service. Manual or automated monitoring systems can improve response times and mitigate the worst impacts of flooding with early detection. Engineering staff would be needed to manage the implementation of the system and determine warning triggers (whether measured manually or automatically), and Operations and Maintenance staff would be needed to implement response.	15	Short	1-3 years	$$	Operational Services
W-5	Review HVAC sufficiency at all pumping facilities to ensure the system is designed for increased temperatures. Review HVAC equipment connections to standby power in the event of power failures and maintenance practices in high-temperature conditions as needed.	Extreme heat may lead to high temperatures in pumping stations which could impact functionality. A review of cooling capacities at pumping stations is low-cost and could be coupled with other asset initiatives (e.g., condition assessments). New infrastructure should be designed to consider a larger range and potentially higher ambient temperatures. This adaptation measure would reduce the likelihood of equipment failures in extreme heat events.	15	Medium	2-5 years	$$	Engineering, Operational Services

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
W-6	Continue to inspect and maintain backup generators for the water booster station and consider installing backup power at the sanitary lift station.	As flooding due to extreme precipitation and lightning events may lead to more frequent power outages, having backup power systems at booster stations helps avoid or reduce interruptions to the water network. Installing a fixed or mobile backup power system at the sanitary lift station and ensuring that the generator at the water booster station is in good working order may become more important in the future.	15	Medium	2-5 years	$$	Engineering, Operational Services
W-7	Monitor for problematic sites for odour control issues in the sanitary system. Additive systems and/or air scrubbers may be used to respond to issues.	There is a potential for future high temperatures to lead to increased corrosion in the sanitary system, which could lead to more odour events. Preventative maintenance and asset management practices can respond to corrosion, and there are odour management practices that the Town may consider applying to respond to odour events as needed. Wastewater additives and air scrubbers may be used at concentrated point sources.	15	Medium	2-5 year	$$	Operational Services

$:<$10,000
$$: $10,000-$100,000
$$$: $100,000-$1M
$$$$: $1M+

Like linear engineered assets, some water and sanitary infrastructure is located within the Regional and 100-year floodplain areas and may be at risk of flood-related damage. See Figure 7 and Appendix A for an overview of exposed areas in the sanitary network. More detailed information on creek flooding is available in the Town of Aurora's Tannery Creek Flood Study (Aquafor Beech Ltd., 2019). Precipitation associated with future climate conditions has not been modeled, so at-risk assets are likely to include more than what is shown on the map below and in the recent flood study.

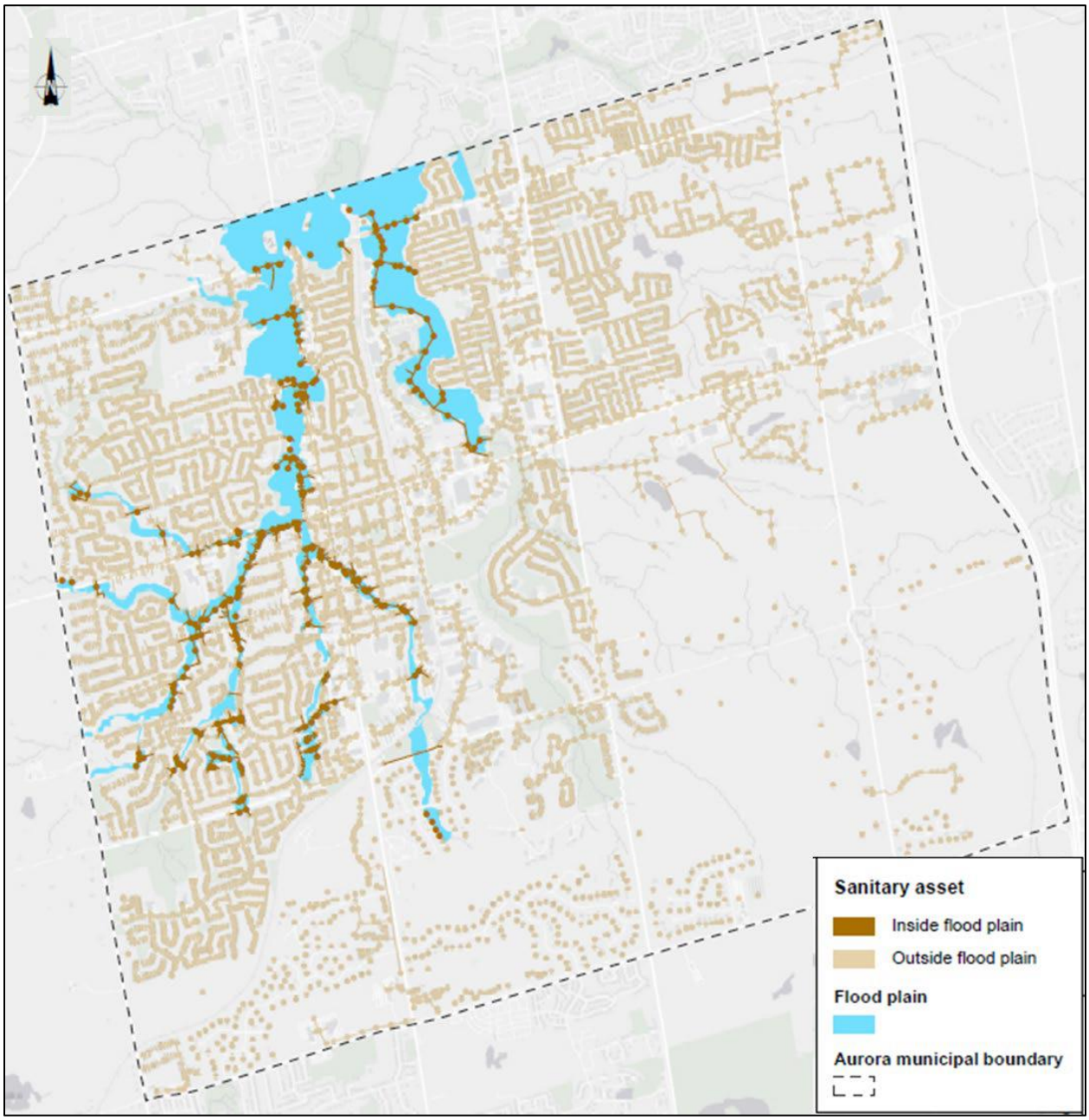

Figure 6: Map of Sanitary infrastructure located in floodplain areas.

6.3 Parks and Natural Heritage System

Most risks associated with Parks and Natural Heritage are related to damaged landscaping from increasing temperatures and severe weather events. Increasing temperatures may also impact the operation of recreation facilities like ice rinks, requiring more maintenance and increasing operating costs. Actions to adapt parks and natural heritage assets to climate change focus on operations and maintenance changes and exploring solutions to improve water use and storage for landscaping needs (Table 11).

Table 11: Adaptation Actions for Parks and Natural Heritage System

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
P-1	Conduct a study to investigate rainwater capture and storage needs and solutions for irrigation and drainage improvements for sports fields, parks, and municipal facilities.	Sports fields become unusable during extended periods of hot, dry weather, and after periods of heavy rain. Capturing and storing rainwater during rainy periods can make more water available for irrigation during drought conditions. Improvements to water storage and irrigation infrastructure should be considered in a study alongside field drainage improvements to minimize interruptions to field usage.	25	Long	1-3 years	$$	Recreation Services, Facilities Management
P-2	Plan for low maintenance landscaping with hardy species adapted to future climate conditions.	As temperatures warm, choosing native plants for landscaping can improve local ecosystem health and make landscaping more resilient to climate change. Planted species may need to change over time as climate conditions shift. Consider future climate projections when planning new landscaping works and consider opportunities for increasing urban biodiversity.	15	Long	>10 years (ongoing)	$	Environment, Operational Services

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
P-3	Plan for changes to ice rink management in warmer winters.	Warmer winters and increased variability in snowpack may strain the Town's ability to provide consistent outdoor ice-skating rinks to the public. If or when skating rinks become difficult to maintain with natural conditions of snow and cold temperatures, consider alternative methods of ice generation, or reduce the level of service related to public outdoor skating facilities.	15	Medium to Long	1-3 years	$$	Community Services - Recreation Services, Operational Services
P-4	Adopt maintenance procedures to proactively identify hazardous trees and undertake preventative maintenance before damage occurs during extreme events.	Conduct regular inspections of parks and natural heritage assets to identify sick or damaged trees that could become a hazard during extreme weather events (wind, lightning, storms). Undertaking preventative maintenance on these trees will reduce risk and reduce reactive cleanup costs.	12	Short	1-3 years	$	Operational Services
P-5	Adopt maintenance procedures to inspect parks following extreme weather events to identify damaged landscaping and amenities to prioritize repairs and minimize service disruptions.	Conduct damage inspections following extreme events to address hazards caused by debris or damage to trees that may require repair (i.e., trees and plants contributing to soil stability).	12	Short	1-3 years (Policy change)	$	Operational Services

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
P-6	Perform a study to define the value, climate risks, and opportunities associated with natural capital assets (i.e. green infrastructure) in the Town.	Understanding the value of the Town's green infrastructure is important to incorporate these assets into the AMP. The Town should update the 2013 study on the value of natural capital assets with information on the location, form, and value of its green infrastructure to be incorporated into the AMP. The study should also apply climate science and risk findings from this work to assess the potential climate risks and opportunities associated with ongoing management and protection of green infrastructure in Aurora.	-	Short	1-2 years	$$	Engineering, Planning, Recreational Services

$:<$10,000
$$: $10,000-$100,000
$$$: $100,000-$1M
$$$$: $1M+

Green infrastructure is defined in the Provincial Policy Statement as “natural or human-made elements that provide ecological and hydrological functions and processes and includes natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs”. These assets can exist on both public and private land but provide communities with a variety of natural services that complement the services provided by built infrastructure like roads and storm sewers. The most common infrastructure function provided by green infrastructure is stormwater management as soils and vegetation can absorb and slow rainwater runoff from nearby roads and buildings. Beyond helping to manage stormwater runoff and flooding, green infrastructure can reduce risks related to extreme heat and the urban heat island effect as trees and vegetation provide shading and evaporative cooling that can significantly reduce local air temperatures. Trees and other vegetation can moderate temperatures in both the summer and winter, lowering building energy demand for nearby buildings or buildings with green roofs. In this way, the passive services provided by green infrastructure go beyond improving community resilience and can help reduce GHG emissions associated with heating and cooling as well as emissions associated with the manufacturing and construction of other infrastructure like piped storm sewers. Further, this type of living infrastructure absorbs atmospheric carbon dioxide, storing it in soils and plant biomass.

The dual benefits for climate change adaptation and mitigation provided by green infrastructure make these assets incredibly valuable to the Town’s overall approach to climate action, while also advancing other community priorities like recreation, health, and livability. Additionally, as green infrastructure assets are living systems, they do not depreciate in value like other built infrastructure that degrades over time. Instead, green infrastructure can gain value and function more effectively as plant communities mature. This means that these assets need to be managed differently than traditional built infrastructure with an emphasis on maintaining and preserving natural and green spaces in a healthy state, particularly in key areas like riparian buffers and low-lying areas that will receive the greatest benefits for avoided flood damage.

Incorporating municipally owned green infrastructure into asset management planning is a provincial requirement under O.Reg. 588/17, effective July 2025 should the assets meet the capitalization threshold for financial reporting. It is recommended that the Town take a holistic approach to understand the value of green infrastructure present in the community and how it could be managed and expanded to provide the maximum benefits to the community. For natural assets, the Town should consider funding protection and restoration initiatives rather than the construction and rehabilitation work that is needed for built infrastructure. This is collaborative work that should be conducted with the input from the LSRCA, The Regional Municipality of York, and other local stakeholders as required.

6.4 Facilities

The highest rated moderate risks for facilities are related to increases in extreme summer temperatures, which may exceed building cooling capacities. Risks are also present for damage related to heavy precipitation and severe weather events. Adaptation actions for facilities focus on incorporating future climate projections into future cooling system upgrades and improving operation and maintenance procedures to identify and correct weather-related damage to facilities before major repairs are required (Table 12).

Table 12: Adaptation Actions for Facilities

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
F-1	Monitor cooling demand at facilities to identify where exceeding maximum cooling capacities is possible with high summer temperatures. Upgrade HVAC systems to meet future cooling demands, prioritize key facilities that could be used as cooling centers.	Both extreme and average summer temperatures are expected to increase in the future putting strain on cooling systems and potentially exceeding system capacity during extreme events making it difficult to maintain comfortable indoor air temperatures. Identifying which systems are most likely to have capacity challenges with future temperature will help to prioritize upgrades at the time of asset renewal or sooner if necessary. Facilities that are used as cooling centers, or that vulnerable populations rely on (e.g., Aurora Family Leisure Complex, Aurora Public Library) should be prioritized to maintain comfortable temperatures in extreme heat.	25	Short	5 years	$$$	Community Services - Facilities Management

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
F-2	Consider both current and future cooling demands with increased temperatures during the planning and design of HVAC and electrical systems. Where cooling systems are being replaced, assess and upgrade the electrical system accordingly.	Electrical systems are designed based on maximum cooling loads. If increased temperatures exceed the capacity for cooling at certain facilities, upgrades to both the cooling system and electrical system may be required. An engineering assessment would be required to determine capacity needs and plan for future climate conditions.	20	Short	5 years	$$$	Facilities Management
F-3	Provide access to backup power at all facilities critical to Town operations to maintain essential operations during power outages. Prioritize low-carbon sources of backup power where possible.	Although difficult to predict, lightning strikes and storms may become more frequent in the future. Along with wind and heat events, critical buildings should be prepared for power outages in the future. This is particularly important for facilities that are designated for use as emergency shelters.	20	Short	1-3 years	$$$	Community Services – Facilities Management
F-4	Install lightning protection systems on tall or isolated buildings (such as Town Hall, the Aurora Community Centre), and those which are deemed critical for Town operations.	Although difficult to predict, lightning strikes may become more frequent in the future. This could damage electrical systems in buildings, and potentially cause power outages. Critical buildings should be prepared for extended power outages in the future. This is particularly important for facilities that are designated for use as emergency shelters.	16	Medium	1-3 years	$$	Community Services – Facilities Management

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
F-5	Continue to inspect and maintain roof systems, paying particular attention to domed roofs at the Sports Dome and the JOC regularly and after extreme wind events. Proactively repair signs of material distress to avoid roof failure.	The Aurora Sports Dome and JOC bubble roofs were previously damaged in high wind events. Although these have since been repaired, domed fabric roofs remain more vulnerable to extreme wind than fixed building roof enclosures. As extreme wind events may increase in the future, continue to inspect and maintain roof systems, paying particular attention to domed roofs at the Sports Dome and JOC regularly and after extreme wind events to proactively repair signs of material distress.	18	Short	Ongoing	$	Community Services – Facilities Management
F-6	Monitor air quality for key municipal facilities (e.g., those with many staff or public users) and consider upgrading HVAC systems to accommodate higher-rated filters such as MERV 13 equivalent filters as well as including space for the addition of MERV 8 pre-filters in case of a poor air quality event.	Wildfires in Canada are projected to increase in the future, and smoke from either nearby or distant fires can impact air quality in Aurora. This may reduce the indoor air quality in buildings and increase the frequency of filter replacement. Filter sizing increases must remain within manufacturer recommendations to not impact equipment efficiency.	16	Medium	1 year	$$	Community Services – Facilities Management

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
F-7	Continue to inspect parking lots and hardscaping regularly to identify heat-related damage and implement small repairs where feasible to avoid further degradation in hot weather. Review the granular base structure and asphalt mix design during the next replacement cycle.	Extreme heat can lead to increased deterioration and wear on hardscaping.	16	Medium	Ongoing	$ - $$	Operational Services, Engineering
F-8	Monitor internal drainage systems in facilities and prepare for a projected increase in precipitation events. Where facilities rely on sump pumps to manage inflow and roof drainage, review precipitation load calculations based on future climate projections, and incorporate the increased load when sump units are to be upgraded or replaced.	A projected increase in extreme precipitation may lead to an increase in below-ground flooding events at residences and at Town facilities. It is best practice to store electrical and mechanical equipment above grade where possible and ensure that where sump pumps are used, these are designed to manage current and future projected extreme precipitation and flooding events.	15	Short	1-3 years	$$	Community Services – Facilities Management

Action ID	Action	Description / Justification	Risk Rating	Priority	Duration (Years)	Cost Range	Lead
F-9	Continue inspections of facilities structures regularly and after extreme wind events. Proactively repair damages as needed. An engineering study would be required to assess whether projected wind loads may surpass designed structural capacities at facilities, which could be initiated if regular inspections identify potential wind-related issues.	There is a potential for wind loads to increase in the future, which may exceed the designed capacities of the facility structures. Building structures are inspected regularly (every 5 years) to monitor for deterioration and damages. In addition to this existing practice, inspections of facilities after extreme wind events could identify any areas requiring further inspection.	15	Short	Ongoing	$-$$	Community Services – Facilities Management, Engineering

$:<$10,000
$$: $10,000-$100,000
$$$: $100,000-$1M
$$$$: $1M+