City of Kitchener
Consolidated Asset Management Plan Summary
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Introduction

The City of Kitchener (the City) is in Waterloo Region, in the heart of southwestern Ontario. The City covers an area of 137 square kilometers and has a population of approximately 270,000; making it the largest City in the Region and the Grand River Watershed alike. The City of Kitchener has been designated as a growth area through the Provincial growth plan: Places to Grow and has seen significant population growth that is expected to continue through the next decade.

The City owns and operates several classes of core (water, wastewater, stormwater etc) and non-core (parks, facilities, etc), infrastructure assets that form the foundation from which services are delivered to its residents. This consolidated summary of the City’s core assets will communicate the requirements for the sustainable delivery of services through management of assets, compliance with regulatory requirements, and required funding to provide the appropriate levels of service over the planning period as they relate to the defined ‘core’ assets. The Plan has been prepared in accordance with Ontario Regulation 588/17 – Asset Management Planning for Municipal Infrastructure, under the Infrastructure for Jobs and Prosperity Act, 2015. The Regulation lays out the requirements for all AMPs, as well as deadlines to meet to certain milestones.
Water Utility

The City of Kitchener (the City) is a growing municipality located in the Region of Waterloo. The City owns and operates infrastructure from which services are delivered to residents, including those assets that fall under the Water Utility, covered in this Asset Management Plan (AMP). The City and Water Utility have been practicing sound asset management planning for several years, as evidenced by programs, plans and procedures that are documented throughout this AMP. Recent successes via investment through the Water Infrastructure Program (WIP) include a decrease in water quality complaints because of watermain cleaning, the clearance of a valve replacement backlog, and a decrease in the 5-year average of watermain breaks.

This AMP is prepared in accordance with O. Reg 588/17 – Asset Management Planning for Municipal Infrastructure, which lays out the requirements for Asset Management Plans prepared by municipalities across Ontario and milestones that all municipalities are required to meet. This Plan meets the July 1st, 2022 requirements.

State of the Infrastructure

This Asset Management Plan covers the watermains, valves, hydrants and meters that make up the Water Distribution System owned and operated by the City of Kitchener, which together have a 2021 replacement value of more than $1 Billion and are generally in Very Good Condition. The table below provides average asset consumption, or age as a proportion of estimated useful life. Overall, watermains are more than halfway through their useful life. This can be attributed to an increase in infrastructure investments made between the 1950s and 1970s. These assets may be beginning to deteriorate and could soon require replacement or rehabilitation. This is being addressed through the WIP.

<table>
<thead>
<tr>
<th>Asset</th>
<th>Quantity</th>
<th>Condition</th>
<th>Average Asset Consumption</th>
<th>2021 Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meters</td>
<td>69,519</td>
<td>Good</td>
<td>34%</td>
<td>$12,841,585</td>
</tr>
<tr>
<td>Valves</td>
<td>7,748</td>
<td>Good</td>
<td>36%</td>
<td>$141,203,000</td>
</tr>
<tr>
<td>Watermains</td>
<td>913,539 m</td>
<td>Very Good</td>
<td>53%</td>
<td>$793,332,280</td>
</tr>
<tr>
<td>Hydrants</td>
<td>4,609</td>
<td>Very Good</td>
<td>36%</td>
<td>$69,135,000</td>
</tr>
</tbody>
</table>

Levels of Service

Levels of service are an indicator of how well a service is provided, both from the service users point of view (Customer LOS) and service providers point of view (Technical LOS). They can be defined by regulation, such as O.Reg 588/17, or the City. These metrics are important to track as they can reveal trends in service delivery year over year, and highlight areas for improvement, as well as indicate the success of programs that are implemented by the Utility. The table below is a summary of Levels of Service, as they relate to service attributes such as reliability, scope, and quality.
<table>
<thead>
<tr>
<th>Service Attribute</th>
<th>Corporate LOS</th>
<th>Type</th>
<th>Performance Measure</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affordability</td>
<td>Services are provided in the most cost-effective manner and in-line with other Municipalities</td>
<td>Customer</td>
<td>Total Cost to Provide Water/Population</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customer</td>
<td>Total # of Units Without Water Due to Main Breaks</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customer</td>
<td>Total # of Hours Without Water Due to Main Breaks</td>
<td>↔</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customer</td>
<td># of Water Pressure Complaints per 1000 people</td>
<td>↔</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical</td>
<td>% Valves Cycled</td>
<td>↑</td>
</tr>
<tr>
<td>Reliability</td>
<td>Supply Water to all users who require it with minimal service interruptions</td>
<td>Technical</td>
<td>% of Mains in Good or Very Good Condition</td>
<td>↔</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical</td>
<td>% Watermains Cleaned</td>
<td>↔</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Legislative</td>
<td>The number of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system.</td>
<td>↔</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Legislative</td>
<td>The number of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system.</td>
<td>↔</td>
</tr>
<tr>
<td>Quality</td>
<td>Provide a supply of water that is consistently safe and of high quality</td>
<td>Customer</td>
<td># of Water Quality Complaints per 1000 people</td>
<td>↔</td>
</tr>
</tbody>
</table>
### Lifecycle Management Plan

The lifecycle management plan lays out activities required to uphold levels of service. These can be grouped into several categories such as operations/maintenance, replacement, or acquisition. When executed well, these activities can reduce costs and extend the useful life of assets. The table below provides definitions and examples of each category.

<table>
<thead>
<tr>
<th>Lifecycle Management Activity</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Operations/Maintenance             | Regularly scheduled inspections and maintenance, or more significant repairs and activities associated with unexpected events | - Watermain cleaning program  
- Valve cycling program  
- Scheduled Inspection programs |
| Renewal/Replacement                 | Significant repairs to extend the useful life of an asset. This also includes assets that are replaced at the end of service life, but does not accommodate a change, improvement or expansion to service. | - Valve replacement  
- Meter replacement  
- Watermain replacement |
Financial Summary
The Water Utility is an enterprise asset group, meaning they are funded entirely by revenues from user rates, or fees. These revenues fund capital projects as well as operations, maintenance, and administration costs, etc. Budgets for capital projects and maintenance and operations are created yearly on a 10- and 5-year horizon, respectively. The figure below provides the actual expenditures from 2015-2021 as well as the forecasted budgets until 2031. These are the costs / budgets required for the lifecycle management activities required to uphold levels of service.

Fees are subject to increases from time to time, which have more recently been addressed in the Water Infrastructure Program (WIP). The WIP was established to address the replacement needs gap for aging
water, storm, and sanitary infrastructure. The WIP reviews current rates and provides recommendations on when and how much rates should increase to close the funding gap created by the fact that there is an increase in replacement projects required, as a result of increased infrastructure spending in the 1950s, 60s and 70s.
Sanitary Utility

This section provides a summarized analysis of the current status of the City’s sanitary assets, what investigative and monitoring efforts are performed, and how current business processes align with the City’s corporate asset management strategy’s two guiding principles.

1. Balancing asset condition and level of service.
2. Allocating financial resources among priorities.

The Sanitary Utility is responsible for the installation and disposal of the variety of sanitary network assets, which include the likes of wastewater pipes, laterals, manholes, syphons, forcemains, pump stations. The Sanitary & Stormwater Utility (SSU) provides overall stewardship for the day-to-day operation and maintenance of the sanitary assets outlined in the utility. For the purposes of this plan, the existing asset inventory has been categorized into three asset groups:

- Sanitary Gravity Mains
- Sanitary Laterals
- Sanitary Manholes

It should be noted that while the Sanitary Utility is responsible for wastewater pumping stations and associated forcemains, those entities have unique attributes, and will be considered as a separate and distinct asset category and will be analyzed in a separate asset management plan.

An analysis of current and historic expenditures and costs for routine, betterment, service-oriented activities and capital replacements was undertaken. The analysis outlined within this document, including some descriptive charts, illustrates the current state of affairs and identifies that there are opportunities to fill in some data gaps.

As seen from the detailed asset management plan for the Utility, Kitchener has a healthy sanitary network with 76% in excellent structural health and relatively few mains that are extremely old and/or in poor condition. Similarly, Kitchener has a significant operations and maintenance need, with approximately 48% of the network with identified maintenance issues. The detailed asset management plan describes an operations and maintenance strategy which only requires the rate of inflation to maintain these assets to the defined levels of service.

This first AMP focused heavily on the City’s capital responsibilities and thus there is opportunity in this second iteration to delve into the cause and effect of maintenance activities related to the condition of the asset; the long term lifecycle management plan associated with optimizing the level of service; and the financial management plan necessary to sustain the expectation of services provided by this asset category. The asset entities covered by this updated plan are:

- Sanitary Gravity Mains
- Sanitary Service Laterals
- Sanitary Manholes
Sanitary System Assets Groups

Sanitary Waste Water

- Gravity Mains
- Manholes
- Service Laterals
- Forcemains
- Pumping Stations

* Sanitary pumping stations and associated forcemains will be outlined in a separate and distinct asset management plan.

The cost to replace sanitary assets (excluding restoration, etc.) within a full reconstruction – determined to be 31.8% of total cost – is the basis for calculations for replacement cost. Notably, these reconstruction costs include paying for portions of an entire project cost, including the likes of excavation, structure disposals, new structures, traffic control, road and site restoration. Thus the Sanitary Utility cost-shares all reconstructions at 46% of each project. Project engineering and administration at 20% is a component of all these capital projects.

The estimated replacement value of the City’s sanitary mains, manholes, service laterals is **$955,133,112**. This most current valuation parallels with the approximate 4.5% growth of infrastructure asset inventory counts, and 4.5% reconstruction cost increase since the 2013 plan.

**Estimated replacement costs of sanitary (wastewater) infrastructure (in 2017 dollars)**

* replacement cost in dollars; with percentage of overall asset category value
Asset Inventory

In order to understand local rates of sanitary main degradation the first asset management plan was completed in 2013, an effort to store data about disposed pipes was undertaken. Prior historical information was removed from the primary GIS layer and inspection history and related condition was unavailable. The updated process allows for information queries to be made against sanitary mains which have been removed. The disposed asset data is stored in a separate data table and each disposed asset record has a retired year entered.

Sanitary Mains

Sanitary mains are the primary conveyor of wastewater effluent and are typically found beneath municipal streets, inaccessible except via manholes, and following the lie of the land to ultimate treatment primarily at the Kitchener Wastewater Treatment Plant, with some pumped or flowing to Waterloo and Cambridge. With an average age of about 33 years – a generic and average 41% proportion of 80-year expected useful life consumed – there are indeed a handful of full-functioning pipes over a century old.

Percentage breakdown by 10-year intervals of sanitary main compared to expected useful life (80 years)

![Percentage of Active Sanitary Mains by Age/Era Compared to Expected Lifespan](chart.png)
There are 13,269 active sanitary segments between manholes at time of writing totaling 799 kilometers, representing about 4.2% growth since the Phase 1 AMP in 2013. There are no combined storm water and sanitary sewers. This inventory of sanitary mains has an approximate replacement value of $733,983,600, at 77% of the overall asset category value.

With the three charted values below representing:

- sum length of pipes of the specified material type,
- percent of sum length that the specified material type represents,
- average age of the pipes of the specified material type,

**Material classification of sanitary mains**

Sanitary Service Laterals
Sanitary service laterals provide inputs to the sanitary main via smaller-diameter pipe connections to a property. The municipality owns the service from the main to the property line.
There are 61,449 active sanitary services laterals of Kitchener ownership at time of writing. This inventory has an approximate replacement value of $150,500,891, at 16% of the overall asset category value.

**Sanitary Manholes**

Sanitary manholes provide access to the network of sanitary mains. There are 12,128 active sanitary manholes at time of writing. This inventory has an approximate replacement value of $70,628,621, at 7% of the overall asset category value.

**Installation Profiles**

In order to assist the City with analysis, it is helpful to understand the installation profiles of the wastewater assets. As noted, a concerted effort to update installation dates for wastewater assets was performed in 2017.

As is common for municipalities in Canada, post-war city-building activity boomed, and the installation profiles of sanitary assets show this at Kitchener. Critically, for interpretation of the following charts, new installations were the sole sanitary network changes until reconstructions of existing rights-of-way began in earnest in the 1970s. Thus, these charts show new installations and replacement activities thereafter.

**Asset Installation Profile – sanitary mains**
4.2.3 Asset Installation Profile – sanitary services

For asset lifecycle planning purposes, the installation profiles of sanitary main assets in relation to the material type used at the era of installation is compared and analyzed. There is an expectation of
differing longevities of asset materials which informs Kitchener’s planning for replacement, while data-driven decision-making on asset condition and performance is completed, and not on age alone.

Level of Service

<table>
<thead>
<tr>
<th>LOS CATEGORY</th>
<th>INDICATOR</th>
<th>DATA RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public expectations</td>
<td>Percent of surveyed local residents somewhat or very satisfied.</td>
<td>84%</td>
</tr>
<tr>
<td>Public contact services</td>
<td>All-hours contact center capability.</td>
<td>Yes</td>
</tr>
<tr>
<td>Work management priorities</td>
<td>Defined priorities by activity type.</td>
<td>Set, adjustable.</td>
</tr>
<tr>
<td>Standard operating procedures</td>
<td>Published procedures and repair timelines.</td>
<td>Yes. Full list of activities not encompassed.</td>
</tr>
<tr>
<td>Asset installation and replacement</td>
<td>Regulatory requirements met; specifications documented.</td>
<td>Yes</td>
</tr>
<tr>
<td>Environmental protection</td>
<td>Defined protocols meeting MOECC requirements.</td>
<td>Yes</td>
</tr>
<tr>
<td>Inspections - sanitary mains</td>
<td>Physical inspection of infrastructure and condition rating.</td>
<td>Annual selected sets and targeted inspections for specific projects. 64% inspected.</td>
</tr>
<tr>
<td>Inspections - sanitary services</td>
<td>Physical inspection of infrastructure and condition rating.</td>
<td>100% rate for post-reconstructions only.</td>
</tr>
<tr>
<td>Inspections - manholes</td>
<td>Physical inspection of infrastructure and condition rating.</td>
<td>Annual. 95.7% inventory inspected.</td>
</tr>
</tbody>
</table>
A balanced approach to sustain the sanitary assets to retain the highest value in the longer term is still aligned with the original asset management plan. As always with asset management, the challenge will be achieving the right balance between cost, [condition], level of service and risk. The City of Kitchener has elected to place risk [mitigation] at the top of the priority measures, thereby ensuring that the City's current investment in sanitary infrastructure is safeguarded. The City believes that its strategy for long term sustainability will result in lower costs overall over the long term.
Stormwater

This asset management plan provides a detailed analysis of the current status of the City’s storm assets, what investigative and monitoring efforts are performed, and how current business processes align with the City’s corporate asset management strategy’s two guiding principles.

1. Balancing asset condition and level of service.
2. Allocating financial resources among priorities.

The Sanitary and Storm Utility (SSU) is responsible for the planning, installation, maintenance and disposal of all City-owned storm water infrastructure. The City’s Sanitary and Stormwater Maintenance and Operations Section, within the SSU, provides overall stewardship for the day-to-day operation and maintenance of the storm assets outlined in the utility. For the purposes of this plan, the following asset types will be address:

- Storm Gravity Mains
- Storm Catchbasins
- Storm Manholes
- Storm Leads
- Storm Inlets
- Storm Outlets
- Weirs
- Storm Culverts
- Storm Ponds/Facilities
- Watercourses
- Ditches
- Low-impact Development
- Oil/Grit Separator (quality devices)

An analysis of current and historic expenditures and costs for routine, betterment, service-oriented activities and capital replacements was undertaken. The analysis outlined within this document, includes some descriptive charts, illustrating the current state of affairs and identifies that the Utility has a very detailed dataset.

Kitchener has a storm mains network with over 94% of the inspected mains in excellent structural health and fewer than 6% of inspected mains in average or poor condition. Within the detailed asset management plan, the document describes how those which are in need or anticipated to be in need in short order have a long-term capital funding strategy in place.

Kitchener has 10% of the inspected mains of the network with identified operations and maintenance issues. Section 7 in the asset management plan describes an operations and maintenance strategy which only requires the rate of inflation to maintain these assets to the defined levels of service, though the Council report INS-17-070 states that “the stormwater program is relatively new and has a larger maintenance gap than water and sanitary”.

By documenting all current information sets including asset inventories; defined service levels; service-oriented activities; betterment expenditures; projected capital revenues and costs, the Sanitary and
Storm Utility has the information it requires to make future decisions that will incorporate asset management strategies in providing services to Kitchener’s residents.

The cost to replace storm assets (excluding restoration, etc.) within a full reconstruction – determined to be 12.8% of total cost – is the basis for calculations for replacement cost. Notably, these reconstruction costs include paying for portions of an entire project cost, including the likes of excavation, structure disposals, new structures, traffic control, road and site restoration. Thus, the Storm Utility (of the Sanitary and Storm Utility) cost-shares all reconstructions at 23% of each project. Project engineering and administration at 20% is a component of all these capital projects and is included in the values in figure 4.0.1.

The estimated replacement value of the City’s storm infrastructure is $1,034,719,798. This most current valuation is a substantial 44% increase over that determined for the 2013 plan. The chart below shows the breakdown of the overall replacement value by asset type.

Estimated replacement cost (valuation) of storm infrastructure

There are 16,275 active storm main segments totaling 643 kilometers, representing about 5.2% network length growth since the Phase 1 AMP in 2013. This inventory of storm mains has an approximate replacement value of $542,163,181, at 45% of the overall asset category value.

Diameter classification of storm sewers in Kitchener, summed by length is as follows:
Storm Manholes
Storm manholes provide access to the network of storm mains. There are 14,599 active storm manholes. This inventory has an approximate replacement value of $64,752,993, at 5% of the overall asset category value.

Storm Catchbasins
Storm catchbasins provide for surface ingress of storm water to the network of storm mains, and for some quality control by way of a sump. There are 11,032 active storm catchbasins at time of writing. This inventory has an approximate replacement value of $40,591,492, at 3% of the overall asset category value.

Oil and Grit Separators (as a Storm Quality Control device)
Storm quality control devices provide for basic, primary storm water treatment prior to entry to the network of storm mains. There are 93 Kitchener-owned and 1 shared ownership with the Region of Waterloo OGSs at time of writing. This inventory has an approximate replacement value of $6,821,124, at 1% of the overall asset category value.
Storm Ditches and Culverts
Ditches and culverts provide a surface level conveyance of storm water alongside, and as crossings of municipal roadways. There are 8,900 meters of ditches and 283 meters of storm culvert under Kitchener ownership. This inventory has an approximate replacement value of $1,680,062, at less than 1% of the overall asset category value.

Stream Reaches
Stream reaches provide for natural surface water flow following the lie of the land. There are 1,165 discrete segments of stream reaches of Kitchener ownership. This inventory has an approximate replacement value of $163,131,750, at 27% of the overall asset category value.

Storm Facilities / Ponds
Storm ponds are a key component of Kitchener’s stormwater management program.

There are 163 designated storm ponds of Kitchener ownership. This inventory has an approximate replacement value of $66,996,532, at 6% of the overall asset category value.

Storm Low-impact development (LID) components
Low-impact development components provide for more natural storm water capture and mitigation as close to the source as practical, with a goal of mimicking a natural hydrological cycle. These efforts are part of new build-outs or retrofits and in right-of-way reconstructions. Examples can include bioretention, permeable pavers, infiltration galleries, enhanced swales, cooling trenches, rainwater capture.

Using these components provides a distinct and purposeful effort on the City’s part to address climate adaptation, and mitigate potential intense weather events, as discussed in the detailed asset management plan. There are 605 identified LID components of Kitchener ownership. This inventory has an approximate replacement value of $489,385, at less than 1% of the overall asset category value.

Storm leads, inlets, outlets, weirs
Ingress to the stormwater network is facilitated by leads and inlets, and egress and attenuation from the storm network is facilitated by outlets and weirs. Identified Kitchener-owned components include 13,794 storm leads, 601 inlets, 914 outlets, 95 weirs. This inventory has an approximate replacement value of $15,697,279, at 1% of the overall asset category value.

With age being a common predictor of condition, the storm mains network has an average age of about 30 years – a 38% proportion of 80-year expected useful life consumed.
Percentage breakdown by 10-year intervals of storm mains compared to expected useful life of 80 years.

An important distinction should be made between asset condition indicators and asset consumption. While the City has robust condition data from camera inspections of the sewers and associated defect observation coding, this does not provide a correlation to consumption (of estimated lifespan) of storm pipes. For example, a CCTV coding of 3 out of 5 does not necessarily correlate to 48 years of an expected 80-year asset lifespan expended.

Though this method is not yet employed at Kitchener, the installation profiles of storm main assets in relation to the material type used at the era of installation may be compared and analyzed. There is an expectation of differing longevities of asset materials which may provide for more refined asset lifecycle planning.

Levels of Service

Levels of Service (LoS) define and describe the output and value that is delivered by the organization to its end users and the practices that are followed to achieve it. These Levels of Service are driven by the following factors:

- Mandatory requirements such as legislation obligations to meet certain goals and standards
- Limitations on current infrastructure and technical requirements to meet standards such as response times and engineering standards
- Community expectations on the acceptable output and value provided
The City of Kitchener and the Stormwater Utility have been working on creating a refined and comprehensive list of Levels of Service and performance measures. The Levels of Service that have been chosen for Storm Water follow O. Reg. 588/17 legislated requirements, as well as additional metrics that encompass the value and work provided by the Stormwater Utility. The following are agreed upon Levels of Service for Stormwater assets. Levels of Service are currently being monitored and reviewed by a working group.

### Levels of Service Statements

<table>
<thead>
<tr>
<th>Asset Category</th>
<th>Value of Service</th>
<th>Levels of Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Water Utility</td>
<td>Efficiency</td>
<td>Storm Services are provided in the most cost effective and Efficient manner and in-line with other Municipalities</td>
</tr>
<tr>
<td></td>
<td>Quality</td>
<td>Proactive Inspection Program to ensure Quality Infrastructure and Services</td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
<td>Continuous Storm Water Services are provided without interruption</td>
</tr>
<tr>
<td></td>
<td>Sustainability</td>
<td>Environment is protected through designed safe guards</td>
</tr>
</tbody>
</table>

The Level of Service Statements represent high overarching *corporate values* that are trying to be achieved through specific work. The high-level values are *Efficiency, Quality, Sustainability and Reliability* and they are impacted by both Customer and Technical work and performance. Each statement has several performance measures that can track its achievement as well as numerous work activities that staff do to ensure the infrastructure is running smoothly.

**Value of Service – Efficiency**

The City of Kitchener Storm Water Utilities is comprised of 8 asset groups with a replacement value of **$1,197,851,548**. The SSU group works to keep these assets running as smoothly and as efficiently as possible. The aim is to keep the costs as low as possible for users while maintaining the highest quality services possible.

**Value of Service – Quality**

With a network of infrastructure that spans the entire City and delivers services to over 240,000 citizens a focal point of the SSU is to ensure the quality of those services and infrastructure stays at a high level. A proactive inspection program is utilized that focuses on keeping the infrastructure condition as high as possible and ensuring any potential issues in the network are caught on time.
Value of Service – Reliability
The City of Kitchener works to ensure that all asset groups of the Stormwater system are operating as designed and that services are provided without interruption. As of 2019, Stormwater complaints and flooding due to public system issue were at an all-time low.

Work done to keep the infrastructure reliable, and running is centered around repairing and replacing assets such as Storm mains and catchbasins. In 2019, the number of repairs/replacements has decreased from the prior year and has fallen in-line with the 5-year averages. The trends are being monitored and work activities will be adjusted as needed.

Value of Service – Sustainability
Ensuring the environment is protected is a large part of Stormwater planning. Climate change continues to become more prevalent, so continuing work is done to ensure that the City of Kitchener Stormwater infrastructure is prepared for all possibilities. There is currently a review of City of Kitchener properties that are resilient to 5- and 100-year storms, and as data is obtained it will be used to impact future planning.

Customer Levels of Service
Customer Levels of Service can be identified as community expectations on certain services as well as how the more technical work activities are impacting customer experiences. The Customer Levels of Service performance measures highlight data that has direct impact on a citizen. Currently only trends are being monitored, but in the near future specific targets and goals for the performance measures will be set as more data is obtained and considered.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>Average Residential Stormwater Fee/ Lot</td>
<td>$176.64</td>
<td>$164.76</td>
<td>$150.00</td>
<td>$137.00</td>
<td>$125.76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% Maintenance Budget Spent</td>
<td>1.01</td>
<td>1.12</td>
<td>1.16</td>
<td>1.21</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% Capital Budget Spent</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.02</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>SWM Facility Sediment Removal (m3)</td>
<td>365.6</td>
<td>2785</td>
<td>2636</td>
<td>6112</td>
<td>2735</td>
<td></td>
</tr>
<tr>
<td>Reliability</td>
<td># of Stormwater Related Customer Complaints/ 1000 People Served</td>
<td>0.20</td>
<td>6.19</td>
<td>3.72</td>
<td>1.9</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost of Stormwater Education Program / 1000 People Served</td>
<td>$44.02</td>
<td>$443.00</td>
<td>$561</td>
<td>$239.90</td>
<td>$725.29</td>
<td></td>
</tr>
<tr>
<td></td>
<td># calls regarding Flooding due to public system issue/ 1000 people served</td>
<td>0.03</td>
<td>0.19</td>
<td>0.11</td>
<td>0.16</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Sustainability</td>
<td>Area of permeable Pavement</td>
<td>916</td>
<td>916</td>
<td>916</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total # of Spills that Reach the Receiving Environment</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of Properties resilient to a 100-year storm</td>
<td>Data Collection in Progress</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of Properties resilient to a 5-year storm</td>
<td>Data Collection in Progress</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Customer Levels of Service Trends

The City of Kitchener is always aiming to provide the best Level of Service given the resources available. Looking at the figures in table above, it shows that the trend for Customer Levels of Service seems to be that the performance is consistent or in some cases has increased. While there is consistency in areas such as the budget planning process, spending only what is planned, and in the number of Low Impact Development (LID) implementations, there are also areas that have improved. There has been a decrease in the number of customer complaints and calls regarding flooding in the City, as they are at all time low in the year 2019.

The trends highlighted could be due to numerous factors including city population growth, an outlier year, resource constraints, as well as increase in costs to provide services.

Technical Levels of Service

The Technical Levels of Service performance measures are a combination of actual work activities done by SSU staff, inspections and benchmarking data. They highlight the technical work that is done by staff on Stormwater assets that help keep all infrastructure healthy and running smoothly.

Currently only trends are being monitored, but in the near future specific targets and goals for the performance measures will be set as more data is obtained and considered. The table below shows total assets worked upon or inspected, irrespective of the number of work orders.

*Technical Levels of Service Performance Measures and Work Activities*
Technical Levels of Service Trends

The City of Kitchener is always aiming to provide the best Level of Service given the resources available. The current trends in the Technical Levels of Service can be seen in Table 5.2.1. The trend from 2018 to 2019 seems to be for the performance measures to trend downward or stay consistent. The year 2018 seemed to be an outlier as there were spikes in many performance measures that seem to have been normalized again in 2019.

A downward trend is not necessarily a negative. In some cases, such as the downward trend in Repairs/Replacements under Reliability, it could be seen as positive as fewer breaks and problems occurred in those asset groups. Since there are numerous reasons for these potential changes, this is a topic that is being investigated more thoroughly through a working group and is currently lacking concrete data. As more research is done, a more in-depth look into these trends will be able to be identified.

*Data obtained from National Water & Wastewater Benchmarking Initiative as well as City of Kitchener Corporate Business Plan and Work Management System*
Bridges & Culverts

For the purpose of analysis the asset types have been pooled into 5 asset groups. These groupings are based on how capital and operational budgets are presented, the work activities performed, and the type of services provided by each asset type.

The asset groups covered by this plan are:

- Multi-modal Bridges
- Concrete Culverts
- Corrugated Steel Pipes (CSP)
- Pedestrian Bridges
- Railway Structures (both over and underpasses)

This AMP looks at the estimated asset replacement costs in 2017 Canadian Dollars using the Ontario Ministry of Transportation 2017 algorithmic approach for bridge replacements/rehabilitations to produce a realistic capital need cash flow. The total replacement is estimated to be $118 million dollars for 65 City of Kitchener Engineering-owned sites and 10 additional railway-owned sites.

The figure below provides a summary of the estimated replacement costs of Engineering Structures (excluding land value, engineering, utilities and environmental mitigation measures).

Estimated Replacement Costs of Structures (2017)
Typically recommended funding for a structural inventory would include sufficient capital expenditures to allow for full replacement of infrastructure as it ends its design life expectancy. A rule of thumb usually estimates that 1.5-2.0% of the value of the structural inventory be expended annually to ensure that the structure inventory can be maintained in perpetuity. With an asset value of $118m the City of Kitchener Engineering Division should be spending on average $1.77-2.36m per year.

Asset Inventory
Bridges (Multi Modal)
In general, a bridge is a structure including supports erected over a depression or an obstruction, such as water, natural area, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 3.0m between under-copings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening. A bridge carries a passage that can be a roadway or railway across an obstruction utilizing direct bearing of its elements to carry its self-weight and loading from usage. The City of Kitchener has an inventory of 27 Multi Modal Bridges.

Concrete Culverts
A culvert, on the other hand, is a structure that allows water to flow under a road, railroad, trail, or similar obstruction from one side to the other side. Typically embedded so as to be surrounded by soil, a culvert may be made from a steel pipe, reinforced concrete or other material. The soil placed above and around the culvert structure aids in the distribution of loading from usage. If the amount of soil/fill is less than 300 mm in depth and the span of the site is more than 3m then the site is considered a bridge.

The City of Kitchener has an inventory of 34 culverts that have spans over 3 m or are in combination with other adjacent culverts as described above that the Kitchener Engineering Division maintains, 20 of which are concrete culverts. These sites are grouped as an asset grouping due to similar; function, load carrying characteristics, asset valuation, approval purpose, life expectancy, typical defects, remedial measures to restore condition, inspection technique, and consumption.

Corrugated Steel Pipe Culverts
There are 14 Corrugated Steel Pipe culverts (CSPs) that the City of Kitchener Engineering Division maintains. They are separated from concrete culverts as they have different load carrying characteristics, life expectancy, typical defects, and remedial measures to restore condition.

Historically, Corrugated Steel Pipe culverts (CSPs) were first introduced to the construction industry in 1896, and they have had many revisions to the basic metal composition, corrugation patterns, and coatings since then. They became popular for wide spread usage during the post-war era as they are typically low cost solutions for small spans, and initially it was believed that their life expectancy would be similar to concrete culverts. As manufacturing technology through the 1960s improved larger single piece circular and oval spans were made available and new concepts for construction of the openings using multiple overlapping curved plates were introduced. These systems became very popular for their low cost and speed of construction that they almost eclipsed the concrete culvert.
Pedestrian Bridges\Boardwalks
The City of Kitchener Division has an inventory of 4 Pedestrian Bridges. There is a wide variety of multi-use trails and pedestrian bridges found throughout the City of Kitchener. A multi-use trail is defined as a paved surface of a range of styles and designs that forms a continuous off-road walking and cycling network. This Asset Management Plan looks at multi-use pathways and Trails that are located within the road right-of-way.

Railway Bridges
Railway grade separations are important facilities that allow the free flow of multi-modal traffic beneath or over railways, ensuring a city’s transportation network is unimpeded by long freight trains, medium speed intercity linkage trains, light rail and future high speed trains. These bridge assets range in age, and their ownership is often based on a case by case basis and set out in individual agreements signed at the time of construction in what is known as a “grade separation agreement/railway board order”. These legal documents stipulate cost sharing and responsibilities for maintenance, inspection and easement conditions.

There are 10 railway overhead/subway structures in the City of Kitchener. The fact that these assets may not be owned, be partially owned or fully owned by the City of Kitchener provides justification for the creation of this asset class, which may be treated separately from the rest of the asset population for funding needs.

Asset Condition
The assessment of an asset’s condition is a valuable source of information to asset owners. The capturing of regularly scheduled condition data provides important insight into the performance of assets and what impact betterment activities are having on extending the serviceable life of infrastructure (i.e. improving or sustaining the overall health of the asset). Without this critical information, the condition of the assets will be evaluated solely on the degradation based on the initial installation date, thereby not taking into account the effect of use, environment factors or other condition specific data. This limits the ability of the asset owner to plan the rehabilitation or replacement for assets in the short and long terms from a financially strategic perspective.

The OSIM inspections require municipal bridges that meet selected criteria to be inspected every 2 years. The resulting scores from this inspection program range from 0 to 100, and for the purposes of representation, have been grouped into 5 categories that have been explained in table below.

The Condition score is calculated by subtracting the Ontario Ministry of Transportation Bridge Condition Index (BCI) from 100. It is noted that plans to start rehabilitation usually begin when the Condition Score is 25 or BCI is 75. Therefore, a good condition score structure could be showing the early signs of deficiencies needing future correction.
Asset Condition Categories

<table>
<thead>
<tr>
<th>Condition Score</th>
<th>Bridge Condition Index</th>
<th>Condition Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 20</td>
<td>100-80</td>
<td>Very Good</td>
</tr>
<tr>
<td>21 - 40</td>
<td>79-60</td>
<td>Good</td>
</tr>
<tr>
<td>41 - 60</td>
<td>59-40</td>
<td>Fair</td>
</tr>
<tr>
<td>61 - 80</td>
<td>39-20</td>
<td>Poor</td>
</tr>
<tr>
<td>81 - 100</td>
<td>19-0</td>
<td>Very Poor</td>
</tr>
</tbody>
</table>

2016 Condition Assessment of Vehicular Bridges (Engineering)

2016 Condition Assessment of Concrete Culverts (Engineering)
2016 Condition Assessment of Corrugated Steel Pipes (CSPs) (Engineering)

2016 Condition Assessment of Pedestrian Bridges (Engineering)
Asset Consumption
The CHBDC and other sources estimate bridge life expectancy to be between 70 and 80 years, and that buried structure that are not exposed to deicing salts usually have a life expectancy of 100 years (similar to concrete sewers). Corrugated Steel Pipes (CSPs) that are not coated can have very low life expectancy dependent upon soil chemistry. In the Kitchener area, the life expectancy of Corrugated Steel Pipes (CSPs) is believed to be 10-35 years. If a Corrugated Steel Pipe (CSP) structure was installed correctly without bulges, missing bolts, and separation in plates and is coated, the service life could be increased to 100 years.
Roads & Sidewalks

The City owns and operates infrastructure from which services are delivered to residents, including roads, sidewalks, walkways and multi-use pathways, covered in this consolidated summary of core assets. The City, its Asset Stewards and Asset Leads have been practicing sound asset management planning for several years, as evidenced by programs, plans and procedures that are documented throughout this AMP.

State of the Infrastructure
This section covers the infrastructure assets that provide transportation services to the community, which comprises of roads, sidewalks, walkways, and multi-use pathways in place of sidewalks within the road right of way, which together have a 2021 replacement value of $1,321,504,160 and are generally in good to excellent condition. The table below provides average condition information and replacement cost.

<table>
<thead>
<tr>
<th>Asset</th>
<th>Quantity</th>
<th>Condition</th>
<th>2021 Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
<td>783 km (centerline length)</td>
<td>Good</td>
<td>$1,097,165,325</td>
</tr>
<tr>
<td>Sidewalks and Walkways</td>
<td>1185.8 km</td>
<td>Excellent</td>
<td>$156,992,767</td>
</tr>
<tr>
<td>Multi-Use-Pathways (within the boulevard)</td>
<td>67 km</td>
<td>Excellent</td>
<td>$67,346,068</td>
</tr>
</tbody>
</table>

Asset Age Profile
Asset age is an important factor in estimating financial value and for some assets it can be a good indicator of condition, which could help determine when lifecycle interventions are necessary. Sidewalk and walkway installation dates were mostly complete, however, like roads accuracy decreases as dates become older than 1965. Engineering construction project history documents were recorded as far back as 1965 and was used to infer or fill in gaps in installation dates.

The series of figures on the following pages provides installation profiles along with its 2021 replacement costs for roads, sidewalks, walkways, and BMUPs. Another method of plotting asset data age is against estimated service life. Many of the City’s roads have outlasted its expected service life, in particular the road surface has held up longer than 20 years.
Asset Installation Profile by Replacement Cost - Roads

Asset Installation Profile by Replacement Cost – Sidewalks and Walkways
Asset Condition Profile

Road inspections are conducted every two years for the entire road network, which include surface distress assessments (SDI) and ride comfort measurements (RCI). Structural adequacy data (SAI) via deflection testing was collected 3 times approximately 10 years apart on major roads. SDI, RCI, and SAI together make up the pavement quality index (PQI) and is primarily driven by SDI. The PQI calculation is a proprietary model built by Stantec and has been in place since 1996. Refer to 3.2 for condition ratings specific for roads.

Sidewalks are inspected once a year as per the Minimum Maintenance Standards (MMS), which include walkways and BMUPs. Condition ratings were developed based on the natural groupings (poor to excellent) on the number of defects per sidewalk, walkway and BMUP segment. On average there are .25 defects per sidewalk segment, or 1 defect for every 4 sidewalk segments. The figure below summarizes the overall network condition for roads and Figure 2.8 shows road class portions within asset condition profiles. Most of the network is in Good to Excellent condition. Most road classes are in each of the condition ratings; there are no poor arterial roads.
This next figure summarizes the overall network condition for sidewalks and walkways. As of 2021 71% of the network is in excellent condition where there are zero defect. Most BMUPs were installed recently and are in excellent condition with zero defects.
Levels of Service

Levels of service are an indicator of how well a service is provided, both from the service users point of view (Customer LOS) and service providers point of view (Technical LOS). They can be defined by regulation, such as O.Reg 588/17, or the City. These metrics are important to track as they can reveal trends in service delivery year over year, and highlight areas for improvement, as well as indicate the success of programs that are implemented by the Asset Leads or Stewards. The table below is a summary of Levels of Service, as they relate to service attributes.

<table>
<thead>
<tr>
<th>Service Attribute</th>
<th>Corporate LOS</th>
<th>Performance Measure</th>
<th>Target</th>
<th>2021 Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Provide a road network that can accommodate peak traffic flows with minimal delays</td>
<td># of time streets experience E or F LOS from Transportation Master Plan (refer to Table 3.4)</td>
<td>Avoid E or F</td>
<td>C or better</td>
</tr>
<tr>
<td>Quality</td>
<td>Provide a road network that is in good condition and offers a smooth driving experience</td>
<td>Average PQI</td>
<td>70</td>
<td>78.3</td>
</tr>
<tr>
<td>Availability</td>
<td>Provide a network of sidewalks with good connectivity</td>
<td>Roads with 1 or 2 sides of sidewalk depending on the road functional classification</td>
<td>All roads to have sidewalks on both sides</td>
<td>17% of roads with sidewalk on one side</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>83% of roads with sidewalk on both sides</td>
</tr>
</tbody>
</table>

Lifecycle Management Plan

The lifecycle management plan lays out activities required to uphold levels of service. These can be grouped into several categories such as operations/maintenance, replacement, or acquisition. When executed well, these activities can reduce costs and extend the useful life of assets. The table below provides examples specific to roads and sidewalks.
<table>
<thead>
<tr>
<th>Lifecycle Management Activity</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Operations/ Maintenance     | Regularly scheduled inspections and maintenance, or repairs associated with unexpected events | • Scheduled inspection programs for roads (RoadPatrol and RoadMatrix Assessments)  
• Snow and ice removal/control  
• Pot hole repairs  
• Utility cut restoration  
• Crack sealing  
• Scheduled inspection for sidewalks  
• Scheduled sidewalk repairs |
| Renewal/ Replacement         | Significant repairs to extend the useful life of an asset. This also includes assets that are replaced at the end of service life, but does not accommodate a change, improvement, or expansion to service. | • Full road reconstruction  
• Road resurfacing program |
| Acquisition/ Growth          | Activities required to expand services to previously un-serviced areas or expand existing services to meet growth demands. | • Subdivision development and expansion as identified in the Development Charges Study  
• Surface reconstruction or Streetscaping |
| Disposal                     | Activities associated with the disposal of an asset once it has reached the end of its useful life or is otherwise no longer needed by the City of Kitchener. | • N/A |
| Non-Infrastructure Solutions | Actions or policies that lower costs, extend the life of an asset, identify needs, etc. | • Transportation Master Plan (2013)  
• Vision Zero Strategy (2022-2025)  
• Cycling and Trails Master Plan (2020)  
• Complete Streets Guidelines (2019)  
• Development Charges Background Study (2022) |
Financial Summary

Roads and sidewalks are funded by general revenues, inter-department transfers, loans, grants and user fees. These revenues fund capital projects as well as operations/maintenance, and administration costs. Each year budgets for capital projects are created for a 5 year horizon and operations/maintenance are created yearly. The figure below provides the actual expenditures from 2015 – 2021 as well as the forecasted budgets until 2031. These are the costs/budgets required for the lifecycle management activities required to uphold levels of service.
Conclusions

Asset management should be a continuously improving process that involves the periodic review and update of asset management plans and procedures. Some recommendations for future improvements to asset management within the various categories that the City maintains are related to various benchmarking studies. Benchmarking will help to manage resources and set and monitor levels or service. To support benchmarking and future analysis it is recommended to improve data inventories and automate data queries where possible.

The City has yet to fully understand the effect and magnitude climate change has on operation and maintenance requirements, however work is underway to model risks from a stormwater perspective. Understanding the City’s response to past climate events will help to better plan for possible future scenarios.

Renewal work is determined by data-driven decisions, which allows for long term capital planning. Operations and maintenance work is mostly reactive to needs that are presented in the same year. Ideally, specific budgets and accounts are created for operations and maintenance work so that better analysis can be performed on where there are specific shortfalls in resources and allow for longer term planning.