



AGENDA

SPC ON UTILITIES AND CORPORATE SERVICES

February 14, 2018, 9:30 AM
IN THE COUNCIL CHAMBER
Members

Councillor W. Sutherland, Chair
Councillor P. Demong, Vice-Chair
Councillor D. Colley-Urquhart
Councillor D. Farrell
Councillor J. Gondek
Councillor S. Keating
Councillor J. Magliocca
Mayor N. Nenshi, Ex-Officio

1. CALL TO ORDER
2. OPENING REMARKS
3. CONFIRMATION OF AGENDA
4. CONFIRMATION OF MINUTES
 - 4.1 Minutes of the Regular Meeting of the SPC on Utilities and Corporate Services, 2018 January 19
5. CONSENT AGENDA
 - 5.1 Deferral Report: Waste to Energy Technology, UCS2018-0147
 - 5.2 2017 Watershed Planning Update, UCS2018-0093
 - 5.3 2017 Flood Resiliency and Mitigation Annual Update, UCS2018-0092
6. POSTPONED REPORTS
(including related/supplemental reports)

None
7. ITEMS FROM OFFICERS, ADMINISTRATION AND COMMITTEES

7.1 Water Utility Billing Adjustment Process and Wastewater Rate Report, UCS2018-0091

8. ITEMS DIRECTLY TO COMMITTEE

8.1 REFERRED REPORTS
None

8.2 NOTICE(S) OF MOTION
None

9. URGENT BUSINESS

10. CONFIDENTIAL ITEMS

10.1 ITEMS FROM OFFICERS, ADMINISTRATION AND COMMITTEES
None

10.2 URGENT BUSINESS

11. ADJOURNMENT



MINUTES

SPC ON UTILITIES AND CORPORATE SERVICES

**January 19, 2018, 9:30 AM
IN THE COUNCIL CHAMBER**

PRESENT: Councillor W. Sutherland, Chair
Councillor P. Demong, Vice-Chair
Councillor D. Colley-Urquhart
Councillor D. Farrell
Councillor J. Gondek
Councillor S. Keating

ALSO PRESENT: Deputy City Manager B. Stevens
Acting City Clerk T. Rowe
Legislative Assistant M. A. Cario

1. CALL TO ORDER

Councillor Sutherland called the meeting to order at 9:30 a.m.

2. OPENING REMARKS

Councillor Sutherland welcomed everyone to the first SPC on Utilities and Corporate Services of 2018, and noted the meeting would include a presentation from Administration on the role the SPC on Utilities and Corporate Services.

3. CONFIRMATION OF AGENDA

Moved by Councillor Demong

That the Agenda for the 2018 January 19 Regular Meeting of the SPC on Utilities and Corporate Services be confirmed.

MOTION CARRIED

4. CONFIRMATION OF MINUTES

4.1 Minutes of the SPC on Utilities and Corporate Services, 2017 December 15

Moved by Councillor Demong

That the Minutes of the SPC on Utilities and Corporate Services held on 2017 December 15, be confirmed.

MOTION CARRIED

5. CONSENT AGENDA

None

6. POSTPONED REPORTS

(including related/supplemental reports)

None

7. ITEMS FROM OFFICERS, ADMINISTRATION AND COMMITTEES

7.1 UCS Orientation Presentation - Verbal Report, UCS2018-0058

Distribution with respect to Report USC2018-0058

- Utilities and Corporate Services Committee: Real Estate Orientation
Moved by Councillor Demong

That with respect to Report UCS2018-0058, the following be approved:

That the SPC on Utilities and Corporate Services receive this Report for information.

ROLL CALL VOTE:

For: (6): Councillor Sutherland, Councillor Demong, Councillor Colley-Urquhart, Councillor Farrell, Councillor Gondek, and Councillor Keating

MOTION CARRIED

8. ITEMS DIRECTLY TO COMMITTEE

8.1 REFERRED REPORTS

None

8.2 NOTICE(S) OF MOTION

None

9. URGENT BUSINESS

None

10. CONFIDENTIAL ITEMS

Moved by Councillor Demong

That in accordance with Section 197 of the *Municipal Government Act* and Sections 23, 24 and 25 of the *Freedom of Information and Protection of Privacy Act*, the SPC on Utilities and Corporate Services recess at 11:14 a.m. to reconvene in Closed Meeting, in the Council Lounge, to discuss the following confidential items:

10.1.1 Report UCS2018-0053

10.1.2 Report UCS2018-0055

MOTION CARRIED

The SPC on Utilities and Corporate Services moved into Public Session at 11:19 a.m. with Councillor Sutherland as the Chair.

Moved by Councillor Demong

That the SPC on Utilities and Corporate Services Committee rise and report.

MOTION CARRIED

10.1 ITEMS FROM OFFICERS, ADMINISTRATION AND COMMITTEES

10.1.1 Proposed Method of Disposition – (East Shepard Industrial) – Ward 12 (Cllr. Keating) File No. 10460 74 ST SE, UCS2018-0053

(Held Confidential subject to Sections 23, 24 and 25 of *FOIP*)

That, subject to Section 197 of the *Municipal Government Act*, the following members of Administration were in attendance, in Closed Meeting: T. Rowe (Clerk), M.A. Cario (Clerk), B. Stevens (Advice), T. Benson (Advice), D. Cassidy, J. Halfyard, Y. Sayani, S. McClurg, B. Graham, E. Lee, J. Moisan, R. Dupuis, S. Alexander

Moved by Councillor Demong

That with respect to Report UCS2018-0053, the following be approved:

The SPC on Utilities and Corporate Services recommend that Council:

1. Approve Recommendation 1 contained in Report UCS2018-0053;
2. Request the Recommendations, Report and Attachments 1, 2 and 3 remain confidential pursuant to Sections 23, 24 and 25 of the *Freedom of Information and Protection of Privacy Act* until the report is published in the Council agenda; and
3. Request that Attachments 4 and 5 remain confidential pursuant Sections 23, 24 and 25 of the *Freedom of Information and Protection of Privacy Act*.

MOTION CARRIED

10.1.2 Summary of Real Estate Transactions for the Third Quarter 2017, UCS2018-0055

(Held Confidential subject to Sections 23, 24 and 25 of *FOIP*)

That, subject to Section 197 of the *Municipal Government Act*, the following members of Administration were in attendance, in Closed Meeting: T. Rowe (Clerk), M.A. Cario (Clerk), B. Stevens (Advice), T. Benson (Advice), D. Cassidy, J. Halfyard, Y. Sayani, S. McClurg, B. Graham, E. Lee, J. Moisan, R. Dupuis, S. Alexander

Moved by Councillor Keating

That with respect to Report UCS2018-0055, the following be approved:

The SPC on Utilities and Corporate Services recommend:

1. That Council receive this report for information; and
2. Request that the Recommendations, Report and Attachments remain confidential pursuant to Sections 23, 24 and 25 of the *Freedom of Information and Protection of Privacy Act* until the report is published in the Council agenda.

MOTION CARRIED

10.2 URGENT BUSINESS

None

11. ADJOURNMENT

Moved by Councillor Demong

That this meeting adjourn at 11:22 a.m.

MOTION CARRIED

The following items have been forwarded to the 2018 January 29 Regular Meeting of Council:

Consent:

Proposed Method of Disposition – (East Shepard Industrial) – Ward 12 (Cllr. Keating)
File No. 10460 74 ST SE, UCS2018-0053

Summary of Real Estate Transactions for the Third Quarter 2017, UCS2018-0055

The next Regular Meeting of the SPC on Utilities and Corporate Services is to be held on 2018 February 14.

CONFIRMED BY COMMITTEE ON

CHAIR

ACTING CITY CLERK

Deferral Report: Waste to Energy Technology

EXECUTIVE SUMMARY

Administration is requesting a deferral for a report on waste-to-energy technology. As part of the Waste Diversion Target Update (UCS2015-0835), Administration committed to report back in Q1 2018 on the potential application of waste-to-energy technology. A report on the overarching strategy for waste and recycling will be brought to the Standing Policy Committee (SPC) on Utilities and Corporate Services in Q2 2018, and it is proposed that the report on waste-to-energy technology be included as part of that strategy report.

ADMINISTRATION RECOMMENDATION:

That the SPC on Utilities and Corporate Services recommends that Council defer Administration's report on waste-to-energy technology until no later than 2018 June.

PREVIOUS COUNCIL DIRECTION / POLICY

On 2015 December 7, as part of the Waste Diversion Target Update report (UCS2015-0835), Council directed Administration to report back in Q1 2018 on the potential application of waste-to-energy technology.

BACKGROUND

In 2007, Council approved the 80/20 by 2020 waste diversion strategy (UE2007-35). The original plan indicated that 10 per cent of waste diversion would be addressed with emerging waste-to-energy (WTE) technologies.

In 2015, Council adopted a revised target of 70 per cent waste diversion by 2025, to be accomplished by diverting organic and recyclable materials. WTE is not part of the strategy for achieving this target.

INVESTIGATION: ALTERNATIVES AND ANALYSIS

Administration will bring a report on the overarching strategy for waste and recycling to the SPC on Utilities and Corporate Services in Q2 2018. Administration is requesting a deferral for the report on WTE so it can be included as part of this broader strategy report in Q2 2018.

Stakeholder Engagement, Research and Communication

No impact has been identified with respect to this deferral. Waste & Recycling Services will continue to monitor the WTE industry.

Strategic Alignment

There is no impact of this deferral to strategic corporate objectives or Action Plan 2015-2018.

Social, Environmental, Economic (External)

No impact has been identified with respect to this deferral.

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Deferral Report: Waste to Energy Technology

Financial Capacity

Current and Future Operating Budget:

No impact has been identified with respect to this deferral.

Current and Future Capital Budget:

No impact has been identified with respect to this deferral.

Risk Assessment

No impact has been identified with respect to this deferral.

REASON(S) FOR RECOMMENDATION(S):

Administration will bring a report on the overarching strategy for waste and recycling to the SPC on Utilities and Corporate Services in Q2 2018, which will include a report on waste-to-energy technology.

ATTACHMENT(S)

None

**Utilities & Environmental Protection Report to
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2017 Watershed Planning Update

EXECUTIVE SUMMARY

The City of Calgary is dedicated to implementing the Government of Alberta's Water for Life Strategy through its water management framework that ensures reliable and resilient water servicing for Calgary and regional customers. Working with the Province and regional partners, The City aims to protect the water supply, use water wisely, keep rivers healthy and build resiliency to flooding. The City delivers on this commitment through three lines of service: water treatment and supply, wastewater collection and treatment, and stormwater management.

The City is achieving targets related to river water withdrawal, water consumption, and reducing pollutant loadings to the river. The City continues to make progress on protecting areas close to the rivers, implementing stormwater management initiatives, making major upgrades to the Bonnybrook wastewater treatment plant, and building flood resiliency. This report summarizes the actions taken in 2017 to protect Calgary's water supply, use water wisely, keep our rivers healthy, and build resiliency to flooding.

ADMINISTRATION RECOMMENDATION:

That the Standing Policy Committee on Utilities and Corporate Services recommends that Council receive this report for information.

PREVIOUS COUNCIL DIRECTION / POLICY

On 2013 May 29, the Standing Policy Committee (SPC) on Utilities and Corporate Services received the Watershed Management Planning Annual Update (UCS2013-0046) report for information. The report included annual progress updates for the Water Efficiency Plan and the Stormwater Management Strategy.

Subsequent Watershed Management Planning Update reports from 2014 to 2016 (UCS 2014-0108, UCS2015-0080, UCS2016-0167, and UCS2017-0266) were received for information.

BACKGROUND

Increased pressure on the watershed from regional growth and land use combined with climate change impacts make watershed management one of Calgary's most critical environmental resiliency challenges. The City works with the Province and regional partners on integrated watershed management, which addresses the important relationship between watershed protection, climate resiliency, and land use. The City's integrated watershed management approach aims to achieve the following goals:

- | | |
|-----------------------------|---------------------------------|
| 1. Protect our water supply | 3. Keep our rivers healthy |
| 2. Use water wisely | 4. Build resiliency to flooding |

INVESTIGATION: ALTERNATIVES AND ANALYSIS

Attachment 1 is a results-based accounting summary of watershed protection performance in 2017. Attachment 2 describes in detail the actions The City is taking in the goal areas outlined above, as well as challenges and priorities for 2018.

2017 Watershed Planning Update

Goal #1: Protect our water supply.

Reliable, secure, high-quality water supplies are essential for Calgary and the region. 2017 highlights:

- A Water Supply Management Framework is being implemented to build greater synergies among plans related to water efficiency, source watershed protection, drought management, climate change, infrastructure planning, and regional servicing.
- Development of a Source Water Protection Plan is underway, and is based on mitigating risks to Calgary's source watershed and on best practices from other jurisdictions. Water quality evaluation, and internal, external, and First Nations engagement was conducted in 2016-2017. The plan will be finalized in 2018.
- The Utility identified key climate adaptation priorities, and actions will be included in the next business planning cycle in alignment with the future Corporate Climate Resilience Plan.
- An uncharacteristically dry and hot summer resulted in Administration initiating an internal Drought Advisory Phase from 29 August to 2 October, requiring increased watershed monitoring, coordinating business units on water conservation readiness, and operational management to maximize water storage.
- The City participated in the Provincial Bow River Working Group project which developed recommendations for immediate and long-term flood and drought mitigation solutions for the Bow River watershed.
- The City is preparing for more stringent Health Canada guidelines on lead in drinking water. A review of The City's current practices on lead service connection management is required to develop an expanded strategy to meet the new guidelines anticipated for 2018.

Goal #2: Use water wisely

The City is on track to achieve the Council approved Water Efficiency Plan target to accommodate Calgary's population growth with the same amount of water removed from the river in 2033 as in 2003. 2017 highlights:

- Calgary's overall water use is on track to meet the 2033 target, with total per capita water demand decreasing by 29 per cent since 2003. Residential water demand was approximately 224 litres per capita per day in 2017.
- Calgary's highest total water use in a single day occurred on July 7 and remained below the current capacity of The City's water treatment plants.
- New water efficiency programming is underway for the industrial, commercial and landscape sectors and residential programming is being reviewed in consideration of the gains already made.
- The City continued to identify and fix watermain leaks, saving an estimated 6.5 million litres per day in 2017.

Goal #3: Keep our rivers healthy

The City's Total Loading Management Plan and Stormwater Management Strategy aim to reduce pollutants from entering the Bow River. The Riparian Action Program aims to improve the health of areas near rivers, and minimize further loss of riparian areas. 2017 highlights:

- Major upgrades to the Bonnybrook Wastewater Treatment Plant continued, including construction of the Biosolids Dewatering Facility, digester upgrades, and initiating

2017 Watershed Planning Update

construction of a flood protection berm for the Plant. These improvements will ensure The City continues to meet regulatory requirements and support population growth.

- Sediment and phosphorus loadings from stormwater and wastewater remained below provincial objectives.
- The construction of the Bowmont East Stormwater Quality Retrofit pond was completed. Once operational, it will significantly reduce sediment load to the Bow River in this area.
- The Riparian Action Program continued to advance, with seventeen bioengineering and riparian planting projects either designed, under construction or completed in 2017. Monitoring of riparian health indicates that Calgary's city-wide riparian health is improving.
- The City developed a set of indicators to inform the development of a comprehensive watershed health index which will help evaluate watershed health and inform urban development practices.

Goal #4: Build resiliency to flooding

The City continues to implement the recommendations made by the Expert Panel on river flood mitigation, with 15 of the 27 recommendations complete and the remaining underway. The City is also advancing the Community Drainage Improvement (CDI) Program aimed at reducing risk of stormwater flooding in communities. Flood resiliency and CDI program activities are summarised in a separate report to Council (UCS2018-0092). 2017 highlights:

- Council approved the Flood Mitigation Measures Assessment and Implementation Plan, including budget approval for specific projects. The approach includes combination of local, upstream, and non-structural mitigation measures to continue improving flood resiliency for Calgary.
- The City applied for \$81 million for community based flood mitigation projects through the Alberta Community Resiliency Program. The first set of funding awards from these applications will be announced in 2018.
- The CDI Program invests in stormwater infrastructure improvements in established communities with the highest risk of local stormwater flooding. In 2017 the Program delivered planning, design and construction activities in several communities as scheduled.

Stakeholder Engagement, Research and Communication

The City collaborates with internal and external stakeholders including Calgarians, community groups, non-governmental organizations, the development industry, land owners, regional partners, neighbouring communities and the Provincial and Federal governments to achieve watershed management goals. Through community engagement, surveys, and a strong presence in the community, The City continues to learn more about customers, their level of awareness and expectations to inform programs to improve the Water Utility's lines of service.

Strategic Alignment

The City's work aligns with the Provincial Water for Life strategy and regional watershed management plans. Moving forward on watershed management goals contributes to a number of Strategic Action areas in Council's Priorities for 2015-2018:

- A city of inspiring neighbourhoods (N2 - Build resiliency to flooding, Enable developments that meet the Municipal Development Plan and Calgary Transportation Plan; N5 -

2017 Watershed Planning Update

Systematically invest in established neighbourhoods as they evolve to accommodate changing community need; and N8 - Integrate watershed protection with land use planning).

- A healthy and green city (H3 - Manage the interrelationships between flood protection, water quality and quantity, and land use; H4 - Work with our regional partners and the Government of Alberta on an integrated approach to the watershed; and H6 and H10 – Lead by example and build awareness of shared responsibility to protect the environment).
- A well-run city (W5 - Integrate customer and stakeholder feedback to drive programs and service improvements).

Social, Environmental, Economic (External)

The City's programs and projects protect and enhance watershed health and address public health and safety, protect property, and increase community awareness. Our watershed management initiatives work to ensure healthy rivers for Calgary and neighbouring communities.

Secure and reliable water sources are critical to economic growth and community vitality. A culture of community sustainability is fostered by promoting water conservation that can contribute to deferring infrastructure expansions and help offset increases in water utility rates. Our flood mitigation program is building community resiliency and protecting critical infrastructure and communities from flood risk.

Financial Capacity

Current and Future Operating Budget:

Program initiatives to achieve the watershed management planning goals are incorporated in the 2015-2018 Utilities budget.

Current and Future Capital Budget:

Program initiatives to achieve the watershed management planning goals are incorporated in the 2015-2018 Utilities budget.

Risk Assessment

Sustainable management of water resources is one of Calgary's most significant community resiliency challenges. Integrated watershed management planning helps to evaluate and take action to reduce risks to our watershed from growth, anticipated changes to service delivery, and the impacts of climate change. Key risks identified include:

- Changes to regulations and policy direction, such as the establishment of the Calgary Metropolitan Region Board and future direction on Provincial flood policy will require The City to adapt service delivery, strategies and infrastructure. The City maintains a close working relationship with regulators, partners and internal and external stakeholders to help inform and prepare for anticipated regulatory changes.
- Climate variability, potential for drought, regional population growth and servicing present water supply risks. The two highest risks to Calgary's water supply and quality include upstream forest fires and land development. Climate resiliency planning for the Water Utility and the Integrated Water Supply Management Strategy will help further define and address these risks. Examining drought vulnerabilities and risks will help us

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2017 Watershed Planning Update

develop and prioritize drought strategies The City also continues to enhance water efficiency programs and seek new innovations in water conservation programming.

REASON(S) FOR RECOMMENDATION(S): This report is provided for information as an update on progress of watershed management implementation and planning.

ATTACHMENT(S)

1. Attachment 1 – 2017 Watershed Planning Activity and Results Summary
2. Attachment 2 – 2017 Watershed Planning Update



2017 Watershed Planning Activity and Results Summary

Goal 1: PROTECT OUR WATER SUPPLY

Background: Story Behind the Baseline

Goal: Reduce risks to Calgary's water supply and ensuring reliable, secure, high quality water supply for Water Services customers.

Risks: Regional growth and impacts from land development results in pressures on Calgary's water supply and water quality. The region is prone to drought and future water supply limited because of climate change impacts and the provincial closure of the South Saskatchewan River Basin to new water licenses.

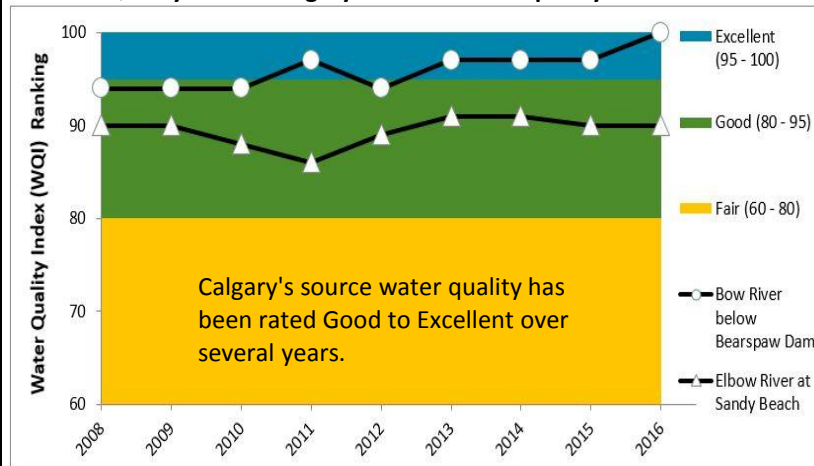
2018 Planned Actions - Highlights

- Advance water resource plans through the Water Supply Management Framework: finalize the Source Water Protection Plan, initiate Drought Vulnerability and Risk Assessment, and advance the Water Utility's climate resilience program.
- Work with the Calgary Metropolitan Region Board to ensure future regional water servicing aligns with The City's Water Supply Management Framework.
- Advocate for implementation of the Bow River Working Group recommendations to manage drought and flood: quick wins and major infrastructure.
- Review The City's practices on lead service connection management to expand the strategy to meet new Federal guidelines on lead in drinking water anticipated for 2018.

What We Did: 2017 Highlights

- Initiated a Water Supply Management Framework to build greater synergies among water efficiency, source watershed protection, drought management, climate change, and regional servicing.
- Development of a Source Water Protection Plan is underway, based on mitigating risks to Calgary's source watershed.
- Key climate adaptation priorities were identified for the Utility with actions to be included in the next business planning cycle.
- An internal drought advisory in the hot and dry summer/fall required increased watershed monitoring and maximizing water storage.
- Participated in the Provincial Bow River Working Group project which recommended flood and drought mitigation solutions.
- Prepared for more stringent Health Canada guidelines anticipated on lead in drinking water.

Water Quality Index - Calgary's source water quality



Strategic Alignment

H3: Manage the interrelationships between flood protection, water quality and quantity, and land use.

H4: Work with our regional partners & the GOA on an integrated approach to the watershed.

H6: Continue to build public awareness & understanding of our shared responsibility to conserve & protect the environment.



2017 Watershed Planning Activity and Results Summary

Goal 2: USE WATER WISELY

Background: Story Behind the Baseline

Goal: The Water Efficiency Plan (WEP) calls for the same amount of water to be withdrawn from the river in 2033 as was taken out in 2003.

Risks: Population growth in the Calgary region increases water demands on the rivers and Calgary's treatment plants. Establishment of the Calgary Metropolitan Region Board will require The City to adapt regional service delivery, strategies and infrastructure in the future.

What We Did: 2017 Highlights

- Annual water withdrawn from the rivers was 8 per cent higher than in 2016 due to the dry, hot summer and fall, but was still well below the 2003 benchmark despite a population growth of approximately 30 per cent since 2003.
- Overall water use is on track to meet the 2033 target at 378 litres per capita per day (lpcd) for all customer types. Residential water demand was 224 lpcd.
- Calgary's highest total water use in a single day occurred July 7 and remained below the current capacity of Calgary's water treatment plants.
- New water efficiency programming is underway for the industrial, commercial and landscape sectors while residential programming continues to be redesigned.
- Continued to identify and fix watermain leaks, saving 6.5 million litres per day in 2017.

2018 Planned Actions - Highlights

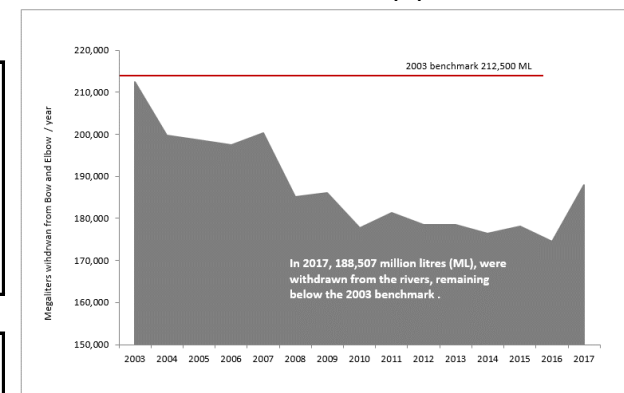
- Continue to build understanding of the Industrial, Commercial, and Institutional sector water profile, values, and preferences to inform water conservation programming.
- Design and develop education, outreach and communications programming to reduce outdoor water use to address peak day demand.
- Align water efficiency programming, demand forecasting and infrastructure planning.
- Continue to provide education and outreach to customers about the Water Utility, leaks and high-water consumption, outdoor water use, and conservation.

Strategic Alignment

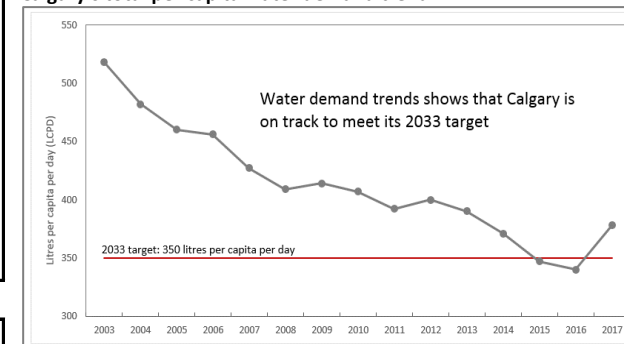
H3: Manage the interrelationships between flood protection, water quality & quantity, and land use.

H6: Continue to build public awareness and understanding of our shared responsibility to conserve and protect the environment.

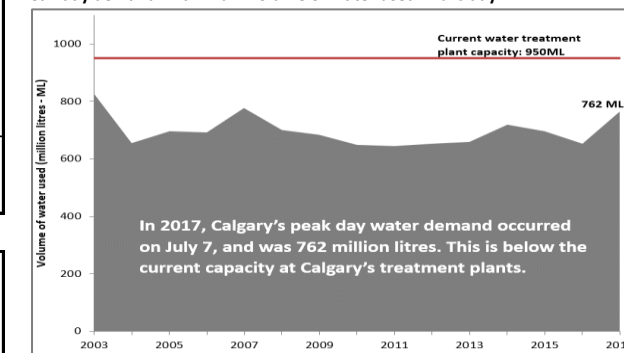
Annual water withdrawal from rivers and population



Calgary's total per capita water demand trend



Peak day demand: Maximum volume of water used in one day





2017 Watershed Planning Activity and Results Summary

Goal 3: KEEP OUR RIVERS HEALTHY

Background: Story Behind the Baseline

Goal: The City's Total Loading Management Plan and Stormwater Management Strategy aim to reduce pollutants from entering the Bow River. The City's Riparian Action Program aims to improve the health of areas near rivers, and minimize further loss of riparian areas.

Risks: Pollutants in waterways can impact water quality and river health, and cause maintenance and infrastructure upgrade issues.

What We Did: 2017 Highlights

- Major upgrades to the Bonnybrook Wastewater Treatment Plant continued, including the biosolids facility, digester upgrades, and a flood protection berm.
- Sediment and Phosphorus pollutant loadings from stormwater and wastewater remained below provincial objectives.
- The Bowmont East Stormwater Quality Retrofit pond was completed, which will reduce sediment load to the Bow River.
- Continued to advance the Riparian Action Program, with seventeen bioengineering and riparian planting projects underway or completed in 2017. Riparian health monitoring indicates city-wide improvement.
- Developed a set of indicators to inform a comprehensive watershed health index.

2018 Planned Actions - Highlights

- Advance the Riparian Action Program: riparian restoration, integrate riparian maps in land use planning, continue outreach.
- Update The City's Stormwater Management Strategy and targets.
- Negotiate Approval to Operate 2018-2028. Continue wastewater treatment plant upgrades, and advance the Wastewater Loading Management Program.
- Complete storm pond modifications in 2 communities, and plan 3 more in 2018.
- Plan the next phase of watershed health index reporting, and report new indicators in the 2018 MDP monitoring report.

Strategic Alignment

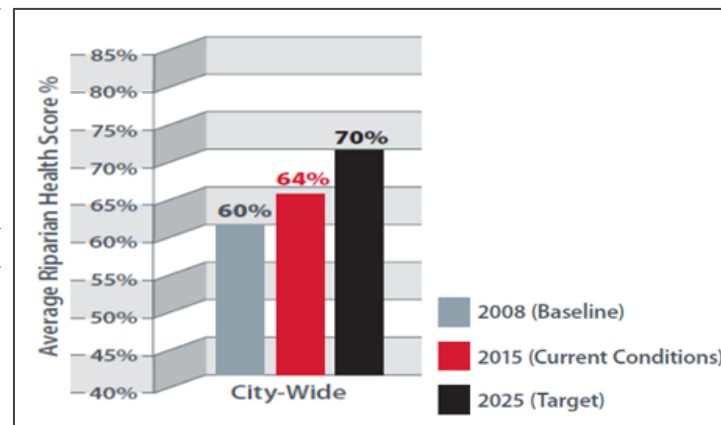
H3: Manage the inter-relationships between flood protection, water quality and quantity, and land use.

H4: Work with our regional partners & the GOA on an integrated approach to the watershed.

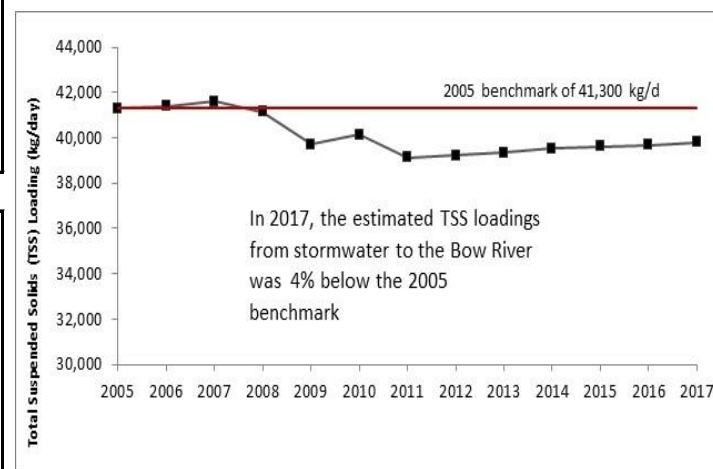
H6: Continue to build public awareness & understanding of our shared responsibility to conserve & protect the environment.

H10: Lead by example & manage regulatory risks to protect public health & the environment.

City-wide riparian health scores



Total Suspended Solids (TSS) to the Bow River from stormwater





2017 Watershed Planning Activity and Results Summary

Goal 4: BUILD RESILIENCY TO FLOODING

Background: Story Behind the Baseline

Goal: Implement the long-term Flood Mitigation and Resilience Strategy. Advance strategies to accelerate the Community Drainage Improvement (CDI) Program aimed at reducing risk of localized flooding in communities.

Risks: Another major flood in Calgary is likely to occur, and would cause significant disruption to critical systems and services, Calgarians, businesses, and cause damage to public and private property. The costs of local flooding will continue until infrastructure upgrades are installed. These costs may hinder redevelopment in the affected communities.

What We Did: 2017 Highlights

- Council approved the Flood Mitigation Measures Assessment, Implementation Plan and budget for specific projects. The approach includes combination of local, upstream, and non-structural mitigation measures to continue improving flood resiliency for Calgary.
- Applied for \$81M for flood mitigation projects through the Alberta Community Resiliency Program.
- As of 2017, 15 of the Flood Expert Panel recommendations are complete and 12 are in progress.
- Mitigation complete or is ongoing has reduced exposure to river flood damage by about 30%.
- The Community Drainage Improvement Program is on track, delivering planning, design and construction activities as scheduled in 2017.

2018 Planned Actions

- Continue to build resiliency to flooding - deliver implementation of key flood mitigation investments, advocate for upstream mitigation, pursue flood policy review, and advance Expert Panel recommendations.
- Advance the Community Drainage Improvement program of stormwater infrastructure upgrades in communities experiencing local flooding including: examining overall program prioritization, initiating new and completing projects underway, and pursuing funding sources for projects.

Strategic Alignment

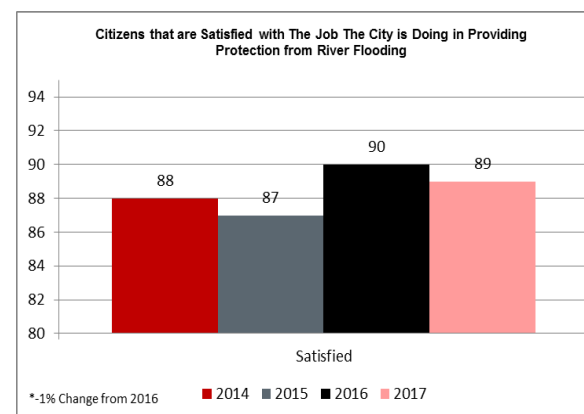
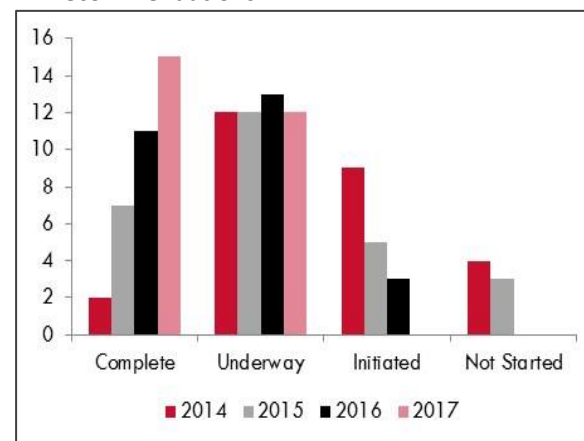
H3: Manage the interrelationships between flood protection, water quality & quantity, and land use.

N5: Systematically invest in established neighbourhoods as they evolve to accommodate changing community needs.

H3.2 Continue to strengthen the strategy and actions for the Drainage line of service to improve its overall performance and condition.

N2: Build resiliency to flooding.

Progress on the 27 Expert Panel recommendations



WATERSHED PLANNING



2017 WATERSHED PLANNING UPDATE

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1. INTRODUCTION

1.1 WATERSHED PLANNING – OUR PURPOSE

The City of Calgary works to ensure we have a healthy, resilient watershed capable of providing clean, reliable water for our current needs and future generations. The City is dedicated to implementing the Government of Alberta's *Water for Life Strategy* through an integrated water management framework that ensures reliable and resilient water servicing for Calgary and regional customers. The City provides drinking water and wastewater treatment to about 1 in 3 Albertans. Working with the Province and regional partners, The City aims to protect the water supply, use water wisely, keep rivers healthy and build resiliency to flooding. The City delivers on this commitment through three lines of service: water treatment and supply, wastewater collection and treatment, and stormwater management.

Increased pressure on watersheds from growth in the region as well as the impacts of a changing climate make watershed management one of Calgary's most critical resiliency challenges. The City's commitment to watershed protection considers the needs of a growing customer base and balancing the economic, social and environmental impacts of our decisions, programs, and actions. Sustainable management of our shared water resources is the driving force behind an integrated watershed management approach.



1.2 OUR GOALS

We endeavor to achieve the following goals to protect public health and the watershed:

- 1. Protect our water supply** by reducing risks to our water source.
- 2. Use water wisely** through responsible and efficient use.
- 3. Keep our rivers healthy** by reducing impacts on the rivers.
- 4. Build resiliency to flooding** through mitigation, emergency planning, and education.

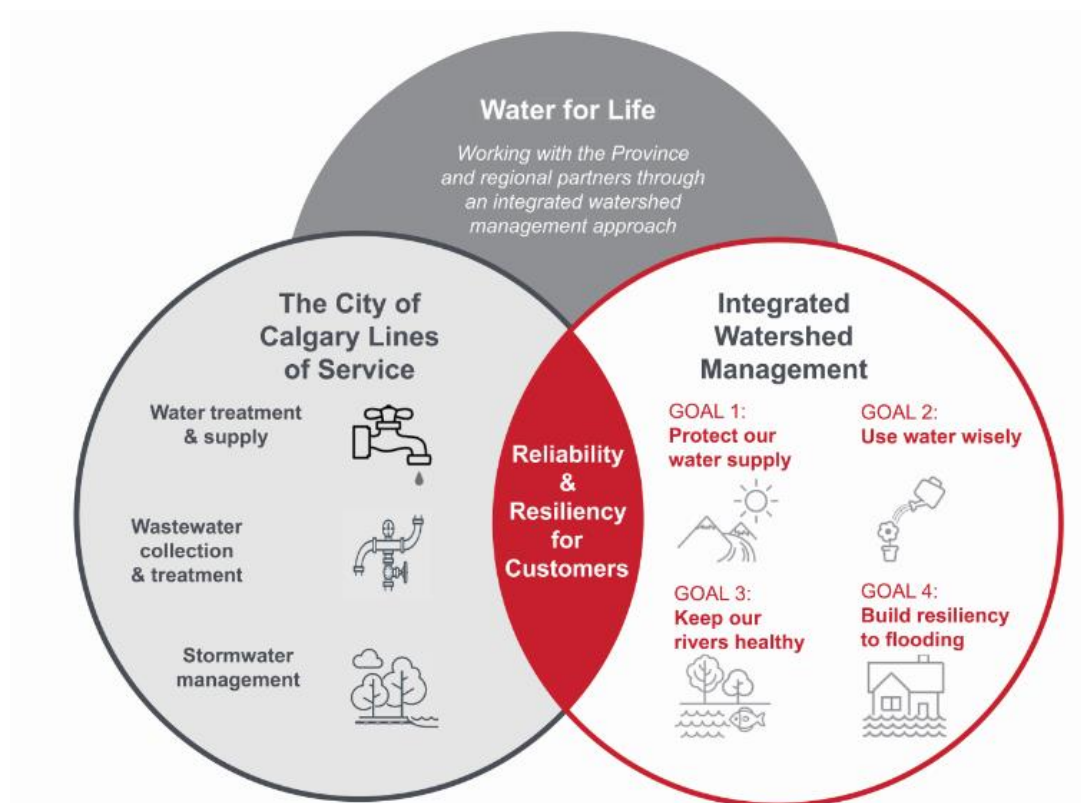


FIGURE 1.1 WATERSHED PLANNING DIVISION - STRATEGIC FRAMEWORK

The City's integrated watershed management framework (Figure 1.1) is designed to be flexible in delivering these goals while also responding effectively to emerging issues and customer needs. We use adaptive management to evaluate progress, risks, and the effectiveness of our services. This approach guides business decisions and investment planning for a sustainable watershed.

We work to achieve the four goals by:

- Collaborating closely with partners on common issues
- Conducting research and analysis to manage risks
- Developing and delivering strategies, plans and programs
- Advocating for sound policy
- Investing in infrastructure and business improvements
- Using innovation to optimize business decisions

This report describes the actions taken to achieve the goals, and address The City's watershed challenges and priorities.

1.3 ALIGNMENT WITH COUNCIL PRIORITIES

The City's watershed management goals are aligned with the priorities set by City Council's *2015-2018 Action Plan*, with a focus on the priorities outlined in Table 1.1. Examples of how our work helps achieve these priorities are highlighted throughout this report.

Table 1.1 Council's 2015-2018 Action Plan Priorities related to protecting watershed health

H3.1 Align preparedness and natural resource plans to implement a whole systems approach to manage the inter-relationships between flood protection, water quality and quantity, and land use.
H3.2 Continue to strengthen the strategy and actions for the Drainage line of service to improve its overall performance and condition.
H4.1 Collaborate with staff and regulators to enhance environmental performance and contribute to regulatory decision-making.
H4.2 Support the implementation of the Calgary Metropolitan Plan through an integrated approach to the watershed. <i>(to be replaced by the new Regional Growth Plan)</i>
H6.1 Proactively seek and collaborate with partners to conserve and protect air, land and water resources.
H10.1 Operate facilities and systems to ensure compliance with regulatory requirements and to protect public health and mitigate the impacts of our business on air, land and water.
H10.2 Effectively use research to improve decision-making and environmental performance.
N2.1 Implement recommendations from the Flood Expert Management Panel as directed.
N2.2 Continue to invest in priority flood resilient infrastructure to reduce the impact of and vulnerability of future events.
N5: Systematically invest in established neighbourhoods as they evolve to accommodate changing community need
N8.1 Support the development of measures to integrate watershed protection with land use planning.
N8.2 Support incorporation of Low Impact Development source control practices in public land development and redevelopment. <i>(Green stormwater infrastructure)</i>
W5.1 Integrate feedback from customers and stakeholders to drive programs and service improvements, and enable two-way communication.

2. GOAL #1: PROTECT OUR WATER SUPPLY

Economic and urban growth in Calgary and the region is dependent on a safe, reliable, and secure water supply. The region is prone to drought and future water supply is limited because of climate change impacts and the provincial closure of the South Saskatchewan River Basin to new water licenses. These impacts are expected to increase pressures on The City's water and wastewater treatment plants, as well as Calgary's stormwater system. Watershed protection aligns with the Provincial Water for Life Strategy, South Saskatchewan Regional Plan and supports regional watershed management plans of which The City is a partner. An integrated water supply management approach will help identify risks facing water supply and operations, and recommend actions to address challenges.

2.1 WATER SUPPLY MANAGEMENT

Calgary's shared water resources in the watershed require long-term integrated planning to meet the needs of customers, especially as climate variability continues to impact water availability. To address this water management priority, The City's Water Supply Management Framework will align various water supply, demand and infrastructure plans. In 2017, we drafted the Source Water Protection Plan, and prioritized regional servicing issues, climate adaptation and drought management. The framework will provide flexibility to enhance water supply resilience, both now and in the future. It will help to set a basis for planning and decision-making and build greater synergies among plans related to water efficiency, source watershed protection, drought, climate change, infrastructure planning, and regional servicing. Figure 2.1 illustrates key plans and programs related to this framework.

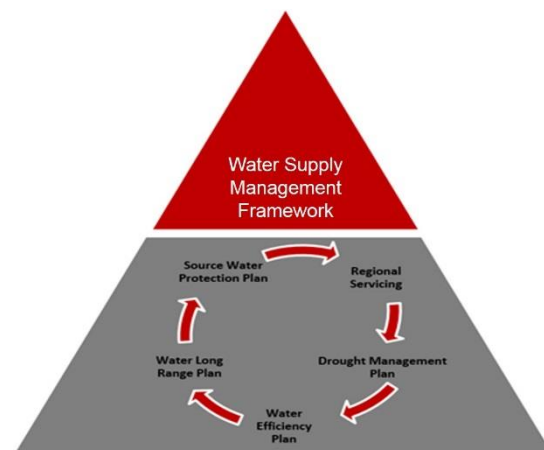


FIGURE 2.1 KEY PLANS AND PROGRAMS OF WATER SUPPLY MANAGEMENT FRAMEWORK

2.2 CLIMATE IMPACTS ON WATER MANAGEMENT

Climate change will alter how and when we receive precipitation in Calgary's watershed, affecting both water quantity and water quality. Mountain snowpack melting may occur earlier in the year, precipitation will fall with greater intensity, and summers will become hotter, drier and longer. With increasing temperatures and drought conditions, water demands will likely increase. Snowmelt water may fill reservoirs earlier in the year and will have to support increased water demands for a longer, hotter outdoor water use season. Water management practices and storage capacity for both extreme flood and drought will be priorities in preparing for climate change.

A reliable, secure and high quality water supply is essential for Calgary and we are taking action to plan for an uncertain climate future. This past year, The City identified impacts climate change will have on the Water Utility and a number of mitigative actions were identified. These actions will be built into work plans, and a key task in 2018 will be examining changes in rainfall intensity so we can understand potential impacts to stormwater management.

Priorities over the next business cycle include a technical analysis to support changes to how water infrastructure and programs are designed and prioritized, collaboration with stakeholders on climate adaptation initiatives, and development of a program to report on climate adaptation progress in the Utility. Many of these actions will be integrated into existing and planned projects and programs with some new critical actions being included in the business planning process for 2019-2022.

2.3 SOURCE WATER PROTECTION

The City of Calgary draws its water from the Bow and Elbow rivers. This water is ultimately generated in the source watershed, which includes all land from which water collects and flows downstream to the Bearspaw and Glenmore water treatment plants (Figure 2.2). Source water protection is the first line of defense to minimize the risk of contamination of our drinking water supply. The City completed a Source Watershed Assessment and Risk Characterization study, which identified the two highest risks as:

- Potential for major wildfires in the forested headwaters causing contamination.
- Current and future land development resulting in higher contamination risks from increased stormwater runoff.

Calgary's Source Water Protection Plan is based on mitigating risks to Calgary's source watershed, best practices from other jurisdictions, and water quality evaluation data. Extensive internal, external and First Nations engagement conducted in 2016-2017 also informed the Plan. The Plan will be finalized in 2018 and establishes four goals to proactively prevent, reduce or mitigate key source water quality risks as part of a multi-barrier approach to providing safe, clean, high-quality drinking water to our customers. These goals were selected based on risk priorities, commitments to customers and stakeholder engagement:

1. Protect the source watershed through enhanced land use planning processes and requirements
2. Promote innovation in stormwater management to protect source water quality
3. Leverage key partnerships for risk mitigation
4. Effectively involve stakeholders and citizens through education and research.

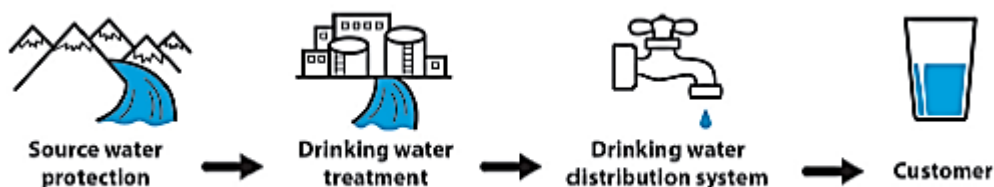


FIGURE 2.2 SAFE DRINKING WATER STARTS AT THE SOURCE AND IS MANAGED THROUGHOUT THE DISTRIBUTION SYSTEM

2.4 DROUGHT MANAGEMENT

The summer of 2017 was characterized by record high temperatures and very little precipitation, resulting in low flows on the Bow and Elbow rivers, and lower levels at Glenmore Reservoir. Southern Alberta and some Calgary regional municipalities were significantly impacted by drought conditions and imposed water use restrictions. Infrastructure investment at The City's water treatment plants and community efforts on water conservation allowed us to manage water supply and demand, resulting in no need for water restrictions.

The City has developed guidelines, including four drought phases, to guide actions in the event of drought conditions:



FIGURE 2.3 CALGARY'S FOUR DROUGHT ACTION PHASES

While a public drought advisory was not required in 2017, an internal drought Advisory phase was in effect from August 29-October 2 of 2017 to increase The City's state of readiness:

- Increased water quality and quantity monitoring of watershed, operational and regional conditions
- Corporate-wide collaboration on readiness for additional water conservation measures if necessary
- Managing water treatment operations to maximize production and storage efficiency
- Prioritizing where and how much water is used in park spaces.

Regionally, we increased our operational communication with Alberta Environment and Parks, TransAlta and the Irrigation Districts to share successes and challenges and discuss opportunities to improve Bow River operations. This collaboration will continue in 2018 and beyond.

In 2018, The City will develop a long-term drought management plan that considers climate change adaptation as well as Calgary's drought response readiness. Examining drought vulnerabilities and risks will help us develop and prioritize drought strategies to minimize impacts on the watershed and customers.

2.5 WATER QUALITY

The City takes a source-to-tap view of drinking water quality, which means that as water travels from the mountains, through our water treatment plants across the city through the distribution system and to customer taps, the water is tested at every step to ensure its quality is maintained. The City's drinking water is safe and reliable,

and meets or is better than the Guidelines for Canadian Drinking Water Quality. Monitoring results on key drinking water quality parameters can be found at www.calgary.ca/water. Calgary's wastewater treatment plants help ensure that the ecological integrity of the Bow River is protected for downstream communities. Treated wastewater in Calgary consistently complies with Alberta Environment & Parks' regulations.



THE CITY TESTS DRINKING WATER FROM SOURCE TO TAP

2.5.1 CALGARY'S SOURCE WATER QUALITY

Both the Bow River near the Bearspaw Dam and the Elbow River near the Glenmore Reservoir provide very high quality water supply to The City's water treatment plants, according to The City's long term analysis. We use the federal Water Quality Index (WQI) to track conditions, which translates data from multiple water quality parameters into a score from 0-100, along with a descriptor (Excellent, Good, Marginal, Poor). The Bow River typically has 'Excellent' water quality, while the Elbow River typically has 'Good' water quality. Over the last decade, we've observed consistently high WQI ratings near the City's water treatment plants (Figure 2.4).

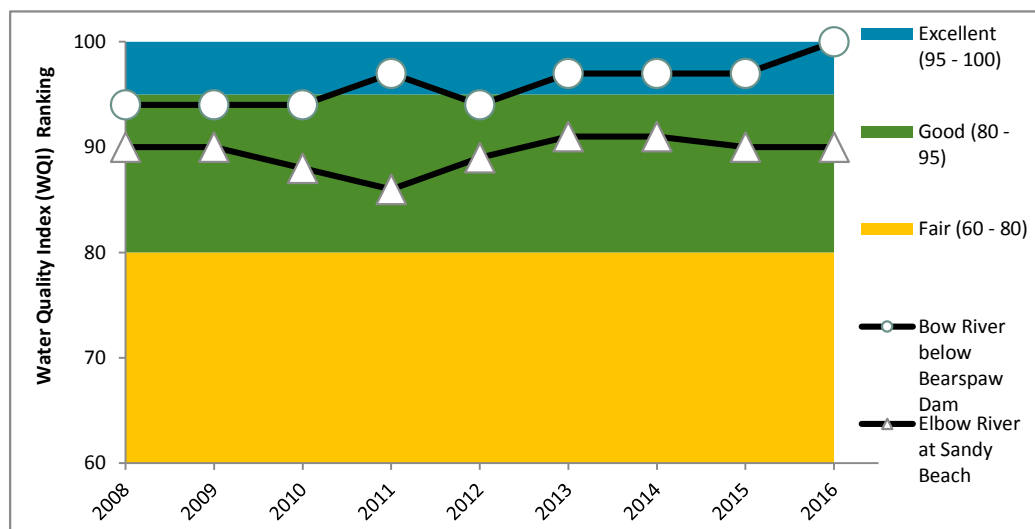


FIGURE 2.4 WATER QUALITY INDEX - CALGARY'S SOURCE WATER

With a larger flow, the Bow River is expected to be more resilient to changes in water quality compared to the Elbow River. However, current and future infrastructure and land use changes could impact The City's source water quality. Maintaining source water quality is part of the multi-barrier approach for producing safe drinking water.

2.5.2 LEAD SERVICE CONNECTION AND WATER QUALITY IMPACTS

Calgary's drinking water quality meets or performs better than all federal and provincial health guidelines. Our water quality team closely monitors drinking water daily from the river, to our treatment plants and throughout the distribution system, which delivers water to homes and businesses.

Lead is not found in our source water in the Bow or Elbow rivers. Prior to 1950, lead was commonly used for water service piping. Copper and plastic pipes have since replaced lead. A service connection is the water pipe that connects from The City's water main to the piping inside residences and businesses. The service connection is on both public and private property. A lead service connection is a connection made out of lead piping.

In Calgary there are 601 active lead service lines out of a total of 336,452 active water service lines - about 0.2 per cent of the total service count (Figure 2.5). These service lines are predominantly confined to the inner city area. For many years, The City has been managing lead through several initiatives including the Tap Water Sampling Program and Customer Rebate Program for filtration devices. Lead service connections are typically replaced when nearby water mains are replaced, when sites are redeveloped and when determined necessary through the tap water sampling program.

Health Canada is updating their guideline for lead in drinking water. The new guidelines will change the health risk-based maximum acceptable concentration (MAC) from 10 ug/L to 5 ug/L. The City was consulted by Health Canada during the update process. We anticipate that Health Canada will adopt these new lead guidelines in 2018. A review of The City's current practices on lead management is required so that we can develop a new strategy to meet the new MAC for lead. That strategy may include a more aggressive lead service replacement program for 2019-22, which would require additional capital investment in this program.

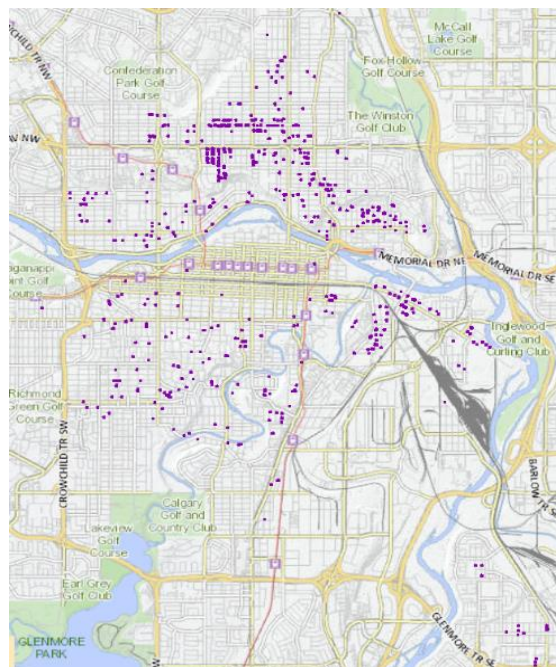


FIGURE 2.5 LEAD SERVICE PROPERTIES

2.6 REGIONAL COLLABORATION

Under the *Modernized Municipal Government Act*, a mandatory Growth Management Board is established for the Calgary region on 2018 January 1. Under the new Board, all municipalities are required to amend statutory plans and make decisions consistent with the growth plan for the entire region. This is a significant shift from the voluntary nature of the Calgary Regional Partnership (CRP), where priority for water and wastewater servicing was given to CRP members. The City is committed to providing existing customers with continued water and wastewater servicing and will work with the new Calgary Metropolitan Region Board on the new regional growth plan and servicing plans which will be developed over the next three to five years. The City's regional water, wastewater and stormwater servicing policy is presented in a separate report to Council (IGA2018-0089).

Alberta Environment and Parks, The City of Calgary, and the Western Irrigation District (WID) entered into a Western Headworks Stormwater Management Agreement in 2013. This agreement allows The City to discharge stormwater into the Western Headworks Canal, which is owned by the WID. This agreement also specifies some obligations The City has to fulfill, including payment of an annual fee, best management practices and water quality monitoring. The objective is to achieve net-zero increases in run off volumes, rates and loadings for urban stormwater entering the Western Headworks Canal.

The City is participating in the assessment of a regional stormwater solution for lands east of Calgary, known as the Cooperative Stormwater Management Initiative (CSMI). CSMI partners are comprised of

representatives from The City, City of Chestermere, Rocky View County, Town of Strathmore, Wheatland County and the Western Irrigation District. A Master Stormwater Agreement is under review to determine The City's future participation in CSMI. Details on the status of this initiative are in a separate report to Council (IGA2018-0090).

The City participated in the Provincial Bow River Working Group project that made recommendations for flood and drought mitigation in the Bow River watershed in an August 2017 report. A number of 'quick wins' were identified to improve flood and water supply resiliency in the region if implemented. Additionally, a proposed flood-focused reservoir upstream of Calgary would have short-term water supply benefits for Calgary, with three locations identified for further study. However, the majority of reservoir scenarios to address drought were focused on southern Alberta agricultural irrigation downstream of Calgary. More details on this initiative are found in a separate report (UCS2018-0092).

2.7 PRIORITIES IN 2018

Table 2.1 summarizes activities The City plans to take to continue protecting our water supply in 2018.

Table 2.1 Goal #1: Protect Our Water Supply – 2018 focus

2018 Planned Actions
Finalize The City's Source Water Protection Plan.
Initiate Drought Vulnerability Risk Assessment.
Examine changes in rainfall intensity to better understand impacts to the Water Utility.
Initiate development of an expanded strategy to address the new federal guidelines on lead.
Work with the Calgary Metropolitan Region Board to ensure future regional water servicing aligns with The City's Water Supply Management Framework and associated plans and programs.
Continue to ensure best management practices are adopted to manage stormwater, erosion and sedimentation for urban stormwater entering the Western Headworks Canal.
Determine direction and participation in regional stormwater management activities.

3. GOAL #2: USE WATER WISELY

3.1 WATER EFFICIENCY PLAN

In 2017, The City continued to implement recommendations made in the 2016 Water Efficiency Plan (WEP) Update. This included a shift in focus away from residential customer or user incentive based programs to industrial, commercial and institutional (ICI) customers, and outdoor water use. These programs aim to continue reducing overall water consumption and achieving The City's 2033 water demand target. Targeting outdoor water use helps reduce water demand, specifically aiming to reduce the peak day demand, an important consideration in planning new water treatment plant infrastructure.



CITY STAFF INTERACTED WITH OVER 4,000 CALGARIANS ON WATER EFFICIENCY IN 2017

In 2017, The City began implementing the revised WEP, with focus on:

- Understanding customer water usage data (e.g. high water users)
- Benchmarking water use
- Water use planning and forecasting
- Partnership development with the landscaping industry to support water efficiency programming.

Market and customer research was conducted to support program design. This data helps deliver targeted programs and services effectively and cost-efficiently, in ways that work for the customer. For example, program development is underway for the ICI and landscape sectors and residential programming is being redesigned.

There are two programs in the research and development phase that will support ICI water efficiency: the capacity buyback program and an irrigation efficiency program. The capacity buyback program encourages and rewards ICI organizations that reduce water use, and involves a customer water audit and report that provides options to increase their water efficiency. Once permanent water-saving measures are implemented, a one-time rebate is provided based on water savings. Irrigation specific programming focused on identifying and offering opportunities to increase the efficiency of irrigation systems and inform, educate and guide practices to reduce excess watering.

To support residential customers and ongoing reduction in outdoor water use, research is currently underway to redesign the YardSmart Program. The program is based on market research and working with the landscape sector, garden supply partners, developers and builders to drive change and reduce outdoor water use. These changes will help further address peak day demand. In the meantime, water efficiency communications and messaging will continue to be delivered through events and targeted education programs for indoor/outdoor residential and ICI customers, through traditional and social media channels and existing partnerships.

3.2 CALGARY'S WATER USAGE

Calgary's Water Efficiency Plan includes a "water neutral" goal of accommodating future population in 2033 with the same amount of water removed from the rivers in 2003. The City's water efficiency measures have been successful in helping Calgarians' meet this goal by reducing water usage over the last 14 years, despite population growth during that time in Calgary and the region. In 2017, annual water withdrawn from the Bow and Elbow rivers was 188,507 million litres (ML), remaining below the 2003 benchmark of 212,500 ML (Figure 3.1). This was about 8 per cent higher than in 2016, likely due to uncharacteristically hot and dry summer and fall, despite minimal population growth over the year.

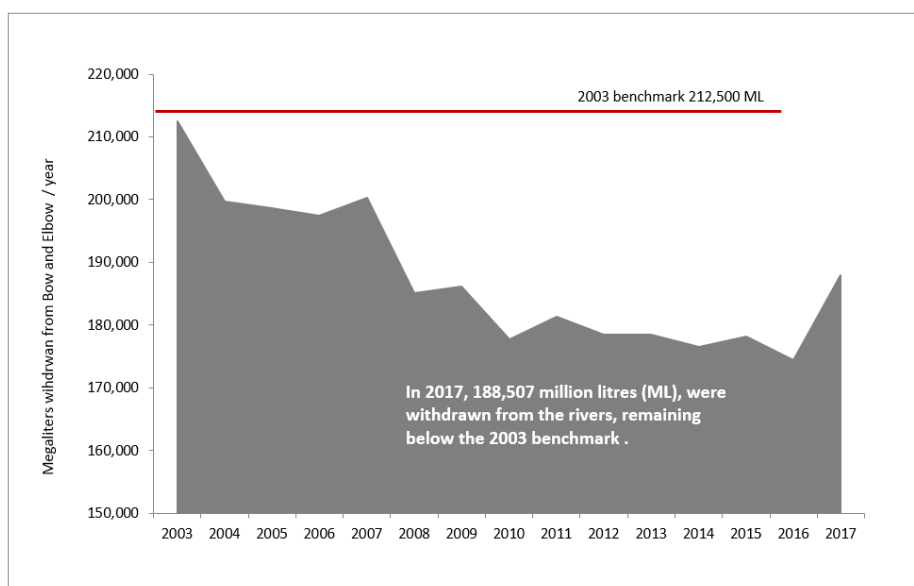


FIGURE 3.1 ANNUAL WATER WITHDRAWAL (ML/YEAR) FROM THE BOW AND ELBOW RIVERS

Reducing water demand can delay the need for infrastructure expansion projects and create operational savings. Lowering water demands in Calgary will also help protect drinking water supply for downstream users, minimize water pollution, maintain the health of local watersheds, and reduce greenhouse gas emissions. Supporting customers with water efficiency and education programs increases awareness and encourages behaviours and actions that benefit both citizens and the watershed.

3.3 CALGARY'S PER CAPITA WATER DEMAND

Single and multi-family residential customers make up the majority of Calgary's water demand, followed by ICI customers (Figure 3.2). Per capita water demand is the average volume of water used per person per day. In 2017, Calgary's overall water use (including residential, ICI and municipal demand in Calgary) was 378 litres per capita per day (lpcd), well on track to meet the 2033 target of 350 lpcd (Figure 3.3) and a 29 per cent decrease since 2003.

Of the overall water use in 2017, single-family residential demand was estimated to be 224 lpcd, slight increase from recent years. The increase was due in large part by the extended hot and dry conditions in the summer and fall of 2017. This suggests a shift to programming focused on outdoor water conservation and ICI processes has the potential to bring summer water consumption down across Calgary.

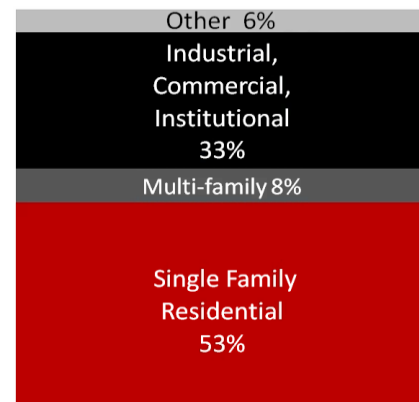


FIGURE 3.2 WATER DEMAND BY CUSTOMER TYPE

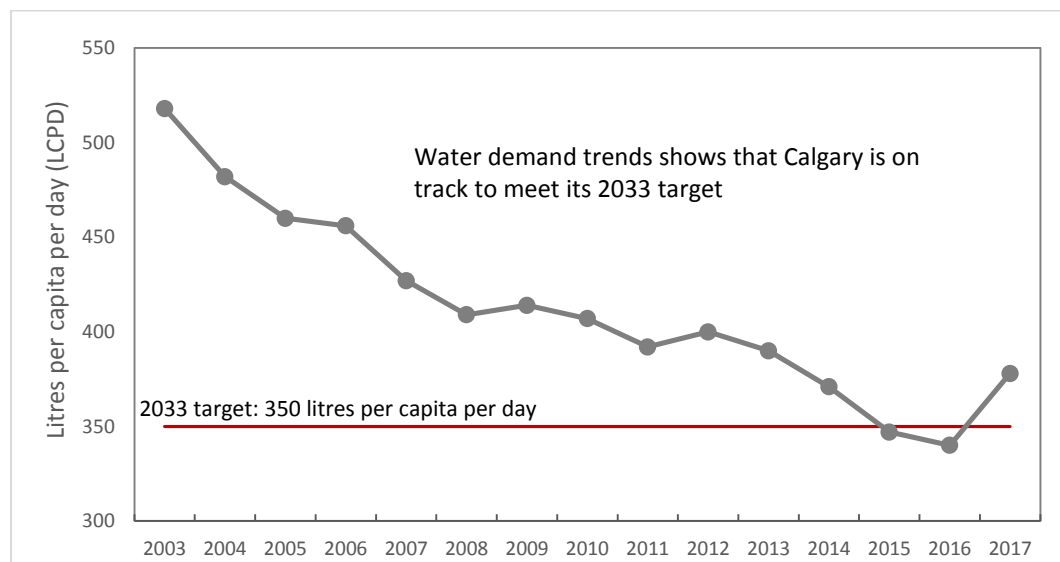


FIGURE 3.3 CALGARY'S TOTAL PER CAPITA WATER DEMAND TRENDS OVER TIME

3.3.1 CONSERVATION AND EDUCATION PROGRAMS

The City of Calgary has developed a number of programs since 2005 to encourage conservation and water savings for customers. Through customer actions, we have been successful at keeping water demand within our WEP goals. The program has also provided residential customers with savings through reduced water consumption. Collective actions by customers have resulted in considerable water savings in Calgary. In 2017, the YardSmart program reached over 5,000 Calgarians through rain barrel sales, Beauty on a Budget classes, Diggin' In workshops, and other public events. We also interacted with over 4,000 customers regarding water conservation and stormwater education at events such as Feeding 5,000, Earth Hour, and the Canada 150 Celebration. The



**YARDSMART DIGGIN' IN GARDENING
DEMONSTRATION**

City also gave tours to 1,127 people through school and public tours at the Glenmore Water Treatment and Pine Creek Wastewater Treatment Plants. Audiences were engaged in water conservation and watershed protection through programs and education efforts of The City's various watershed education partners such as River Watch, Yellow Fish Road, and Alberta Science Network.

3.4 PEAK DAY DEMAND

The one day in a year that Calgary requires the most water is referred to as the peak day demand. This typically occurs in the spring or summer, as water demand can spike from outdoor watering activities and cooling of buildings. Peak day demand is an indicator of the maximum amount of water being used by Calgarians. In 2017, Calgary's peak day water demand occurred on July 7, and was almost 762 ML, which is below the 950 ML water treatment plant capacity (Figure 3.4). This year's peak day was higher than in 2016 and can likely be attributed to the significantly drier and hotter than average summer conditions experienced in Calgary in 2017.

Although the peak demand remains under the current water treatment plant capacity, it is important to continuing monitoring, as it can be highly variable from year to year based on population, conservation practices, and potential climate change and weather impacts. The peak day demand is a primary driver for investment in water treatment plants, as both Bearspaw and Glenmore water treatment plants must produce sufficient water to meet demand on the peak day, especially with population growth. Reducing peak day demand through outdoor water efficiency programs, targeting the commercial and irrigation and landscaping sectors could help delay the need of water treatment plant investments.

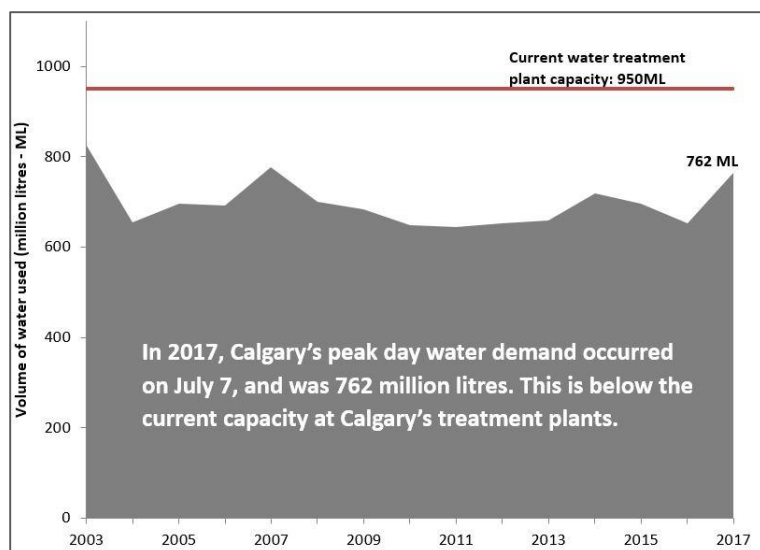


FIGURE 3.4 PEAK DAY DEMAND – MAXIMUM VOLUME OF WATER USED IN CALGARY IN ONE DAY

3.5 LEAK DETECTION

To reduce non-revenue water loss, as well as protect property, the environment, and drinking water quality, we conduct leak detection testing on City infrastructure. This is a critical part of our infrastructure maintenance program, as water from leaks in underground pipes with good soil drainage does not typically reach the surface and can go unnoticed for a long time. Leaks that are identified through the leak survey program are scheduled for repair. Leak detection and repair completion rates are monitored on a section-by-section basis. In 2017, City crews surveyed 241 kms of water mains and identified and fixed 14 leaks, leading to estimated water savings of 6.5 million litres per day, enough water to serve over 29,000 people per day.

3.6 PRIORITIES IN 2018

The City will continue working with customers to encourage responsible and efficient use of water. Activities planned for 2018 are summarized in Table 3.1.

Table 3.1 Goal #2: Use Water Wisely – 2018 focus

2018 Planned Actions
Continue to build our understanding of the ICI sector-Water profile, values, and preferences to inform water conservation programming.
Design and develop education, outreach and communications programming to reduce outdoor water use to address peak day demand.
Continue to provide education and outreach to citizens about the Water Utility, leaks and high-water consumption, outdoor water use, and the importance of conservation.
Continue aligning water efficiency, demand forecasting and infrastructure planning.

4. GOAL #3: KEEP OUR RIVERS HEALTHY

As the Elbow and Bow rivers flow through Calgary, they supply our city's drinking water, provide recreation, and support aquatic ecosystems. Calgary's stormwater and treated wastewater is released into these two rivers. Excess nutrients, sediment, bacteria and other pollutants that enter our rivers can negatively impact fish and wildlife, the ecosystem and drinking water. The City works diligently to manage these risks and protect the areas adjacent to rivers and creeks.

Protection of Calgary's waterways is guided in part by The City's Approval to Operate from the Province, which outlines sediment management and pollutant loading objectives for the Bow River. The City's Approval to Operate its wastewater system is up for renewal in 2018 and is informed by the Receiving Water Assessment and Total Loading Management Plan (TLMP). The TLMP ensures that pollutant loadings to the Bow River remain below certain levels by guiding future stormwater and wastewater source control practices and infrastructure decisions.

The City also has a Stormwater Management Strategy, approved by Council in 2005 that aims to reduce pollution from stormwater runoff entering the rivers. We are continuously working to improve the way stormwater is managed, through research and evolving strategies and programs. Managing water quality is a major component of our alignment to the South Saskatchewan Regional Plan. This section highlights the results of these efforts in 2017.

4.1 WASTEWATER MANAGEMENT

4.1.1 APPROVAL TO OPERATE

The City of Calgary operates its wastewater system, which includes three wastewater treatment plants and a wastewater collection system, under the Environmental Protection and Enhancement Act. The approval applies to the construction, operation and reclamation of our wastewater system. The current approval expires October 1, 2018 and on November 8, 2017, The City of Calgary submitted an application to renew the approval for another 10 years to Alberta Environment and Parks (AEP). Obtaining the approval from AEP ensures that The City continues to operate its wastewater system in accordance with environmental regulations.

4.1.2 WASTEWATER TREATMENT PLANTS

In 2017 the three wastewater treatment plants in Calgary (Bonnybrook, Pine Creek and Fish Creek) produced treated effluent compliant with the Municipal Approval to Operate and Federal temporary authorization limits (Fish Creek only) established to protect river water quality.



THE BONNYBROOK WASTEWATER TREATMENT PLANT IS UNDERGOING MAJOR UPGRADES

Major upgrades to the Bonnybrook Wastewater Treatment Plant continue to ensure regulatory requirements are met and to support population growth. In 2017, The Bonnybrook Expansion Project included the completion of phase 1 of the Plant D expansion that included upgrades and expansion of the sludge digesters. This resulted an increase in capacity, hydraulic mixing performance and processing of biogas production. Detailed design of the remainder of the project is scheduled to be complete early in 2018.

A \$162 million contract for Plant D Secondary Treatment work was awarded in November 2017. This will increase the installed treatment capacity by 20 per cent and meet the effluent quality parameters specified under the Provincial Approval to Operate. The project is scheduled to start in March 2018 with Plant D Secondary Treatment online by September 2021. The remaining budget requests will be included in the 2019-22 One Calgary submission. Construction of the flood protection berm also started in 2017. This berm will provide flood protection for the plant, minimizing disruption to operations if another 2013 flood were to occur.

4.1.3 RECEIVING WATERS ASSESSMENT

Alberta Environment and Parks has indicated they may reduce ammonia discharge limits from the Bonnybrook and Pine Creek wastewater treatment plants in the future. The City is addressing this possibility through a Receiving Waters Assessment to examine the impact of the effluent from our wastewater treatment plants on the Bow River. The assessment screened more than 121 substances to see which of them could have an impact on the aquatic habitat. Un-ionized ammonia was determined to have potential to exceed the Provincial and Federal water quality guidelines. Major exposure (chronic toxicity) of this substance can have lethal impact on fish.

There is also a high likelihood that Provincial un-ionized ammonia guidelines could be exceeded downstream of the Fish Creek wastewater treatment plant (WWTP), prior to the South Catchment Upgrade/Expansion. Environment Canada has given temporary authorization to allow un-ionized ammonia discharges. However, The City is proactively addressing this issue with AEP because of anticipated regulation of discharges from Fish Creek WWTP.

4.1.4 BIOSOLIDS MANAGEMENT

One of the largest projects completed this year at Bonnybrook was the construction and commissioning of the biosolids dewatering facility that will provide biosolids to The City's new composting facility. Biosolids, a nutrient-rich organic material produced by wastewater treatment are a valuable resource that The City has been using for decades. Our current Biosolids program includes Calgro™ program, demonstration projects, and the organics composting facility. The Calgro™ program has provided biosolids to local farmers as fertilizer since 1983. The treated biosolids are safely applied under the soil to agricultural lands following Provincial guidelines, and used to grow grains, oilseed, legumes, forage crops, trees and sod.

The Biosolids Demonstration Project initiated in 2013 in partnership with SYLVIS is providing nutrients for one of the largest willow plantations in North America. The Calgary Zoo is currently obtaining all of their veterinary-



CALGARY ZOO GIRAFFES BEING FED CITY OF CALGARY WILLOW PLANTATION BRANCH

recommended browse and forage willow requirements from this plantation. The woody material from the willow harvest may also be used in the future as a feedstock for a number of other initiatives, including The City's new composting facility.

The City of Calgary's composting facility is the largest of its kind in Canada, producing compost from food and yard waste collected from the Green Cart and biosolids produced at Bonnybrook wastewater treatment plant. The facility will produce a compost that is safe to use in commercial and residential applications and will add valuable nutrients to the soil. Biosolids and green cart waste are kept separate and composted separately in the facility.

4.1.5 INDUSTRIAL, COMMERCIAL AND INSTITUTIONAL (ICI) CUSTOMERS

Some industrial, commercial, and institutional establishments produce wastewater that may have a higher concentration and contain different contaminants that cause it to exceed wastewater quality guidelines – this is called high-strength wastewater. In 2016, The City initiated the Wastewater Loading Management Program to improve management of high-strength wastewater from ICI customers, as this wastewater is technically challenging and expensive to manage and treat. The program is an opportunity to identify and implement cost-effective, resource efficient, reliable, and equitable strategies that meet customers' needs for wastewater load management while at the same time contributing to optimal use of existing wastewater treatment plant capacity.



PINE CREEK WASTEWATER TREATMENT PLANT

The City continued to advance the program in 2017 by completing a current state assessment increasing The City's understanding of customer needs, wastewater system operating sensitivities and operational efficiencies. This work has set the foundation from which to build enhancements and make business process improvements. Work on the Program will continue in 2018 to identify and assess wastewater load management options.

4.2 TOTAL LOADING MANAGEMENT



THE CITY WORKS TO REDUCE POLLUTANTS FROM STORMWATER AND WASTEWATER

Pollutant loadings into the waterways can affect water quality and river health, and can create maintenance issues for Calgary's wastewater and stormwater infrastructure. The City's Total Loading Management Plan ensures that pollutant loadings to the Bow River remain below certain levels. The plan includes provincially set pollutant loading objectives for both wastewater treatment plants and stormwater. This helps minimize the impact of wastewater discharges and stormwater runoff on the Bow River's water quality and contributes to maintaining a healthy aquatic ecosystem. Total loadings are also related to river flows so will vary somewhat depending on seasonal fluctuations.

4.2.1 TOTAL SUSPENDED SOLIDS IN THE BOW RIVER

Total suspended solids include organic and inorganic materials that are suspended in stormwater and treated wastewater. These materials enter our waterways and can impact water quality and aquatic habitat. Figure 4.1 shows that The City has remained under the Provincial guideline for total suspended solids (TSS) loadings into the river from stormwater and wastewater sources. Urban runoff from stormwater contributes a significantly higher proportion of total suspended solids to the Bow River compared to wastewater effluent.

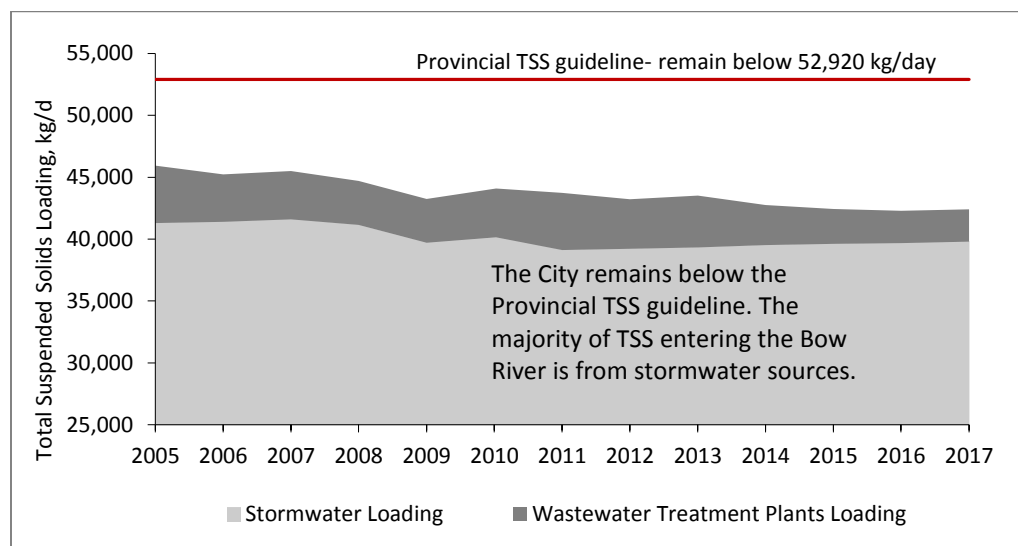


FIGURE 4.1 TOTAL SUSPENDED SOLIDS (TSS) LOADING TO THE BOW RIVER FROM STORMWATER AND WASTEWATER

4.2.2 PHOSPHORUS IN THE BOW RIVER

Phosphorus is a nutrient that can have detrimental impacts to fish and other aquatic life when present in high concentrations. Too much phosphorus can cause accelerated plant growth, algae blooms and low dissolved oxygen. The City's Total Loading Management Plan has set a total loading objective for Total Phosphorus. At 210 kg/day, the primary source of Total Phosphorus entering the Bow River in Calgary is from treated wastewater effluent, with the remaining 86 kg/d contributed from stormwater (Figure 4.4).

Figure 4.2 shows reported Total Phosphorus loadings from both stormwater and wastewater to be below the Provincial guidelines in 2017. Treated wastewater contributes more than double the amount of Total Phosphorus to the Bow River compared with stormwater sources.

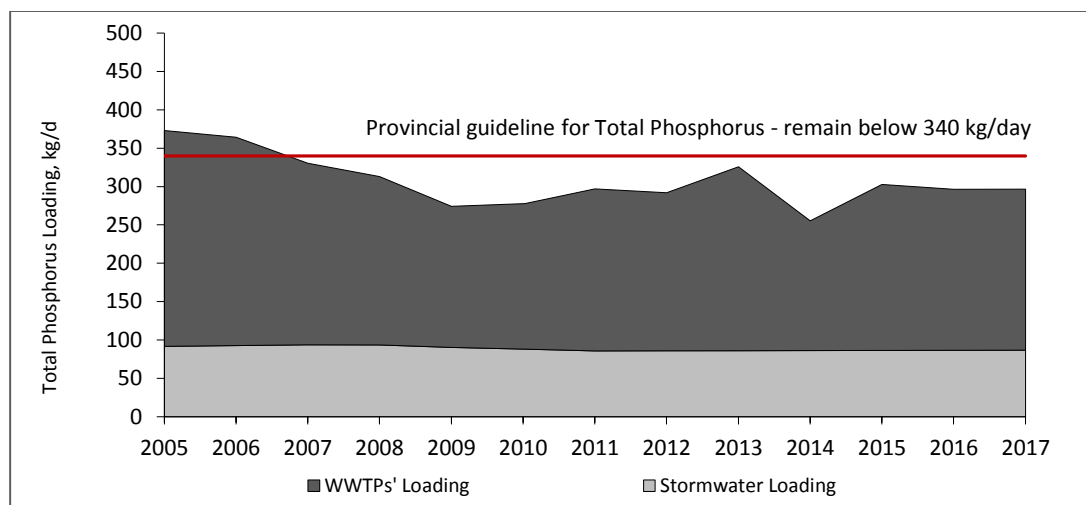


FIGURE 4.2 TOTAL PHOSOPHORUS LOADINGS TO THE BOW RIVER FROM WASTEWATER AND STORMWATER

4.2.3 TOTAL LOADING MANAGEMENT PLAN UPDATE

Every five years as part of the Total Loading Management Plan (TLMP) update, The City evaluates stormwater and wastewater pollutant loadings and screens for parameters that can impact the aquatic ecosystem. In the 2017 TLMP update, total suspended solids (TSS) and total phosphorus (TP) continue to be the key parameters identified that require management to mitigate environmental impact to Calgary's watershed.

The City uses computer models to simulate total pollutant loadings to the Bow River. In 2017, further refinements to the Bow River Water Quality Model incorporated changes in wastewater treatment, and stormwater infrastructure, and integrated more robust stormwater management information. The model will be used to assess the impact of future wastewater treatment plant effluent and stormwater infrastructure on the Bow River. It will also provide guidance for a renewed Stormwater Management Strategy scheduled to be complete in 2022.

As part of the TLMP update, The City conducted a Total Loading Objectives Assessment to re-assess loading objectives. Recommendations from the assessment are part of the application package for the renewal of The City's Wastewater Approval in 2018.

4.3 STORMWATER MANAGEMENT

The City's 2005 Stormwater Management Strategy's goal is to maintain TSS loadings from stormwater in the Bow River at or below 2005 levels, even with a growing city. In 2017, estimated TSS loadings from stormwater to the Bow River were 39,799 kg/day, which is below the 2005 benchmark (Figure 4.3). Stormwater retention ponds, wetlands, and green stormwater infrastructure projects are effective in reducing TSS loadings to the rivers.

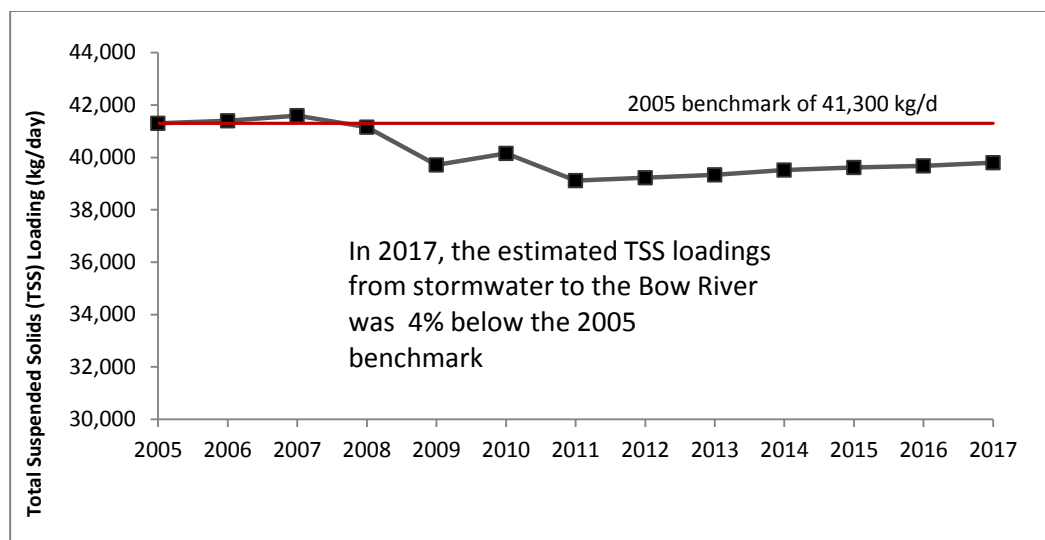


FIGURE 4.3 TOTAL SUSPENDED SOLIDS (TSS) TO THE BOW RIVER FROM STORMWATER

4.3.1 STORMWATER MANAGEMENT STRATEGY UPDATE

As Calgary and the region grow, stormwater management presents several unique challenges because it typically has no discrete point of origin, leading to management limitations and is tied to land use practices, planning and development. Both wastewater and stormwater are sources of water pollution in our watershed, however wastewater is manageable with infrastructure upgrades, leaving stormwater as the greater challenge as Calgary continues to urbanize and the climate changes.

Various stormwater and land management practices have helped manage impacts of a growing city (e.g. innovative technologies to manage stormwater drainage, introduction of green and natural infrastructure and erosion and sediment control measures). The City's stormwater management system has benefitted from investments put in place over the last decade or so, including innovative stormwater quality retrofits, the Community Drainage Improvement Program, and green stormwater infrastructure.

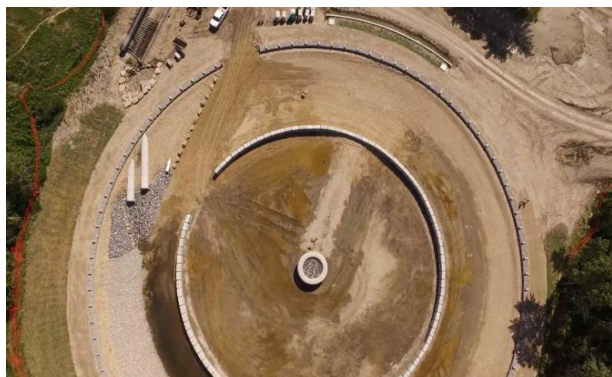
As practices and standards have evolved and new issues such as climate impacts have emerged, an improved understanding of stormwater impacts warrants a fresh look at stormwater management. A revamping of the 2005 Stormwater Management Strategy is required to ensure progress on sustainably managed stormwater.

In 2017, The City completed a framework to facilitate the update of the Stormwater Management Strategy. Over the next three years, The City will conduct extensive stakeholder engagement with customers, internal and external stakeholders and the development industry to advance the strategy. New stormwater quality targets are also being examined to provide key input on the new Strategy.

4.3.2 STORMWATER QUALITY RETROFIT INVESTMENTS

The City constructs stormwater quality retrofit projects such as wet ponds or constructed wetlands across the city. These projects improve the quality of water by removing solids and other pollutants before it enters our rivers.

The construction of the Bowmont East Stormwater Quality Retrofit pond in Dale Hodges Park was completed in 2017 and it will be operational in 2018. The project is anticipated to reduce the amount of sediment that enters the Bow River from the 1687 ha catchment by approximately 50 per cent, and will restore the natural park area located within the disturbed Klippert lands. This project includes the use of a circular Nautilus Pond™, which is a form of advanced stormwater treatment technology. The



BOWMONT PARK - STORMWATER WILL ENTER THE PARK THROUGH THIS CIRCULAR NAUTILUS POND™, WHERE MOST SEDIMENT PARTICLES ARE REMOVED.

The 37th Street Stormwater Quality Project includes construction of an oil-grit separator, to be completed in 2018. The project will provide stormwater treatment for a currently untreated developed catchment area, which discharges via the 37th Street Storm Trunk. This project will improve water quality in this sensitive area, which includes the Weaselhead Flats natural environment park and the Glenmore Reservoir, which provides Calgary's drinking water.

innovation represented in this project is the result of a partnership with the Public Art Program.

The Riverbend Trunk pond is being constructed to accommodate increased road runoff, facilitate future development, manage flows and provide stormwater treatment for industrial areas, which to date have not received treatment. Design of this facility is expected to be complete by February 2018, with construction completion scheduled for 2019.



STORMWATER IS FURTHER TREATED IN NATURAL-LOOKING WETLANDS AT BOWMONT PARK

4.3.3 STORMWATER PONDS

There are over 300 wet and dry storage ponds in Calgary's stormwater drainage system. These ponds reduce the amount of sediment and other pollutants entering our rivers. They also provide some flood mitigation by holding stormwater and releasing it slowly back into the stormwater system, reducing peak flows. The City's Pond Condition Assessment Program continued in 2017, with approximately 26 per cent of wet ponds and wetlands analyzed since the inception of the program in 2015.

The program identified the need for regular maintenance to ensure that the ponds are operating effectively. The program also identified five wet ponds that require structural modifications to function properly, meet regulatory requirements, and ensure safety standards are met.



SAFETY SIGNAGE AT A STORM POND

In 2017, effort was undertaken on two wet ponds and catchment areas (Hidden Valley and Confederation Park) to define options for modifications and improvements. This work is continuing in 2018 with work on the additional three ponds expected to start in 2018 and phased over the next business cycle. These projects include design, construction, maintenance and addressing operational challenges such as algae growth.

Research into options to control algae in Calgary's wet ponds will continue in 2018. Information collected through several seasons will capture both cool and hot temperatures, ensuring that cost-effective solutions are implemented and have been properly tested for future use.

4.3.4 GREEN STORMWATER INFRASTRUCTURE



THIS RAIN GARDEN IS AN EXAMPLE OF GREEN STORMWATER INFRASTRUCTURE

Green stormwater infrastructure (GSI), also known as low impact development, uses natural processes to treat stormwater and allows water to be absorbed and filtered by soil and vegetation. GSI is a key opportunity to improve Calgary's adaptation to climate change and to foster resiliency. The City is completing an internal GSI Strategy, which outlines the challenges and opportunities of using GSI as a viable stormwater management tool. A work plan developed in 2017 will support the implementation of GSI over the next two budget cycles. The strategy and work plan will be completed in 2018 at which time The City will determine how to advance this work.

4.3.5 EROSION AND SEDIMENT CONTROL

Construction activity in Calgary exposes highly erosive subsoil, which is easily transported off-site by wind and water. In 2017, to protect the watershed and storm infrastructure from the impacts of construction site sediment, City staff conducted 415 site inspections and reviewed 521 erosion and sediment control plan applications. When implemented, the erosion and sediment control plans approved during the year are expected to reduce soil loss from construction sites by 27,922 tonnes. This results in less sediment entering our waterways.

4.4 RIPARIAN ACTION PROGRAM

Riparian areas are located along the edges of rivers and creeks within our watershed. They are unique ecosystems largely defined by the complex interactions that happen when land meets water. Networks of healthy, well-connected riparian areas provide many ecological, social and economic benefits including water quality protection, resilience to flood and drought, biodiversity, and recreational opportunities.



VOLUNTEERS CONTRIBUTING TO A RIPARIAN PLANTING PROJECT ALONG THE BOW RIVER

The City's Riparian Action Program provides direction and management actions to maintain and improve riparian health, and minimize further loss of riparian areas. The program also provides guidance on outreach and education actions by offering various opportunities to connect Calgarians with the rivers.

The City continued to advance this program in 2017 by completing the mapping of ephemeral and intermittent streams throughout Calgary. These streams appear either after a heavy rainfall or snow melt event, or only exist during part of the year. Mapping them helps us understand how they function, so we can plan to protect these types of streams.

Bioengineering incorporates plant materials with synthetic support materials to stabilize river banks, reduce erosion and establish vegetation. Seventeen bioengineering and riparian planting projects were either designed, undergoing construction or completed in 2017. Citizens and education partners contributed to a riparian planting project along the Elbow River, and stakeholders have learned about the Riparian Action Program through presentations and workshops. Opportunities to help connect citizens with our rivers and riparian areas will continue in 2018, including identifying partnerships with key education and stewardship organizations.

4.4.1 MONITORING RIPARIAN HEALTH

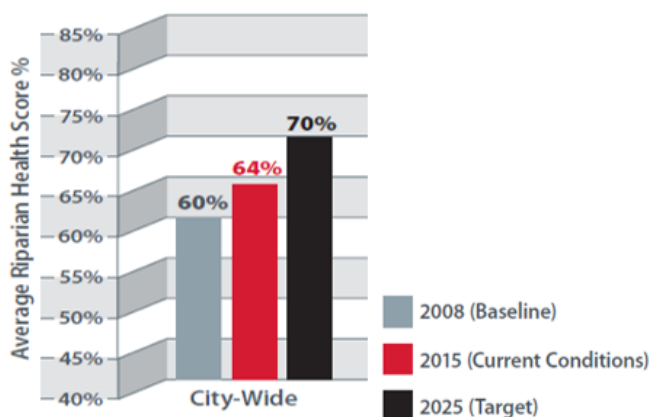


FIGURE 4.4 CITY WIDE RIPARIAN HEALTH SCORES

The Riparian Monitoring program is underway to measure riparian health trends and the success of riparian restoration projects. The City will monitor over 50 bioengineering bank restoration sites and 15 riparian planting restoration sites for the next 5 years to gather an understanding of restoration performance and plant health. Since 2013, the number of restoration sites using bioengineering techniques has exceeded the number of hard engineering projects.

Monitoring to date indicates that Calgary's city-wide riparian health is improving (Figure

4.4). Baseline surveys of riparian health were conducted across 57 sites in Calgary. Healthy riparian areas generally have diverse plant cover, deeply rooted and stable banks, minimal disruption from humans, wildlife or livestock, and experience minimal artificial flows.

Assessments showed that overall riparian health scores in Calgary have improved, with 25 per cent of sites showing an improving health trend and very few sites showing a declining health trend. Overall, the City-wide average riparian health score at monitored sites increased by four per cent.

Key factors contributing to this trend include restoration and management improvements, and natural vegetation recovery. We are making progress towards our 2025 target for average city-wide riparian health of 70 per cent. The Riparian Monitoring Program will continue to measure progress towards our riparian health targets, as well as provide recommendations on the effectiveness of various

bioengineering techniques, which combine living and non-living plant materials to help stabilize river and stream banks.

4.4.2 RIPARIAN LAND USE PLANNING

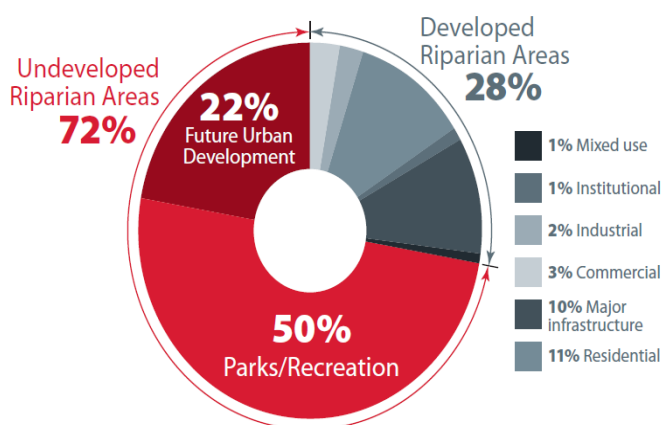


FIGURE 4.5 MAJOR LAND USE IN RIPARIAN AREAS (2012)

Less than one third (28 per cent) of riparian areas are developed in Calgary along major rivers and streams (Figure 4.5). The remaining portion is undeveloped, with 50 per cent conserved as parks and recreation areas, and 22 per cent awaiting future urban development.

Retaining open spaces along major rivers and creeks and critical ephemeral and intermittent streams is important to reduce further loss of riparian areas (Table 4.1).

Mapping projects like the Ephemeral and Intermittent Stream Mapping have helped identify riparian areas in future urban development areas, and will inform how to protect and manage development around these areas using appropriate planning tools.

Table 4.1 Riparian land-use indicators and targets

Outcome	Indicator	Area	Baseline	2026 Target
Further loss of riparian areas is minimized	Riparian open spaces along major perennial creeks and rivers	City wide	73%	No net loss
		Bow River	75%	
		Elbow River	62%	
		Nose Creek + West Nose Creek	67%	
	Riparian open spaces along ephemeral and intermittent watercourses	City Wide	36%	Tools are being evaluated to minimize the loss of ephemeral and intermittent streams during planning and development

DESIGN OF BIOENGINEERING DEMONSTRATION PROJECT IN INGLEWOOD

4.5 NOSE CREEK WATERSHED WATER MANAGEMENT UPDATE

4.6 WETLANDS MANAGEMENT IN AN URBAN CONTEXT

In 2004, City Council approved the Wetland Conservation Plan, making Calgary one of the first municipalities in Canada to adopt a wetland protection policy that protects urban wetlands. The City has put concerted efforts towards managing wetlands in an urban setting, especially when there is proposed development. This past year, the focus has been to collaborate with Alberta Environment and Parks (AEP) on their updated Wetland Policy, with a focus on getting clarity on requirements for preserving wetlands in an urban context. AEP values retention of urban wetlands as long as an adequate level of functionality is retained. The City has been working with AEP to define the level of

functionality, the risks (regulatory, operational and environmental) associated with the Provincial policy and how it will translate into an approval process for both the Province and The City.

4.7 WATER REUSE

In 2017, The City initiated the rainwater and stormwater reuse program to have another mechanism available for watershed management. The scope of the initiative is to enable rainwater and stormwater reuse for internal plumbing and irrigation. This will ensure that proposed reuse systems are effective at managing risks associated with public health, environmental protection, and prevent cross contamination into The City's water infrastructure. The program will also ensure that The City is compliant with provincial regulations for approving water reuse systems. The City is working closely with the Province on this as they develop the future Provincial policy on water reuse.

To support this policy development, AEP initiated a pilot to use stormwater to maintain four natural wetlands within an urban development in northeast Calgary. The City is a part of the working group for this pilot and the work will be integral in expanding acceptable reuse applications for stormwater as well as paving the way to a practical approach to maintain wetlands in an urban context.

4.8 WATERSHED HEALTH INDICATORS

There are several watershed health metrics that can be used to strengthen urban development practices and understand the health of our watersheds. The City is reviewing and expanding the metrics used to evaluate watershed health in an urban context. A suite of indicators was identified and refined in 2017 by an interdisciplinary working group as the initial phase to develop a watershed health index for Calgary. Using this suite of indicators, a comprehensive watershed health index will be developed to be included in future Municipal Development Plan (MDP) reporting.

The metrics developed relate to water quality, habitat, landscape, hydrology and morphology. They were selected using criteria established by the working group and an assessment of best practices, with the intention that monitoring these indicators will inform appropriate watershed management and land use planning actions.



**WATERSHED HEALTH IS IMPACTED
BY URBAN DEVELOPMENT**

These metrics align with The City's strategies and plans, as well as regional watershed health assessments and indices. While a comprehensive index is being developed, this current information will be used to contextualize the final Municipal Development Plan Monitoring and Reporting process in Q2 2018. Impervious surfaces will be reported and new indicators on riparian health will be included as supplementary indicators. This is the last report before the MDP is reviewed.

The next phase of the watershed health index project will include a gap analysis and refinements of metrics to develop the index and examine watershed health issues within Calgary's sub-watersheds.

4.9 PRIORITIES FOR 2018

To continue reducing the impacts on the watershed and keeping our rivers healthy, The City's focus areas for 2018 are summarized in Table 4.2.

Table 4.2 Goal #3: Keep Our Rivers Healthy – 2018 focus

2018 Planned Actions
Negotiate with Alberta Environment and Parks The City's Approval to Operate 2018-2028.
Continue implementation of Bonnybrook Wastewater Treatment plant upgrades.
Advance the Wastewater Loading Management Program by identifying and assessing wastewater load management options.
Total Loading Management Plan: Negotiate new loading objectives with AEP. Assess new water quality model to better understand The City's loading impact on the watershed.
Continue work on The City's Stormwater Management Strategy and developing targets in alignment with customer commitments and engaging with key internal and external stakeholders.
Continue to invest in Stormwater Quality Retrofit projects
The Pond Condition Assessment Program will continue including pond redesigns, retrofits, and study of broader catchment areas to mitigate pond issues.
Complete the Green Stormwater Infrastructure Strategy and Work Plan. Evaluate resources for implementation over the next two business cycles.
Continue implementation of: riparian monitoring program, riparian restoration, bioengineering and fish habitat compensation projects, outreach initiatives, and integration of riparian maps in land use planning processes.
Complete the update of the Nose Creek Watershed Water Management Plan and report to Council.
Plan the next phase of developing a watershed health indicator and reporting on watershed health – initiate comprehensive gap analysis and refinements of metrics to examine watershed health issues within Calgary's sub-watersheds.

5. GOAL #4: BUILD RESILIENCY TO FLOODING



5.1 RIVER FLOOD MITIGATION AND RESILIENCY PROGRAM

The City continued to focus significant effort and investments in flood resilience and protection in 2017. As part of this work, The City delivered the results of a comprehensive Flood Mitigation Measures Assessment (FMMA, UCS2017-0266) in 2017. The FMMA results now serve as the framework for The City's long-term Flood Mitigation and Resilience Strategy. City Council endorsed the strategy on 2017 April 10, and identified flood mitigation as a top strategic priority for The City of Calgary.



FLOOD MITIGATION IS A TOP PRIORITY FOR CITY COUNCIL

The City continued to implement the recommendations made by an independent Flood Expert Management Panel as directed by Council in 2014. Significant progress has been made on these recommendations and as of 2017, 12 recommendations are underway and 15 are completed.

The City has received \$40.3 million for various flood mitigation and resilience projects through the Alberta Community Resiliency Program to date. In 2017, The City applied for \$81 million for six more community based flood mitigation projects (PFC2017-0462). Mitigation work that is already complete or is ongoing has reduced Calgary's financial exposure to flood damage by about 30 per cent. Updates on progress on The City's Flood Mitigation and Resilience Strategy is discussed in detail in a separate report (UCS2018-0092).

5.2 LOCALIZED FLOODING AND THE COMMUNITY DRAINAGE IMPROVEMENT PROGRAM

Intense rainfall events can trigger localized stormwater flooding and cause property damage. As we anticipate increased extremes in seasonal changes and high intensity rain events, The City understands that these climate change impacts are important to consider when planning future infrastructure investments and how we manage Calgary's stormwater drainage system.

The City organizes response strategies to mitigate these extreme events and safeguard public safety and property. Innovative operational and infrastructure measures to mitigate the impacts of localized flooding have been deployed, such as improved response times, and The City has made efforts to improve public awareness about these events.

Long-term resilience to local flooding is delivered through the Community Drainage Improvement (CDI) Program. The program invests in drainage infrastructure upgrades to mitigate localized flood risk, with a focus on established communities with the highest risk of stormwater flooding. The CDI Program delivered an estimated \$9.5M of planning, design and construction activities in 2017. A summary of current CDI investments and 2017 activities is found in a separate report (UCS2018-0092).

5.3 PRIORITIES FOR 2018

In 2018, The City will continue to build resiliency to river flooding and implement actions to reduce stormwater flooding, as summarized in Table 5.1.

Table 5.1 Goal #4: Build Resiliency to Flooding – 2018 focus

2018 Planned Actions
Continue to build resiliency to flooding - deliver implementation of key flood mitigation investments, advocate for upstream mitigation, pursue flood policy review, and advance Expert Panel recommendations.
Make progress on The City's drainage program - advance the Community Drainage Improvement program of stormwater infrastructure upgrades in communities experiencing local flooding. Continue evaluating options to accelerate delivery of the CDI Program.

**Utilities & Environmental Protection Report to
SPC on Utilities and Corporate Services
2018 February 14**

**ISC: UNRESTRICTED
UCS2018-0092
Page 1 of 6**

2017 Flood Resiliency and Mitigation Annual Update

EXECUTIVE SUMMARY

The City is dedicated to implementing the Government of Alberta's Water for Life Strategy, through its water management framework that ensures reliable, resilient water servicing for Calgary and regional customers. Working with the Province and regional partners, The City aims to protect the water supply, use water wisely, keep rivers healthy, and build resiliency to flooding.

This report provides a summary of the activities undertaken by The City of Calgary's Flood Mitigation program in 2017 to address the goal of building flood resiliency in Calgary. As of 2017 December, all the Expert Management Panel on Flood Mitigation recommendations (PFC2014-0512) are either complete or substantially underway.

Updates on the City Council-approved Flood Mitigation Measures Implementation Plan (PFC2017-0162), as well as the current status of Provincial upstream mitigation work, are included. The report also provides updates on the Community Drainage Improvement (CDI) program aimed at mitigating the impacts of local stormwater flooding in communities. A more comprehensive report is provided as Attachment 1.

ADMINISTRATION RECOMMENDATION:

That the Standing Policy Committee on Utilities and Corporate Services recommends that Council receive this report for information.

PREVIOUS COUNCIL DIRECTION / POLICY

On 2014 June 26, Council approved the River Flood Mitigation Panel Final report (PFC2014-0512), which included direction to provide an annual update to City Council on progress related to the recommendations from the Expert Management Panel on River Flood Mitigation.

On 2016 May 25, the Drainage Financial Plan Progress Report (UCS2016-0414) included an update on the Community Drainage Improvement (CDI) program. This report included a commitment to the ongoing evaluation of opportunities to accelerate CDI projects and was received for information.

On 2015 May 27, The SPC on Utilities and Corporate Services received the Flood Resiliency and Mitigation 2014 Annual Report (UCS2015-0082) for information. A subsequent annual update for 2015 was received for information on 2016 April 27 (UCS2016-0168) and 2017 April 10, (UCS2017-0266). The 2016 update also outlined The City's strategic approach to watershed and community level flood mitigation measures for Calgary. The subsequent implementation plan was approved by Council on 2017 June 26 (PFC2017-0462).

BACKGROUND

In 2014 June, the Expert Management Panel on River Flood Mitigation delivered 27 recommendations to Council aimed at achieving a safer, more flood resilient Calgary. To date all recommendations are substantially underway, with 15 of the 27 recommendations complete. Appendix A of Attachment 1 summarizes progress on the recommendations.

2017 Flood Resiliency and Mitigation Annual Update

In 2016, The City completed a comprehensive Flood Mitigation Measures Assessment (FMMA), which examined river flood mitigation measures for both the Bow and Elbow rivers to reduce Calgary's flood risk. The FMMA recommended that upstream structural mitigation, combined with community and property-level mitigation measures as the most cost-beneficial approach to increase Calgary's flood resilience. Non-structural measures such as revised development policies and building regulations were also identified as helping provide further reduced flood risk in light of ongoing climate uncertainty.

On 2017 June 26, Council approved the Flood Mitigation Measures Implementation Plan (PFC2017-0162), which included funding approvals to begin work on community barriers at four locations. These projects are pending service level negotiations and funding assistance from the Province and are located:

- Downtown from Jaipur bridge to Reconciliation bridge;
- In Sunnyside-Hillhurst, from the Peace bridge to the existing community flood barrier;
- In Bowness, along Bow Crescent; and
- From the existing Inglewood flood wall to the south-eastern portion of Pearce Estate Park.

In 2015 October, the Province committed to moving forward the Springbank Off-stream Reservoir (SR1) for flood mitigation on the Elbow River. The Province also entered a five-year agreement with TransAlta to manage reservoirs on the Bow River between May and July each year to mitigate seasonal river flooding. The Province also committed \$150 million to The City through the Alberta Community Resilience Program (ACRP) over ten years to deliver community-level flood mitigation. As of 2017, \$40.3 million has been provided by ACRP to The City for ten flood mitigation projects. Once complete, these projects will reduce Calgary's flood risk by as much as 30 per cent.

As part of its commitments, the Province also initiated the Bow River Working Group (BRWG) and Advisory Committee with The City of Calgary and other stakeholders in 2015 October to improve flood and water supply resiliency in the region. A number of 'quick wins' were identified to improve flood and water supply resiliency in the region if implemented. Additionally, a proposed flood-focussed reservoir upstream of Calgary would have short-term water supply benefits for Calgary, with three locations identified for further study. However, the majority of reservoir scenarios to address drought were focussed on southern Alberta agricultural irrigation downstream of Calgary.

INVESTIGATION: ALTERNATIVES AND ANALYSIS

RIVER FLOODING

Watershed mitigation – Elbow River

Once completed, the Springbank Off-Stream Reservoir (SR1) operated in tandem with the Glenmore gates, will provide flood mitigation on the Elbow River for a flood event similar to 2013. The City has also identified two gravel bars in the community of Mission to be reshaped to support SR1 and the Glenmore gates and to continue to provide the expected level of mitigation. Construction on the gravel bars is expected to occur throughout 2018. Glenmore gates is expected to be operational by 2020.

2017 Flood Resiliency and Mitigation Annual Update

On 2016 June 23, the Canadian Environmental Assessment Agency (CEAA) announced that a federal environmental assessment for SR1 would be undertaken. Alberta Transportation submitted the environmental assessment report to CEAA on 2017 October 17, which CEAA subsequently referred back to Alberta Transportation for additional information on 2017 November 20. Work is underway by Alberta Transportation to provide the additional information requested. As part of the assessment, CEAA invited stakeholders including The City of Calgary to participate in a technical working group for the SR1 project. The City will continue to provide technical support for SR1 until the environmental review process is complete.

Watershed mitigation – Bow River

The City of Calgary co-chaired the Bow River Advisory Committee and participated on the BRWG with Alberta Environment and Parks, which has been evaluating water management options on the Bow River since 2015. In 2017 August, the BRWG released the *Bow River Water Management Project Final Report*, which outlined short, medium, and long term operational and infrastructure improvements to improve flood mitigation and water supply on the Bow River.

The report recommended that a single new reservoir upstream of Calgary, combined with additional operational efficiencies and modifications at existing reservoirs would provide significant flood mitigation for Calgary. The efficiencies and modifications includes negotiating a long-term watershed agreement with TransAlta and extending the Ghost Reservoir flood operations agreement and drawdown rate.

These operational modifications and upstream mitigation, once complete, will work in combination with the community barriers being constructed by The City to provide mitigation up to a flood event similar to 2013. As of 2018 January, the Province has begun follow-up work on the BRWG's short-term, "quick-win" mitigation recommendations. For recommendations related to large infrastructure recommendations, next steps have not yet been communicated by the Province. Work on a long-term solution requires Provincial commitment, and actions to move forward must be addressed collaboratively with stakeholders.

The City continues to stress to the Province that flood mitigation is one of its top strategic priorities. An upstream reservoir on the Bow River is a holistic water management solution for the watershed and is critical to Calgary's flood resilience, while also providing short-term water supply benefits.

Community mitigation

Applications to the ACRP program for the four community barriers identified above and two additional projects, the Upper Plateau Separation and the 9th Avenue SE Bridge Replacement, were submitted to the Province on 2017 September 29. Design for the Upper Plateau Separation and the 9th Avenue SE Bridge Replacement began in 2017.

Pending service level negotiations with the Province and confirmation of ACRP funding, The City will advance detailed design work on the four community barriers identified in the FMMA. Also beginning in 2018, The City of Calgary will reach out to affected communities to provide information on the FMMA and seek input on these projects before designs are finalized.

2017 Flood Resiliency and Mitigation Annual Update

Property mitigation, flood policy and mapping

An internal City-wide working group led by Calgary Growth Strategies was established in 2017 to evaluate changes made to the Municipal Development Plan (MDP) and Land Use Bylaw (LUB) after the 2013 floods. In 2018, the group will continue to review the effectiveness of existing measures, and will also explore potential changes to the MDP and LUB to further improve Calgary's flood resiliency.

The City anticipates that new Flood Hazard Area (FHA) maps will be released by the Province in 2018. The new maps will likely have implications on any potential policy changes made by The City, including future redevelopment in the floodway. However, implications are uncertain at this time.

STORMWATER FLOODING

Localized flooding occurs when stormwater drainage infrastructure cannot manage the volume of stormwater either from precipitation, snow or ice melt. Communities built prior to 1990 are at the greatest risk due to aging infrastructure and historic design standards. The CDI program was established to address this risk. It uses a triple bottom line cost-benefit approach to prioritize investments in communities to address infrastructure issues that cause stormwater flooding for these communities. In 2017, local improvement investments were made in the communities of Sunnyside-Hillhurst, Christie Park, Glendale, and Glenbrook, and Optimist Park. Design was also commenced on several projects in Woodlands-Woodbine, Cedarbrae, and Braeside. Delivery of the CDI projects and expected benefits for communities remains on track.

Two CDI projects, Sunnyside pump stations #1 and #2 are also currently supported by the ACRP program. These projects will help mitigate local stormwater and river flood risk for the community by pumping excess stormwater back into the river. Design was started for both projects in 2017 and interim upgrades at Sunnyside pump station #2 have been completed. A third project, the Upper Plateau Separation, was submitted to ACRP for funding consideration in 2017 and is expected to begin in 2018.

New drainage studies for the communities of Renfrew and Macleod Trail were also started in 2017. The studies are expected to finish in 2018 and will inform future CDI program investments. A prioritized list of current and future identified CDI projects is in Appendix C of Attachment 1.

Stakeholder Engagement, Research and Communication

Building flood resiliency is a shared responsibility of all orders of government as well as Calgarians. The City has developed strong relationships with the Province, TransAlta, businesses, and community leaders, as it works to build Calgary's flood resilience. Administration continues to support the BRWG and implementation of the *Bow River Water Management Final Report* recommendations. The City is also participating in CEAA's environmental assessment review of the SR1 project.

The City undertook public engagement throughout 2016 to gather input on the potential flood mitigation measures and to inform Administration's recommendations. Engagement included a Community Advisory Group, a phone survey, community workshops, open houses and online

2017 Flood Resiliency and Mitigation Annual Update

engagement. The City will also be reaching out to communities and citizens in 2018 as design work begins on the four community barriers identified in the FMMA.

Strategic Alignment

Moving forward on flood mitigation and resiliency strongly supports and contributes to a number of Strategic Action areas in Council's Priorities for 2015-2018:

- A city of inspiring neighbourhoods (N2 - Build resiliency to flooding, and N3 - Enhance The City's capacity and resiliency to prepare for and respond to pandemics, natural disasters and emergency situations).
- A healthy and green city (H3 - Manage the interrelationships between flood protection, water quality and quantity, and land use, and H4 - Work with our regional partners and the Government of Alberta on an integrated approach to the watershed).

Social, Environmental, Economic (External)

Administration conducted a comprehensive sustainability analysis based on The City's Triple Bottom Line Policy, Sustainability Direction and watershed protection goals as part of its Flood Resiliency and Mitigation Strategy. Details on the social, environmental and economic analysis that was conducted can be found in report UCS2017-0266.

Financial Capacity

Current and Future Operating Budget:

There are no operating budget implications from this report.

Current and Future Capital Budget:

The four community barriers, Upper Plateau and 9th Avenue SE Bridge projects were submitted in 2017 September to the ACRP for funding. These projects were approved by Council as part of the Flood Mitigation Measures Implementation Plan (PFC2017-0462). Administration is negotiating service level for the barriers with the Province and ACRP funding for the 2017 submissions is pending Provincial approval. Current ACRP projects underway since 2014 are funded within the existing capital budget and are listed in Appendix B of Attachment 1.

Council previously approved an accelerated capital budget for the CDI program for the 2015-2018 business cycle. Strategies for continued investment in the CDI program will be presented to Council as part of the 2019-2022 service plans and budget planning.

The City continues to pursue potential external funding opportunities for new projects as they arise. Any funding from the Province or the Federal Government may require up to a 60 per cent cost share by The City to be approved.

Risk Assessment

Another major flood in Calgary is likely to occur and would create significant disruption to critical systems and services, Calgarians, and businesses, and cause damage to public and private property. A significant flood poses health and safety, environmental, and business continuity risks. The approach to flood mitigation described in this report has been designed to mitigate the potential damages associated with a major flood.

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A number of risks also remain for implementing Calgary's flood mitigation. Key risks include:

- Flood mitigation service level for community barriers is under negotiation with the Province and ACRP funding for the four new barriers is dependent on these negotiations. Administration continues to advocate for a combined approach of upstream and community level mitigation, which considers financial constraints and community acceptance.
- A new reservoir on the Bow River may not be built for many years or at all, leaving significant flood risk for Calgary. The need for an upstream reservoir is identified by the BRWG but location, costs, and timelines remain uncertain, and next steps have not yet been communicated by the Province. The City continues to strongly advocate for this work through the BRWG and other avenues.
- Flood risk on the Elbow River remains if the Springbank Off-stream Reservoir is delayed, leaving significant flood risk on the Elbow River for Calgary. The Province remains committed to this project and The City continues to support the development of the reservoir, despite opposition from some stakeholders.
- The Province and TransAlta may not continue their agreement for seasonal operation of the Ghost Reservoir after 2021. The Province is taking steps to negotiate a long term agreement with TransAlta, and Administration continues to advocate for this as a key contributor to flood mitigation for Calgary.
- New Provincial FHA mapping and policy has not yet been released, creating uncertainty over how future Provincial regulations could impact The City. There is a risk that The City will have to review policies again once the Provincial maps and policies are released.
- Construction of barriers may disrupt communities and require land access negotiation in some cases. Barriers can also be over-topped during larger flood events. Administration is implementing communications tactics and developing engagement planning to work with communities to provide the best flood protection possible with the least disruption.

Administration is actively working with the Province and stakeholders to mitigate all of these risks, amidst continued uncertainty.

REASON(S) FOR RECOMMENDATION(S):

Flood mitigation remains a top strategic priority for City Council. While The City of Calgary can implement some mitigation measures within its jurisdiction, it is essential that timely upstream watershed level mitigation is in place to reduce Calgary's overall flood risk and that The City continue to advocate for this mitigation.

ATTACHMENT(S)

1. 2017 Flood Resiliency and Mitigation Update

FLOOD RESILIENCY AND MITIGATION



2017 Update Report

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1. INTRODUCTION

The City of Calgary has undertaken significant work to increase Calgary's flood resilience and reduce the risks faced by Calgarians since the 2013 floods. The City continues to focus resources and efforts by:

- Investing in flood resilience and protection
- Increasing our understanding of flood risk
- Strengthening flood-related policies
- Partnering with others for a more flood resilient Calgary, and
- Communicating with Calgarians about their flood risk.

In the aftermath of the 2013 flood, The City formed an independent Expert Management Panel to develop recommendations to guide The City's flood resilience work. The panel released the *Expert Management Panel Report on River Flood Mitigation* in 2014 (PFC2014-0512) which outlined 27 recommendations that The City has worked to implement since 2014. Significant progress has been made on these recommendations and a full summary of progress to date can be found in Appendix A of this report. As of 2017, all recommendations are either underway or are complete (Figure 1).

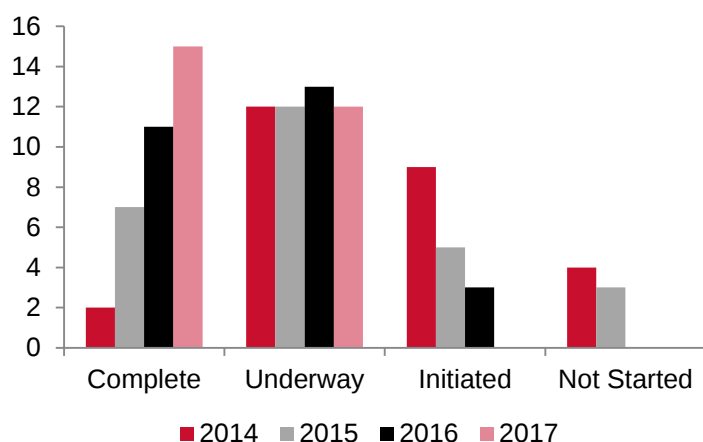


FIGURE 1: EXPERT MANAGEMENT PANEL RECOMMENDATIONS PROGRESS

stakeholders to achieve this goal. This report provides a summary of the work that was done in 2017, and identifies priorities for 2018.

Overall, citizen satisfaction with The City's work on flood mitigation remains high (Figure 2), and continue to believe that protection from river flooding is important (Figure 3). The City recognizes this and flood mitigation is one of The City's top strategic priorities.

As part of this work, The City completed a comprehensive Flood Mitigation Measures Assessment (FMMA, UCS2017-0266) in 2016. The FMMA results serve as the framework for The City's long-term flood mitigation and resilience strategy. City Council endorsed The City's strategy, and identified flood mitigation as a top strategic priority for The City of Calgary.

Building flood resiliency is a shared responsibility among The City, other orders of government, community partners, and citizens. The City continues to actively work with

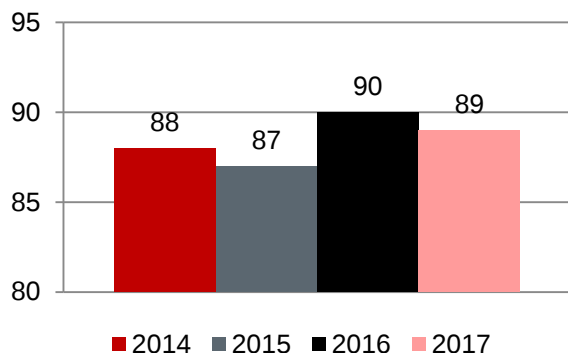


FIGURE 2: PERCENTAGE OF CITIZENS THAT ARE SATISFIED WITH THE JOB THE CITY IS DOING IN PROVIDING PROTECTION FROM RIVER FLOODING

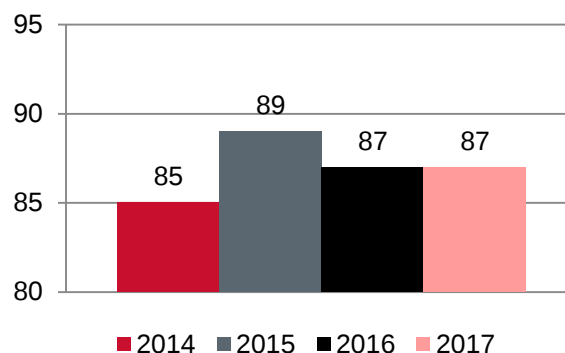


FIGURE 3: PERCENTAGE OF CITIZENS THAT BELIEVE PROTECTION FROM RIVER FLOODING IS IMPORTANT

The City is dedicated to implementing the Government of Alberta's Water for Life Strategy through its water management framework that ensures reliable and resilient water servicing for Calgary and regional customers. This report provides a summary of the activities undertaken by The City of Calgary's Flood Mitigation program in 2017 to address the fourth goal of the integrated watershed management framework that focuses building flood resiliency in Calgary. Working with the Province and regional partners, The City aims to protect the water supply, use water wisely, keep rivers healthy and build resiliency to flooding (Figure 4). Updates on the other three goals are addressed in a separate report to the Standing Policy Committee on Utilities and Corporate Services (2017 Watershed Planning Update, UCS2018-0093).

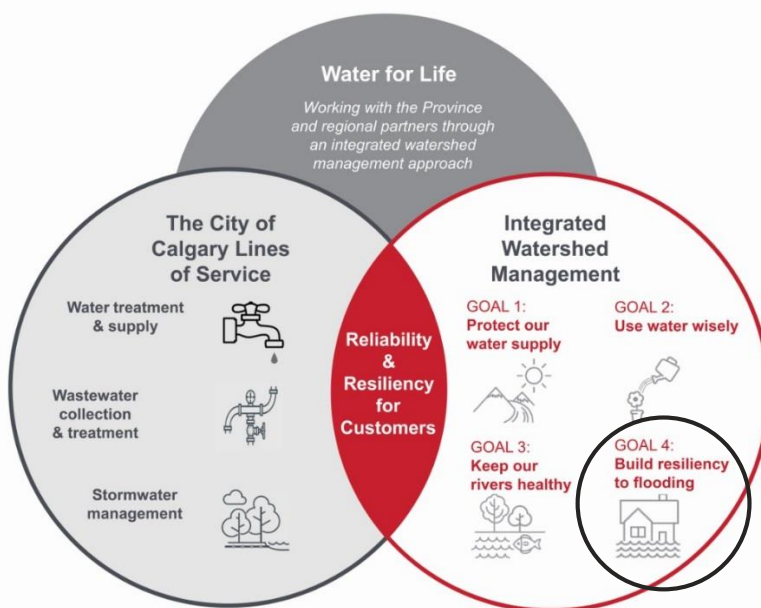


FIGURE 4: INTEGRATED WATERSHED MANAGEMENT FRAMEWORK

2. SUMMARY OF 2017 ACTIVITIES

2.1 2017 SEASONAL CONDITIONS

The City of Calgary monitors snowpack conditions year round. From May to July conditions are monitored 24 hours a day, 7 days a week, when Calgary's flood risk is at its highest. For the spring of 2017, the snowpack in the Bow and Elbow basin was average to slightly above average. Snowmelt started in mid-May and continued through mid-June. Above normal temperatures during snowmelt resulted in a much higher than average run-off to the Bow River, though conditions on the Elbow River remained normal. The resulting peak flow through Calgary on the Bow River was 453 m³/s on June 11 – well above the typical average flow. For safety, a boating advisory was issued by The City of Calgary between June 1 and June 19. However, no emergency response activities were required in 2017.

During the summer, above average temperatures and much lower than average precipitation resulted in flows in both the Bow and Elbow dropping significantly, remaining just above the drought advisory phase for much of the late summer. While flows remained above trigger conditions in Calgary, The City initiated an internal drought advisory from August 29 to October 2 because of regional water shortages and above average irrigation demands. During this period, The City's Water Oversight Committee and internal business units worked collaboratively to prepare actions to reduce water consumption in the event conditions worsened. However, public advisories to reduce consumption were not required and impacts to the general public were minimal.

2.2 FLOOD READINESS

In addition to monitoring Calgary's flood risk, The City of Calgary holds an annual Flood Readiness Campaign every year from May 15 to July 15. The Flood Readiness Campaign is designed to help educate citizens about river flooding and be prepared for a potential flood. The campaign's goals are to:

- Develop a greater understanding of what The City does to prepare for river flooding
- Help citizens understand how flooding occurs
- Show citizens how to prepare for and mitigate against flooding
- Help citizens stay informed of river conditions and flood risk during flood season.

As part of The City's campaign in 2017, a number of activities were undertaken to inform citizens and increase reach with providing flood risk information. These included:

- Overhauling The City of Calgary's flood portal at Calgary.ca/floodinfo
- Working with Community Associations, Councillors, and Provincial Members of the Legislative Assembly (MLAs) to share messaging with citizens via social and print media
- Information booths at The City's Disaster Alley and at community events
- General local media coverage, resulting in 21 articles and related media stories.

In 2017, City staff visited residents in the Mission area, who are at the highest risk of evacuation should flooding occur on the Elbow River. Residents received information packages that included information to help them be more prepared for a future flood event and evacuation order. Staff also responded to questions and concerns raised by residents at the door. Copies of the Flood Readiness Guide were delivered to targeted households that are at the highest risk of flooding. The guide provides information on understanding flooding, preparing for emergencies including flooding, and how to stay informed during May to July, when flood risk is highest.



THE CITY OF CALGARY'S FLOOD READINESS GUIDE IS AVAILABLE ONLINE AT WWW.CALGARY.CA/FLOODINFO

3. FLOOD MITIGATION MEASURES ASSESSMENT

The City completed a comprehensive Flood Mitigation Measures Assessment (FMMA) in 2016. In 2017, the results of the FMMA were presented to City Council. The assessment found that a combination of watershed, community, and property-level mitigation measures will provide a flexible and adaptable flood mitigation program that provides the most cost-beneficial flood resilience for Calgary (Figure 5). The FMMA also identified that non-structural mitigation measures will provide additional benefit. The recommendations from the FMMA reflect The City's principles and priorities for flood mitigation, including:

- Maintaining public safety and operation of critical infrastructure
- Ensuring sustainable water management amidst climate uncertainty
- Cost-beneficial investments
- Maintaining adaptability and flexibility
- Providing an equitable level of protection on both rivers, and
- Working with communities to ensure receptivity and shared responsibility to reduce flood risk.

Based on the findings of the FMMA, a report was approved by City Council on 2017 April 10, which recommended that City Council direct Administration to:

1. Work with Council to advocate for an upstream reservoir and continuation of the Provincial-TransAlta operational agreement for the Bow River
2. Continue supporting the development of the Springbank Off-stream Reservoir on the Elbow River by the Province
3. Develop an implementation and funding plan for community level flood mitigation and report back to Council through the SPC on Utilities and Corporate Services or the Priorities and Finance Committee by Q2 2017
4. Explore the development of a property level mitigation program
5. In alignment with Provincial mapping and policy updates, conduct further investigation on land use policy and building regulations for areas prone to flooding, and
6. Work with City Council to confirm and communicate to other orders of government that flood mitigation is a top strategic priority for The City of Calgary.

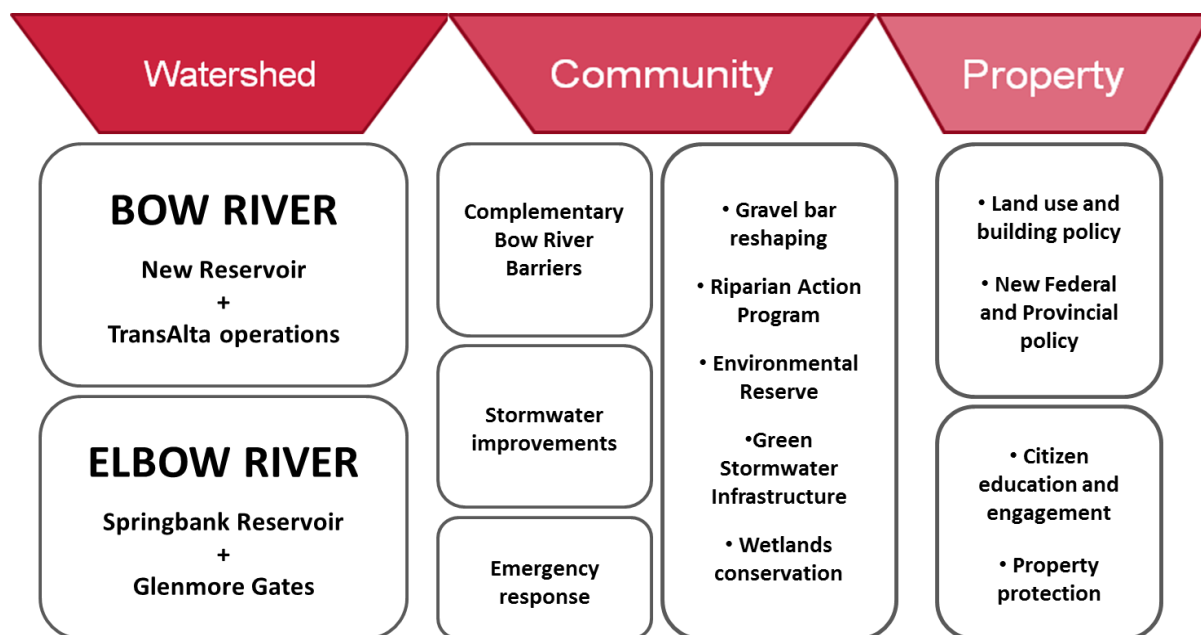


FIGURE 5: FLOOD MITIGATION MEASURES ASSESSMENT RECOMMENDED APPROACH

Based on the FMMA, a combination of upstream mitigation and community level structural mitigation is being pursued. This approach provides adaptability and flexibility in our ability to manage flood risk. Initial planning and design for barriers located in Calgary's downtown and in Sunnyside-Hillhurst, Bowness and Pearce Estate-Inglewood has been initiated. These projects will provide flood mitigation benefit while upstream measures on the Bow River are being pursued by the Province, and are designed to be scaled to address future climate uncertainty. These barriers will also work with recommended future upstream structural mitigation to further reduce flood risk once all components are in place.

4. DEVELOPMENTS IN 2017

4.1 WATERSHED MITIGATION – ELBOW RIVER

The Springbank Off-Stream Reservoir (SR1) project was announced by the Province in 2015 and will consist of a reservoir approximately 18.5 kilometers upstream of the Glenmore Dam that will temporarily store water during a flood and release water slowly back into the Elbow River. Studies have confirmed that SR1 is the best location for an upstream reservoir to mitigate flood risk for Calgary and other communities downstream. SR1 is critical to building flood resiliency on the Elbow River for Calgary.



UPGRADES AT THE GLENMORE DAM INCLUDE REPLACING THESE STOP LOGS WITH AUTOMATED STEEL GATES FOR IMPROVED WATER STORAGE AND FLOOD MITIGATION CONTROL.

The FMMA identified that current work to upgrade the gates on the Glenmore Dam, combined with construction of the SR1 upstream of Calgary, will provide flood mitigation similar to a 2013 event on the Elbow River. Community-level structural mitigation is not recommended on the Elbow River, as it would cause significant disruption to communities and private properties, and require significant land acquisition to accomplish.

On 2016 June 23, the Canadian Environmental Assessment Agency (CEAA) announced that a federal environmental

assessment for SR1 would be undertaken. Alberta Transportation submitted the environmental assessment report to CEAA on 2017 October 17, which CEAA subsequently referred back to Alberta Transportation by CEAA for additional information on 2017 November 20. Work is underway by Alberta Transportation to provide the additional information requested.

As part of SR1's environmental assessment, The City was invited to participate on the CEAA's Technical Working Group for SR1. The City of Calgary will work with Provincial and Federal counterparts, as well as local stakeholders to review information, and provide advice throughout the environmental assessment process. The Technical Working Group first met on 2017 November 8.

During 2017, The City continued its infrastructure upgrades to the Glenmore Dam. The Glenmore Dam has been key part of Calgary's drinking water infrastructure system since the early 1930s. 85 years of continual service and the ever increasing demands of a growing city means the time has come for an extensive upgrade. These improvements will not only extend the life of the Dam, but will help manage our drinking water supply and give us the ability to better control low and high river flows.

The first phase of the project involved moving the water and gas utility lines, which ran across the top of the dam, to a new tunnel excavated underneath the Elbow River. Work has now begun on Phase II, which includes a new bridge deck with better access for maintenance and pathway users, concrete work on the face of the dam, and a new steel gate and hoist system. While the normal maximum operating levels of the reservoir remains the same, the new gate system will provide greater flexibility to manage reservoir storage during low flows in the winter and high flows in the spring.

4.2 WATERSHED MITIGATION – BOW RIVER

In 2017, The City of Calgary continued to co-chair the Bow River Working Group (BRWG) with the Province to assess flood mitigation and water supply on the Bow River. The *Bow River Water Management Project final report* was released by the Province on 2017 August 11, and outlines the findings and recommendations from the BRWG process. The report identified a number of short, medium, and long term operational and infrastructure improvements to mitigate against flood impacts in Calgary.

The BRWG report recommended that a single new reservoir upstream of Calgary, combined with additional operational efficiencies at existing reservoirs will provide significant flood mitigation for Calgary. The efficiencies and modifications include negotiating a long-term watershed agreement with TransAlta, and extending the Ghost Reservoir flood operations agreement and drawdown rate. Once complete, these actions will work in combination with the community barriers being constructed by The City to provide mitigation to a flood event similar to 2013.

A proposed flood-focussed reservoir upstream of Calgary would have short-term water supply benefits for Calgary. Three locations for a new reservoir were identified, and feasibility studies are recommended to be completed within two years. The majority of reservoir scenarios to address drought were focussed on southern Alberta agricultural irrigation downstream of Calgary.

A Provincial study is underway to investigate the feasibility of drawing down the Ghost Reservoir more quickly for a more efficient flood response. As of 2018 January, the Province has begun follow-up work on the BRWG's short-term, "quick-win" mitigation recommendations. For recommendations related to large infrastructure recommendations such as upstream reservoirs, next steps have not yet been communicated by the Province. Work on a long-term solution requires Provincial commitment, and actions to move forward must be addressed collaboratively with stakeholders.

The City continues to stress to the Province that flood mitigation is one of its top strategic priorities. An upstream reservoir on the Bow River is a holistic water management solution for the watershed and is critical to Calgary's flood resilience, while also providing short-term water supply benefits.

4.3 COMMUNITY MITIGATION

The FMMA identified that new upstream infrastructure on both rivers and operational efficiencies, combined with the community-level flood barriers on the Bow River, are necessary to provide mitigation

to a flood event similar to 2013. Administration delivered a funding and implementation plan to City Council on 2017 June 26 to support design of four new community barriers in high flood risk locations:

- Downtown from Jaipur bridge to Reconciliation bridge
- Sunnyside-Hillhurst, from the Peace bridge to the existing community flood barrier
- Bowness, along Bow Crescent
- From the existing Inglewood flood wall to the south-eastern portion of Pearce Estate Park.

Initial planning and design for permanent flood barriers in Calgary's downtown as well as in the communities of Sunnyside-Hillhurst, Bowness, Pearce Estate-Inglewood has been initiated. These barriers will provide flood mitigation benefit while upstream measures are pursued by the Province.



THE WEST EAU CLAIRE BARRIER IS PART OF THE CITY'S EAU CLAIRE PUBLIC REALM PROJECT AND WILL BE INTEGRATED WITH THE EXISTING PARK AREA. IT IS A CRITICAL COMPONENT TO THE DOWNTOWN'S FLOOD RESILIENCE.

The downtown barrier is critical to Calgary's flood resilience as nearly half of the downtown is at risk should a significant flood event occur. It will integrate into The City's Eau Claire Public Realm initiative, which includes the West Eau Claire flood barrier currently under construction. When the downtown barrier is complete, it will connect to both the West Eau Claire flood barrier and the Centre Street lower deck flood barrier and serve as a single piece of flood mitigation infrastructure for all of the downtown.

The four barriers are designed to be scaled to address future climate uncertainty, and work with upstream operational efficiencies and recommended upstream reservoir on the Bow River to further reduce flood risk once all components are in place. Starting in 2018, The City will work with the communities where barriers will be located.

In September 2017, The City submitted proposals to Alberta Environment and Parks (AEP) Alberta Community Resilience Program (ACRP) for the four community flood barriers. Funding assistance from AEP for these projects is pending service level negotiations with the Province. More information regarding the ACRP and ACRP-funded projects can be found in Appendix B.

In addition, the Upper Plateau Separation project for the community of Sunnyside-Hillhurst, which provides further mitigation for the community, was approved in the FMMA and the Funding and Implementation Plan, and was submitted to ACRP in 2017 September for funding consideration.

Two gravel bars along the Elbow River in the community of Mission and five gravel bars on the Bow River at Centre Street Bridge, 10th Street Bridge, Crowchild Trail, Carburn Park, and Inglewood were also identified in the FMMA. These projects will help further reduce Calgary's flood risk by removing obstructions to the rivers' flow. The City is currently working to identify funding for these projects. Work on the Mission Island, Scollen Bridge and Centre Street gravel bars began in 2017 and is expected to continue throughout 2018.

5. ALBERTA COMMUNITY RESILIENCE PROGRAM

On 2015 October 26, AEP committed \$150M over 10 years to The City of Calgary through the ACRP for community-level flood mitigation projects. The City of Calgary has received funding from the ACRP for projects since 2014, and \$40.3M has been provided to The City to date. All ten ACRP-supported projects are currently in design or under construction, and once completed, are expected to reduce Calgary's flood risk by as much as 30 per cent. A summary of The City's current ACRP projects can be found in Appendix B.

In September 2017, The City submitted ACRP proposals to AEP for four community flood barriers, the Upper Plateau Separation project in Hillhurst-Sunnyside, and the 9th Avenue Bridge replacement project, which provides critical emergency access to the community of Inglewood. These projects are pending AEP approval and service level negotiations with the Province.

6. PROPERTY MITIGATION, POLICY AND MAPPING

Non-structural flood mitigation measures such as land use planning and policy changes are being explored in greater detail by The City. Such measures can provide significant reduction in Calgary's overall flood risk over the long term, as well as increasing resilience to climate change impacts. In 2014, changes to the Municipal Development Plan (MDP) and Land Use Bylaw (LUB) were made to provide guidance and better regulate development within the Flood Hazard Area (FHA, Figure 6). Starting in 2017 The City of Calgary established an internal City-wide working group led by Calgary Growth Strategies, to explore potential changes to The City's existing land use and building regulations to further increase Calgary's flood resilience.

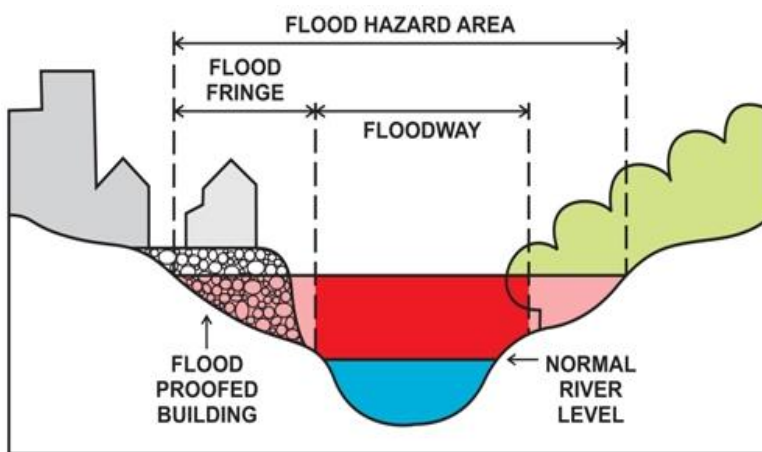


FIGURE 6: DIAGRAM OF THE FLOOD HAZARD AREA. NEW FLOOD HAZARD AREA MAPS FROM THE PROVINCE COULD INCREASE THE OVERALL SIZE OF THE FLOODWAY IN THE FUTURE. DEVELOPMENT IN THE FLOODWAY IS NOT PERMITTED. (SOURCE: [HTTP://AEP.ALBERTA.CA/WATER/PROGRAMS-AND-SERVICES/FLOOD-HAZARD-](http://AEP.ALBERTA.CA/WATER/PROGRAMS-AND-SERVICES/FLOOD-HAZARD-)

As part of this work in 2017, The City began reviewing the effectiveness of those initial approved non-structural measures. In 2018, The City will continue to review the effectiveness of these measures, recommend improvements where needed and analyze possible new policy and building regulation measures to improve flood resiliency. Potential policies for developed and greenfield areas that are being assessed include:

- Land use bylaw amendments, guidelines or policies that will reduce damages in flood risk zones over time.
- Education, communication and notification tools to increase property owners' and residents' awareness of their flood risk and mitigation opportunities.
- Regulating land use or occupancy types permitted in flood risk areas.

This project will include citizen engagement, as well as discussions with Provincial counterparts to understand the implications of policy and mapping changes and the availability of Provincial relief programs such as Disaster Recovery for citizens. As part of this work, The City is analyzing flood risk data to see how this information can be used to improve communicating flood risk to Calgarians and to inform land development policies in areas with increased flood risk. Work is also ongoing to make The City's existing inundation mapping more accessible and easier to understand for citizens, and will continue to improve accessibility to this information throughout 2018.

A key component that will inform The City's future land use planning or flood plain development policy is the Province's release of updated Flood Hazard Area (FHA) regulatory maps. It is anticipated that new FHA maps will be publicly released in early 2018, and will have implications for any policy changes The City is considering. The Province has also initiated a process to update its Floodway regulations, and the Federal government continues to work on developing floodplain development guidelines for the country.

The City is communicating with both orders of government, including sitting on several federal Advisory Panels and Committees, and is taking all of these potential developments under consideration as it proceeds with any recommendations for policy changes as they relate to development or redevelopment in the flood plain. The flood mapping, policy and land use regulation work will continue throughout 2018.

7. STORMWATER FLOODING

As The City of Calgary has grown over the past 140 years, stormwater management standards have advanced to respond to ever changing weather patterns and our evolving knowledge. This has resulted in varying levels of drainage service in communities across Calgary. Communities developed prior to 1990 have the greatest need for stormwater infrastructure upgrades to meet current minimum servicing standards. The 2013 flood event also renewed focus on how The City manages river flooding and stormwater backup for communities in close proximity to the rivers.

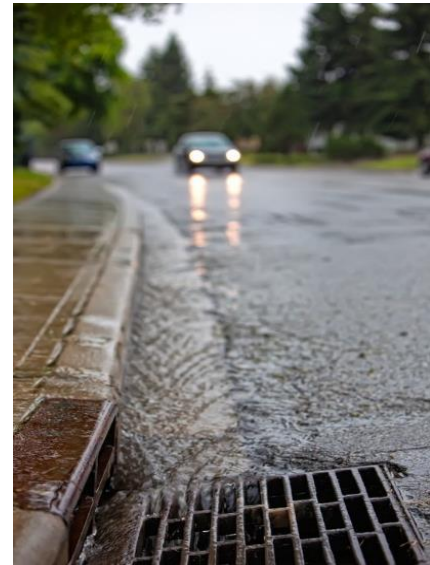
7.1 LOCALIZED FLOODING

Local stormwater flooding occurs in communities when drainage infrastructure cannot manage the volume of stormwater resulting from precipitation, or snow and ice melt. Localized flooding can also occur due to a restriction in the underground system or a surface grading issue. When communities are in close proximity to the river, these areas can be further impacted by adjacent river flood events. In 2017 March, The City worked to identify how resources can be best deployed during adverse weather in the summer, particularly for short duration-high intensity summer storms where there is flash flooding as well as immediate safety and property impacts.

For the 2017 season, The City focused on four key areas:

- Improving public messaging and communication regarding “normal” and “emergency” run off concerns to increase public awareness.
- Mapping problem areas to identify communities with the greatest risk and identify opportunities for improvement.
- Creating a response plan to summer storms that identified opportunities to share information, engage City partners, and improve record-keeping and reporting from the field.
- Addressing specific flooding issues in the area of communities of Deer Run and Lake Bonavista through the installation of temporary sand filled barriers. These neighbourhoods have been identified for study within the Community Drainage Improvement (CDI) program for future improvements.

Although The City strives to improve our response to localized flood events, they continue to be a challenge as rainfall events can be unpredictable. Communities with broader stormwater system issues will be addressed through the CDI program. Work done under the CDI program in 2017 is summarized in the section below and a list of current and future projects can be found in Appendix C.



LOCAL STORMWATER FLOODING CAN OCCUR QUICKLY AND UNPREDICTABLY.

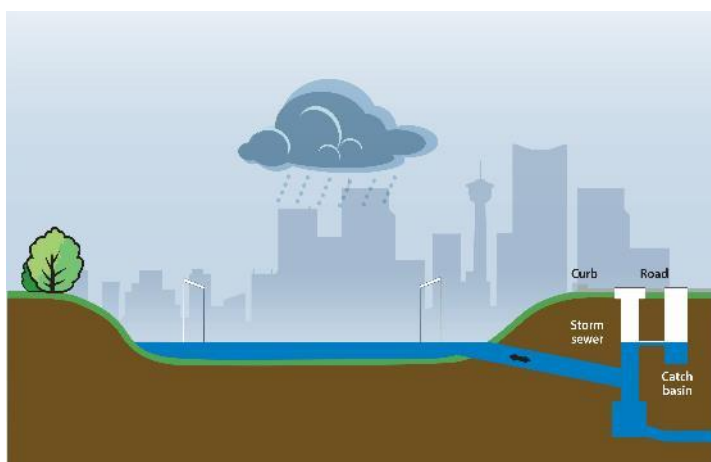
7.2 COMMUNITY DRAINAGE IMPROVEMENT PROGRAM

The CDI program invests in stormwater infrastructure improvements with a focus on established communities with the highest risk of local stormwater flooding. The Program prioritizes projects based on flood risk, potential impacts to the community and the cost-effectiveness of the proposed infrastructure upgrades. A drainage study is first completed for selected communities, which assesses flood risk and presents options for upgrades. Investment decisions are then evaluated based upon which

projects provide the greatest benefits to customers and communities. This is measured based on reduction to damages caused by local flooding as well as social, economic, and environmental impacts.

In 2017, a number of planning, design and construction activities were completed through the CDI program, including:

- Continuation of drainage studies for the communities of Renfrew and Macleod Trail, with completion expected in 2018. These studies will inform future CDI program investments.
- Design for stormwater projects in Sunnyside:
 - Stormwater pump station #1
 - Phase 2 improvements to stormwater pump station #2. Interim upgrades to pump station #2 were completed in 2017 and will support the Phase 2 upgrades for the project;
 - The Upper Plateau Separation project, which will reduce Sunnyside-Hillhurst's stormwater flooding risk by disconnecting their stormwater system from communities located above them in the upper plateau.
- Design for the Woodlands-Woodbine (WWCDI) projects, including Bebo Grove Pond, 24 Street SW Storm Diversion and Braeside Dry Pond.
- Completion of the 14.5 Street improvement project and interim upgrades to stormwater pump station #2 in Sunnyside-Hillhurst.
- Commencement of design for upgrades to outfall G20C in collaboration with Alberta Infrastructure. Work will continue through 2018 and is required to accommodate piped infrastructure under the future South West Ring Road at Sarcee Trail and Glenmore Trail. Once complete, this will complete CDI upgrades servicing the communities of Westgate and Christie Park.
- Completion of infrastructure upgrades in the communities of Christie Park and Sarcee Trail.



CROSS-SECTION OF A DRY POND. WATER COLLECTED IN A DRY POND DURING A RAINSTORM IS HELD UNDER THE STORMWATER PIPES HAVE THE CAPACITY TO DRAIN THE WATER AWAY. WHEN NOT IN USE, A DRY POND CAN BE USED FOR RECREATION OR LEISURE PURPOSES

Work done utilized value-engineering practices, flexible procurement, and leveraging of external funding to help drive cost efficiencies.

Infrastructure Canada committed \$2.1M through the New Building Canada Fund toward the construction of pump station #1 in Sunnyside in 2016 November, and ACRP announced an additional \$9.8M to support construction of pump stations #1 and #2 in 2017 April. The pump stations will function together as part of the overall community-wide drainage improvements occurring in Sunnyside-Hillhurst to remove

stormwater from the community and pump it back into the river. The City will continue to identify external funding opportunities for CDI projects and will continue to explore opportunities to enhance delivery of projects through the CDI program in 2018.

8. ACTIONS FOR 2018

One of The City's key actions for 2018 is initiating the implementation of the community level flood barriers. This will involve significant work with flood affected communities to gather input through public engagement where applicable, create detailed designs for each project and work with private land owners. Securing funding from the Province and Federal government to support these projects is a priority.

The City will continue to work closely with the Province on conducting further work to support the implementation of the BRWG Water Management Report recommendations, and development of upstream mitigation on the Bow and Elbow Rivers.

Planned Actions:

Flood mitigation and resilience

- Begin initial work to support the community level flood mitigation measures, including initial communications with communities, developing community engagement plans, initial design of the four barriers, and internal resourcing of this work.
- Work with Council to advocate for an upstream reservoir on the Bow River and support the development of the Springbank Off-stream Reservoir by the Province.
- Support and advocate for upstream Provincial projects through the Springbank Reservoir Technical Working Group, and the Bow River Working Group.
- Advocate for appropriate Provincial flood policy and Federal guidelines through engagement with the Province and participation in national floodplain guideline discussions.
- In alignment with Provincial flood mapping efforts and Federal floodplain guideline development, support Calgary Growth Strategies' work on reviewing and evaluating potential change to existing policy and building regulations for flood-affected areas.
- Deliver annual public flood awareness communications.
- Lead annual updates to flood emergency response procedures.
- Continue collaborating with the Province to support improved monitoring and river forecasting through discussions regarding a common forecasting platform.

Community Drainage Improvement (CDI) program

- Consider recommendations from planning studies currently in progress for the Renfrew and Macleod Trail CDI projects in the overall program's project prioritization.
- Initiate design of the Upper Plateau Separation project, which will reduce Sunnyside-Hillhurst's stormwater flooding risk by disconnecting their stormwater system from communities located

upslope in the upper plateau. Continue to identify external funding opportunities for this project.

- Proceed with construction of continued improvements to stormwater pump stations #1 and #2 in Sunnyside.
- Construction of drainage improvements for the Woodlands-Woodbine CDI projects, benefitting the communities of Woodlands, Woodbine, Braeside and Cedarbrae.
- Initiate the Deer Run and Lake Bonavista CDI study.
- Continue to explore opportunities to enhance delivery of drainage improvement projects through the CDI program in 2018.
- Report back to Council as part of the 2019-2022 Budget and planning process with an update on strategies for continued investment in the CDI program.

APPENDIX A – EXPERT MANAGEMENT PANEL RECOMMENDATIONS

1. INVESTING IN FLOOD PROTECTION

Recognizing the scale of impact caused by flooding, continued significant investments are needed for flood mitigation. Citizens believe that investment in flood mitigation is important and The City is working with all orders of government to explore opportunities and secure funding for investments in flood resilience. To date, The City has received \$40.3M from the Alberta Community Resilience Program (ACRP) for ten projects, and applied for an additional \$81.3M for six projects in 2017.

Investing in flood protection Expert Management Panel recommendation	Status	Timeline	2017 update
Prepare a time-phased plan to modify structures that constrain river flow during flood events, such as pathways and bridges. (4b)	Underway	Ongoing	Flood levels are currently considered as part of lifecycle project planning and implementation. Repair and reconstruction of bridges and pathways after 2013 were designed to withstand the 100+ year level flood, as are current bridge construction projects. This recommendation is linked to The City's Climate Change Adaptation Plan. Future construction or replacement of existing structures will be informed by future land use planning and development policy work.
Develop a comprehensive climate adaptation plan and implementation tools to reduce The City's infrastructure and operational vulnerabilities. (6d)	Underway	2018-2022	Internal engagement was conducted across the entire Corporation to identify actions that may be taken to adapt to a changing climate based on the vulnerabilities and risk assessment. Over 800 actions were identified Corporate-wide. Some of these actions have been included in business plans for 2018-2022.
Connect with the provincial body overseeing flood protection and loss reduction and support the Province's continuing analysis of flood mitigation options and implementation of appropriate measures through the watersheds. (6b)	Underway	Ongoing	The Bow River Water Management Report was released on 2017 August 11, and recommends a number of mitigation scenarios along the Bow River. In 2018, The City will continue to participate in the Bow River Working Group to identify ways to move the report's short, medium and long term recommendations forward. The City also continues to connect with Provincial counterparts through regular meetings on watershed level solutions to flood mitigation.

Increase the operating water storage capacity of the Glenmore Reservoir on the Elbow River through modifications to the Glenmore Dam. (3b)	Underway	2015-2020	The Glenmore Dam infrastructure improvement program includes a project to elevate the dam's gates to help control flooding and manage water supply. Work to support the construction of the gates has started, and the project is expected to be operational in 2020. The elevated gates will increase capacity at the Glenmore Reservoir and, operated in tandem with the proposed Springbank Reservoir, will provide mitigation for a 2013-level flood on the Elbow River.
Construct additional or higher flood barriers in key locations throughout the city and update temporary flood barrier plans to protect against higher flood levels. (3d)	Underway	2014-2026+	Temporary barrier planning continues to be updated on an annual basis as part of The City's flood emergency response procedures. The Flood Mitigation Measures Assessment (FMMA) identifies four additional community level barriers to be constructed as part of The City's flood mitigation strategy. The City has started initial design for these barriers and will be reaching out to inform communities on the FMMA and barriers in their communities, and where applicable, seek input into barrier design prior to potential construction.
Provide an annual update to City Council on progress related to the recommendations from the Expert Management Panel on River Flood Mitigation. (6f)	Complete	Ongoing	Annual updates are provided by Water Resources to Council's Standing Policy Committee on Utilities and Corporate Services.
Evaluate social, economic and environmental impacts of flood mitigation options. (6c)	Complete	2015-2016	A triple bottom line approach was used to assess possible flood mitigation measures as part of the FMMA. The Assessment determined that a combination of upstream mitigation, community level mitigation, and property level mitigation was the most cost-sustainable approach to reducing Calgary's flood risk. The recommendations generated from this assessment were approved by Council in April 2017 (UCS2017-0266)
In partnership with the Province, compare the three major capital works options for mitigating floods on the Elbow River. (3a)	Complete	2015-2016	The Springbank Off-stream Reservoir (SR1) was announced by the Province in 2015, and the Province has proceeded with this project, which is currently undergoing a federal environmental impact assessment. The City is participating on the Technical Advisory Committee for the Environmental Assessment of SR1 currently being undertaken by CEAA.
Establish a permanent team within The City to oversee flood preparedness and resilience. (6a)	Complete	2015-2016	Funding requests for a permanent team were approved in December 2014. The Watershed Planning Division was established in 2015, and supports this team.

2. UNDERSTANDING FLOOD RISK

There will always be a risk of river flooding and Calgary Emergency Management Association (CEMA) has identified flooding as Calgary's number one hazard and risk. The Expert Management Panel included several recommendations around understanding flood risk, which is one of The City's core strategies for building resiliency. In 2016 The City continued to conduct research, modeling, and monitoring to better understand Calgary's flood risk.

Understanding flood risk Expert Management Panel Recommendation	Status	Timeline	2017 update
Urge the Province to regularly review and update official flood hazard maps. (5b)	Underway	2018	The City is expecting the Province to release draft maps of the new Flood Hazard area (FHA) in early 2018. The Province has indicated municipalities will be engaged before maps are released. The City remains in contact with Alberta Environment and Parks and is monitoring the implications of new FHA mapping.
Develop a suite of watershed-scale climate models to capture various weather event scenarios, with input from regional partners, post-secondary institutions and other orders of government. (5d)	Underway	2022+	Projected trends in precipitation and temperature were developed for the 2050s and 2080s and were used to conduct a vulnerability and risk assessment to identify high risk climate scenarios for Calgary and region. Further climate analysis is required to support the update of design standards in preparation for changing climate conditions. The City is supporting research being conducted by the University of Saskatchewan to develop forecasting and climate modelling tools for our region. Opportunities may arise with the federal government and regional climate centers to provide this type of climate analysis in the future.
Collaborate with academic and other partners to develop computer models that identify groundwater movement in Calgary in relation to flood conditions. (5e)	Complete	2017	In 2016, The City completed two assessments on groundwater impacts relating to flooding, which were included in The City's updated Flood Damage Assessment.
Maintain a comprehensive flood risk database integrated with existing geographic information systems (GIS). (5c)	Complete	2015-2016	In 2016, The City produced a GIS based flood risk damage profiles at the community level. This data was created as part of The City's Flood Damage Assessment and has been incorporated into The City's GIS database.
Publish up-to-date, graduated flood maps for public information. (5a)	Complete	2015	Inundation maps prepared by The City for up to 100-year return periods have been posted to Calgary.ca/floodinfo and are available to the public. Work continues to make this information easier to access for Calgarians.

3. STRENGTHENING FLOOD-RELATED POLICIES

Land use policies, design standards, and flood-proofing building practices, when used alongside structural protection investments, can greatly enhance community resilience to flooding. The City remains committed to working closely with the Provincial and Federal governments on policy consultation regarding flood hazard area mapping, policy development, practices and regulations, and flood design levels.

Strengthening flood-related policies Expert Management Panel Recommendation	Status	Timeline	2017 update
Create graduated flood protection level requirements for City infrastructure. (1b)	Underway	Ongoing	Flood levels are currently considered as part of lifecycle project planning and implementation. For the Flood Mitigation Measures Assessment, a 1:200 level was used as reference. This recommendation is linked to the Climate Adaptation Program and CEMA's critical infrastructure strategy. A City-wide working group led by Calgary Growth Strategies has been established to explore land use and building regulation changes to increase Calgary's flood resiliency.
Expand the review of the Land Use Bylaw and other development regulations to update flood resiliency requirements for private property in flood risk areas. (1c)	Underway	2019	A City-wide working group led by Calgary Growth Strategies has been established to explore land use and building regulation changes to increase Calgary's flood resiliency.
Review The City's existing land-use planning documents and develop amendments, new guidelines or policies that will minimize development in the floodplain over time. (4a)	Underway	2019	The City is working on potential changes to floodplain development guidelines or policies as part of the City-wide working group currently led by Calgary Growth Strategies.
Perform a social, economic and environmental analysis to evaluate the need for a minimum flood protection level above the 1:100 flood for land-use planning and structural protection across Calgary. (1a)	Complete	2017	The FMMA completed in 2016 and 2017 analyzed a variety of scenarios up to a 1:200 flood event. The FMMA determined that protection to a 2013 event was the most cost-beneficial scenario, which was considered a 1:100 flood event. The City currently reviews all Area Structure Plans, Area Redevelopment Plans, building permits, and City projects to identify flood risks and structural requirements based on various flood protection levels.

4. PARTNERING FOR A FLOOD RESILIENT CALGARY

The City recognizes the important role partnerships play in implementing the Expert Management Panel's recommendations. The City depends on strong partnerships with the Province, other stakeholders such as TransAlta, flood-related organizations, citizens and communities upstream and downstream to build flood resiliency.

Partnering for a flood resilient Calgary Expert Management Panel Recommendation	Status	Timeline	2017 update
Pursue a common river forecasting platform with Alberta Environment and Parks (AEP) and TransAlta for faster and more accurate information and alerts about future flood events. (2a)	Underway	2019+	The City and AEP currently work together to share information to inform their respective forecasting platforms. The City received funds from the National Disaster Mitigation Program in 2017 to support this work, starting in 2018. The Province is currently prototyping several new forecasting platforms and The City has discussed potentially sharing a platform in the future. The City will work with the Province to identify common requirements as the Province develops its platform.
Strengthen partnerships with utility providers to improve resiliency of their infrastructure and operations, with first priority to energy supply and communication networks. (1d)	Complete	2017	The Flood Emergency Response Manual is updated annually to ensure maximum protection of critical city infrastructure and vulnerable communities. CEMA has developed a critical infrastructure strategy to support CI owners in their understanding of disaster risk and how to reduce their risk. CEMA has identified core utility providers and businesses as key stakeholders.
In partnership with Alberta Environment and Parks and TransAlta, expand the network of river and weather monitoring stations upstream of Calgary and protect stations from damage during flooding. (2b)	Complete*	2017	Since 2013, The City has repaired or replaced damaged monitoring stations and installed some new stations. *This recommendation is considered complete. However, as part of forecasting platform discussions (see 2a), future monitoring station installations by the Province would benefit The City of Calgary.
In partnership with the Province, develop a time-phased plan to remove buildings from areas with high flood risk, while minimizing the disruption to affected communities. (4c)	Complete*	2017	The voluntary Provincial buy-outs program is complete and the Province has begun demolition of properties. No further Provincial buy-outs are planned at this time. *This recommendation is considered complete but may be re-visited in the future, depending on potential future Provincial policy. Currently, the Province maintains ownership of the 19 properties in Calgary.
Continue to cooperate with TransAlta and the Province to increase flood storage on the Bow River through operation of existing TransAlta facilities. (3c)	Complete	2016	The Province and TransAlta have a 5-year agreement in place for Ghost Reservoir operations, ending in 2021. The Bow River Working Group has recognized the importance of this agreement for flood mitigation and identified extending the agreement as a "quick-win" opportunity.
Host a national flood risk workshop to share best practices & develop a networking group. (6e)	Complete	2015	The City hosted the 2015 Livable Cities Forum on Building Flood Resilient Communities in September 2015 in partnership with Canadian Water Resources Association and ICLEI Canada. The City is involved in national initiatives that bring together various stakeholders to share and develop new practices, mapping and guidelines to reduce flood risk.

5. COMMUNICATING WITH CALGARIANS

It is critical for The City to keep Calgarians informed, provide resources and engage with citizens when it comes to building flood resiliency. Since 2013, City staff has met regularly with citizens, community members, organizations, community action groups, flood task forces and media for engagement and to provide community-specific updates on flood mitigation and resilience strategies.

Communicating with Calgarians Expert Management Panel Recommendation	Status	Timeline	2017 update
Develop programs that support building owners to implement flood resiliency measures. (2e)	Underway	2019+	The City continues to support building and homeowners understand their flood risk through annual communication through its Flood Readiness Campaign. Further development of a formal program to educate and support owners has been considered and is dependent on resourcing at this time. Flood Impacted People and Property Project (FLIPPR) concluded as of 2016. The Flood Permit Grant Program co-administered with Red Cross to provide permits to homeowners not eligible for the Disaster Relief Program ended as part of FLIPPR conclusion.
Incorporate lessons learned from the 2013 flood to enhance communication channels to keep Calgarians informed of conditions that may lead to high river levels. (2c)	Complete	Ongoing	The City established a cross-corporate communications plan and flood readiness communications plan. Updates, information, and general communications are provided annual through The City's social media, local media and advertising, information sessions, and e-mail flood newsletter.
Expand the flood risk communication strategy and provide information and tools that empower Calgarians to make informed choices and better manage their personal flood risk. (2d)	Complete	2015-2016	The City established a cross-corporate communications plan and flood readiness communications plan, including providing information through annual open houses scheduled during flood season and regular newsletter and website updates.

APPENDIX B –CURRENT ACRP-SUPPORTED FLOOD MITIGATION PROJECTS

Project Name	Project Status	Project Description	Estimated Completion Date
Glenmore Dam Elevated Hoists	Underway	Installation of 2.5m high automated steel gates to replace the existing 1.5m manual stop log system to increase storage at the Glenmore Reservoir.	2020
Bonnybrook Wastewater Treatment Plant Flood Mitigation	Underway	Construction of a flood barrier on the eastern perimeter of the Bonnybrook Wastewater Treatment Plant, with groundwater and stormwater management enhancements to protect the plant from flooding.	2018
Heritage Drive Permanent Flood Barrier	Underway	Construction of an earth-filled berm along Glenmore Trail at Heritage Drive and Glendeer Circle SW (underneath Graves bridge) to prevent flooding of major infrastructure and roadways in the area.	2018
Centre Street Bridge Lower Deck Flood Barrier Improvements	Underway	Construction of removable flood barriers that will be installed in the lower deck of Centre Street Bridge to prevent flooding into Chinatown.	2018
West Eau Claire Flood Barrier	Underway	Construction of a flood barrier along the Bow River downstream of Eau Claire to the Peace Bridge.	2018
Sunnyside Pump station #1	Underway	Construction of a new, flood dedicated, two story pump station to dewater the community of Sunnyside during high water events for river and stormwater management.	2019
Sunnyside Pump station #2	Underway	Flood resilience improvements associated with an upgraded pump station in the community of Sunnyside.	2019
Roxboro Sanitary Liftstation Replacement	Underway	Flood resilience improvements associated with a replacement sanitary liftstation in the community of Roxboro.	2017
Stormwater Outfall Improvements	Underway	Resilience upgrades to fifteen stormwater outfalls to prevent potential back flooding into affected communities.	2018
Western Headworks Site Condition Improvements	Underway	Bank improvements in the area to allow operation of a nearby outfall gate to reduce flood risk for the community of Inglewood as well as the Calgary Zoo, Deerfoot Trail, and Pearce Estate Park. Additional improvements for emergency access for river emergencies.	2018
Upper Plateau Separation	In design	Partial separation of Hillhurst-Sunnyside's stormwater system from communities located above in the upper plateau catchment area.	2020
Downtown Flood Barrier	Applied September 2017	Construction of a permanent flood barrier from Jaipur Bridge to Reconciliation bridge.	2022
Sunnyside Flood Barrier	Applied September 2017	Construction of a permanent flood barrier in the community of Sunnyside.	2022
Bowness Barrier	Applied September 2017	Construction of a permanent flood barrier in the community of Bowness.	2024+
Pearce Estate Park Flood Barrier	Applied September 2017	Construction of a permanent flood barrier in Pearce Estate Park near the community of Inglewood.	2024+
9 th Avenue Bridge Replacement	Applied September 2017	Raising of the 9 th Avenue Bridge to prevent damage during high water events and maintain access for fire and emergency services for the community of Inglewood.	2020

APPENDIX C – COMMUNITY DRAINAGE IMPROVEMENT PROGRAM PRIORITIZATION LIST DECEMBER 2017

Project Name	Cost Estimate*	Benefit/Cost Ratio**	Project Status	Construction Start Date/ Business Cycle**
Christie Park Upgrades & Sarcee Trail (formerly Westgate)	\$3,845	20	Complete	2015-2018
North West Inner-City - 14.5 Street	\$444	15	Complete	2015-2018
Woodlands/Woodbine - Bebo Grove and 24 St SW (formerly Pond D)	\$22,143	9	Design	2015-2018
Woodlands/Woodbine - Braeside Dry Pond (formerly Pond A)	\$6,836	9	Design Complete -- Tendered	2015-2018
Woodlands/Woodbine - Local Improvements	\$6,558	6	Design	2019-2022
North West Inner-City - Pump Station #1 – Sunnyside ¹	\$9,992	4	Design	2015-2018
North West Inner-City - Pump Station #2 – Sunnyside ²	\$10,165	4	Interim Improvements Complete, Phase 2 in design	2015-2018
North West Inner-City - Upper Plateau Separation ²	\$36,900	7	Design	2019-2022
Westgate - Ditch Upgrade / G20C Outfall ³	\$4,809	1	Design	2015-2018
North West Inner-City - Kensington Close	\$2,200	13	to be funded	2019-2022
North West Inner-City - 7th Avenue	\$2,000	8	to be funded	2019-2022
North West Inner-City - 19th Street & 9th Avenue	\$2,100	8	to be funded	2019-2022
North West Inner-City - 19th Street & 6th Avenue	\$600	8	to be funded	2019-2022
North West Inner-City - South of Riley Park	\$11,200	6	to be funded	2019-2022 (Partial Scope)
North West Inner-City - Crescent Road	\$1,100	11	to be funded	Beyond 2022
North West Inner-City - Pump Station #4 - Hillhurst	\$11,700	8	to be funded	Beyond 2022
North West Inner-City - Pump Station #3 - Hillhurst	\$8,400	7	to be funded	Beyond 2022
Pineridge / Rundle Dry Pond B	\$4,175	6	to be funded	Beyond 2022
Palliser/Oakridge - Phase 2 and Phase 1	\$18,326	6	to be funded	Beyond 2022
Tuxedo/Mount Pleasant - Phase 2, Phase 1, and Local Improvements	\$14,196	5	to be funded	Beyond 2022
Pineridge / Rundle Storage Duct #2	\$2,824	5	to be funded	Beyond 2022
Shawnessy Stormwater Upgrades	\$20,197	3	to be funded	Beyond 2022
North West Inner-City - 10th Street	\$10,900	2	to be funded	Beyond 2022
North West Inner-City - 14th Street	\$14,900	2	to be funded	Beyond 2022
Palliser/Oakridge - Phase 3	\$11,247	2	to be funded	Beyond 2022
North West Inner-City - 17th Street & 23rd Avenue	\$3,800	2	to be funded	Beyond 2022
Oakmount Dry Pond (Oakmont Way Rev Report)	\$492	1	to be funded	Beyond 2022
Macleod Trail CDI Secondary Improvements ⁴	\$6,777	TBA	TBA	TBA
Total	\$248,826			

* - Cost estimates based on 2015 study estimates, except for projects underway or complete.

** - Benefit/Cost ratio is based on original project scope and costing (costing updated in 2015)

*** - Construction schedules are subject to change with the addition of new projects added to the list.

1 - with funding from the Alberta Community Resilience Program (ACRP) and the New Building Canada Fund

2 - with funding from the Alberta Community Resilience Program (ACRP)

3 - Alberta Transportation completing Westgate Ditch Upgrade via Southwest Ring Road. City to complete downstream outfall upgrades to accommodate ditch upgrade

4 - Study completed, projects identified in study to be sequenced and list reprioritized with existing projects.

**Utilities & Environmental Protection Report to
SPC on Utilities and Corporate Services
2018 February 14**

**ISC: UNRESTRICTED
UCS2018-0091
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Water Utility Billing Adjustment Process and Wastewater Rate Report

EXECUTIVE SUMMARY

This report is in response to Notice of Motion 2017-31 which directed Administration to report back through Standing Policy Committee (SPC) on Utilities and Corporate Services no later than Q1 2018 with recommendations and options in response to residential customer concerns regarding their water bills. It presents a summary of changes that have been made to effectively respond to customers with abnormally high, unintentional water consumption, and provides insight into the implications of these policy changes and potential considerations for further action. This includes a new billing adjustment process developed and implemented on 2017 October 01 along with an independent review of water meter practices. ENMAX, the contracted service provider for utility billing and customer care, also completed a third party review of its billing system.

ADMINISTRATION RECOMMENDATION:

That the SPC on Utilities and Corporate Services recommends that Council direct Administration to:

1. Further investigate options for appeal mechanisms, and report back to Council through the SPC on Utilities and Corporate Services with a recommendation by Q4 2018.
2. Incorporate the financial impacts of the billing adjustment process into utility rate setting for 2019-2022.
3. Identify the requirements for an assistance program for low income customers and bring to Council for consideration in 2018 as part of the Utility's 2019-2022 business planning.

PREVIOUS COUNCIL DIRECTION / POLICY

On 2017 September 09, Council adopted Councillor Colley-Urquhart's Notice of Motion (NM2017-31) on "*Water and Wastewater Consumer Billing Irregularities*" and directed Administration to report back through SPC on Utilities and Corporate Services no later than Q1 2018 with recommendations and options.

Administration was directed to immediately forgive high bills, analyze the scale and scope of the issue, research potential consumer appeal mechanisms, and provide cost estimates for free inspection services. It also included a request to review the cost of wastewater and drainage to reflect that all water used is not returned to the wastewater system. The Notice of Motion is included as Attachment 1.

BACKGROUND

Administration is authorized by the Water Utility Bylaw (40M2006) to adjust bills for customers that experience abnormal water consumption. In April 2016, the Water Utility implemented a water billing adjustment process for customers experiencing leaks and undetermined high consumption. This process was developed in response to customer feedback and replaced the Water Forgiveness Program, which often took months for customer resolution to be reached, required customers to provide proof of a leak and receipts for repair prior to receiving a credit of 100% of the above average consumption. The April 2016 revised process expanded eligibility to customers with high consumption from an undetermined cause and offered partial bill adjustments.

Water Utility Billing Adjustment Process and Wastewater Rate Report

A significant improvement to accompany this process was the addition of proactive notifications to customers from ENMAX, following an extremely high meter reading. This notification takes place before the bill is sent out and supports the customer in potentially identifying and resolving the issue more promptly. The City and ENMAX work with each customer who shares concerns about higher than normal bills, including completion of a High Water Consumption Investigation Checklist. If the cause cannot be found, ENMAX and The City move into a more extensive investigation, which includes checking billing processes and having City technicians conduct an on-site inspection.

In August 2017, customers expressed dissatisfaction with the process citing concerns with partial adjustments, and accuracy of utility billing and water meters. In response, a new billing adjustment process was implemented on 2017 October 01. The Water Utility and ENMAX are confident in the accuracy of the billing system and water meters. To provide assurance and strengthen customer trust and confidence, consultants were contracted to conduct independent reviews of the reliability and accuracy of these systems.

INVESTIGATION: ALTERNATIVES AND ANALYSIS

Of the Water Utility's 345,000 residential metered customers, 99.5% receive monthly bills that reflect regular water consumption levels within their average range. Of the customers who experience abnormal consumption, typically about 30% of those are unable to determine the cause of the water use.

The most common cause for increased consumption is an undetected water leak, typically a toilet or fixtures leaking in the home. Other causes include leaks in hot-tubs, irrigation systems, burst pipes, humidifiers or water heaters. Attachment 2 provides examples of recent customers who have received a high bill due to water consumption.

Another reason for a high bill is a billing delay, which results in more than one month of consumption appearing on a bill. Meter exchanges are part of the Water Utility's preventative asset maintenance program and may result in a billing delay. The Water Utility recognizes that this can create challenges for customers and is making improvements to reduce billing delays.

New Bill Adjustment Process for Residential Customers

A new bill adjustment process for residential customers was implemented on 2017 October 01. If a customer receives a bill equal to or greater than three times their average seasonal monthly use, and the consumption was unintentional and has returned to normal, they are eligible to have that bill adjusted to the amount of their average bill (monthly basic service charges and average water consumption) for a maximum of three billing cycles. Three billing cycles provide sufficient time for leaks to be identified and repaired. In addition, customers must complete the High Water Consumption Investigation Checklist to be eligible. The City engaged a consultant to support development of the new billing adjustment process. This included a survey of leak adjustment policies of 15 large North American water utilities, which confirmed The City's new process is aligned with best practices.

Attachment 3 provides a visual representation of the ENMAX and City processes for identifying and responding to customers with abnormally high consumption.

Water Utility Billing Adjustment Process and Wastewater Rate Report

Since putting the new protocol in place on 2017 October 1:

- 757 customers who received partial adjustments between April 2016 and July 2017 were provided a top up to a 100% adjustment resulting in a total of about \$407,000 in adjustments.
- 924 customer accounts were reviewed from 2017 October 1 to 2017 December 31 under the new criteria and adjustments totalling \$540,000 were provided.
 - About 70% of reviewed accounts met the eligibility criteria. 90% of ineligible customers escalated to The City for review by the Director. The Director reviewed each escalated case to determine if there were unique or extenuating circumstances.

General Service Customer Bill Adjustment

A program does not exist for General Service (industrial, commercial and institutional) customers because the demand for a program has not been as high as for residential customers. General Service customers typically have greater oversight of their systems and they have other avenues for compensation. A small number of General Service customers have inquired and have been reviewed on a case by case basis. Further work will occur in 2018 to determine appropriate approaches for these customers.

Inspection Services

In cases where the cause of high consumption remains unknown following completion of The City's High Consumption Investigation Checklist and consumption does not return to normal, City technicians check the customer's water meter and inspect fixtures and appliances throughout the home. In many cases, a leak is either discovered or evidence of a previous leak is found and advice is provided to the customer. Each inspection is provided at no cost to the customer and the cost (approximately \$600 per visit) is incorporated into the rates paid by all residential customers. The City conducted approximately 160 high consumption inspections in Q4 2017. In rare cases where the technician cannot determine the cause through visual inspection, a customer may require the assistance of a plumber.

Customer Assistance Programs

The bill adjustment process and the inspection services provided are considered a type of customer assistance program, with costs borne by the entire customer class. Although The City does not have a formal customer assistance program for low income customers challenged with paying for essential services, a recent Citizens Perspective survey found that 77% of those surveyed support the idea. The Utility will be bringing forward an assistance program for low-income customers for Council consideration as part of 2019–2022 business planning.

Meter Accuracy

It is not unusual for customers to question the accuracy of the meter following receipt of a high bill. To provide assurance and strengthen customer trust, the Water Utility commissioned an independent review of the City's residential water metering controls, practices, and technology. The consultant reviewed industry benchmarks, surveyed other municipalities, and provided a number of recommendations for improvement. The full report is available in Attachment 4.

The City of Calgary uses positive displacement meters for residential customers, as do the majority (98%) of Canadian municipalities, as they are a proven technology, are extremely reliable, and relatively inexpensive. These are mechanical devices with mechanical registers

Water Utility Billing Adjustment Process and Wastewater Rate Report

that measure a discreet volume of water that passes through the meter. The design of the meter inherently mitigates any potential for over registration when installed correctly. Meter failure or malfunction has not been the cause of any high consumption cases for the City of Calgary.

The report indicates that the Water Utility follows American Water Works Association's standards and demonstrates industry leading practices associated with the application, testing and replacement of its metering infrastructure. All municipalities surveyed have customers experiencing high bills, none of which experienced a meter failing by over reading consumption.

Meter Technologies

Approximately 88% of Calgary's residential customers have Automated Meter Reading (AMR) Technology which allows for remote meter reading, which is a form of smart metering. Further technological advancement to Automated Metering Infrastructure (AMI) offers a number of benefits, including reduced meter reading costs, improved data analytics to support conservation, and early detection of leaks through the ability to see real time information. Attachment 4 includes further details for these technologies. The Water Utility plans to investigate the potential for implementing AMI in development of the long-term metering infrastructure strategy in the next business cycle.

Billing System Accuracy Review

ENMAX engaged an independent third party to conduct a review of ENMAX meter reading, high consumption detection, data and invoicing practices. The investigation focused on the accuracy of the flow of data from meter reading to ENMAX's billing system, and validation that the correct consumption volume and correct rates were used through to the correct invoicing to customers. ENMAX has reviewed the findings and has confidence that its meter reading, high consumption detection, data and invoicing practices are operating effectively and reliably. Additional information on ENMAX's review is available as Attachment 5.

Wastewater Rates

The Water Utility recognizes that the presentation on the bill is not clear for customers. The rates do account for the fact that not all water being used by a customer enters the wastewater collection system. As determined by consumption analysis through the Cost of Service Study conducted in 2014, the proportion of water used by the residential customer class that is returned to the collection system is 0.9 (90%), on average over the course of a year. This is termed the wastewater return factor. This is reflected on a customers' bill as a reduced wastewater rate (90% of the rate), as opposed to what most customers expect to see on their bill as a lower volume (i.e. 90% of the water volume). Because wastewater is not metered, the application of a wastewater return factor to determine wastewater charges is considered best practice for wastewater utilities. This has been confirmed through an independent consultant undertaking The City's Cost of Service Study. Further detail on the wastewater return factor is provided in Attachment 6.

Customer Appeal Mechanisms

Development of the new bill adjustment process included more clearly defining the escalation process to the Water Utility. Customers not satisfied with the eligibility criteria are escalated by ENMAX to the Water Utility. As set out in Section 32 (4) of the Water Utility Bylaw 40M2006, the Director, Water Resources has the discretion to adjust the customer's abnormally high bill, taking into consideration various factors including any circumstances of the case which the Director considers relevant.

Water Utility Billing Adjustment Process and Wastewater Rate Report

Law and Legislative Services conducted a preliminary review of potential options for customer appeal mechanisms and governance oversight approaches possible within The City's existing governance structure and authority. Options include 1) Monitoring the effectiveness of the new (October 2017) customer escalation process, implemented as part of the new bill adjustment process; 2) using an existing board such as the Licence and Community Standards Appeal Board; or 3) establishing a new Council committee or appeal body. Further work is required to evaluate and recommend a utility billing appeal mechanism. Additional background and initial options analysis are available in Attachment 7.

Stakeholder Engagement, Research and Communication

The City of Calgary and ENMAX have been collaboratively working towards improving the customer experience. An example of this is the ENMAX Municipal Centre of Excellence, a dedicated team of customer service representatives trained to handle more complex municipal water customer calls. Customer feedback will continue to be monitored to determine if revisions to the billing adjustment process are required.

Strategic Alignment

The processes to support customers with abnormally high water consumption contribute to a number of Strategic Action areas in Council's Priorities for 2015-2018:

- A healthy and green city (H6- Continue to build public awareness and understanding of our shared responsibility to conserve and protect the environment).
- A well-run city (W5 - Regularly collaborate and engage citizens to encourage participation in City decision-making, and better communicate the reasons for the decisions).

Social, Environmental, Economic (External)

The new bill adjustment process is meant to balance the customer's experience knowing that having an abnormally high bill can be difficult, the importance of homeowners monitoring their water use, and The City's accountability to all rate payers to use their financial resources responsibly. From an environmental perspective, The City's ongoing commitment to metered water billing will continue to play a large role in achieving the City's water conservation goals, as customers are able to monitor and adjust their water consumption.

While the billing adjustment process is one type of customer assistance program, the Water Utility also recognizes the need to support low income customers who are financially challenged to pay their bills.

Financial Capacity

Current and Future Operating Budget:

The Water Utility will absorb the revenue loss associated with the new billing adjustment process in 2017 and 2018. Revenue loss for 2017 totaled approximately \$947,000, which includes adjustments on 2016 bills. The estimated impact is expected to be approximately \$1.5 million annually going forward.

Further work is required to determine the operating budget impact of providing an assistance program for low income customers.

Utilities & Environmental Protection Report to
SPC on Utilities and Corporate Services
2018 February 14

ISC: UNRESTRICTED
UCS2018-0091
Page 6 of 6

Water Utility Billing Adjustment Process and Wastewater Rate Report

Future billing adjustment process costs will be accounted for in the water and wastewater rates proposed by Administration for 2019-2022.

Current and Future Capital Budget:

There are no capital budget implications of this report.

Risk Assessment

The new billing adjustment process presents some risk to water conservation, as some customers may be less motivated to monitor and remedy water leaks when receiving full adjustments. This is mitigated by limiting the adjustment period to three billing cycles.

Customers who do not experience abnormal, unintended water use may not support recovery of the cost of the billing adjustment process through future rates. Other customers may make use of the process on multiple instances and their participation will be monitored to determine if a restriction on frequency (i.e., one adjustment per year) is required in the future.

Despite efforts to improve the process and communication, some customers will continue to believe that the meter is over-registering their water consumption.

REASON FOR RECOMMENDATION(S): The recommendations aim to meet the needs of our customers, while continuing to protect water as a precious resource and ensure The City uses all rate payer money responsibly.

ATTACHMENTS

1. Notice of Motion 2017-31
2. Residential Customer Experiences - High Water Bills
3. Bill Adjustment Process Diagram
4. Water Metering Technology Review Report
5. ENMAX Billing System Review
6. Wastewater Return Factor
7. Consumer Appeals Options



NM2017-31
NM **RECEIVED**

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THE CITY OF CALGARY
CITY CLERK'S

09/11/2017

NOTICE OF MOTION
CC 661 (R2009-05)

WATER AND WASTEWATER CONSUMER BILLING IRREGULARITIES

Councillor Diane Colley-Urquhart

WHEREAS the City of Calgary Waters Services is responsible for the delivery of water and wastewater services with ENMAX being the bill collector;

WHEREAS there have been numerous consumer complaints in 2017 regarding skyrocketing water and wastewater billings with these being the City of Calgary customers and not ENMAX;

WHEREAS these excessive unsubstantiated billings are having a significant social and financial impact on residents who in turn have no recourse;

WHEREAS there is no formal appeal mechanism for citizen complaints to be personally heard, with consumers being punted around from 311 to ENMAX and City Water Services with no remedy;

WHEREAS ENMAX bills the water charge to residential consumers at a rate of \$1.74774000/m3 and also charges a sewer charge of \$1.3956000/m3, and the sewer charge assumes that all water entering the residence through the compulsory water metre intake is then returned as wastewater into the drainage system;

WHEREAS the water consumed by persons in private dwellings when multiplied by the charge for sewer appears to result in a potential \$1.5M annual windfall for The City.

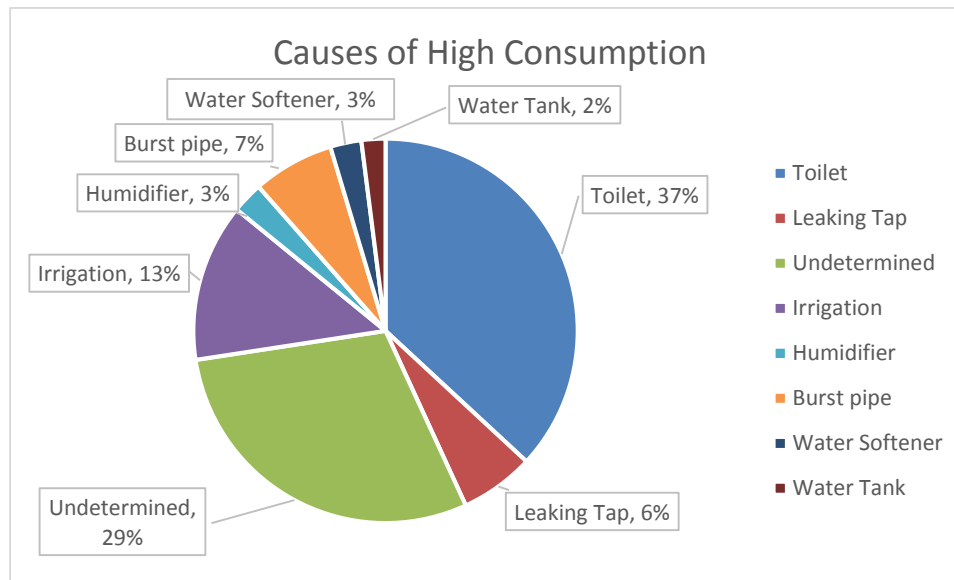
NOW THEREFORE BE IT RESOLVED THAT Administration be directed to:

1. Forgive these exorbitant consumer bills immediately, and only require affected consumers to pay the average monthly amount they have previously been incurring.
2. Conduct a detailed analysis of past trends on billing irregularities to:
 - a. Understand how often this occurs;
 - b. Factors related to why this occurs;
 - c. Examine the technological aspects of the billing process to identify potential issues with water meters;
 - d. Pre-emptive options to alert consumers of billing irregularities.
3. Bring forward consumer appeal mechanisms and governance oversight approaches for Council consideration.
4. Bring forward cost estimates for providing free City inspection services for consumers.
5. Review the actual cost of Wastewater and Drainage to more accurately reflect that not all m3 of water entering a residence is exactly the same as the m3 of water entering the sewer system.
6. Report back to Council through the Standing Policy on Utilities and Corporate Services no later than Q1 2018 with recommendations and options.

Signature of Member(s) of Council

Residential Customer Experiences – High Water Bills

Causes of High Consumption



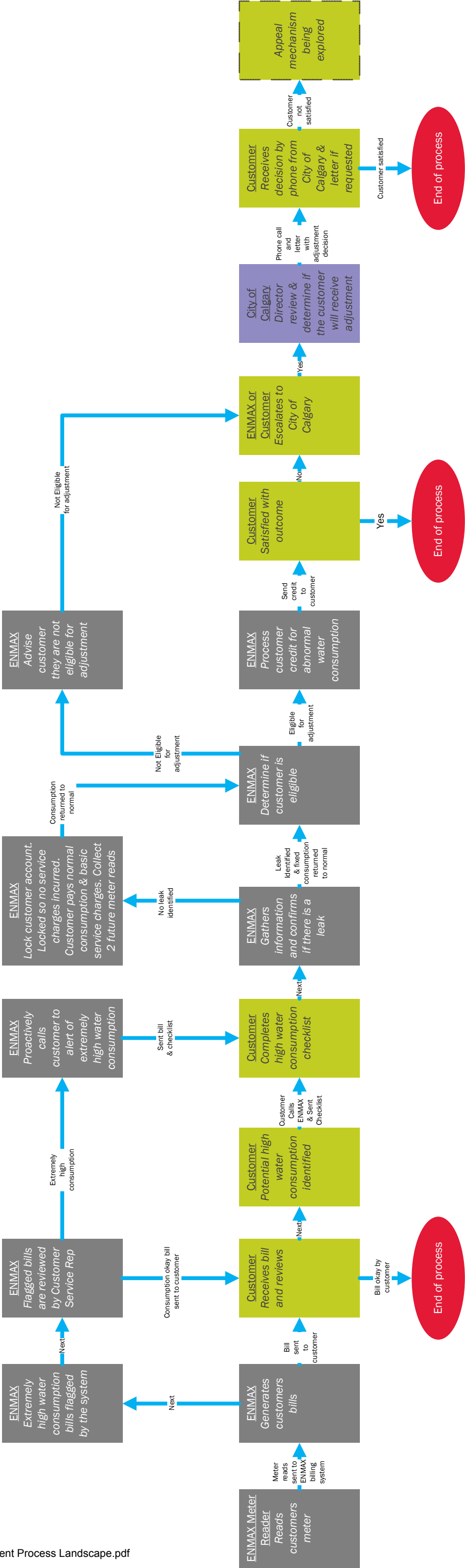
Source: 2017 ENMAX customer data

The following illustrates various City of Calgary customer experiences with high water consumption.

Scenario	Consumption	Bill with High Consumption
Customer monthly consumption between 21 and 27 cubic metre for 12 months. Customer experiences consumption in August 2017 of 35 cubic metres and shares that this is high consumption	35 cubic metres	\$125
Bathtub faucet not sealed properly and dripping for one month	83 cubic metres	\$295
Customer unable to determine cause for increased consumption for November and December	96 cubic metres	\$350
Customer had increased water usage for summer months. Customer shares that water was used to bring grass back to life, but disputed this action would result in this amount of water	147 cubic metres	\$550
Customer had increased water use for July and August. Customer states that trees and shrubs were watered, but disputed this action would result in this amount of water	188 cubic metres	\$675
Water softener leak for one month	200 cubic metres	\$680
Underground damage to irrigation line causing leak for two months	370 cubic metres	\$1,200
A toilet flapper remained open so water ran continuously for three months	413 cubic metres	\$1,350
Toilet tank water level set too high and overflow tube ran continuously for three months	1,766 cubic metres	\$5,600

Note: It is estimated that one person uses 7 cubic metres per month.

ABNORMAL WATER CONSUMPTION BILL PROCESS



REPORT

City of Calgary

Water Metering Review Residential Metering Technology



January 2018



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Executive Summary

1 CONTEXT AND PURPOSE

The City of Calgary (The City) has approximately 345,000 water meters installed in residences to measure customer consumption of water. These meters are critical to the operation of the water utility allowing it and the municipality to recover the cost of providing water services, as well as providing customers the assurance that they are being billed in a transparent and fair manner for the water they consume. The reliability and accuracy of this metering infrastructure is therefore important for all stakeholders, and supports or mitigates occasions of unintended or high consumption enquiries.

The City engaged Associated Engineering to provide an independent review of The City's residential water metering technology, and the controls and practices for this technology. This report provides the results, insights and recommendations gained from the review which comprised a comparison of Calgary practices with best practices regarding metering technology, together with a survey and follow-up interviews with other Canadian municipalities.

2 FINDINGS

2.1 Metering Technology

Water metering technology is well proven and has been applied to support billing of water consumption since Roman times. The City uses an industry standard positive displacement meter for residential metering purposes. These meters have a design that is extremely reliable and inherently mitigates over recording. It also provides an accurate record of consumption for many years before requiring replacement. 98% of meters installed in Canada are positive displacement meters. The replacement of these devices is driven by the wear of mechanical parts that leads to the under recording of water consumption. This requires the utility to replace the meter to mitigate potential loss of revenue.

The City is in the upper quartile for most practices and demonstrates many industry leading practices associated with the application, testing and replacement of its metering infrastructure including an industry leading testing facility.

Manual meter reading is a labour-intensive activity that has driven the adoption of smart metering. Smart metering is the application of technology to transmit meter readings to data collectors and utility information systems. Most municipalities have adopted some form of automatic meter reading (AMR) that allows the collection of meter readings by handheld or vehicle mounted data collectors. Many municipalities are going further with the adoption of advanced metering infrastructure (AMI) that provides a fixed network of data collectors and supports continuous provision of meter readings and enhanced customer services. The City currently has approximately 88% of meters read through handheld AMR data collectors.

All participating communities acknowledged the many benefits of AMI however, the transition takes considerable effort with implementation spanning several years. Some communities are struggling to make a supporting business case for the transition due to the capital investment required for meter upgrades, the installation of a fixed data collection network and billing integration impacts.

2.2 High Consumption Investigation and Billing

The results of the review showed that all municipalities are faced with customers concerned about high consumption billing. Most municipalities respond to these concerns through a visit to the customer's home to check for common sources of leaks. Most municipalities have a process whereby a customer can have their meter tested for accuracy. When the meter is found to be accurate, it is common for the customer to pay for the process of meter testing. If the meter is found to be over-registering, the municipality has a process for correcting the billing error. No community reported having had a meter fail by over-registering consumption and needing to utilize the billing correction process.

3 RECOMMENDATIONS

Through the review, a number of practices were identified that could be improved. A full explanation of the rationale in support of the recommendations is contained in the body of the report. The recommendations have been summarized and grouped into three themes listed below.

Strategy Development

- a) Review and build on the strategy for smart metering to keep it current with technology trends, and guide decisions made today regarding the selection and installation of technology.
- b) Review and document the strategy and guidance for replacing versus refurbishment of water meters that have been removed from customers properties considering both costs and benefits. Include consideration of which components should be salvaged and matched with other components.

Meter Testing

- c) In order to minimize the potential for lost revenue, review the weighting of low, medium and high flows in determining overall meter accuracy.
- d) Test a sample of meters at different age profiles in order to gain additional sample data to determine the optimal replacement period.
- e) Verify the manufacturers' accuracy claims, through the testing of a sample of new meters. Monitor the usefulness of this programme through the evaluation of risks and costs.
- f) Ensure the procedure for removal of meters; includes capping the ends of meters at the time of removal to avoid the formation of crystals that could lead to meters testing lower than what they were when installed.

- g) In order to duplicate the conditions in which the meter was operating when in service; the order of testing should be changed from *high-to-low* flow to *low-to-high* flow.
- h) Review the analysis of flow meter testing results and application in determining optimal replacement strategy.

Meter Installation

- i) Review practice of allowing vertical meter installation to confirm the risks associated with potential under reading are acceptable.

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List of Abbreviations

AMI	Advanced Metering Infrastructure
AMR	Automatic Meter Reading
AWWA	American Water Works Association
ERT	Encoder Receiver Transmitter – Itron brand of MIU
LCD	Liquid Crystal Display
M6	AWWA Manual on Water Meters – Selection, Installation, Testing, and Maintenance
MARS	Meters and Related Services – A company that specialises in water meter testing equipment
MIU	Meter Interface Unit
NWWBI	National Water and Wastewater Benchmarking Initiative
QA/QC	Quality Assurance / Quality Control
RF	Radio Frequency
WHO	World Health Organization

Glossary

Advanced Metering Infrastructure – the transmission of meter readings automatically to fixed network infrastructure (i.e., pole/mast mounted receivers and transmitters).

Automatic Meter Reading – the transmission of meter readings automatically to handheld or vehicle mounted data collectors.

Encoder – a device that converts information from the meter register into another format to support transmission of meter reading to remote reader or via MIU to a remote receiver.

Manual Read Meter - a meter that is read by viewing the register and noting the digits in a notebook or into an electronic device.

Meter Interface Unit – an electronic attachment to a meter allowing the transmission of the meter register readout to a remote receiver using RF technology.

Meter Register – The component of a meter device that registers (and displays) the actual meter reading.

National Water and Wastewater Benchmarking Initiative – a benchmarking initiative created in 1998 to allow Canadian municipalities to measure, track and compare performance across aspects of water and wastewater service provision.

Smart Metering – the principle of using technology to read meters automatically transmitting the signal to the utilities billing systems.

1 Introduction

1.1 CONTEXT, PURPOSE, AND SCOPE

The City of Calgary (The City) has approximately 345,000 water meters installed to measure residential customer consumption of water. Recognizing the importance of water metering and associated billing, and the need to demonstrate to Council and the public, responsible stewardship of the water meter portfolio, The City has engaged Associated Engineering to provide an independent review of The City's application and use of metering technology.

The purpose of this report is to provide the results of the review of metering technology practices, and a comparison with industry standards and practices used by other municipalities across Canada. The review has been focused on residential water meters only. These range in size from 15 mm to 25 mm meters, and therefore excludes any review of practices or technology for industrial, commercial or institutional water metering or network metering.

The scope of the review includes the following elements:

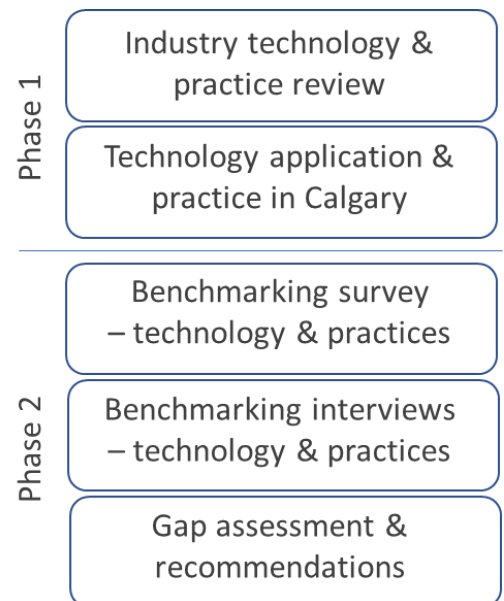
- Trends in water metering including the adoption of smart metering;
- Metering technology including metrology, materials, registers and meter interface units (MIU) including their reliability and accuracy;
- Meter testing and refurbishment including testing standards, use of test bench facilities and refurbishment and replacement strategies;
- High consumption investigations and strategies.

1.2 METHODOLOGY

The approach to undertaking the review has been carried out in two key phases as indicated below.

Phase 1 - The first phase has focussed on understanding the technology applied, and the associated practices for testing and replacement of water meters at The City. The review took the form of reviewing documentation, including standard operating procedures (SOPs) and work instructions, together with an on-site visit to the water meter testing facility, coupled with interviews of key staff. Practices were compared with AWWA standards, industry practices and manufacturers recommendations.

Phase 2 – The second phase has comprised a benchmarking study with other Canadian municipalities. The benchmarking study comprised an initial survey of NWWBI members to respond to questions regarding metering practices and unintended, and high consumption policy and testing practices.



Following the survey, three municipalities were selected for follow-up interviews by telephone to determine more details regarding their practices.

The analysis of these survey results, follow-up interviews, and review of Calgary practices provided validation of many practices and lead to recommendations regarding other practices.

2 High Level Trends in Metering

2.1 INCREASING PUBLIC AWARENESS OF WATER CONSUMPTION

Metering water consumption is a universally accepted means by which water utilities can effectively recover their costs for providing water, encourage conservation of water, and provide data that can be used for analysing consumption patterns that in turn support improved planning for water and wastewater systems.

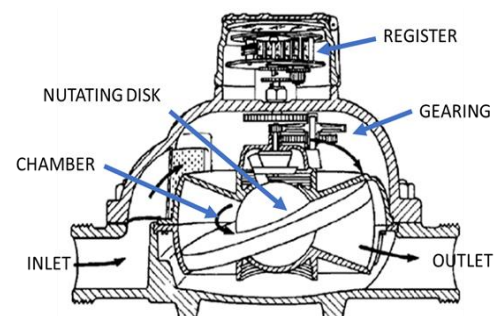
A diverse range of metering devices of different construction, size and performance have been used throughout history. The process of standardizing water metering began in 1913 resulting in a standard being approved by the American Water Works Association (AWWA) in 1921. There have been several revisions to the standard and additional specifications developed as needed over time, typically at least every five years. The AWWA standards on water metering are followed by most, if not all, water utilities that meter their water supplies throughout North America.

Many municipalities have experienced an increase in the cost of treating and pumping water associated with deteriorating raw water quality, increasing water quality regulations, and increasing energy costs. As the increase in the cost of water is passed on to consumers, there has been a corresponding increase in public awareness of water rates and consumption. Consumers are more engaged today than they have been historically. However, there is still generally a lack of understanding of the costs associated with delivering the level of service expected of municipal water supply systems which often causes misunderstanding and occasional disputes between customers and the utility provider. It is essential for utility providers to demonstrate accurate measurement of water provided and fair charges associated with the service. Water metering is the foundation stone of this strategy.

2.2 METER DEVICES

There are a variety of technology choices that a utility can choose from for residential metering. In North America the standard meter in the 50 mm or smaller sizes (residential) has been the positive displacement meter of which there are two variations; the nutating disc and oscillating piston. Essentially equal in performance, these meters have proven by experience to be unrivaled for their combination of accuracy, long life, simple design, moderate cost and easy maintenance.

In a positive displacement meter, a chamber fills with water which then rotates, passing a defined volume of water forward. The volume is calculated based on the number of times these chambers are filled and emptied. The movement of a disc or a piston drives an arrangement of gears that registers and records the volume of water. This registration will be a true representation of flow, assuming the register was appropriately matched to the meter and calibrated. Approximately 98% of small diameter meters installed in municipalities in Canada are positive displacement meters.



2.3 SMART METERING

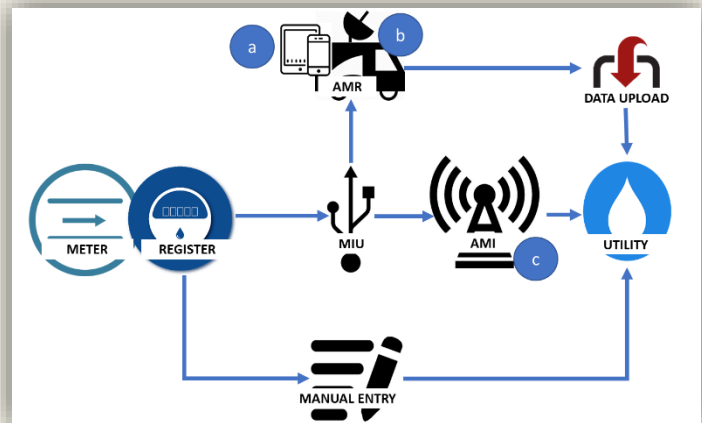
2.3.1 Smart Metering – Industry Practices

Meter reading technology has advanced significantly in recent years. The many disadvantages associated with having to read a meter directly have driven the advancement of technology that allows for the collection of data without going onto a customers' property; this technology became known as Automatic Meter Reading (AMR). For AMR, the mechanical readout of the meter is converted to a digital form by using an encoder. This digital signal is transmitted to a remote device reader. There are two types of encoders, incremental and absolute. The water metering industry refers to meters containing incremental encoders as 'pulse meters' and meters containing absolute encoders as 'encoder meters', although both are encoders. There are fundamental differences between the two types of encoders each with associated advantages and disadvantages. The pulse meter was the first remote reader to be used in the residential water metering industry.

Smart Metering

There are essentially three different approaches to smart metering that revolve around the approach to which the meter reading data is collected:

- Handheld device data collection
- Vehicle mounted data collection
- Fixed network data collection (AMI) – e.g., pole mounted receiver / transmitter.



Once the ability to transmit to a remote reading device was developed, the majority of municipalities in Canada (with meters in basements) quickly moved to have a remote output. There are only a handful of utilities that still use "direct read" meters. In the late 50's and early 60's, most municipalities switched to either a digital pulse meter (outside odometer) or encoder (remote touchpad technology to extract the reading without having to go into the home). Once this was in place, meter reading was carried out more frequently (typically quarterly).

The introduction of digital signals using signal encoder assemblies allowed the development of AMR which has now advanced into a system that can transfer data directly to a central data collection facility with little or no human intervention. This type of AMR is called Advanced Metering Infrastructure (AMI) systems. Both AMR and AMI are now referred to in the industry as Smart Metering.

The key benefits of smart metering include the efficiency opportunity to read meters automatically which speeds up the process of meter reading, and the elimination of typing errors caused by transcribing the observed reading into a log or device.

Furthermore, the adoption of AMR and AMI technology allows the utility to respond to regulatory changes or pressure from the public, customer lobby groups, and watchdogs who are seeking accountability and transparency from utility providers in a climate of increasing costs. This leads to a need for the utility to demonstrate equity in tariff baskets, provide a variety of billing options and provide value added services to customers, a trend that is commonly provided by other utility providers (gas, electric and communications).

The majority of the large water utilities in Canada have moved towards implementing meters with smart metering technology. Five years ago, most utilities viewed AMR as a cost-effective solution, however utilities are now looking at the more advanced technology of AMI for a number of reasons as indicated below.

Benefits of Advanced Metering Infrastructure (AMI)

Meter Reading Improvements – The costs associated with staff having to physically drive or walk by residences is eliminated or significantly reduced. This reduces any safety concerns associated with this activity as staff do not have to mobilize to collect the data. Data collection is more efficient and manual entry errors are reduced, providing the utility with more accurate and frequent data. Costs associated with fleet, fuel and labour are reduced.

Water Conservation and Data Analytics – Conservation measures can be monitored and quantified by the utility supporting reports on program effectiveness. This is a level of transparency much of the public is expecting. The consumption data can also be analysed for trouble shooting and planning purposes.

Early Detection of Leaks – AMI technology supports the creation of District Metering Areas which can be used by municipalities to detect pipe leaks before extensive damage has been caused by the water. This will reduce the likelihood of excessive erosion and infrastructure damage. Early detection allows for a planned response where repair work can be scheduled for an optimal time mitigating the costs associated with reactive or emergency work.

Customer Service Improvements – AMI supports enhanced customer services including allowing customers to understand their water consumption and compare their consumption to others through web portals or apps, provide access to live data to address billing related issues, and provide leak notifications to the customer or utility. The ability for customers to see real time consumption instead of reviewing historical usage will reduce the number of customers challenging their billings. In addition, the ability to read more frequently allows the utility to move to more frequent billing cycles to help homeowners manage the increasing costs of traditional quarterly billing.

System Versatility – AMI systems provide the ability to add other appurtenances to the system in the future such as pressure sensors, remote shut off valves, acoustic leak detection, and other devices.

2.3.2 Smart Metering – City of Calgary Status

Long Term Metering Strategy

The City of Calgary has widely adopted the concept of smart metering. Currently approximately 88% of The City's meters incorporate technology allowing the reading of meters through hand held data collectors. The remaining are read manually and are currently being targeted for exchange. Every year, new AMR capable meters are installed through the lifecycle replacement program. The approach demonstrates the most basic implementation of AMR.

While many municipalities are moving towards AMI systems there are a number of risks for The City to consider such as:

- The older ERTs (50W and 60W) are not AMI capable and would need to be fully replaced. This would result in some meters being replaced before the end of their service life.
- All ERTs are mounted on the meter in the basement which impedes signal transmission to any devices further than a few meters away. While this works adequately with handheld data collectors that are in relative proximity, the location of the ERT could hinder a possible future AMI implementation leading to the requirement for more network infrastructure to support, if possible at all. The Itron ERTs or new chosen AMI System MIUs would need to be moved outside, which in turn would require wire runs through property walls. While most communities that implement AMI do run wires outside successfully, this may be a significant concern for homeowners. A less favourable solution is to mount the ERT on the basement ceiling rather than on the meter device.
- Currently, water meter reading and billing is managed in conjunction with the electrical utility, ENMAX. Calgary would need to consider how an AMI system would be managed with ENMAX as there could be synergies associated with implementing shared AMI infrastructure. However, the majority of water utilities that have a local electricity utility have opted to keep the AMI systems separated. The drivers and use cases for the system are different and it was determined to be difficult to align priorities and manage the relationships.

Recommendation 2.1: The City should review and build on the strategy for smart metering to keep it current with technology trends and guide decisions made today regarding selection and installation of technology.

3 Metering Technology

3.1 METROLOGY

Metrology is the science of measurement and concerns the measuring device component of the water meter. There are two broad groups of devices:

- a) mechanical meters e.g., standard positive displacement meters
- b) non-mechanical meters such as magnetic flow meters or ultrasonic devices.

3.1.1 Metrology – Industry Practices

The majority of Canadian municipalities continue to use mechanical meters as these provide a number of benefits including:

- **Proven technology** – based on designs over 125 years old.
- **Reliable and long lasting** – Accuracy does decrease over time leading to under reading, especially at low flows, but only nominally at intermediate and high flows. Over time, the internal components of the meter will wear resulting in the meter under-registering the volume of water. The value of lost water at low flow is minimal compared to the cost of meter replacement, but is a key factor that determines meter replacement strategy.
- **Unit Cost** – given that 98% of meters installed in the Canadian market are positive displacement meters, the cost of these devices is relatively inexpensive.
- **Design reliability** – Positive Displacement Meters inherently measure a discreet volume of water. Combined with a mechanical register, the design inherently mitigates over registration. This however, assumes that the correct register is installed (corresponding to meter size) and the data relating to the billing determinants is correct in the billing software.

Although many utilities in Canada have piloted or tried residential non-mechanical flow meters, very few utilities have implemented them as their standard device for a number of reasons:

- **Initial cost** – Higher initial capital cost than for a wholesale implementation; would be a significant impact on the utility. This would be compounded by the need to access customer properties, usually basements, where the majority of meters are located in colder climates.
- **Battery powered** – These devices require the battery to be operational in order to make a reading. The battery is recognized to be the weakest link in the meter assembly. While they are typically expected to have a 20-year life, if they do fail the device stops reading and subsequent usage needs to be estimated.
- **Shorter lifecycle** – The battery life expectancy of approximately 20-years forces the utility to replace the entire metering device within 20-years of installing it, regardless of the condition of the meter. This impacts the cost/benefit or payback associated with meter replacement, and may therefore negate any savings associated with the improved technology. This relatively short replacement cycle does not



compare favorably with conventional mechanical meters which often have an economic life expectancy in excess of 20-years before replacement is required. Mechanical meters will eventually wear with time. There is a break-even point in relation to the rate structure versus accuracy where it makes financial sense to replace the meter. Since the wearing of the aging meter will always favour the customer, with mechanical meters, utilities have the option of altering their replacement strategy if outside factors could potentially delay a replacement program. However, this option is not available with non-mechanical meters that must be replaced to mitigate complete loss of reading.

- **Unproven technology** – Non-mechanical meter technology has not been used for residential water metering for any considerable time to prove battery life. While technology is used in other aspects of water metering, most applications where it is used have power supplies and do not rely on batteries.

However, there are some significant advantages to non-mechanical meters including:

- **Accuracy** – Non-mechanical meters maintains their accuracy curve for the life of the meter. Typically, manufacturers offer a warranty for the 20-year life.
- **Low Flow Accuracy** – Non-mechanical meters maintain their accuracy at low flows for life (typically low flow accuracy degrades more quickly than other flow rates on mechanical meters).

3.1.2 Meters - City of Calgary Status

The City of Calgary uses a mechanical positive displacement meter for its 15 mm to 25 mm residential meters. These meters meet the AWWA guidelines and are an acceptable industry standard for residential billing purposes. The City of Calgary Water Services, has a meter inspection process that ensures meters have the correct register matched to the size of the meter and register configuration is correct to avoid errors when inputting meter information into the billing system.

3.2 MATERIALS

3.2.1 Materials – Industry Practices

The meter casing of both mechanical and non-mechanical meters is predominantly constructed of either bronze or plastic. This is driven by NSF 61 Drinking Water System Component requirements which pertains to the health impacts of materials in contact with water. Many manufacturers now offer lead free bronze alloys which exceed current and potential future Health Canada regulations lead content in water fittings.

Although plastic is less expensive to manufacture only a small percentage of meters installed are plastic. This is partly driven by the relative newness of plastic meters and lack of track record of long term reliability. It is also a function of a preference to use metallic meters to maintain the electrical continuity on metallic pipes negating the requirement for additional grounding straps. Another potential issue with plastic installations is the cracking of the casing when installed on relatively high-pressure systems.



3.2.2 Materials - City of Calgary Status

The mechanical meters used by The City are made of bronze and are entirely consistent with NSF 61 Drinking Water System Component requirements.

3.3 REGISTER

3.3.1 Register – Industry Practices

The register is the component of the device that shows the actual meter reading and has traditionally been made of a series of dials that indicate volume of water passed. Traditional devices are comprised of six dials that indicate down to 100 litre intervals (00000.0 m³). Higher resolution dials tend to have eight dials and register down to 0.1 litre intervals (0000.0000 m³). As the technology improves and the need increases for more accurate understanding of consumption, the trend has been towards the higher resolution meter registers. However, the primary driver to increase resolution is the advanced technology of AMR and AMI which provide features that can enhance the detection of leaks and backflow.

The register is generally a mechanical device or a battery operated digital device. Mechanical registers are the most commonly used devices in Canadian utilities and are a well proven technology that is long lasting with low failure rates compared to battery powered devices. In addition, if a mechanical device does stop working it will not lose the last reading, and therefore reduces the risk of lost consumption up to the point of failure detection.

Electronic registers indicate the meter reading on an LCD display that generally requires battery power to operate. These are generally lower cost units, however they face similar issues to non-mechanical meters that require batteries – i.e., they will completely stop recording in the event of battery failure and will lose the meter reading at the time of failure leading to a greater level of estimation of meter reading and potential lost revenue.

The life expectancy of battery operated devices is typically 20-years which can force a meter replacement timeline that may not be optimal given the other meter components. This will also require access to property basements potentially creating more frequent, difficult and costly replacement programs.

3.3.2 Meter Register - City of Calgary Status

The City of Calgary still uses mechanical registers, which are the most reliable and considered current industry best practice in Canada.



3.4 METER INTERFACE UNIT

3.4.1 Meter Interface Units – Industry Practices

The meter interface unit (MIU) is the component that interfaces with the water meter register and transmits a radio frequency (RF) signal to a receiver for the purposes of automatic meter reading. MIUs typically capture and store hourly consumption data for a period of up to about 96 days (3 months). The data is then downloaded to a data collector (hand held or vehicle mounted) in an AMR type system, or can be transmitted to a fixed receiver in an AMI type system.

The use of RF devices in the home has drawn some public attention regarding exposure to RF fields and its effect on humans. However, the World Health Organization (WHO) states that *“Considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that weak RF signals from base stations or wireless networks cause adverse health effects.”* Smart meter transmissions of RF energy are significantly lower than other types of device such as wireless routers, cell phones or walkie-talkies, and Health Canada concludes that exposure to RF energy from smart meters does not pose a public health risk.

The MIU is usually a programmable device that allows the utility to change meter read intervals, transmission intervals or other parameters. This programming needs to be undertaken carefully as it can impact on battery life and in turn void the warranty on the device, as well as introduce data errors associated with incorrect programming. Most MIUs for AMR applications are shipped pre-programmed reducing the risk of error.

The MIU can be programmed to work with normal AMR (hand held or vehicle mounted data collection) or with AMI systems (fixed network). The trend in MIU deployment is to have a device that can easily be migrated from AMR to AMI to allow for future upgrades while taking advantage of AMR efficiencies today. However, the transmitters need to be powerful enough to make this transmission.

3.4.2 Meter Interface Units – City of Calgary Status

The City of Calgary uses the Itron ERT which is a programmable device that is pre-programmed prior to shipping. In addition to sending the current meter reading to the meter reader, the device stores data for 30 days. While this information can aid high water consumption investigations, the issue will typically not be identified within a 30-day period before the data is overwritten in the ERT.

The City has a number of Itron ERT models currently in use, including the 50W, 60W and 100W models. Only the recent version – the 100W – is migratable to an AMI type system should The City wish to move in that direction. The previous ERTs (50W and 60W) are not AMI capable and would need to be fully replaced.

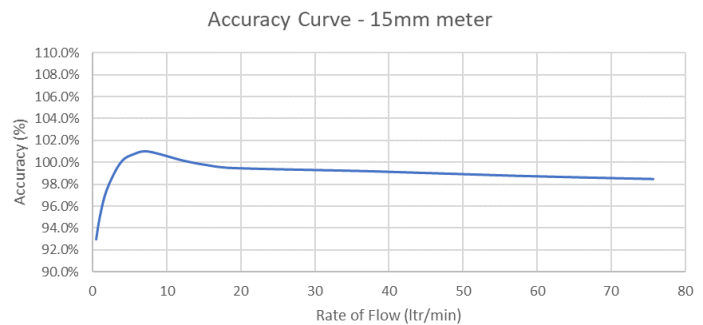


Recommendation 2.1 covers the requirement to review the application of appropriate technology now to support the implementation of technology in line with defined direction of the utility. In the application of new technology, consideration should also be given to the data retention abilities of the MIU.

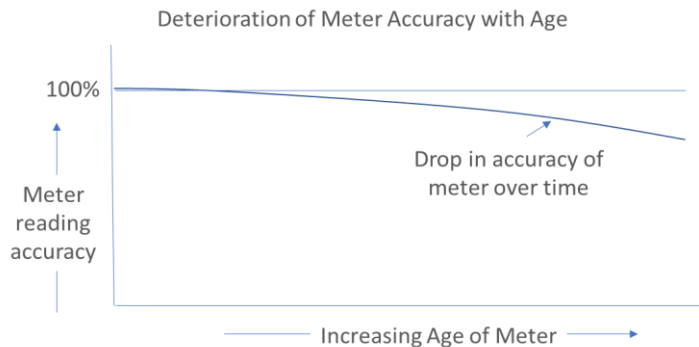
4 Meter Testing & Refurbishment

4.1 METER ACCURACY AND TESTING

Water meters have an inherent variation in accuracy over their design range of flows as indicated in the figure. At low flows, meters in good condition will typically under register. As the flows increase to about 10% of the design capacity of the flow meter, registration of flow increases. At higher flows the accuracy of flow meters reduces. The AWWA sets standards for meter testing accuracy of between 101.5% and 95% of actual volume that passes through the meter compared with what the meter records during testing.



As a mechanical device, water meters are subject to wear and deterioration at a rate that depends on a number of factors including volume of water passed, water quality and rates of flow. The wear and deterioration can also impact on the accuracy of the meter reading and generally leads to a trend of under recording as more flow is able to bypass the worn elements of the device.



Testing of water meters by the manufacturer or utility is of great importance for two main reasons:

- Prior to installation, to protect customers against meter inaccuracy that could result in over-registration and over charging.
- to identify inequities and lost revenue that result from under registration of meters and drive meter refurbishment and replacement programs.

The AWWA has developed guidelines for determining the overall accuracy score for water meters. The guidelines weight the accuracy score determined at different flow rates to reflect overall meter accuracy under normal water usage conditions (see Table 4-1 following). While these weightings may be considered suitable and best practice, an alternate weighting framework may be considered.

Prior to shipping all meter manufacturers test their meters and provide a warranty for meter accuracy for a period or volume passed. These warranties are for a level of accuracy at different flow rates as per the accuracy curve in the figure above. While there is no AWWA guidance on validating these manufacturer test results, some utilities choose to conduct their own quality control of new meter shipments through the testing of a sample of new meters.

The warranty information also typically relates to normal recommended installation i.e., horizontal installation of flow meters. The industry standard and best practice is to install meters in a horizontal plane. All meter manufacturers' installation manuals clearly state this and the AWWA M6 Manual states that meters are designed to optimally perform in a horizontal orientation. Some meter designs have shown uneven and faster wear due to orientation which could lead to the potential of under-registration earlier in the meters life. While many manufacturers have provided letters allowing vertical installations, most utilities adhere to horizontal installation guidance as best practice.



Horizontal Setting of Water Meters in Vertical Pipework

(Source: AWWA M6 Manual)

The industry best practice for removing a water meter that has been taken out of service for testing is to cap or plug the ends of the meter when it is removed. It is then delivered to the testing bench in the same condition including moisture levels in the meter chamber, as it was when in service. Allowing the meter to dry before testing allows the crystallization of dissolved solids. This may lead to under recording on the testing facility.

4.1.1 Meter Accuracy and Testing - City of Calgary Status

Meter Test Accuracy Weightings

Water meters removed from service as part of the water meters replacement program are tested on The City's in-house meter test bench. The City also tests water meters at the request of property owners in relation to anomalous readings, complaints or meters extracted for other reasons. The City uses the accuracy guidelines established by AWWA to score meter accuracy. The testing results are analyzed by cumulative meter usage and an overall meter accuracy score determined based on AWWA guidelines (see Table 4-1 below).

Recommendation 4.1: The City should consider an alternate weighting to the flow rates from AWWA guidelines. An extensive study conducted by another municipality led to a revision of the weightings it uses to determine an overall meter accuracy score that puts more emphasis on low flow accuracy. The study found that a higher proportion of flows through the meter are in the low flow profile for the water meter.

Table 4-1
Water Meter Accuracy Testing Weightings

Flowrates	Gallons Per Minute	AWWA Weighting	Revised Weighting
Low	0.25	15%	30%
Intermediate	1.5	70%	59%
High	14	15%	11%

Recommendation 4.2: The City should analyze results by age versus total consumption (usage). The City should also establish an annual testing plan to sample meters in groups from the field to determine when the optimal change out should be, rather than just meters that have been extracted for complaint or event reasons. Many utilities have found that age based replacement of meters is more economical due to the efficiency gains of being able to work in a neighbourhood with similar aged properties and meters.

Testing of New Meters

New shipments of meters are inspected on arrival according to a work instruction and new meter evaluation checklist. This ensures a consistent approach to the inspection of new meters however, it does not include the actual testing or verification of meter accuracy of new meters.

Recommendation 4.3: The City should consider establishing a program to test new incoming meters from the manufacturer to audit the meters against their test certificates. This program can be adjusted based on results over time.

Installation Orientation

The City commonly installs meters in a vertical orientation. While a letter from Badger does indicate that this is an acceptable practice, it also states that the extended low flow accuracy warranty is void in a vertical orientation. Test benches are always orientated in the horizontal plane, including the Calgary test bench, and therefore it is not possible to test and assure the accuracy of meters installed in the vertical orientation. Positive displacement meters installed in a vertical position are likely to under-register earlier in the meters life, resulting in a shorter economic life cycle or present a revenue risk for The City.

Recommendation 4.4: The City should review its practice of allowing vertical meter installation and determine appropriate course of action to mitigate risks of under-registration.

Capping of Removed Meters

The City's standard operating procedure for removing a water meter from a property for testing does not appear to include any reference to the capping of water meters before delivery to the testing facility. Capping the meter preserves the internal moisture conditions of the meter and enables more accurate testing of meters.

Recommendation 4.5: The City should ensure that the standard operating procedure for removing water meters for testing includes the capping of the meter immediately before conveying to the testing facility.

4.2 TESTING BENCH

4.2.1 Testing Bench – Industry Practices

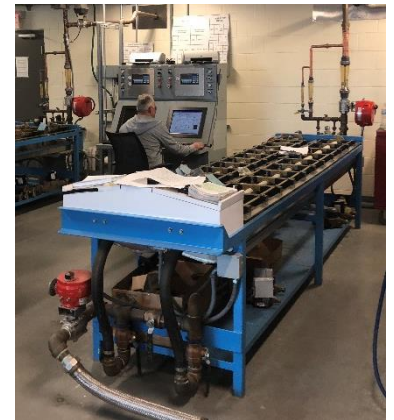
Most utilities test their water meters either in-house, in a purpose built testing facility, or outsourced, often to the meter supplier. For smaller utilities, the cost of developing an in-house testing facility may be prohibitive and outsourcing this activity will be the preferred approach. However, given the volume of meter testing required by a large utility such as Calgary, it is more cost effective to develop an in-house testing facility.



The AWWA M6 manual provides an indication of best practices in the set-up of a testing facility for small, medium and large-scale operations. This includes the use of defined volumes of water, temperature control and testing process from low-intermediate-high flow rate testing. The industry best practice is to start testing at the low flow first to avoid “cleaning out” the meter base. Typically, a meter will develop build up in the meter chamber area from various minerals in the water (depending on water quality, etc., such as calcium build-up). When the meter is tested at low flow first, the meter is operated in much the same conditions as it was when in service with regards to amount of scale build-up on the internal components. Real in-situ low flow accuracy can only be measured if it is done first. As the flow rate is increased, scale will be dislodged and the in-situ conditions are no longer present.

4.2.2 Test Bench Facility - City of Calgary Status

The City of Calgary test bench is high quality and overall testing practices on old meters are good. The use of the MARS Small Test Bench is well controlled by a standard operating procedure and associated work instruction that provides a clear indication of the required set up and running of the facility including the software. The software, while recognized to be dated, is still adequately functional for the purposes of testing water meters.



Testing Sequence

City staff indicated that the testing of meters begins at high flow rates and then proceeds to intermediate and then low flows, contrary to best practices indicated above.

Recommendation 4.6: Consideration should be given to changing the order of testing to follow AWWA best practices of low-intermediate-high order of testing.

4.3 REFURBISHMENT AND REPLACEMENT OF WATER METERS

4.3.1 Meter Refurbishment and Replacement – Industry Practices

Refurbishment of residential water meters is not common practice and is largely a function of the unit price of a meter versus the labour cost for time spent refurbishing the meter. A number of factors impact on both of these dimensions including the size of the utility (economies of scale), specifications of the meter and the ability to replace individual components of the meter assembly (meter housing, register and MIU).

The lack of cost effectiveness to refurbish a meter drives most utilities into a meter replacement program. At the time of extraction of a meter, typically a new or tested meter will be reinstalled. The extracted meter will be subsequently tested for accuracy, if within age or usage limits, and be shelved or scrapped depending on test results.

Typically, the meter and register would be replaced at the same time. The replacement of the MIU is dependent on the type of register and where it is mounted. MIUs mounted to the exterior of the property would be typically left in place (depending on the age and warranty of the MIU), however an integrated meter-register-MIU assembly would be replaced as a single unit.



Best practice planned replacement programs are developed based on statistical testing results on meter accuracy that would determine an optimum age or volume for meter replacement which balances the cost of replacement with the value of potentially lost revenue to the utility. Industry best practices are to manage meter replacement programs around age to allow for more efficient installation programs by working in neighbourhoods with common installation profiles. This is also supported by easier access to the meter information in the utility meter asset management system. A usage driven program would result in more random locations throughout The City, leading to a relatively inefficient replacement program.

4.3.2 City of Calgary Refurbishment and Replacement Practices

Meter Refurbishment

The City of Calgary has a relatively low unit price for water meters driven by the economies of scale in purchasing meters. The integrally mounted ERT necessitates the replacement of the whole unit at the time of meter extraction. The City does currently undertake limited repairs and refurbishments of approximately 25% of the meters it exchanges. This includes the removal of the transponder and potential redeployment subject to testing success.

Recommendation 4.7: The City should continue to review the cost effectiveness of the number of repairs completed on water meters through the consideration of labour costs, and average accuracy of repaired device versus the cost of new meters and their associated accuracy.

Guidance for Disposal or Refurbishment

The work instruction for repairing meters does not give any indication as to the conditions that should be met for a meter to be repaired.

Recommendations related to this practice would be to decouple the register and ERT, and potentially retrofit to an existing meter that is not too old (i.e., less than 10 years). The shipping combination of register, ERT and base should also be investigated further to clarify if there is a programming issue that prevents older components being coupled with newer components.

Recommendation 4.8: The City should determine and document clear guidance on when meters that have been removed from service should be refurbished. This should also include an indication of the components of the meter assembly that can be redeployed onto a different metering assembly.

Data Analysis

It is clear that the City has undertaken considerable analysis of testing results and financial analysis on optimal timing for replacement of water meters in line with best practices. The analysis of low, medium and high flows on different meter sizes would be considered industry leading. However, a high level review of the statistical regression analysis indicates that more data is needed to support the fit of the trend line of meter accuracy over time. The insight gained may lead to enhancement of optimal lifecycle replacement intervals associated with meter under-registration.

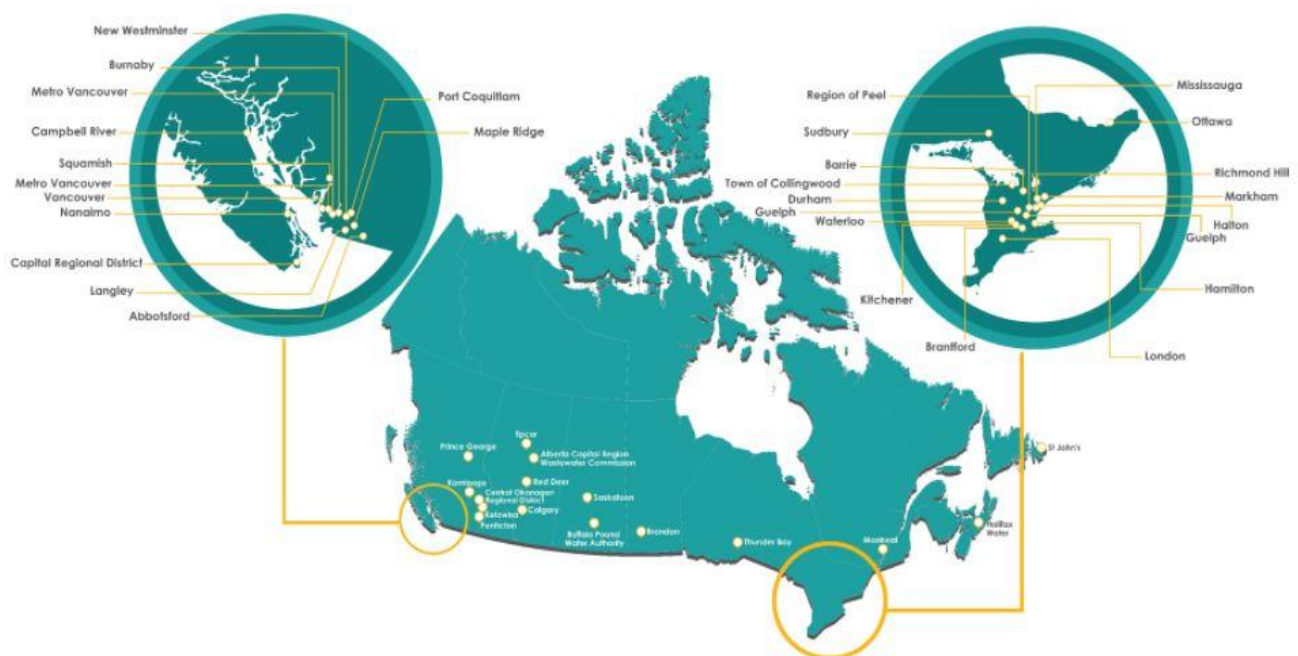
Recommendation 4.9: The analysis of flow meter testing results should be investigated further to confirm the optimal meter replacement strategy. This will be further supplemented by increased testing data that will be gained on the implementation of Recommendation 4.2.

5 Benchmarking Study

5.1 BENCHMARKING APPROACH

The benchmarking study is intended to provide a comparison of The City's metering practices with those of other municipalities. The study does this by comparing a number of metrics such as percentage of types of meter installed, as well as a comparison of processes applied in other municipalities.

The benchmark survey consisted of two components. The initial survey was sent to municipalities using the *National Water and Wastewater Benchmarking Initiative* (NWWBI) network. NWWBI was created in 1998 to allow Canadian municipalities to measure, track, and compare utility performances. It currently consists of 55 municipalities from across Canada as indicated in the figure below.



Questions were sent to the participating municipalities using an online survey provider. This initial phase is a broadcast effort, intended to acquire general information from a broad set of municipalities.

Based on the results from the NWWBI survey, three communities were selected for follow up discussions, allowing for a more detailed review of their metering infrastructure and management practices. The filtering criteria between the two phases was dependent on each municipality's service size, types of meters and registers, maintenance practices, replacement strategies and consumption issues. Discussions were focussed on fine tuning results from the initial NWWBI survey to gain a greater understanding of the key components that Calgary wishes to compare.

5.2 BENCHMARKING SURVEY

The NWWBI survey is split into three sections, focussing on meter and register type, maintenance and replacement strategies and high consumption incidents, respectively. The questions are as follows:

Section 1 – Meter Types and Meter Reading

1. How many small (15 mm - 25 mm) residential meters do you have?
2. What type of small residential water meters do you have in your system? E.g., solid state, positive displacement, multi-jet, other?
 - What is the percentage of total (residential) meters for each type?
 - What type of meter are you currently installing for residential customers?
3. What meter reading systems do you use and what percentage of your customers are on each of those systems? E.g., manually read, AMR or AMI?
 - What is your reading percentage rate for each type?
4. What is the meter reading percentage (monthly/quarterly/annually by breakdown of meter?
5. What type of meter register do you have in your system? E.g., Pulse, encoder, direct read
 - What is the percentage for each type?

Section 2 – Meter Replacement/Accuracy

6. Do you have a small meter replacement strategy or program? Please describe.
7. Do you test your small meters for accuracy after they have been replaced; Do you use this testing information to further develop your replacement strategy?
8. Does technology drive any part of your replacement strategy?



Section 3 – High Customer Consumption

9. For Customers who have a high consumption billing concerns, do you have field staff that will go on-site and investigate the issue? If so, what will they check? E.g., Help customer identify leaks, check meter for signs of damage to the meter, verify meter reading.
10. Do you have a QA/QC program or test for new meters supplied to you?
11. If a customer is disputing the accuracy of the meter, do you have program to test the meter?
12. Does your Utility have fees/charges associated with meter testing for dispute resolution? (YES/NO answer.)
 - If you answered yes, can you please describe the fees/charges included in meter testing?

5.3 RESULTS OF BENCHMARKING

A total of 10 municipalities responded to the NWWBI survey. Since all members of the NWWBI enter into a confidentiality agreement that commits to the protection of the identities of the participants, each respondent has been assigned an alpha-numeric identifier in the charts that follow.

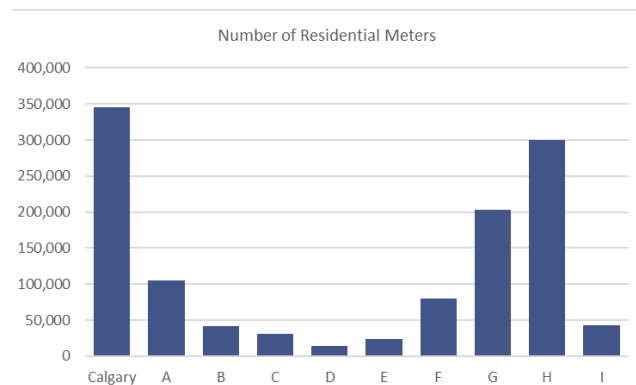
The answers to the questions were tabulated and graphed to determine if there are obvious trends or patterns.

Installed Meter Base

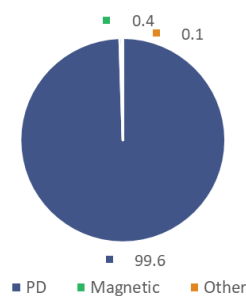
Of the municipalities surveyed the meter base varies significantly. The installed meter numbers ranged from 14,000 meters to 345,000 meters, with Calgary being the largest.

Despite the variation in size of installed meter base, it is clear that all municipalities have a predominance of mechanical positive displacement meters for their residential customers. A small number of magnetic meters are in use and one community is currently installing new magnetic meters.

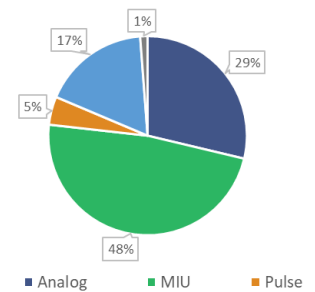
Most cities had a combination of the older pulse type registers and the newer encoder type. It was not clear from the data if cities were making a concerted effort to move towards one type or the other. As discussed in Section 2.1 the preference for one type over the other is a complex issue and each municipality will make that decision based on a number of factors.



Water Meter Type, All Responses



Meter Register Type, All Responses



Calgary Summary	Comparison with industry:
Installed meter base: 345,000	Industry standard
Type of meter: 100% positive displacement	

Terminology

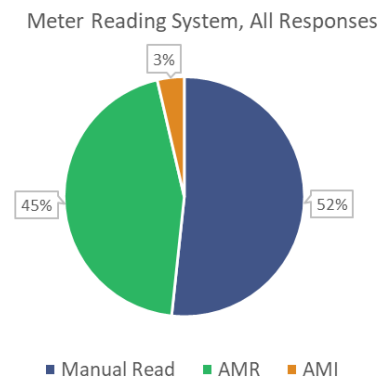
The results of the survey revealed some differences in the industry in the usage of terminology. In order to verify the data, phone calls were made to some municipalities to clarify information; such as what was meant by 'manual read'. It was discovered that some people felt 'manual' meant a person had to enter a household, read a meter register and write the information down. To others, it meant the meter reading

was sent to a touchpad located outside the house which was then read by a person touching a probe to the touchpad. For the purposes of this analysis, AMR included installations where the reading is sent to an MIU and read through the use of a reading device including touchpads.

Smart Metering and Advanced Metering Infrastructure (AMI)

All the municipalities in the survey have installed, or are planning to install, some type of AMR system. The survey indicates that 5 of the 10 municipalities surveyed take meter readings monthly with the remaining bi-monthly or quarterly. There is a strong correlation with reading frequency and application of AMR.

Only two municipalities indicated any use of AMI systems, although a number indicated a plan to move towards AMI. In follow-up phone calls, other municipalities indicated they were also contemplating moving to AMI and some had it written into Master Plan documentation, although this was not reflected in their responses to the survey.

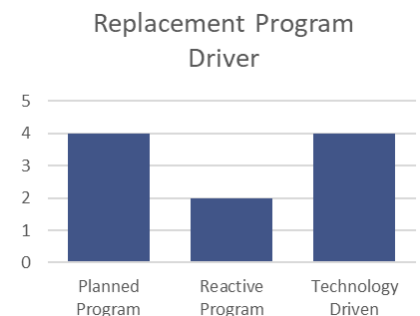


Calgary Summary	Comparison with industry:
Application of Smart Metering: 88% handheld AMR Non-smart meters: 12% direct read	Industry standard

Meter Replacement and Strategy

Four municipalities have a replacement strategy driven by age or usage of the meter. Two municipalities replaced meters only on a reactive basis. The remaining municipalities (four) have either completed or are in the process of a wholesale change of meters in line with a strategy to adopt AMR or AMI.

The majority of the respondent's report using a combination of contracted replacement work for the main replacement programs, and in-house replacements usually on a small scale.



Calgary Summary	Comparison with industry:
Meter replacement program: Planned replacement program based on usage and technology	Industry leading

High Customer Consumption

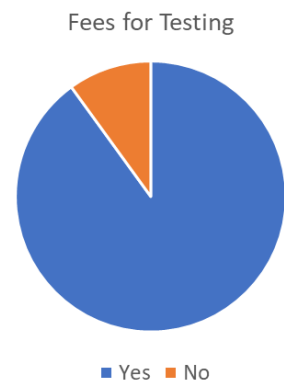
The survey results indicate that all municipalities surveyed offer field services to customers who have high consumption billing concerns. When a customer called in expressing a concern with an unusually high bill, staff would work with the customer to determine if there is an obvious cause. The consistent components include leak checks and detection practices, confirmation of meter operation and accuracy, and discussion points and information to facilitate customer understanding. In follow-up conversations with municipalities

one noted they proactively notify customers when their usage is unusually high. In this case, billing is reviewed before being sent out. If a billing varies beyond a threshold amount, it is flagged for a proactive notification. The customer is provided with a package in the mail that notifies them of the anomaly and provides a checklist of potential sources of water leaks for the customer to check. If the usage is extremely high, the utility will call and visit customer's residences. Most municipalities had sent educational brochures in the past; however, few were continuing the practice on an on-going basis. A small number of communities had a Water Conservation group that took on the task of educating the public.

Calgary Summary	Comparison with industry:
Provision of meter checks and leak investigations	Industry standard

Meter Reading Disputes

In cases of disputed meter accuracy, 90% of municipalities in the survey, including Calgary, will have the meter tested for accuracy when a customer disputes the consumption record and make a request. The charges for testing are the responsibility of the customer if the meter is found to be operating within the accuracy guidelines recommended by AWWA or the manufacturer's specifications. Some municipalities' policy is to charge a fee upfront for this service and then refund the money if necessary. Others will charge the customer only when the test shows the meter was the cause of the high consumption record. Fees for testing ranged from \$87 to \$230.



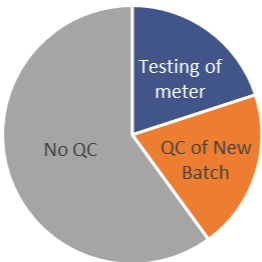
No municipalities reported testing results that showed the meter was over registering. There were some responses that found occasionally errors occurred due to mismatched components or programming errors. Some municipalities indicated they felt a move to AMI would reduce the amount of time and resources required to address the concerns of customers. The quicker response time would also help reduce the amount of revenue lost.

Calgary Summary	Comparison with industry:
Customer initiated meter testing for disputes	Industry standard

New Testing Meter Accuracy

Only one municipality indicated that they tested new, factory supplied meters, although another indicated they had done this in the past. The costs associated with this process were felt to outweigh the benefits. Municipalities made this decision based on the fact that when meters were tested due to high consumption complaints or at the end of its service life, there was a very low incidence of meter failure. Two further municipalities, including Calgary, conduct verification of new batches of meters through inspection and matching of test certificates. The remaining municipalities do not conduct any quality control (QC) on manufacturer supplied meters.

Quality Control and Testing



Calgary Summary	Comparison with industry:
QC inspection is carried out on new meter shipments	Industry leading

The review of the survey results indicates that Calgary meets or exceeds standard metering industry practices in identified areas. The results of the survey have been used to help formulate the recommendations indicated in Section 3 and 4 of this report.

6 Summary and Conclusions

Water metering technology is well proven and has been applied to support billing of water consumption since Roman times. The City uses an industry standard positive displacement meter for residential metering purposes. These meters have a design that is extremely reliable, inherently mitigates over recording, and provides an accurate record of consumption for many years before requiring replacement. 98% of meters installed in Canada are positive displacement meters. The replacement of these devices is driven by the wear of mechanical parts that leads to the under recording of water consumption. This requires the utility to replace the meter to mitigate potential loss of revenue.

Most municipalities have already transitioned from manually read meters to smart meters that transmit meter readings automatically to a data collector. There is also an industry trend in support of converting to AMI systems as all survey respondents acknowledged the many benefits of the advanced technology; however, making a business case for the transition has proven to be challenging for most municipalities. Implementation of an AMI system may have a significant impact on the billing process where billing is shared with or carried out by another utility provider.

The results of the survey indicate that most, if not all, municipalities are faced with customers concerned about high consumption billings. Most municipalities respond to these concerns the same way, that is, a visit to the customers home to check for leaks in fixtures most typically at fault, such as toilets and water softeners. Most municipalities have a process whereby a customer can have their meter tested for accuracy. If the meter is found to be over-registering, the municipality has a process for correcting the billing error. When the meter is found to be accurate, the customer pays for all expenses related to the meter testing.

It is also clear that The City is in the upper quartile for most practices including testing and verifying the accuracy of meters, extent of analysis of testing results and determination of optimal replacement strategies for meters.

The problems The City is currently experiencing regarding the public's perception of inaccurate billings is not unique to Calgary; all municipalities that were a part of this survey have the same response from customers. It is also worth noting that other municipalities have not experienced a meter failing by over reading consumption. The experience reported indicated the failure of a meter resulted in it under reading consumption. There were some municipalities that found errors in mismatched components or errors in programming resulted in over billing of customers.

7 Recommendations

Through the review, a number of practices were identified that could be improved. A full explanation of the rationale in support of the recommendations is indicated in the relevant sections of the report including the observation or finding that lead to the recommendation.

The review of the recommendations would indicate that there are three key themes into which they can be categorized:

- **Strategy Development** – This includes recommendations that relate to the development of overall metering strategy or clarification of strategy elements such as repair versus replacement.
- **Meter Testing** – This includes recommendations that relate to the actual meter testing process including obtaining more representative testing results, changing the order of the testing process and improving the interpretation of testing results.
- **Meter Installation** – There is a single recommendation that relates to the physical installation of water meters in customer's homes.

The recommendations from within the document are captured in the three defined categories below.

Strategy Development

Recommendation 2.1: The City should review and build on the strategy for smart metering to keep it current with technology trends and guide decisions made today regarding the selection and installation of technology.

Recommendation 4.7: The City should continue to review the cost effectiveness of the number of repairs completed on water meters through the consideration of labour costs and average accuracy of repaired device versus the cost of new meters and their associated accuracy.

Recommendation 4.8: The City should determine and document clear guidance on when meters that have been removed from service should be refurbished. This should also include an indication of the components of the meter assembly that can be redeployed onto a different metering assembly.

Meter Testing

Recommendation 4.1: The City should consider an alternate weighting to the flow rates from AWWA guidelines. An extensive study conducted by another municipality led to a revision of the weightings it uses to determine the overall meter accuracy score that puts more emphasis on low flow accuracy. The study found that a higher proportion of flows through the meter are in the low flow profile for the water meter.

Recommendation 4.2: The City should analyze results by age versus total consumption (usage). The City should also establish an annual testing plan to sample meters in groups from the field to determine when the optimal change out should be rather than just meters that have been extracted for complaint or event reasons. Many utilities have found that age based replacement of meters is more economical due to the efficiency gains of being able to work in a neighbourhood with similar aged properties and meters.

Recommendation 4.3: The City should consider establishing a program to test new incoming meters from the manufacturer to audit the meter against their test certificates. This program can be adjusted based on results over time.

Recommendation 4.5: The City should ensure that the standard operating procedure for removing water meters for testing includes the capping of the meter immediately before conveying to the testing facility.

Recommendation 4.6: Consideration should be given to changing the order of testing to follow AWWA best practices of low-intermediate-high order of testing.

Recommendation 4.9: The analysis of flow meter testing results should be investigated further to confirm the optimal meter replacement strategy. This will be further supplemented by increased testing data that will be gained in the implementation of Recommendation 4.2.

Meter Installation

Recommendation 4.4: The City should review its practice of allowing vertical meter installation and determine appropriate course of action to mitigate risks of under registration.

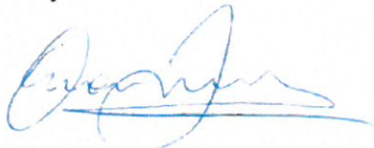
REPORT

Certification Page

This report presents our findings regarding the City of Calgary Water Metering Review Residential Metering Technology.

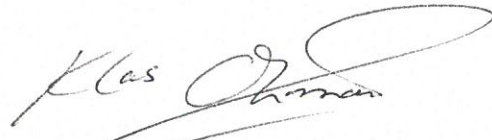
Respectfully submitted,

Prepared by:

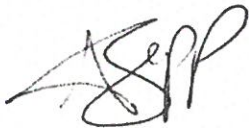


Owen James, C.WEM, C.Env., MIAM

Reviewed by:



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January 15, 2018

Rob Spackman
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In response to City of Calgary municipal customer inquiries related to ENMAX water meter reading, billing and invoicing services, ENMAX engaged an independent third party to conduct a review of ENMAX meter reading, high consumption detection, data and invoicing practices. The investigation focused on three areas:

- the accuracy of the flow of data from meter reading to ENMAX's billing system,
- the validation that the correct consumption volume and correct rates were used through to the correct invoicing to customers,
- and that the City of Calgary's high-consumption identification and notification process was functioning correctly.

ENMAX has reviewed the findings of the independent third party review and has high confidence that its meter reading, high consumption detection, data and invoicing practices are operating effectively and reliably. Highlights of the review included:

- a complete review of all water meter reads dating from January 2015 through July 2017 to their equivalent records in the billing system. The independent third party identified that the records matched or were inherently unmatchable for acceptable reasons (such as proration, or estimation), and in the few instances requiring additional investigation, ENMAX is completing a review. Of note, none of the instances requiring review are related to high water consumption.
- a review of a statistically significant sample of invoices over the same January 2015 through July 2017 period with the findings that all invoices had the correct consumption, rate information and water billing calculations,
- and a test of the process that ENMAX uses to identify abnormally high consumption reads. ENMAX has reviewed the results and confirms that the process is operating as intended.

This will complete the engagement for independent investigation of ENMAX's water meter reading and billing practices related to the service agreement with the City of Calgary's water utility. ENMAX is pleased with the extensiveness and thoroughness of this review and therefore continues to have a high degree confidence in its systems and practices. No further actions are required by ENMAX as a result of this investigation and ENMAX believes that this closes any outstanding obligations.

Sincerely,

A handwritten signature in dark ink, appearing to read "Corry Poole", written in a cursive style.

Corry Poole
VP, Customer Experience

Wastewater Rate

Rates

Within utilities, it is an approved industry practice (according to the American Water Works Association (AWWA)) to have customers classified into customer classes according to the demands that they place on utility systems, especially for establishing rates. As per the AWWA M1 manual¹, “it is neither economically practical nor often possible to determine the cost responsibility and applicable rates for each individual customer served”. Common customer classes in water utilities are residential, residential multi-family, and industrial, commercial and institutional (referred to in the Wastewater Bylaw as General Service). Often, utilities break these general groups down further based on similar servicing requirements and demands.

Rates for water and wastewater services are recommended to Council by Administration for consideration and approval, and are based upon the cost of providing these services to customers. The Water Utility is currently undertaking a Cost of Service Study, and the recommendations from this study will be presented to Council through SPC on UCS in June 2018 and will inform the rates for 2019-2022.

Wastewater Return Factor

Not all water used enters the wastewater collection system and this concept is applied to establish the wastewater rate, referred to as the wastewater return factor. The wastewater return factor is defined as the proportion of water used that is returned to the wastewater collection system.

To calculate the wastewater return factor, water and wastewater system demand is analyzed as part of a cost of service study, which takes place every 4 years.

The customer class is looked at aggregately, and a specific return factor is calculated for each customer class. It is calculated by comparing the customer class' water use, excluding the peak for outdoor water use, to the class' total water use, all on an annual basis.

The following table summarizes the return factors for various customer classes, as articulated in the Wastewater Bylaw.

Customer Class	Wastewater Return Factor
Residential Metered	0.90
Multi-Family Residential	0.97
General Service	0.90

¹ American Water Works Association, “Principles of Water Rates, Fees, and Charges: Manual of Water Supply Practices M1”, Sixth Edition, 2012

The return factor for each customer class is reflected in the wastewater rate that is applied to the volume of water used by that customer class; the higher the return factor, the higher the wastewater rate the customers in that class will pay.

For example, the wastewater return factor for residential metered customers is 0.9, meaning on average 90% of water used by the single family residential customer class is returned to the wastewater collection system. This means that 10% of the water used is not returned to the wastewater system, primarily attributed to outdoor use.

The bill for a residential metered customer does not show wastewater charges based on 90% of the volume of water used. Instead, the customer is charged a lower rate for wastewater, adjusted based on the wastewater return factor for that customer class. The already adjusted rate is what appears on the bill.

Consumption patterns will be analyzed as part of the upcoming cost of service study, and if there are changes in consumption patterns, the return factors will be updated and will be incorporated into rates, and will be in effect for the period of time for which the rates are approved. Application of a wastewater return factor to determine wastewater charged is considered industry best practice as wastewater is not metered.

The calculation below shows a sample of how the return factor is calculated.

Residential Metered Customer Class Return Factor Calculation Example (2016 Data)

Volumes in cubic metres (m³)

- Average monthly consumption in the Dec-Feb period* is 5,120,590 cubic metres per month.
- Dec-Feb annualized consumption is 5,120,590 cubic metres per month x 12 months = 61,447,100 cubic metres
- Total annual consumption residential metered customer class is 67,411,100 cubic metres

$$\frac{\text{December – February annualized consumption (61,477,100 m}^3\text{)}}{\text{Total residential annual consumption (67,411,100 m}^3\text{)}} = 0.91$$

(Based on 2016 data, ~91% of water is returned to the system on average)

*It is assumed that in Dec-Feb period, 100% of water used is collected in the wastewater collection system.

While the information above shows the sample calculations, the table below includes a summary of single family residential consumption data for 2014-2016 that supports the 0.9 return factor.

Customer Class	2014		2015		2016		3-Yr Average WS Return Factor
	Dec-Feb Annualized Consumption m3*	Total Annual Consumption m3	Dec-Feb Annualized Consumption m3*	Total Annual Consumption m3	Dec-Feb Annualized Consumption m3*	Total Annual Consumption m3	
Residential	59,627,237	66,428,908	59,480,601	67,952,914	61,447,073	67,411,086	0.895

Customer Experience

The Water Utility recognizes that the presentation on the bill is not clear for customers. Many customers characterize the wastewater charge on a specific bill as overbilling, because they recognize that a portion of water use during the summer is often outdoors, but this is not reflected clearly on the bill.

There are some customers that return less than 90% of the water to the sewer and some customers that return more than 90% but the wastewater return factor is based on the full customer class, and not the individual customers within the class. It may not seem fair in every individual case, but with these rates and the analysis done to inform them, the goal is to achieve equity across the whole customer class. The alternative to using a wastewater return factor would be to install wastewater meters in individual homes; installation and maintenance of this infrastructure would increase costs for individual customers significantly.

Customers have also indicated that, based on the presentation of drainage and wastewater charges on the bill, they are seen as connected services as opposed to two lines of service.

The Water Utility is committed to improving clarity and transparency on the bill and will be considering ways to modify how the information is presented in the future.

Consumer Appeal Mechanisms and Governance Oversight Approaches Preliminary Option Analysis

Law and Legislative Services conducted a preliminary review of options for potential consumer appeal mechanism and governance oversight approaches possible within the City of Calgary's existing governance structure and authority. Options include 1) Monitoring the effectiveness of the new (October 2017) customer escalation process, implemented as part of the new bill adjustment process; 2) using an existing board such as the Licencing and Community Standards Appeal Board; or 3) establishing a new Council committee or appeal body.

Option 1: Use the billing adjustment escalation process established in October 2017 and monitor and evaluate effectiveness

The new billing adjustment process may address some of the concerns identified in the Notice of Motion, as it includes more formal oversight and escalation to The Director, Water Resources for decision in select cases. Law and Legislative Services has acknowledged this as a formal escalation process. If the desire is to have greater independence from Administration, the new Standard Operating Procedure could be combined with a final review by a committee or tribunal (further discussed in option 2 and 3).

Since October 2017, under this new process, over 250 customers requested a review by the Director, Water Resources.

Option 2: Utilize an existing municipal appeal mechanism; namely the Licence and Community Standards Appeal Board

The Licence and Community Standards Appeal Board is a quasi-judicial board established under the *Municipal Government Act* (MGA) and under bylaw 50M2011. Currently, the Board hears appeals on a variety of matters including: remedial orders (including remedial orders under the Water Utility Bylaw), Livery Vehicle licences, certain event licences and more. The potential exists to amend the scope of this Board to allow it to hear customer appeals related to water bills. Further consideration would be required to consider the appropriateness of the Licence and Community Standards Appeal Board for this kind of review, as the subject matter will vary from that of remedial orders.

In order to expand the scope of the jurisdiction of the Licence and Community Standards Appeal Board, the Water Utility Bylaw and the Licence and Community Standards Appeal Board Bylaw would have to be amended. Additionally, necessary procedures and resources to support the Licence and Community Standards Appeal Board members in administering reviews would need to be established. While this process will take some time to complete, it would be less time and resource intensive than drafting a new bylaw for a new board.

Option 3: Establish a New Committee or Board for Water Bill Appeals

A third option would be to establish a new committee or board specifically for hearing water bill appeals, which would require drafting and adopting a new bylaw. Further logistical and organizational arrangements would also need to be made including adequate staffing, drafting the necessary materials and establishing procedures. This would be much more resource intensive than leveraging an existing mechanism.

In consideration of the above options, pursuing an expanded scope for the Licence and Community Standards Appeal Board appears to be most feasible, as it leverages an existing mechanism, independent of Administration, minimizing the resources required to develop and administer. However, further in-depth evaluation of the viability of the Licence and Community Standards Appeal Board as a formal appeal mechanism is required.