2016 ENVIROVISTA REPORT

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INTRODUCTION

The health of our water supply affects us today and tomorrow. That's why EPCOR goes above and beyond to protect the environment while ensuring future generations have access to clean, safe water.

EnviroVista Champion status is awarded to organizations that promote environmental leadership and recognizes environmental excellence. This is a voluntary provincial program sponsored by Alberta Environment and Parks (AEP) Partners in Excellence initiative. EnviroVista provides unique regulatory status for participating Alberta industrial and manufacturing facilities, including municipal water operations.

EPCOR's Waterworks system was granted EnviroVista Champion Status on June 1, 2011. In our stewardship agreement with the province, EPCOR committed to a set of environmental initiatives that go above and beyond the typical approval-to-operate requirements for municipal water operations.

Many of these commitments are programs and activities EPCOR has had in place for a long time. They are simply how we operate. The Stewardship Agreement recognizes continuous improvements and commits EPCOR to maintaining certain programs, initiatives and performance levels going forward.

Why did we make these commitments? Because we know that continuing these programs is the right thing to do to continue to improve and protect the environment and public health.

HIGHLIGHTS OF 2016 ENVIROVISTA INITIATIVES AND CHALLENGES:

- EPCOR's Drinking Water Treatment Plants completed a second year of **ISO14001** Environmental Management System **registration.** The Distribution and Transmission System completed their registration requirements in early 2017 and will be fully registered to ISO14001 by mid-2017.
- EPCOR received approval to move forward with a comprehensive multi-year water quality monitoring program on the North Saskatchewan River that will provide a better assessment of source water quality and river health. This first-of-its-kind monitoring program will begin in 2018.
- EPCOR initiated a Green Energy initiative that will use green energy sources to supply up to 10% of the energy used to supply drinking water to Edmonton customers. EPCOR has begun to evaluate solar panels as an option to produce this power.
- Energy efficiency was lower than in previous years. Cool and rainy summer weather resulted in a decrease in water demand and lower pumping efficiency, which impacted our ability to meet the system energy index target of 665 kWh/ML.
- EPCOR's energy efficiency initiatives expanded to include the use of energy within the buildings we operate in addition to energy used to pump water at the water treatment plants, the field reservoirs and the booster stations.
- The **Drinking Water Safety Plan was once again reviewed and expanded.** We identified new action plans to better mitigate 14 risks. Action plans were also completed for six risks that were already in the plan.
- EPCOR developed a Water Emergency Exercise Plan for the regional water system with AEP and Alberta Health Services. As part of this plan we co-led a "Troubled Water" desktop emergency exercise involving multiple agencies.
- Our team replaced 292 old lead service lines in Edmonton making 2016 our most successful year since the program began in 2008. We have now replaced 1512 old lead service lines since 2008.
- As part of the Random Day Time (RDT) sampling program, we collected and tested 316 water samples from across the City for lead at the tap. This annual testing program helps us to better assess lead levels in all types of homes and the need for better corrosion control that will reduce lead release from lead service line pipes and plumbing components within homes (like old lead-tin solder and high-lead brass).
- Completed a drain audit at the water treatment plants and reservoirs to identify any piping cross connections that might result in environmental releases to the river or creeks;
- **Edmontonians, on average, used 304 litres of water per person per day** (L/p/d). This is well below the Alberta Urban Municipality Association (AUMA) water use target of 341 L/p/d by 2020; To support water conservation across the City we initiated an information program aimed at addressing high water consumption in schools and subsidized housing.
- EPCOR achieved the lowest level of water loss in the distribution system with an **infrastructure leakage index (ILI) of 1.06**. The industry bench mark is less than 3.0;
- We expanded monitoring of the environmental impacts of releases of treatment solids to the river from the water treatment plants to include an assessment of the impact on the benthic organisms that live in and on the river bed.

River conditions in 2016 were very challenging and we were not able to convert the water treatment plants (WTPs) to direct filtration operations until much later than planned. As a result, we did not meet our goals to continuously reduce the amount of the solids released to the river.

ENSURING PUBLIC HEALTH PROTECTION AND MINIMIZING ENVIRONMENTAL RISKS

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

EPCOR's E.L. Smith and Rossdale Water Treatment Plants (including the system reservoirs) were first registered under both ISO 14001:2004 and OHSAS 18001:2007 in February 2015. These are two international standards for managing facility environmental (EMS) and worker safety (Occupational Health & Safety Management System) requirements, respectively. Collectively these are referred to as the Edmonton Water Treatment Plants integrated Management System (EWTPiMS).

The EMS was originally certified under ISO 14001:2004 by the registrar SAI Global in early 2015. Internal and surveillance audits conducted in 2016 were completed to meet the requirements of both standards and maintain dual registrations of the EWTPiMS. The EWTPiMS conforms to the EPCOR enterprise-wide Health, Safety and Environment Management System HSE-MS which provides an overarching set of high-level standards and procedures that support all of EPCOR's operational activities, in Edmonton and elsewhere. At the Edmonton WTPs and reservoirs, site-specific standard operating procedures (SOPs) address both environmental risks and hazards to workers in each operational functional area.

All audit findings are tracked in a formal Audit Tracker worksheet to facilitate the management of corrective actions. As per the audit schedule for the EWTPiMS, the annual surveillance audit by the Registrar (SAI Global) was conducted in November 2016. The EWTPiMS satisfies the commitment for EPCOR Water Treatment Plants to have an ISO 14001 accredited EMS under the EnviroVista Champion Approval and the related Stewardship Agreement. The ISO 14001 international standard was updated in 2015 to include additional requirements – referred to as the ISO 14001:2015 standard. Transitioning the EWTPiMS to the new ISO 14001 Standard is currently underway and the November 2017 re-registration audit will be to the new Standard.

In addition to the WTPs and reservoirs, the Edmonton Waterworks System includes a large network of pipes and transmission mains – collectively known as the Water Distribution & Transmission (WDT) system - that delivers potable water from the WTPs to reservoirs and from reservoirs to customers. Significant progress was made in 2016 to implement an integrated HSE management system for the WDT system. This system, referred to as the EWDTiMS, will be registered in early 2017 under ISO 14001:2015 and OHSAS 18001:2007. This will fulfill our EnviroVista Stewardship Agreement commitment to have the complete Edmonton Waterworks system registered to ISO 14001 – a major milestone for EPCOR Water Canada.

OPERATIONS PROGRAM

The Operations Program for the Edmonton Waterworks is comprised of plans, operational philosophies and procedures used by staff to manage the waterworks system. This ensures consistent production and reliable delivery of high quality drinking water, while reducing environmental impacts. The comprehensive Operations Program document is a requirement of the EnviroVista Approval and is an integral component of the Edmonton Waterworks' Environmental Management Systems (EWTPiMS and EWDTiMs) that are or will soon be registered under ISO 14001. A team of subject matter experts from across EPCOR Water Canada collaborate throughout the year to keep the Operations Program up to date and changes to the Operations Program are reviewed annually by management. The first Operations Program was first released on December 31, 2012. The most recent revisions to the Operations Program were completed on February 28, 2017 and included:

- Improved consistency for document management and record keeping for all sections of the Operations Program.
- A risk-based approach to hydrant inspections beyond the annual inspection frequency will be implemented in 2017 to meet the requirements of the City of Edmonton Fire Rescue services group.

- In 2016, EPCOR Water Distribution and Transmission completed a process improvement initiative to change the approach to working with developers planning infill development.
- For EPCOR's Cross Connection Control Program, a new City of Edmonton bylaw 17698 and an associated CCC guide was issued. This strengthens compliance and enforcement tools for the cross connection program.
- Routine monitoring in the Distribution System remains the same, but we have adjusted types of locations based on historical risk. We have reduced sampling at field reservoirs and increased it at other locations in the system (dead ends, customer locations, public facilities).
- Updated statistics for the Lead Response Plan (now exceeding targets for lead service line replacements). Information on the lead program is available on EPCOR's website and will be reviewed annually. An update of the Lead Response Plan is also provided later in this EnviroVista annual report.
- In the 2017 review of the Drinking Water Safety Plan, 14 new action plans were identified and added to the Key Risk Action Plan register. There are currently 42 risks with actions plans on the register.
- Capital Budget for Performance Based Regulation Period 2017-2021 - City of Edmonton approved new capital expenditures with a modest increase from the previous PBR period. Asset management, accelerated water main renewals, and accelerated fire protection accounted for most of the increases in expenditures.

DRINKING WATER SAFETY PLAN

EPCOR is committed to maintaining a source-to-tap, multi-barrier approach to provide safe drinking water to its customers. The Drinking Water Safety Plan (DWSP) addresses environmental considerations related to public health risks associated with the supply of drinking water. Over 40 EPCOR managers and subject matter experts were involved in identifying and assessing these risks to the water system and public health. The risks were broken down into five "Source-to-Tap" areas; Source Risk, Treatment Risks, Reservoir Risks, Pipeline Risks and Customer Risks. The DWSP risk assessment was first completed for the Edmonton Waterworks in 2012 and an Action Plan was developed in 2013 to address eight key risks that were determined to require further action.

The DWSP process is based on the concept of continuous improvement and the Plan-Do-Check-Act cycle. The DWSP is reviewed and updated each year. In early 2017, EPCOR convened a team of subject matter experts once again to review the entire DWSP in depth. The team was asked to re-assess all of the existing risks and action plans and identify any new or emerging risks, or risks that required re-evaluation. When assessing risks, the team looked at developing trends and issues in water treatment and supply and incidents that have occurred in EPCOR and in the industry in general. This in-depth review resulted in the addition of 14 risks to the 28 risks that were on the 2016 key risk registry. Key risks are those that require an action plan to reduce the level of risk to acceptable levels. The risks added to the registry in 2017 included:

- Source contamination due to wildfire;
- Contamination of the source water due to impacts of climate change;
- Loss of treatment as a result of flooding in the river;
- Failure of the water treatment filters due to inadequate back washing;
- Low chlorine levels in parts of the distribution system due to low flows and dead ends;
- Depletion of powdered activated carbon supply during a sustained high colour event;
- Potential for loss of communication with transmission system during IT system maintenance;
- Inability to repair critical infrastructure after a transmission main break due to lack of accessibility;
- Inability to repair critical infrastructure after a distribution main break due to lack of accessibility;
- Loss of supply to customers due to failure of a critical main and lack of an alternative supply;
- Risk of water contamination after a large system depressurization event;
- Increased lead concentration at customer tap due to partial lead service line replacements;
- Young children consume water with high lead concentration in day homes and day care centres; and
- Customers exposed to drinking water risk due to impact of in-building water re-use systems

Action plans and programs will be developed in 2017 to mitigate these key risks. Six of the action plans for the 28 risks on 2016 key risk registry were considered completed. There are now 36 risks remaining on the key risk registry with action plans that are in progress. Contact EPCOR for further details on the Drinking Water Safety Plan.

PROTECTING OUR DRINKING WATER SUPPLY

EPCOR'S SOURCE-TO-TAP MULTI-BARRIER APPROACH

1. Source Water Protection

EPCOR maintains a source water protection and monitoring program that identifies risks in our raw water supply from the North Saskatchewan River. EPCOR's Source Water Protection Plan (SWPP) was first developed in 2008 to help mitigate potential risks to Edmonton's source water supplies by understanding the pressures on the watershed. An update to the plan, including enhanced land use maps, water quality assessment, and incorporation of the Drinking Water Safety Plan Risk Assessment, was published in 2014. Key SWPP risks were reviewed in 2015, 2016 and early 2017 as part of the annual Drinking Water Safety Plan review (see section on DWSP).

2. Treatment

EPCOR Edmonton water treatment plants (Rossdale and E. L. Smith) use both conventional and direct filtration treatment methods. When raw water quality is good, typically in the fall and winter months, the plants will shift to direct filtration. This requires a substantially lower dose of alum and results in a significant reduction in the amount of waste discharged to the North Saskatchewan River. (See details in the Reducing Environmental Impacts section of this report). Both conventional and direct filtration treatment removes any bacteria, viruses, *Giardia* cysts and *Cryptosporidium* oocysts that might be present in the untreated river water as follows:

- EPCOR achieves at least 99.97% (3.5 log) physical removal credit for *Giardia* cysts and *Cryptosporidium* oocysts from the raw water during conventional operation by ensuring turbidity of the treated water produced by each filter in the water treatment plant is very low. Filter effluent turbidity is maintained at less than 0.1 NTU on individual filters at all times. The target is to be less than 0.08 NTU. This performance readily exceeds the AEP requirement of less than 0.3 NTU;
- During direct filtration operation, the individual filter effluent turbidity is still maintained at 0.1 NTU or less, but the physical removal credit is reduced to 3.0 log removal. Although *Giardia* cyst and *Cryptosporidium* oocyst removal credit is slightly lower during direct filtration (99.9% versus 99.97% or 3 log versus 3.5 log), the concentration of these parasites in the river is much lower during this period;
- Ultraviolet light (UV) disinfection provides an additional 99.9% (3 log) inactivation credit of any *Giardia* cysts and *Cryptosporidium* oocysts remaining in the water after filtration for both conventional and direct filtration operation;
- Primary disinfection provided by free chlorine provides an additional barrier against *Giardia* cysts, and is the primary barrier against bacteria and viruses;
- The overall removal credit of *Cryptosporidium* oocysts is 99.99997% (6.5 log) during conventional operation and 99.9999% (6.0 log) during direct filtration operation. This exceeds the minimum approval requirement of 99.9997% (5.5 log) that is based on the raw water quality and a health risk assessment. *Giardia* cyst removal is slightly higher due to chlorination; and
- Bacteria and viruses are inactivated by chlorination but are also removed to some extent by filtration. Additional inactivation is achieved by UV disinfection.

Ammonia is added to the water to form chloramines, which provides a lasting disinfectant residual through reservoir storage and throughout the distribution system within the City of Edmonton and the regional waterworks systems.

3. Distribution System

EPCOR ensures the safety of water in the distribution system by maintaining adequate supply pressure. There are continuous pressure monitors at several locations throughout the system. Ongoing maintenance programs that safeguard distribution system integrity and water quality include:

- distribution system pipe and appurtenance replacement;
- main break repair;
- unidirectional flushing and hydrant servicing;
- distribution system leak detection; and
- distribution system pressure monitoring.

(See details on these programs in the Industry Leadership section of this report.)

A Cross Connection Control (CCC) program maintained by EPCOR provides an additional public health protection barrier. The goal of the CCC program is to minimize the potential for unintended backflow into the distribution system from moderate and severe risk customers in the multi-residential, commercial and industrial customer segments. This is done by ensuring Canadian Standards Association approved backflow prevention assemblies are in place for premise isolation and are tested annually as required by the National Plumbing Code of Canada, CSA B64.10 Standard, and the City of Edmonton Bylaw # 15816 EPCOR Water Services and Wastewater Treatment Bylaw. Every year, additional facilities are added to the program. In 2016, 747 facilities were added for a total of 10,307 at the end of the year. In 2016, EPCOR staff inspected 1,070 facilities and issued 13,679 notices to customers and testers for installation requirements, annual testing, test kit calibration and certification renewals. Overall compliance (tracking overdue tests and devices not installed), was at 66% at yearend down 4% relative to the end of 2015.

The Lead Response Program reduces the potential for exposure to lead in tap water for approximately 3,200 homes in mature neighbourhoods of the city that are supplied through lead service lines. See details on this program in the Lead Response Program section of this report.

4. Monitoring

To ensure safety of the drinking water up to the customer connections, EPCOR monitors raw water entering the Rossdale and E. L. Smith Water Treatment Plants, as well as partially treated water and finished drinking water entering the distribution system. In addition, a routine monitoring program ensures water quality throughout the field reservoirs and distribution system. The water is also tested in response to valid customer complaints and following system depressurizations due to main breaks or planned maintenance work.

EPCOR exceeds the minimum amount of monitoring and testing required by the regulator. In a city the size of Edmonton, Health Canada recommends bacteriological testing on 180 samples collected from the distribution system each month. In 2016, 2,576 samples were collected, or, an average of 215 per month. In addition, EPCOR sent an average of 52 duplicate bacteriological samples to the Provincial Laboratory for Public Health each month for an inter-lab quality check. When complaint follow-up and depressurization sampling is included, 3,665 samples were collected in the distribution system in 2016.

In 2016, the EPCOR Water Laboratory carried out approximately 130,000 tests on 8,100 samples of raw water that entered the Rossdale and E. L. Smith Water Treatment plants, partially treated water, the treated water that entered the distribution system, water from the field reservoirs and from various points within the distribution system. EPCOR tested for 190 chemical, physical or microbial parameters for Edmonton water. A further 4,100 tests were conducted by external commercial laboratories on 1,250 samples and included another 206 additional parameters (mainly trace organic compounds). These figures don't include testing conducted for special projects or initiatives such as EPCOR's home sniffing program or the lead response program. Details of all testing and monitoring done are published in monthly and annual Edmonton Waterworks reports that are posted on EPCOR's public website.

In addition to the laboratory testing, EPCOR also uses numerous on-line analyzers to continuously monitor critical treatment performance and water quality variables in the treatment plants, such as chlorine concentration and filtered water turbidity. Back-ups are provided for critical analyzers. There are 137 on-line analyzers at the E.L. Smith WTP and almost 80 at the Rossdale WTP with a quality assurance program in place to confirm they are reliable. Operators at the plants perform frequent bench tests to ensure the performance of these analyzers. In 2015, operators performed approximately 40,000 and 30,000 tests at the E. L. Smith and Rossdale water treatment plants respectively.

OUR STRINGENT WATER QUALITY STANDARDS

THE WATER QUALITY INDEX

The Water Quality Index measures the number of treated water tests that meet EPCOR's internal water quality standards. EPCOR's standards are often more stringent than Provincial requirements or Health Canada Guidelines for Canadian Drinking Water Quality. In 2016, the Water Quality Index score was 99.73% (61,480 out of a total of 61, 644 tests passed our internal quality standards).

EPCOR's Water Quality Index score of 99.73 percent in 2016 was lower than the 2015 score of 99.81 percent, but still above the target of 99.6 percent set in EPCOR's Performance Based Regulation (PBR), which is established through a City of Edmonton bylaw.

SPRING RUN-OFF PROGRAM AND THE HOME SNIFFING PROGRAM

Spring run-off conditions in the North Saskatchewan River vary from year to year and can significantly affect the taste and odour of drinking water. Spring runoff typically starts mid-March to mid-April and results in an increase in the turbidity, colour, taste and odour of the raw water supply drawn from the North Saskatchewan River. Depending on these conditions, EPCOR adjusts its treatment process to remove odour-causing compounds by adding powdered activated carbon. During the winter months our water treatment plants use direct filtration and we must transition back to our conventional treatment mode of operation prior to spring runoff. This allows us to use Powdered Activated Carbon (PAC) as a taste and odour control measure.

In 2016, spring run-off was unusually early and mild. A relatively mild winter and shallow snow cover resulted in gradual runoff conditions during early March. The water treatment plants were well prepared and converted from direct filtration to conventional operation on February 29 (Rossdale) and March 3 (E. L. Smith). Addition of PAC for removal of odours in the river water began on March 7 (E. L. Smith) and March 13 (Rossdale).

The Home Water Sniffing Program measures the effectiveness of EPCOR's spring run-off water treatment strategy. EPCOR recruits a panel of customer volunteers to rate the odour of the treated water from the hot and cold taps in their home. The Home Sniffing Program ran from Feb 19 to May 23, 2016 and each day between 87 to 113 volunteer sniffers participated. The overall Customer Satisfaction Rating was 96.2%. This well exceeded the performance target of 93.8%. In addition, in 2016 there were relatively few customer complaints of odour in the treated water. This was a significant improvement over 2015, when the customer satisfaction was at the target of 93.8% and there were numerous customer complaints of chlorinous odours in the water during run-off.

PERFORMANCE-BASED RATES REQUIREMENTS

In addition to the Water Quality Index and the Home Sniffing Customer Satisfaction Rating, EPCOR strives to meet other requirements set by the City of Edmonton Performance Based Regulation (PBR). These measures ensure EPCOR maintains performance in a number of areas.

Performance against the five Performance Based Regulation aggregate measures is summarized in the following table. The overall score of 108.5 points indicates a trend of continuous improvement over the 2013, 2014 and 2015 scores of 106.8, 107.2 and 108.7 points, respectively.

EPCOR submits a yearly report to the City of Edmonton on the Performance Based Regulation which includes detailed information on each of our performance measures.

Performance Measure	Basis	2016 Target Points[1]	Actual Points Earned[1]
System Reliability Index	water main breaks, repair duration, planned construction, water pressure factor, water loss factor	25.0	28.5
Water Quality Index	number of tests meeting internal standards	25.0	25.0
Customer Service Index	post service audit factor, response time factor, home sniffing factor	20.0	22.7
Environmental Index	emergency response training, completeness of reporting, timeliness of reporting, environment incident reporting, water conservation, watershed protection	15.0	15.8
Safety Index	safety meetings, formal safe work plans, first aid training, work site inspections/observations, lost time frequency rate, injury frequency rate, injury severity rate	15.0	16.5
Total		100.0	108.5

[1]Bonus points can be earned for exceeding performance measures

PUBLIC INVOLVEMENT AND CONSULTATION

COMMUNICATION

EPCOR is committed to being a 'neighbour of choice'. Working together with our stakeholders, we accomplish this goal through open communication and consultation with our customers. We demonstrate a commitment to two-way, transparent communication through face-to-face discussions, open houses and our community advisory panels. In and around our plant sites, EPCOR engages with community leagues and residents to ensure we are keeping our neighbours informed of construction activities and are building a positive rapport with community members.

Within the broader community of Edmonton, we engage with our customers and communicate about emerging issues through multiple channels such as our customer newsletter, broadcast media, news media, EPCOR's external website and social media. EPCOR's external communications encourage wise water use, promote environmental stewardship and create a broader awareness of the importance of safe and clean public drinking water.

CORPORATE ACCOUNTABILITY AND PUBLIC TRANSPARENCY

EPCOR keeps its customers informed about what we are doing to ensure a safe and reliable supply of tap water. A number of reports are made available to the public, including customer-friendly water quality reports:

- 2016 EnviroVista Report (this report)
- 2016 Waterworks Annual Report
- Monthly Waterworks Reports (Operations and Water Quality)
- Monthly Water Quality Summary and Bacteriological Data Reports

COMMUNITY OUTREACH

EPCOR staff participated in several community outreach activities in 2016. Two events that were particularly relevant to drinking water treatment included:

- At the Winter & Summer Family Fun Days in the Cameron Heights community we provided water treatment education to event attendees; and
- EPCOR was involved in Highlandia and Gold Bar Events to educate the community on river quality and reinforce what not to flush to protect our river.

We also launched a new school tour program for grade five students at Edmonton schools that provides them with a hands on water treatment experiment and a tour of the E. L. Smith Water Treatment Plant. In addition, EPCOR donated copies of the book "Living in the Shed" to 128 Edmonton high school and junior high school libraries. Living in the Shed is published by the North Saskatchewan Watershed Alliance and provides and written and pictorial history for the North Saskatchewan River.

COMMUNITY ADVISORY PANEL

EPCOR places a high priority on obtaining public input into all aspects of water service delivery. Since 1993, a voluntary panel has provided feedback on EPCOR policies and programs impacting customers and the community in general. The panel gathers stakeholder input on emerging issues such as water efficiency, legislative and technological changes, pricing, customer care and watershed management.

The panel includes representatives for the environment, the City of Edmonton, commercial customers, industrial and residential customers.

The Water Community Advisory Panel (CAP) reviewed the terms of reference for the group to seek input into EPCOR initiatives and provide information sessions on those initiatives, including:

- Overview of the Edmonton water system;
- Overview of EPCOR's Performance Based Regulation, how Performance Based Regulation is structured and what measurements EPCOR is held to:
- Outline of 2016 on-street construction;
- Overview of Edmonton water use and conservation;
- Overview of EPCOR's Cross Connection Control program; and
- Overview of EPCOR's new Watershed Monitoring project.

CONSULTATION WITH INDUSTRY EXPERTS – WATER QUALITY ADVISORY COMMITTEE

The Water Quality and Advisory Committee (WQAC) includes representatives from EPCOR, Alberta Health Services (AHS), Alberta Health and Wellness, Alberta Environment and Parks (the water regulator), the University of Alberta, the City of Edmonton and the Regional Water Customer Group (RWCG) that represents the municipalities supplied directly or indirectly by the EPCOR drinking water system.

The panel shares information, advises on water quality and treatment issues, reviews water quality standards and guidelines and develops joint risk management protocols. Its scope includes drinking water emergency response, watershed issues, home water treatment devices, bottled water and related drinking water health issues.

A subcommittee was set-up in 2016 co-led by EPCOR, Alberta Environment and Parks and Alberta Health Services to develop a 2016-2020 Emergency Exercise plan for the regional water system. A second "Troubled-Water" desktop emergency exercise was carried out in 2016 with two follow-up exercises carried out in early 2017. The focus of these exercises has been to clarify the roles of the various authorities and stakeholders in a coordinated response to drinking water quality issue that might impact a significant part of the regional water system

The Water Quality Advisory Committee met on January 20, 2017 at the Rossdale Water Treatment Plant. The topics discussed included:

- EPCOR's 2016 distribution water main lining initiative;
- EPCOR's lead program status update and future direction;
- EPCOR communications update (how we communicated with the public on drinking water issues);
- The 2016 North Saskatchewan River high colour event and the impact on treatment;
- EPCOR North Saskatchewan river contamination risk study; and
- Drinking water emergency exercises, specifically the status of the "Troubled Water" series of exercises.

INDUSTRY LEADERSHIP

WORKING PARTNERSHIPS WITH ALBERTA ENVIRONMENT AND PARKS (AEP)/ADVICE AND SUPPORT TO INDUSTRY

In 2016, EPCOR continued to provide expertise and advice to Provincial Government agencies and the water and wastewater treatment industry in Alberta. Examples include:

- EPCOR continued to participate in the AEP-led Capital Region-Industry Heartland Water Management Framework initiative and sat on the Advisory Committee and Modelling Sub-Committee. Through this committee, EPCOR provides stakeholder feedback on AEP's initiative to develop a total loading management system for the stretch of the North Saskatchewan River between Devon (upstream of Edmonton) and Pakan (downstream of Edmonton and the Industrial Heartland). More information on this initiative can be found on AEP's website at: http://aep.alberta.ca/land/cumulative-effects/regional-planning/capital-region/capital-region-cumulative-effects-management.aspx;
- EPCOR continued to participate in the Alberta Drinking Water Laboratory Technical Advisory Committee (ADLTAC) that is providing advice to the government on matters related to drinking water testing and development of new drinking water testing requirements;
- On an international level, EPCOR continued to support Bob Sandford, as the EPCOR Chair for Water and Climate Security at the United Nations University Institute for Water, Environment and Health. Our sponsorship continues moving forward;
- EPCOR hosted an event in conjunction with World Water Day called *Water Matters* – A World Water Day Address featuring Bob Sandford and AEP Minister Shannon Phillips. The event outlined the importance of careful management of this precious resource.
- EPCOR provided advice to AEP staff as they addressed the impact of the Fort McMurray wildfire on the drinking water system in the Fort McMurray town site.

LABORATORY ACCREDITATION

- The quality of the water testing data produced by the EPCOR Water Laboratory adheres to the international management system standard ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories." The EPCOR Water Laboratory has been accredited to ISO/IEC 17025 since 2001 by the Canadian Association for Laboratory Accreditation (CALA). It successfully retained accreditation in October 2015 after CALA completed an assessment as part of the biannual audit cycle. Our next external assessment is schedule for the October 2017.

- As part of our commitment to CALA, several EPCOR employees contributed to the CALA program by volunteering as laboratory assessors and were involved in 10 assessments of other laboratories in 2016. In addition to assessing other laboratories, an EPCOR manager currently sits on the Board of Directors for CALA as a representative of the Prairies (private sector laboratories) and serves as CALA's Treasurer.

WATERSHED AND SOURCE WATER PROTECTION PROGRAMS

EPCOR's Watershed Protection Program (WPP) has two primary goals:

- To provide a safe, secure drinking water supply through source water protection principles
- To ensure minimal effects from our operations on water quality and aquatic ecosystem health in receiving water bodies

EPCOR recognizes watershed-wide environmental planning is necessary and is best achieved by openly collaborating with all stakeholders. In 2016, EPCOR updated its three-year rolling Strategic Watershed Protection Plan and completed initiatives under four broad categories: watershed planning, monitoring and research, implementation, and education & awareness.

1. Watershed Planning

EPCOR recognizes the importance of working within multiple initiatives and/or frameworks to help meet its commitment to safeguard the health of customers from a source water protection perspective and to minimize the effect of its activities on local water quality and aquatic ecosystems. Planning initiatives and/or frameworks that EPCOR continued to support in 2016 include:

- North Saskatchewan Watershed Alliance (NSWA): EPCOR provides both financial and in-kind support to the NSWA. In 2012, the NSWA published the Integrated Watershed Management Plan (IWMP) for the North Saskatchewan Basin after five years of extensive stakeholder engagement and input. The plan lays out recommendations and an approach to manage the North Saskatchewan River watershed, sustain water resources for the long-term and to meet the three strategic goals of Alberta's Water for Life strategy. The underlying principle of the plan is that no further degradation of water quality should occur and improvements should be made where degradation has occurred, based on Water Quality Objectives proposed for the river. In 2016, EPCOR employees were involved in the Headwaters Group, Modeste and Strawberry Creek Riparian Projects, and the Water Quality and Instream Flow Needs working groups of the NSWA. As well, EPCOR was represented on the Board of Directors of the NSWA;
- Capital Region-Industrial Heartland Water Management Framework (CRIH-WMF): The Government of Alberta led CRIH-WMF continued through 2016 and EPCOR was directly involved through the Advisory Committee. This work will set environmental outcomes (including water quality) for the area just upstream of Edmonton to downstream of the proposed industrial development area. The framework includes Maximum Acceptable Loads (MALs) for each of the parameters of concern which is now under stakeholder review;
- Source Water Protection Plan: A major milestone of 2014 was the completion and publication of EPCOR's updated Source Water Protection Plan (SWPP) protecting source drinking water. Highlights of the updated plan include detailed water quality and quantity research summaries, comprehensive land use maps, and inclusion of the source risk assessment completed through the Drinking Water Safety Plan process. In 2016, continued investigation and mitigation plans of the key risks outlined in the SWPP and Drinking Water Safety Plan were developed. Two of the most significant risks (potential source contamination from spills/releases from upstream oil and gas facilities, or from a spill on an upstream bridge) remained action items in the Drinking Water Safety Plan. As such, work is continuing to develop a Geographic Response Plan in partnership with Alberta Environment and Parks (AEP) and characterize the expected fate and water quality characteristics if a spill should occur; and
- Alberta Water Council (AWC): EPCOR, through representation on Watershed Planning and Advisory Councils and the Alberta Lake Management Society, is involved with numerous teams that are making recommendations for management and policy to the AWC and, ultimately, AEP. In 2016, EPCOR continued involvement with the Lake Conservation and Management Project Team. As well an EPCOR employee acted as an alternate board member for the AWC Board, representing the Lake Conservation Sector.

2. Implementation

In 2016, EPCOR continued financial support of the Clear Water Landcare Group which implements agricultural Beneficial Management Practices (BMPs) in the North Saskatchewan River basin, such as 'off stream' watering systems, fencing off of streams, and educational stewardship events. In 2016, work began on the Sasquatch workbook, teaching kids about what a watershed is. EPCOR supported implementation of Leduc County's BMP program through monitoring support and information on where to target BMPs in the Strawberry Creek Watershed. EPCOR also supported the North American Lake Management Society's conference in Banff, Alberta by sponsoring keynote speakers on global water issues.

3. Research and Monitoring

In 2016, EPCOR continued an enhanced monitoring program for 13 select tributaries upstream of Edmonton. As part of an effort to better characterize water quality in the headwaters, Clearwater Landcare and Leduc County took additional samples during storm events for EPCOR as data for high flow events were sparse. As part of this work, a pilot project on Strawberry Creek, that was initiated in 2014 continued, and more frequent and widespread sampling was completed on the creek (at 11 locations) in an effort to understand water quality drivers on a smaller scale. This multi-year project on a sub-watershed that experiences intensive agricultural activity will provide information on the effectiveness of best management practices. In 2015, this work included community watershed workshops in Strawberry Creek where EPCOR presented water quality data and showed stakeholders how to complete water quality sampling and riparian assessments.

EPCOR also partnered with the Alberta Biodiversity Monitoring Institute to continue to develop an ecosystem services model for the NSR watershed and, in particular, Strawberry Creek.

EPCOR also continued to partner with the City of Edmonton to support their Environmental Monitoring Program (EMP) through assessment of water quality samples and assistance in monitoring plan development. Quarterly monitoring also continued for Pharmaceuticals and Personal Care Products (PPCP) in the raw and treated water at both the E. L. Smith and Rossdale Water Treatment Plants. As well as providing information relevant to drinking water quality and public health protection, this monitoring program also provided environmental water quality data that was useful for the Capital Region - Industrial Heartland Water Management Framework.

Ongoing assessment and refinement of monitoring programs continued through the NSR Water Quality and Aquatic Ecosystem Health Monitoring Group in partnership with the NSWA. This group's goal was to develop an integrated, efficient and effective water quality monitoring program that meets the needs and interests of major stakeholders in the basin. In 2016 the focus of the work was to ensure funding through the Performance Based Regulation process and work with AEP, the City of Edmonton, and NSWA to implement the program starting in 2018. EPCOR received approval to move forward with this program as part of the 2017-2021 PBR renewal process.

EPCOR supported the application of the ForWater Network's NSERC proposal throughout 2016 through letters of support and attendance at several planning workshops. This work investigates the use of forest management techniques to protect drinking water sources from the impacts of wildfire.

EPCOR also supported continued work on understanding the impacts of hydrological variability of the North Saskatchewan River under a changing climate with Dr. David Sauchyn of the Prairie Adaptation Research Collaborative. This work will continue into 2017 where runoff predictions and probabilities will be mapped to 2050 based on current climate models.

4. Education and Public Awareness

In 2016, EPCOR sponsored the City of Edmonton's River Valley Clean-Up Project, participated in the City of Edmonton's River for Life initiative and supported RiverWatch. EPCOR is a long-time sponsor of the City of Edmonton's River Valley Clean Up as funding is specifically targeted towards public education initiatives that keep garbage and debris out of the North Saskatchewan River. EPCOR provides financial support to Alberta RiverWatch, a science education program for secondary students. As a corporate sponsor, EPCOR subsidizes the fees for disadvantaged students so that they can

participate in a guided river study along the North Saskatchewan River. EPCOR staff also served on the Board of Directors for the Alberta Lake Management Society and Red Deer Watershed Alliance (RDWA).

EPCOR employees spoke at the NSWA's Water Quantity Forum, the NSWA's Headwaters Meeting, and gave several presentations on Source Water Protection Planning. As well, EPCOR gave its seventh annual guest lecture at the University of Alberta to engineering students on watershed and land use management.

EPCOR also supports Trout Unlimited Canada's Yellow Fish Road Program. Yellow Fish Road is focused on educating youth about the challenges and solutions to stormwater pollution, one of the leading threats to our waters today. The organization delivers its programming through presentations, events in conjunction with EPCOR in our local communities and a stormdrain painting project. Youth learn about how they can protect their watershed and make a difference to the community's water.

DISTRIBUTION SYSTEM UPGRADES

EPCOR undertakes a number of annual capital and operating programs to maintain and continually improve water quality in the distribution system and to minimize unplanned customer disruptions. In 2016, the following water assets were replaced:

Water Asset	
Main Line Valves	297
Hydrants	141

WATER MAIN REPLACEMENT

EPCOR has replaced slightly more than 50% of cast iron water mains in Edmonton's distribution system since 1986. The ongoing replacement of the most deteriorated sections of cast iron pipe has led to continued improvements in overall system reliability and resulted in the lowest average number of water main breaks in Edmonton over the most recent five years since 1960 to 1964. In 2016, 12.7 km of water mains were replaced in Edmonton.

MAIN BREAK REPAIR

In 2016, Edmonton experienced 242 water main breaks as reported in the final 2016 Performance Based Regulation (PBR) progress report to the City of Edmonton. The 2016 total main breaks were down 35 from our 2015 total and continued the generally decreasing trend we have seen over the past 30 years. Most of the main breaks (218) occurred in cast iron water mains. Since 1985, EPCOR has had an aggressive program of renewal and cathodic protection of these cast iron mains. The long-term trend of a reduction in the number of breaks in the cast iron system since the mid 1980's directly reflects the effectiveness of those programs. EPCOR also has a performance target to repair 93.7 per cent of main breaks within 24 hours. In 2016, 98.31% of the breaks affecting water supply to customers were repaired within 24 hours of the water being shut off, exceeding the target.

UNIDIRECTIONAL FLUSHING AND HYDRANT MAINTENANCE

Each year, water mains throughout Edmonton are flushed to remove sediment build-up and biological growth. In 2016, EPCOR continued with the Unidirectional Flushing (UDF) program and flushed 30% of the distribution system. There were 20,210 fire hydrants in the public water system at the end of November 2016. The operation of all fire hydrants located in public right of ways is checked at least twice annually, once as part of the summer UDF/Hydrant Purging program and once as part of the winter check program. This ensures that the hydrants are functional in the event of a fire and the system is compliant with fire code recommendations. EPCOR also has performance measures limiting the

amount of time a hydrant can be out of service (no more than 90 days) and limiting the total number of hydrants that can be out of service on any one day (no more than 120). In 2016, zero hydrants were out of service for more than 90 days and one hydrant was out of service for more than 30 days. The maximum number of hydrants out of service on any one day was 47. The maximum number of days out of service for any one hydrant was 45.

In 2016, EPCOR studied the rate of sediment accumulation in water mains as a potential way of further optimizing flushing frequency for each area of the city. Regular UDF flushing is important to maintain drinking water quality in the pipes, however, it does involve use of water and the flushed water must be dechlorinated. In our study we were able to estimate the amount and characterize the type of sediments removed during several UDF runs in cast iron (CI), asbestos cement (AC), and polyvinyl chloride (PVC) pipes. The results showed that the mass of removable sediments in CI areas was at least 10 times more than in areas with mostly AC or PVC pipes. The chlorine residual was almost unaffected in PVC areas, but significantly deteriorated in CI areas. This study supported the proposal to reduce the flushing frequency in areas of 100% PVC pipes and retain the current flushing cycle in other areas.

LEAD RESPONSE PROGRAM

Approximately 1.5% of Edmonton homes (typically built before 1950) use lead as the material for service pipes. A service pipe is the section that connects the home or business with the municipal water main beneath the street or alley. There are two parts to the service pipe; the section between the water main and the property line is the responsibility of EPCOR and the section from the property line to the home is the responsibility of the property owner.

In 2008, EPCOR proactively initiated a program to address residences and small businesses in the City of Edmonton serviced through old lead service pipes. This program includes:

- Annual notification (reminders) of residents at all homes and small businesses within the city serviced by lead service pipes;
- Offer of testing for lead concentration in the tap water for those residents;
- Offer to provide point-of-use filters that remove lead for customers in homes and small businesses serviced through lead pipes;
- Prioritized lead service pipe replacement of the EPCOR section; and
- Public education on the issue of lead in tap water.

In 2016, the residents at all homes or small businesses with a known lead service were once again reminded of the program by letter. As well as sampling water from homes with lead service lines, EPCOR is also sampling from some homes with non-lead service pipes (mainly copper) because older building plumbing is also a potential source of lead in tap water.

The table below summarizes the lead testing results from 2008 to 2016 that has been provided for homes with and without lead service pipes. All samples were collected using a sampling protocol that is designed to measure the impact of lead service pipes and plumbing components in lead levels measured at the tap. This involves collecting a 4 L sample after no use of water in the home for 30 minutes.

Lead test results from 2008-2016

	Lead Service Pipes	Other Service Pipes
Number of Samples Collected and Tested	5013	356
% where lead concentration was greater than 0.010 mg/L	30%	6.5%
% where lead concentration was greater than 0.030 mg/L	5%	0.3%
50th percentile lead concentration (mg/L)	0.007	0.002
90th percentile lead concentration (mg/L)	0.026	0.014

To compare, the Health Canada Guideline for Canadian Drinking Water Quality health-based Maximum Acceptable Concentration (MAC) for lead is 0.010 mg/L. The lead concentration has been less than the MAC in 70% of homes with lead pipes that were tested. 5% (188 samples) have tested greater than 0.030 mg/L. The lead concentration in the majority (greater than 93%) of homes with non-lead service pipe is less than the Health Canada MAC. Residents of all homes and small businesses are encouraged to flush the building plumbing before consuming the water after the water has been stagnant for more than six hours. This can usually be done by running the kitchen faucet for a few minutes.

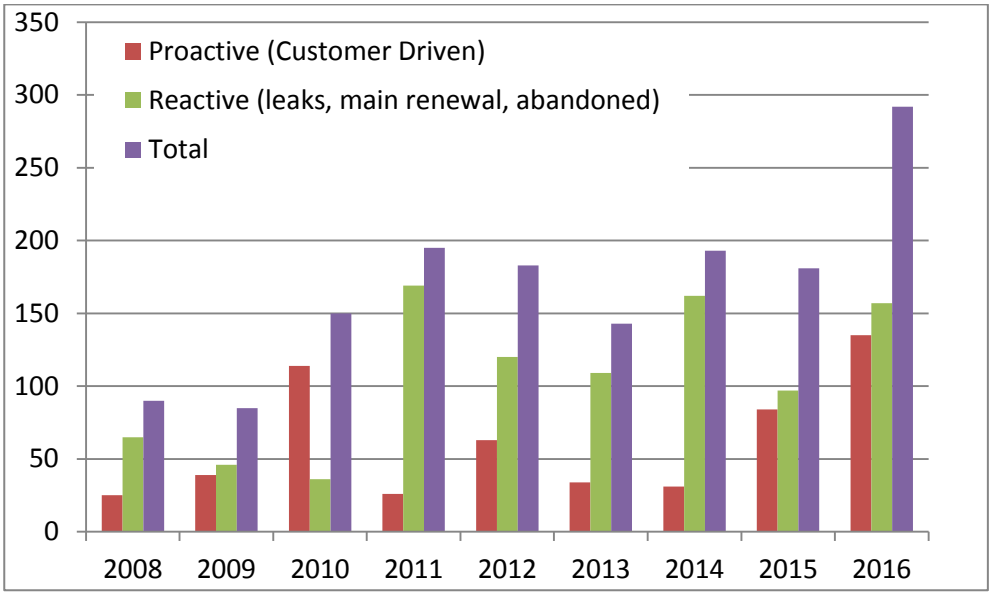
In 2016 EPCOR conducted a study of 316 addresses spatially distributed across the city using a sampling protocol described as "random daytime sampling". This protocol differs from the Health Canada protocol in that there is no requirement for water stagnation in the pipes before sample collection. The goal of the study was to determine an unbiased estimate of the average lead concentration in the city and will be used to inform future decisions regarding the addition of corrosion inhibitors to the water treatment process. The results of the 2016 study are shown in the table below along with the results from a similar 2015 sampling program. The results indicate that lead concentrations may exceed the Health Canada guideline at some homes that do not have lead service lines due to lead release from internal plumbing components (like lead-tin solder or brass). This study will be continued in 2017 with a goal of sampling from more than 300 randomly selected addresses.

Results of Random Daytime Lead Testing	2015	2016
No. Tested	187	316
Mean Pb (ug/L)	.7	1
90^{th} ile (ug/L)	10	6
% < 10 ug/L	90	94
% > 30 ug/L	3	2

There have been 1536 lead services removed from service since 2008— 565 were replaced proactively as part of the lead program, 947 were replaced reactively (due to leaks and other emergency repairs, or as part of water main renewal programs) or were otherwise removed from service. See next figure. There were approximately 3213 Edmonton homes that still had lead service pipes at the end of 2016 according to EPCOR records.

EPCOR is avoiding partial service pipe replacements, where the EPCOR piece is replaced but the owner's lead piece remains. Studies have shown that partial replacements are not effective for reducing lead at the tap and may even result in a temporary increase in lead concentration. As a result, EPCOR prefers to switch out lead service pipes on the public side if the customer is changing out the lead piece on the private side also. This category is called "customer driven" replacements. The priority for replacement is based on the concentration of lead measured at the tap and the presence of high risk individuals in the home (children under five years old and expectant mothers).

Lead Service Replacements Comparing Customer Driven Replacements to Maintenance Driven Replacements



In 2017, EPCOR will be continuing a neighborhood approach to lead service line replacement. EPCOR will provide advanced notice of planned activity in specific neighborhoods to residents living in homes with lead services. This will allow opportunity to plan and coordinate lead service line renewal with the property owner. For in-fill developments EPCOR will be requiring that service line piping material must meet current standards.

Lead service pipe replacement is occurring, but the progress is slow and will eventually be limited mainly by customer service line replacement and the rate of infill development. The results of the random day time sample show that, even in homes without lead service lines, lead can be present at the tap in random samples. EPCOR, therefore, will be evaluating the use of phosphate addition to the water at the water treatment plant for corrosion control. The addition of phosphate as a corrosion inhibitor is expected to reduce lead concentration at the tap not only in homes with lead service pipes but also in homes with other sources of lead such as solder and brass. This testing will be carried out in our pilot plant and will take up to two years to complete.

Other initiatives related to lead that EPCOR is exploring include:

- Considering an incentive program or other alternatives for customer side lead service line replacements,
- Extending the time period for provision free filters for high risk customers, and customers who end up with a partial replacement due to water main renewals.
- Supplying high risk customers with a more robust filtration system to decrease the overall cost of filter replacement to the customer

MEMBERSHIP IN INDUSTRY AND RESEARCH ORGANIZATIONS

EPCOR strives to be an active member in industry organizations that promote public health protection, such as the Water Research Foundation (WaterRF). WaterRF is a not-for-profit organization that coordinates and funds a comprehensive research program related to drinking water. EPCOR renewed its subscription and financial commitment to WaterRF in 2016. As well, EPCOR and its employees were directly involved in a number of WaterRF initiatives. Our roles included:

Member of the Technical Advisory Committee for the following research focus area program:

- Water Utility Finance: Best Practices for Setting Rates, Financing Capital Improvements and Achieving Public Support

Member of the Project Advisory Committee for the following research projects:

- Integrated Treatment Process Management for Drinking Water and Wastewater Treatment Operations: Research Roadmap;
- Developing Water Use Metrics and Class Characterization for Categories in the CII Sector;
- Corrosion of Nonleaded Pump Impeller Alloys in Chlorinated Potable Water;
- An Evaluation of the Value of Structurally Enhanced PVC Pipe;
- Using Next Generation QMRA to Estimate Human Health Risk Posed by Pathogens in Drinking Water; and
- Identifying and Evaluating Opportunities for Reducing Variability of Utility Revenues.

EPCOR participated in the following research projects as a participating utility, in-kind contributor, or financial contributor:

- Case Study Compilation on Applying Risk Management Principles and Innovative Technologies to Effectively Manage Deteriorating Infrastructure
- Securing Value: Integrating Risk Governance with Other Business Functions for the International Water Sector;
- Bench-Scale Evaluation of Alternative Cr(VI) Removal Options for Small Systems;
- Leveraging Data from Non-Destructive Examinations to Help Select Ferrous Water Mains for Renewal;
- Utility Risk Management Methodologies for Buried Assets with Improved Triple Bottom Line Understanding of Pipe Failures;
- Rate Approval Process Communication Strategy and Toolkit; and
- Nitrosamine Occurrence Survey.

EPCOR also continued engagement in various university led research efforts. These included:

- Providing financial support to the University of Waterloo NSERC Senior Industrial Research Chair in Advancing Treatment and Reducing Risk;
- In-kind support for the University of Alberta NSERC Strategic Project “Innovative Tools for Characterization of New Drinking Water Disinfection By-Products and Health Effects”; and
- Financial and in-kind support for the University of Alberta NSERC Collaborative Research and Development Project “Operational Optimization for the Removal of *Cryptosporidium* Oocyst Surrogates in Drinking Water Direct Filtration Processes: A Multi-Scale Approach”.

EPCOR renewed its membership with the Canadian Water and Wastewater Association and the Canadian Association on Water Quality. EPCOR or its employees were involved in various other industry organizations in different capacities, including:

- Canadian Water Network (subscriber);
- Canadian Association on Water Quality (Board Membership);
- American Waterworks Association (member);

- American Waterworks Association—Western Canada Section (Board Membership);
- Western Canada Water (member);
- Canadian Water and Wastewater Association (member);
- Canadian Association for Laboratory Accreditation (Board Membership).

PARTICIPATION IN WATER FOR LIFE AND OTHER AEP INITIATIVES

EPCOR continues to actively participate in Water for Life and other Alberta Environment and Parks initiatives. EPCOR is involved in Watershed Protection and Advisory Councils (WPACs) and supports Watershed Stewardship groups. Activities in 2016 included:

- direct financial and in-kind support to the North Saskatchewan Watershed Alliance and representation on the board, executive (Treasurer) and technical committees;
- ongoing involvement with the Alberta Water Council. An EPCOR employee sat on the board as an alternate and contributed to development of new projects on Lake Management and Source Water Protection; and
- participation on the Advisory Committee for Capital Region – Industrial Heartland Water Management Framework.

RESEARCH ON IMPACTS OF CLIMATE CHANGE ON SOURCE WATER

EPCOR supports research studies that are looking at the impacts of climate change on source water. In 2016 we continued our support of the research project entitled ***"Sustainable Urban Water Management in the Context of Climate Variability and Change"***. This University of Regina study led by Dr. Dave Sauchyn was co-sponsored by EPCOR and the City of Calgary, and major support was provided by Alberta Innovates – Energy and Environment Solutions (AI-EES). The study completed for both the North Saskatchewan River and Bow River provided historic weekly river flow rates (m^3/s) that were calculated for years as far back as 1060 A.D. This latest work expanded upon the earlier tree ring analysis data and 2011 study ("*Past, Recent and Future Hydroclimactic Variability of the North Saskatchewan River*") that related tree ring characteristics to river flow monitoring station gauge data. The reconstructed historic weekly river flow rates show the extreme variability in the hydrologic water balance that has occurred in the past one thousand years in Alberta. This is even before any human-induced changes to the climate. EPCOR used this data to calculate the impact of historical low flows considering the two dams upstream, as well as high water demand scenarios. This was presented at the NSWA Water Quantity Forum in September 2016.

This latest two-year study, completed in November 2015, was supported financially and through in-kind support including staff hours and the acquisition of a 2-D hydrodynamic river water quality model for the North Saskatchewan River (NSR). This model will allow EPCOR to build on the findings of this latest study to examine how changes in NSR seasonal flows may impact water quality.

EPCOR has now initiated a follow-up study that would overlay future climate change scenarios onto historic flow rate data to project a range of possible future water supply scenarios for the decades ahead. This includes predictions of watershed yield and time for river sub-basins that could then be used in water quality models to predict changes in water quality.

In late 2016, EPCOR formed a working group to develop a Climate Change Adaptation Strategy. This strategy will include a summary of the current state of knowledge on changes in water quality and quantity in the North Saskatchewan River and will propose an adaptation strategy for operations. Part of this work is developing management plans for various multi-year drought scenarios and conversely flood conditions. Mitigation and adaptation approaches will be an important component of these plans to ensure resiliency of the Edmonton Waterworks System in the 21st century.

EPCOR has also expressed its support for the proposed *Global Water Futures* (GWF) – a seven-year study that, if funded by the Federal Government, would involve numerous research teams from across Canada and in which EPCOR could serve as a water utility case example. This study would facilitate the development of risk management approaches so

communities across Canada could adapt to future expected water resource challenges that will come from a changing climate and hydrologic water balance.

EPCOR has also been involved in historical climate change work completed by the NSWA and is an active participant in the City of Edmonton Climate Change Adaption Working Group. The City of Edmonton is in the second year of this three year initiative to look the risks and mitigation plans for variety of infrastructure and services in the City, including water and wastewater.

ENERGY EFFICIENCY INITIATIVES

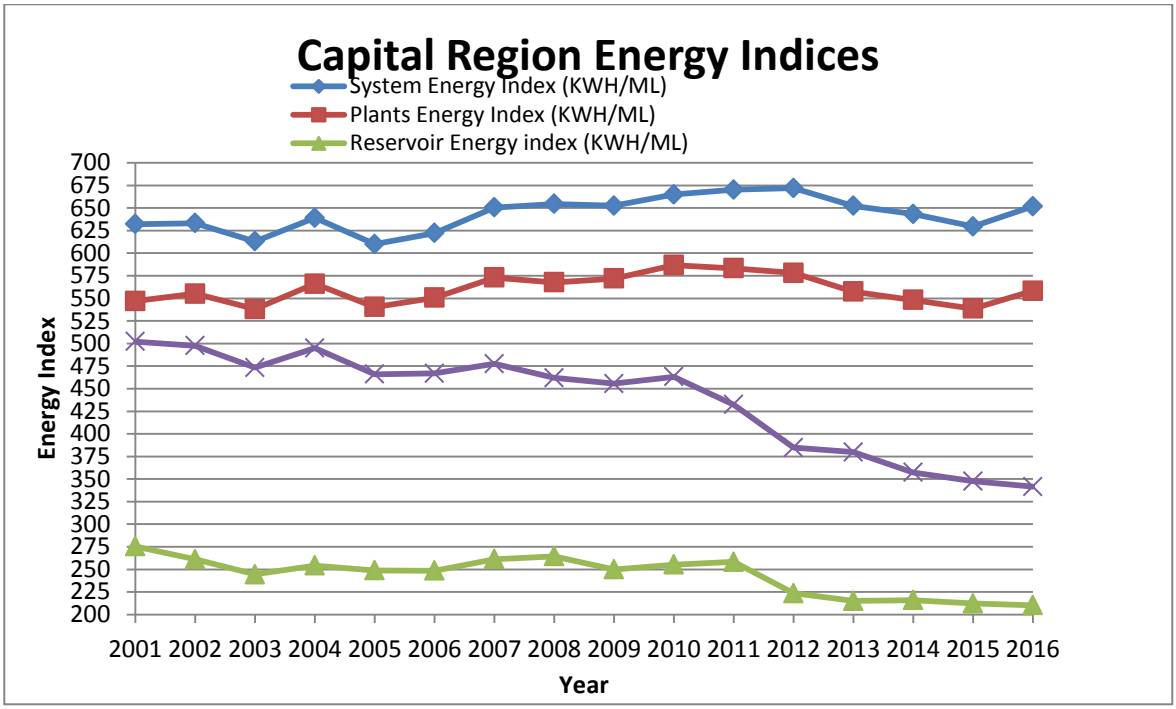
EPCOR's energy efficiency initiatives expanded to include not only energy asset efficiency at the water treatment plants, the field reservoirs, and the booster stations, but also the efficiency of the buildings on our sites. EPCOR has been actively replacing conventional lighting with LED lighting, completing HVAC upgrades, and finding innovative ways to improve building insulation. One such example is the pop-in windows installed at the Heritage Building at the Rossdale site to reduce drafts from older windows and reduce the need for personal block heaters.

EPCOR continued to monitor the water treatment plant energy performance and the reservoir energy efficiency in three existing pressure zones in 2016. The goal is to reduce the Energy Indices through efficient system operation.

Energy Indices (kWh/ML)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
System Energy Index	682	675	682	663	646	645	651	655	664	684	703	715	672
PBR System Energy Index	273	269	271	263	255	254	256	256	260	268	275	279	265
Rossdale Energy Index	629	606	591	585	570	571	578	569	600	592	633	629	596
EL Smith Energy Index	522	532	547	532	518	514	515	532	534	560	559	568	536
Zone I Reservoirs Index	383	349	313	244	251	227	220	227	221	276	293	358	280
Zone II Reservoirs Index	240	231	233	218	210	211	209	210	207	227	233	234	222
Zone III Reservoirs Index	103	102	102	102	102	102	102	102	102	102	102	102	102
Zone IV Reservoirs Index	150	189	175	171	154	165	155	181	170	297	355	313	206

The overall system energy efficiency performance in 2016 did not meet the target of 665 kWh/ML. The summer weather was cool and rainy, which substantially reduced water consumption demand. EPCOR must maintain the distribution system pressure while pumping subsequently less water volume. This reduced the water treatment plant energy efficiency. However, reservoir pumping volume in 2016 has been steady and thus its energy efficiency maintained a slight improving trend as shown in the figure below.



Although EPCOR has been successful in continuous energy efficiency improvement over past few years, there are more challenges ahead. The population of the capital region has been growing fast with an annual average population more than 2.3% over the past 10 years. This trend has been consistent even in the recent economic downturn, and confirmed by the 2016 Census, which reported the total population of Edmonton Capital Region at 1.321 million. However, the new properties are mostly located at the city's edges. More pumping energy is required to overcome the head loses in the water distribution system to reach these new properties. Aging infrastructure also negatively impacts energy efficiency. To meet these challenges, EWSI has implemented a number of energy efficiency initiatives to maximize pumping efficiency and minimize energy loss in the system.

The energy initiatives for 2016 included:

- EPCOR continued an annual program to upgrade capital assets to improve energy efficiency;
- EPCOR started to implement a new energy index KWH/ (ML*per 100,000 water residential account) to better reflect the challenges in population growth as shown the energy index table above. This new energy index will be reported to City of Edmonton as public information starting in 2017; and
- EPCOR has been exploring options for green energy in the Edmonton water system. In the 2017-2021 PBR agreement with the City of Edmonton, EPCOR committed to supplying 10% of the water system energy through Green Energy options.

The energy initiatives for 2017 are:

- An Energy Procurement Plan has been updated to guide future power purchase with green energy.
- EPCOR has been engaging external consultants to evaluate the feasibility of setting up solar panels at the E. L. Smith WTP, Rossdale WTP, and three other reservoirs (Millwoods, North Jasper Place, and Papaschase). The

size of the solar farms planned for E. L. Smith is being determined but could be greater than 10 MW AC. The size of the solar farms planned for the other sites would be less than 1 MW AC if they are carried out.
- Continue the HVAC upgrades at E.L. Smith and Rossdale. Start the HVAC upgrade study for Watermark.
- Start the windows upgrades at E.L. Smith.
- Reinitiate the Energy Efficiency Technical Committee to review the transmission operation strategy, to evaluate winter operation improvement opportunities, and to kick start the reservoir pumping efficiency improvement programs such as installing flow meters for every pump in Kaskitayo and Millwoods reservoir stations.
- Ensure the Mill Woods Booster station works in the full operational mode.

ACTIVE STAFF RECRUITMENT

EPCOR strives to be recognized as an Employer of Choice in Canada. In 2016 we were named one of Alberta's Top 70 Employers for the 11th year in a row, Canada's top employers for Young People for the sixth year, and the Corporate Knight's Future 40 Responsible Corporate Leaders in Canada list. We have a dedicated Talent Sourcing team that focuses on finding top quality candidates from the external talent pool. We also focus on internal employee development and training for technical and leadership positions. EPCOR's Talent Management Department operates the EPCOR School of Business which hosts a multitude of leadership training and professional development courses. EPCOR managers are increasingly involved in succession planning to support employee development to ensure we have a strong pool of talent, now and in the future. EPCOR has been conducting engagement surveys since 2012.

In 2016 EPCOR's overall engagement score surpassed other large Canadian organizations that made up the benchmark group. All Managers are expected to follow up on survey results by creating action plans in collaboration with employees to continually improve overall engagement. These efforts ensure that as we move forward, our teams will remain strong and engaged and will provide our customers with safe and reliable water services while meeting or exceeding environmental requirements.

WATER CONSERVATION PROGRAM

EPCOR Water is interested in ensuring a strong water supply remains in place for generations to come. We are looking for ways to increase awareness within our community regarding water usage and conservation. While most homes and businesses in the City are conservative users, there are still opportunities to consider. EPCOR implements a variety of industry best management efficiency practices which have resulted in significant water efficiency improvements in Edmonton. Some of our 2016 conservation initiatives included:

- Partnership between RONA, the City of Edmonton and EPCOR to host a Home$aver Eco sale. This event promotes the use of water and energy efficient products, general education and awareness. EPCOR's participation in this event included sponsorship and promotion of rain barrels for outdoor water conservation;
- Addressing high water consumption in schools and a subsidized housing operator by sending notification letters and conservation information packages:
- Partnering with government and business to support water efficiency and conservation programs including: City of Edmonton Environment Week, World Water Day and Canada Water Week;
- Promoting conservation and water efficiency through social media channels and updating efficiency information and tools on EPCOR's website to help customers reduce their water wastage;
- Promotion of online tools and resources for teachers and students that support education around water and wise water use:
    - Esmart Kids: An online resource for teachers and students built to encourage learning about using water wisely, and electricity safety/efficiency. During 2016, we saw 50,104 interactions with this site at: http://smartkids.epcor.ca
    - Water Quest: A joint project between EPCOR and Alberta Agriculture, Food and Rural Development. Throughout 2016, we saw 3242 Visits and 16,064 page views of this resource at: http://www.waterquest.ca/

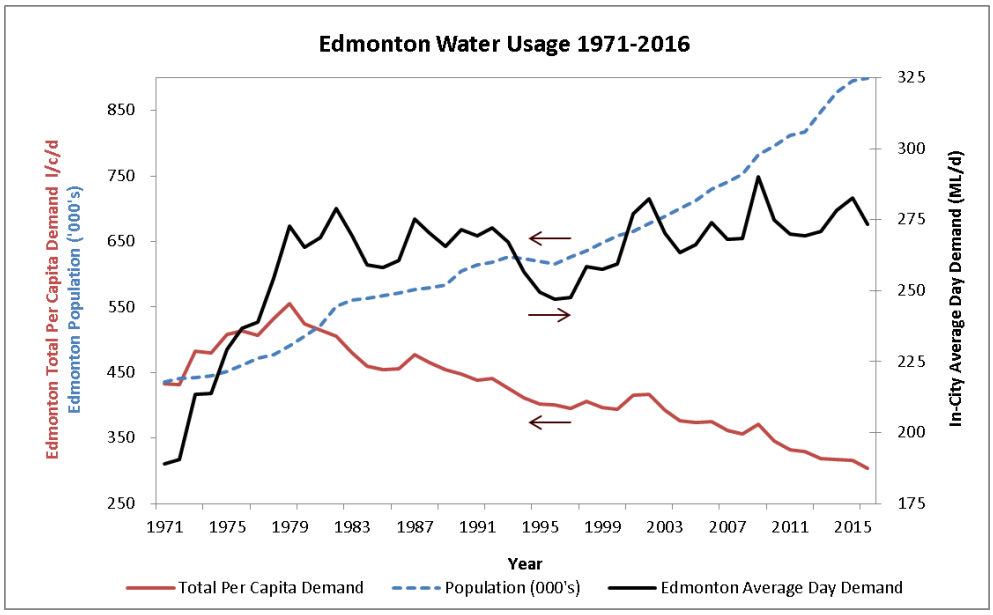
- Reaching out to eight schools that had twice the average water consumption per student per month as compared to the average and one subsidized housing operator with 20 buildings whose water consumption levels were more than four times the average.

Water usage trends are monitored regularly to ensure the conservation program is meeting operational objectives as well as our customers' needs. The figure below shows the trend of Edmonton's total water demand between 1971 and 2016. While population has steadily increased over this period, in-city average day demand has leveled off (with year-to-year fluctuations) and total per capita water use has been on the decline since the early 1980's. In 2016, the total per capita water use was 304 litres per person per day (L/p/d). Residential water use was 193 L/p/d. Edmontonians' continued conversion to high efficiency toilets and clothes washers is projected to decrease per capita water use over the long term.

In comparison, the Alberta Urban Municipality Association (AUMA) has set targets to achieve a total per capita water use of 341 L/p/d and an average per capita residential water use of 195 L/p/d (which is 30% below Alberta municipal sector reported water use from 2001-2006) by 2020. EPCOR has achieved the total per capita metric since 2011, and first achieved the residential per capita metric in 2014.

Going forward, EPCOR's conservation platform will focus on identifying and addressing inefficient water use in different high use customer classes or groups.

Edmonton Water Usage 1971-2016



SYSTEM WATER LOSSES

EPCOR has a program for monitoring and controlling water losses in the distribution system and has adopted the Infrastructure Leakage Index (ILI) as the primary measure of water loss performance. The ILI is the ratio of real water losses compared to the lowest losses possible if all available best management practices were successfully applied. The ILI was developed by the International Water Association (IWA) and is the industry recommended metric to measure the effectiveness of managing and maintaining a municipal water system. It is considered a good overall measure of system performance because it adjusts for water system size and complexity and also enables comparisons between different water systems. For a system of the same size and characteristics as Edmonton's, the Water Research Foundation suggests an ILI of > 3.0 to 5.0. Based on these factors, EPCOR had previously set an ILI benchmark of <3.0 as a reasonable goal. As shown below, EPCOR has consistently achieved ILI's below 2.0 in the past 5 years. As such, in 2016, EPCOR set an ILI benchmark of < 2.0 as a reasonable goal.

Year	ILI	EPCOR Benchmark Target
2012	1.29	<3.0
2013	1.27	<3.0
2014	1.46	<3.0
2015	1.18	<3.0
2016	1.06*	<2.0

*Preliminary metric. The 2016 Water Loss Audit is not yet published and therefore the ILI is subject to change

Consistently low ILI values indicate that EPCOR is managing real losses in a qualified manner. This can be attributed to the cumulative effects of the following factors:

- EPCOR has been actively renewing water mains for 30 years and maintains a strong commitment to continually replace cast iron piping (that is more prone to breaking and leakage) with PVC piping.
- EPCOR maintains a proactive leak management strategy that targets areas with lead services and areas close to the river valley, where the slopes are unstable and susceptible to sliding. In 2013, the program was expanded to include leakage surveys of the older neighbourhoods that were selected for neighbourhood renewal by the City.
- EPCOR has an active customer meter replacement program that ensures average meter life remains low. This results in high levels of meter accuracy and confidence in sales figures.
- EPCOR has a Performance Based Regulation requirement regarding main break repairs. This ensures real losses associated with main breaks are minimized.
- EPCOR tracks a large portion of unbilled authorized consumption through the hydrant permit program. This ensures accurate volumes are used to calculate real losses.
- Edmonton's clay based impermeable soil conditions ensure that most major leakage seeps to the surface close to the leak. This allows citizens to promptly report main breaks.
- Significant effort has been spent in the last couple of years to manage the amount of water used during new water distribution system commissioning in new subdivisions. This has included programs to ensure proper use of pipe lubricants to reduce unnecessary flushing for taste and odour control and implementation of flushing programs in non-contiguous development in the early stages of subdivision construction. As development levels increase to maintain water quality residuals with normal customer consumption levels these flushing programs, which are fully metered and charged to the developer, cease.

REDUCING ENVIRONMENTAL IMPACTS

The treatment of river water to produce clean, safe drinking water generates waste or "residual" streams. Some of these streams, such as the underflow from clarifiers and filter backwash, contain a lot of solid material that is a mixture of the suspended solid material removed from the river water and the solids produced by the addition of alum and, sometimes, powdered activated carbon. Some of these residual streams, such as filter backwash or treated water that does not meet the drinking water specification, also contain chlorine which can be toxic to fish. These waste streams have historically been released back to the river.

EPCOR has evaluated alternative strategies for managing these waste streams. Any successful strategy must balance reduction of environmental impact on the river against cost and our primary objective to meet drinking water treatment standards and to protect public health. Other environmental impacts, such as the energy footprint resulting from processing and transport of residuals to alternate disposal locations must also be factored into the equation.

THE IMPORTANCE OF DECHLORINATION

Drinking water contains residual chlorine, added at the treatment plants to disinfect the water. While it is important to ensure a minimum residual in the water delivered to all customers for protection of public health, the chlorine residual can be toxic to fish as it damages their gills. EPCOR has committed to eliminating all discharges of chlorinated water from its facilities. This includes routine discharges of chlorinated water from the E. L. Smith and Rossdale Water Treatment Plants arising from filter backwashes, filter-to-waste, release of other water that does not meet drinking water specifications, and less frequent discharges of chlorinated water arising from activities at field reservoirs and in the water distribution system.

DECHLORINATION AT THE WATER TREATMENT PLANTS AND FIELD RESERVOIRS

Bisulfite dechlorination systems have been in place and operating the E. L. Smith and Rossdale drinking water treatment plants since 2009 and 2012, respectively, and meeting AEP approval limits since 2010 and 2012. These systems remove chlorine from chlorinated water streams including filter backwash, filter-to-waste and plant by-passes before the water is returned to the river. Plant by-passes include treated water that does not meet drinking water specifications that is returned to the river. As well, procedures are in place to ensure that all planned discharges of chlorinated drinking water from the field reservoirs are dechlorinated prior to release.

In 2016, the dechlorination systems and procedures functioned well and there were no releases of chlorinated water to the river from the water treatment plants or field reservoirs. To reduce the likelihood of future discharges from unknown or hidden sources of chlorinated water, a cross connection study and drain audit was completed at both the plants in 2016. The recommendations (designs and projects) will be completed in 2017.

DECHLORINATION OF WATER RELEASED TO THE ENVIRONMENT IN THE DISTRIBUTION SYSTEM

EPCOR has procedures in place to dechlorinate drinking water released into the environment. This includes both planned releases (i.e. flushing and draining of pipes for maintenance) and unplanned releases (i.e. water main breaks and other emergency events). While it may be difficult to ensure 100% dechlorination of all releases (especially those that occur due to unplanned events like main breaks), the procedures will ensure the majority of the water released from the distribution system is dechlorinated and that potential environmental impacts are mitigated. In 2016, there were no releases of chlorinated water from the distribution system to water courses.

RESIDUALS SOLIDS MANAGEMENT PROGRAM

EPCOR has a program of continuous improvement in place to reduce the impact of solids present in the residual streams released into the North Saskatchewan River from its water treatment plants. Complete, year-round diversion of all solid residual streams from both Edmonton water treatment plants would require building very large, expensive treatment facilities at both water treatment plants and would involve trucking large volumes of solid material to landfills. This zero-discharge option was determined to be very costly and the net Environmental benefit was not clear. The volumetric flow and background solids concentration in the river fluctuates significantly during the year due to natural phenomena, which means that very large facilities would be required to manage the load during all seasons.

The EPCOR program has emphasized minimizing the loading of solids to the river during the fall and winter season, when river flow and the background suspended solid concentration are lowest and the relative impact of the solids discharged on the river quality is the greatest. This is achieved by reduction at source, that is by optimizing and minimizing the amount of alum added without compromising drinking water treatment. If less alum is added to the water for treatment, the amount of solid residuals produced and discharged to the river (especially the amount of chemical residuals) is reduced.

REDUCTION OF WATER TREATMENT PLANTS WINTER SOLIDS RESIDUAL PRODUCTION

Since 2009, the EPCOR Rossdale and E. L. Smith Water Treatment Plants have converted to the direct filtration mode of operation during the winter months to reduce the amount of residuals released to the river. The switch from conventional mode to direct filtration mode involves reducing alum dosing during treatment by up to 80%. This reduces the total mass of solids residuals produced during treatment that has to be discharged to the river by up to 50%. EPCOR's original plan was to operate in direct filtration mode during the months of November through February, and to build facilities to divert the remaining solids produced during these months to on-site solids treatment facilities for eventual landfill disposal (E.L. Smith plant) or sewer disposal (Rossdale plant).

Direct filtration operation has been generally successful in substantially reducing residuals discharged to the river while maintaining excellent treated water quality over the eight years since it was implemented. There have, however, been some operational challenges and the success has varied from year to year. EPCOR has learned that the key variable in determining operational success is the color in the raw water. Colour is a measure or the natural organic content of the raw river water. During the first two seasons (2009-2010, 2010-2011) the colour was relatively low and stable and direct filtration ran very well. However, in subsequent years the color has been higher and more variable in the fall. Early on, EPCOR determined that direct filtration can be operated successfully under the higher and more variable raw water colour conditions with appropriate alum dosing and use of clarifiers for some settling. This option, however, eliminated the possibility of on-site treatment and disposal of solids during the fall and winter without substantial capital investment. With approval from AEP (Sept 2013), EPCOR modified its residual reduction plan to focus on extending the operation of direct filtration into the fall (September to October) and spring season (March), when the water quality of the river is often amenable to direct filtration treatment. In addition, EPCOR has been further reducing residuals production by optimizing and reducing alum and powdered activated carbon treatment in conventional mode operation during other times of the year.

The table below summarizes the actual solids discharged to the river from the two water treatment plants by application of this strategy over the last four years (2013-2016). In a given year, the actual amount of solids discharged to the river depends on the raw water conditions for that year and will, therefore, vary. To determine the effectiveness of the solids reduction strategy against this background variation, EPCOR compares the actual solids discharged from the two treatment plants to the amount that would have been discharged using the 2005-2010 conventional treatment strategy. For example, in 2013 the actual amount of solids residual produced and discharged was 523 tonnes during the winter Direct Filtration period (Jan-Feb, Nov-Dec). If the plant had been operated in conventional mode with the same raw water conditions, 1065 tonnes of residual solid would have been produced and discharged. Direct filtration operation, therefore, achieved a 51% reduction in solids discharged during this period.

Until 2016, the direct filtration strategy has been very successful in reducing the quantity of solids discharged to the river during the winter and fall seasons. The 2016 year was by far the most challenging year for direct filtration operation to date. Spring run-off arrived in early March in 2016, thus shortening the potential extended direct filtration season. Later, after heavy rains in the watershed upstream of Edmonton in August, the raw water colour peaked at a historical high value of 200 TCU and then declined only gradually for the remainder of the year.

Prior to 2016, during the winter season (Nov-Feb), reductions in solids discharge ranging from 43% to 51% have been achieved. Reductions in the extended direct filtration period (Mar, Sept-Oct) have been more varied and have ranged from 0% in 2015 to 37% in 2013. In 2016, extended direction filtration operation in March was not achievable due to an early spring runoff. The Rossdale plant was not converted to direction filtration until December 20th and the E.L. Smith plant was not successfully converted to direction filtration by the end of the year. As result, the reduction in solids discharge during the winter months (Jan-Feb, Nov-Dec) was limited to 12% and no discharge reduction was achieved in the extended direction filtration period (Mar, Sep-Oct). In addition, the high colour and turbidity observed in the river during the summer months caused a much higher total solids loading to both plants during the chemical optimization period compared to earlier years. Overall, EPCOR struggled to reduce solids residuals discharged to the river in 2016.

Solid residuals discharged to the river from the Edmonton Water Treatment plants for the last four years (tonnes)

Operating Mode	Season	2013			2014		
		Baseline+	Actual	Decrease	Baseline+	Actual	Decrease
DF	Jan-Feb Nov-Dec	1,060	523	51%	1,170	581	50%
Extended DF*	Mar Sep-Oct	935	586	37%	936	654	30%
Chemical Optimization	Apr-Aug	18,950	17,840	6%	10,190	9,190	10%
Total	Jan-Dec	20,940	18,940	10%	12,290	10,420	15%

Operating Mode	Season	2015			2016		
		Baseline+	Actual	Decrease	Baseline+	Actual	Decrease
DF	Jan-Feb Nov-Dec	825	470	43%	1280	1133	12
Extended DF*	Mar Sep-Oct	Conventional Mode Operation			Conventional Mode Operation		
Chemical Optimization	Apr-Aug	3,690	3,780	-3%	10,600	10,500	0.9%
Total	Jan-Dec	4,500	4,240	6%	11,900	11,633	2.1

* Direct Filtration
+ Baseline load is calculated using 2005-2010 conventional treatment strategy and actual raw water conditions in 2013, 2014, 2015 and 2016

IMPACTS OF RESIDUALS MANAGEMENT STRATEGY ON DRINKING WATER QUALITY

One of the primary objectives of the residuals management strategy is to achieve environmental benefit (reducing solids loading to the river), without compromising the health and safety of drinking water. Direct filtration has a slight impact on a few quality variables including turbidity, total aluminum, total organic carbon and disinfection by-products. However, the impact is minor when these parameters remain well within health-based guideline levels or approval limits. In previous years, direct filtration operation has been correlated with an increase in the number of detects of very low levels of *Cryptosporidium* oocysts in the treated drinking water at the Rossdale and E. L. Smith water treatment plants. Using Quantitative Microbial Risk Analysis, the risk associated with this level of parasites in the drinking water was determined to be well below negligible risk levels established by Health Canada and the World Health Organization. No *Cryptosporidium* oocysts were detected in treated water during periods of direct filtration in 2016 and the levels of oocysts in the raw water remained below the level of concern. As noted earlier, however, the direct filtration operating period was relatively short in 2016.

CONTINUOUS IMPROVEMENT INITIATIVES

In the spirit of continuous improvement, EPCOR has been investigating strategies to further reduce alum dosing and, thereby, reduce solids loading to the river. These efforts have focused mainly on improving and optimizing direct filtration operation. In 2016 these included:

- *Zeta Potential:* EPCOR has investigated the use of Zeta Potential (ZP) measurements as a way of improving direct filtration operation. ZP is a measure of the charge on the surface of very small particles in water. We have found that ZP potential is closely related to filtration polymer dose and this provides some insights into using filter polymer dose to improve direct filtration operation. In 2016, EPCOR obtained and tested a continuous ZP analyzer for potential to improve direct filtration operation.
- *Alternative Coagulants and Polymers:* EPCOR has been investigating the use of alternative coagulants and filtration polymers for the potential to improve and extend direct filtration operation. Pilot trials with a promising coagulant and polymer are scheduled for 2017.
- *Improving Cryptosporidium Oocyst Removal*: In 2014 EPCOR initiated a research project led by the University of Alberta to study the physical removal of *Cryptosporidium* oocysts during direct filtration operation. The study involves a combination of laboratory bench experiments and pilot-plant challenge experiments. The objective is to determine the mechanisms and variables affecting oocyst removal during filter operation. This will lead to strategies to further optimize oocyst removal during direct filtration. The project started in 2015 and received funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) for two years. In 2016 and early 2017, the research team was able to complete a set of pilot plant experiments using glycopolymer-coated microspheres as surrogates for *Cryptosporidium* oocysts to assess the effect of filter polymer dose and filtration on the effectiveness of direct filtration.
- *Raw Water pH Adjustment*: One of the challenges with direct filtration in the early fall months is the naturally high pH of the river water. In 2016, a second set of trials to test the effect of lowering pH by addition of sulfuric acid to the raw water was carried out at the E. L. Smith water treatment plant but the results were inconclusive.
- *Using Deep Bed Filters*: In 2013-2014, a comprehensive pilot study was completed to assess the feasibility of deep bed filters to provide additional plant capacity and facilitate direct filtration operation. An engineering analysis was also completed to determine the technical and economic feasibility of converting some of the filters at the E. L. Smith Water Treatment Plant to deep bed operation. In 2016, a proposal for a capital project to convert 12 of 18 filters at the E. L. Smith plant to direct filtration mode was approved as part of the EPCOR's 2017-2021 Performance Based Regulation rate application to the City of Edmonton.

ENVIRONMENTAL MONITORING

In addition to reducing the solids loading to the river, EPCOR has also been investigating the environmental impact of the solids that are discharged to the river.

- In 2013 EPCOR began a program of river water sampling and testing to determine the extent of the impact of solids discharges on the river immediately downstream of the discharge points. This sampling program has grown each year through to 2016. In 2013 and 2014, this work involved collecting grab samples from the river or making measurements using hand-held probes from a boat during discharge events. In 2015 and again in 2016, a datasonde was deployed directly in the river downstream of the discharge points to gather additional information to complement the grab sampling. The datasonde is a device that allows essentially continuous in-stream monitoring of key water quality parameters like pH and turbidity. In 2016, a benthic invertebrate health monitoring program was added along with collection of sediment samples to determine chronic toxicity using the freshwater amphipod *Hyalella azteca*. This organism is a good indicator of health of the benthic community.
- So far, the results indicate that suspended solids, pH and total aluminum concentration increase within the near-field mixing zone in the immediate vicinity of the discharge points but return to normal levels within 500m downstream. The exception is dissolved aluminum where limited data has shown increased levels at the discharge point that still persist up to 2000m downstream. Preliminary results of the sediment toxicity tests indicate that water treatment plant solids do not cause mortality in the indicator organism, *Hyalella Azteca*, but may lead to reduced growth. Results from the benthic invertebrate monitoring program will be available in 2017.

Since 2010, EPCOR has been submitted quarterly composite samples of the solids discharges to a third party laboratory for determination of acute lethality using the 96 hour rainbow trout assay. The majority of the samples submitted have indicated no acute toxicity to fish. One sample collected in August showed some toxicity in the lab testing. This result, however, was believed to be due to how the test was carried out and lack of dissolved oxygen in the sample rather than to toxicity of residuals material itself.

EPCOR will continue this monitoring program based on grab sample, datasonde information, benthic invertebrate health monitoring and chronic toxicity determination in 2017. The program will be expanded to include measurement of the impact of the dechlorinated discharges on dissolved oxygen in the river.

LOOKING FORWARD

As we move into the 6th year of Champion status, EPCOR will continue to improve environmental performance through various programs and initiatives in 2017 and beyond. We will strive to pursue and make progress on each of our Stewardship agreements. Going forward, EPCOR will:

- Ensure that the Water Treatment Plant and Reservoirs **Environmental Management System** will be updated to the new 2015 version the ISO14001 standard so that by year-end the entire Edmonton Drinking Water System EMS will be fully registered to latest ISO14001 standard.
- Develop and implement by 2018 a comprehensive multi-year **water quality monitoring program on the North Saskatchewan River**. This program will be developed in conjunction with Alberta Environment and Parks, the North Saskatchewan Watershed Alliance and the City of Edmonton;
- Complete an assessment of Green Energy alternatives, including solar panels to produce electricity, that that will see up to 10% of the water system energy provided by green energy;
- Update the program of research to understand the impacts climate change on the water supply and develop a **Climate Change Adaptation Strategy** that will include management plans for various multi-year drought scenarios and flood conditions in the North Saskatchewan river basin;
- Implement action plans for the priority risks identified in the 2017 **Drinking Water Safety Plan;**
- Explore improvements to the **lead pipe program** including an incentive program or other alternatives for customers and better alternatives to the current point-of-use water filters.
- Begin design for a capital project to convert to deep bed filtration at the E. L. Smith Water Treatment Plant. This initiative will facilitate and potentially **extend direct filtration operation**;
- Continue to **examine the environmental impact of solid residuals** discharged to the river through a program of in-stream water quality sampling and testing including examination on the impacts on the benthic organism community;
- Complete the research project with the University of Alberta on removal of *Cryptosporidium* oocysts from the filters in the water treatment plant during direct filtration operation; and
- Continue to participate in Alberta Environment and Park's Water Management Framework Advisory Committee, North Saskatchewan Watershed Alliance, the Alberta Water Council, the Alberta Drinking Water Laboratory Technical Advisory Committee and other government led or Water-For-Life related initiatives.