COUNCIL REPORT

To: Mayor and Council Date: November 26, 2024

From: Ron Bowles, Chief Administrative Officer File No:

Subject: **Rose Valley Reservoir – Source Water Improvements**

Report Prepared by: Rob Hillis, Acting Director of Engineering and Operations

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PURPOSE

This report provides a comprehensive overview of the ongoing commissioning phase for the Rose Valley Water Treatment Plant (RVWTP) and the recommended source water improvements for the Rose Valley Reservoir.

RECOMMENDATION to Consider and Resolve:

THAT Council direct staff to amend the 2024 Budget to include an $2,500,000 (two million five hundred thousand dollars) for Rose Valley Reservoir - Source Water Improvements funded from Rose Valley Water Reserves;

AND THAT Council direct staff to issue a $50 credit, to the 8,500 accounts of the Rose Valley Water System, at an estimated cost of $425,000, to be funded from the Rose Valley Water Reserves.

STRATEGIC AREA(S) OF FOCUS

Invest in Infrastructure – We will invest in building, improving and maintaining infrastructure to meet the needs of, and to provide a high quality of life for, current and future generations.

Foster Safety and Well-Being – We will pursue through direct action, advocacy, and collaboration with local and regional service providers, investments in community health, needs-based housing, emergency preparedness, policing, and other services that foster safety and well-being in West Kelowna.

BACKGROUND

Under the direction of Council's Strategic Priorities to invest in infrastructure and foster safety and well-being, significant efforts have been directed towards enhancing the

safety, quality and reliability of the water supply. The following sections detail the challenges, lessons learned, progress, and future plans associated with Rose Valley Water Service Area's source supply.

Source Water Quality

Rose Valley Reservoir is fed from a diversion from Bear (Lambly) Creek, which receives its water from upland reservoirs in the Lambly watershed. The source water has experienced increased algae, iron related bacteria, and manganese concentrations. Even with treatment, source water quality can impact the taste and odor of the water after treatment. Ensuring source water quality is important to maintain a robust drinking water source that will also improve the taste and odor of the water.

The source water quality in the Rose Valley Reservoir has experienced changing conditions over time and more source water quality challenges are expected. Increased human caused activity, climate change, and wildfire are placing additional impacts to the watershed. Algae growth has increased along with turbidity, iron related bacteria, and manganese. The McDougall Creek wildfire impacted approximately 98% Rose Valley Reservoir's immediate watershed. This is the last natural buffer and the most critical area as it is closest to the intake that travels directly to the plant. Water quality impacts from the wildfire are expected to last at least five years and will exacerbate existing issues with the water source.

Figure 1: Rose Valley Reservoir Watershed After the McDougall Creek Wildfire

Water Master Plan

The Water Utility Master Plan is a comprehensive review of the utility and provides a roadmap for upgrading the utility to meet best practices and Federal and Provincial guidelines. West Kelowna initiated the master plan process in 2011 after the Westbank Irrigation District and the Lakeview Irrigation District was dissolved and transferred to the City in January 2011. The plan included the two former irrigation districts (Lakeview and Westbank), the West Kelowna Estates Water Service Area, the Sunnyside Water Service Area, and the Pritchard Water Service Area. As part of the plan a holistic review of the source water options was completed.

The plan recommended two centralized treatment plants to treat the two uplands sources and transmission mains projects to interconnect the water service areas. The Powers Creek Water Treatment Plant was already in service, and the future Rose Valley Water Treatment Plant would provide water to the former Lakeview Irrigation District, West Kelowna Estates Water Service Area, Sunnyside Water Service Area, and Pritchard Water Service Area. The plan stated that the treated water goals for manganese is less than .05 mg/L.

An update to the Master Plan is currently in the early stages of development. Data gathering and preliminary plan development is underway, with the plan scheduled to be presented to Council later in 2025. The plan will comprehensively review the utility and develop capital planning, operation and maintenance, and water rate recommendations.

Rose Valley Water Treatment Plant Design Process

The Rose Valley Water Treatment Plant design process began in March 2017 when the City received a grant for $41,002,000. Conditions of the Clean Water and Wastewater Fund grant stipulated that the water treatment plant was to be completed by March 31, 2018. As a project of this magnitude, the completion date was required to be extended several times, but funding requirements required the facility to be completed as soon as possible.

Shortly after receiving the grant, the City retained Associated Engineering to support the Project Management of overseeing the plant's design and construction. With the support of the Project Management consultant, the City issued a Request for Proposals (RFP) to secure the design consultant for the project. The RFP process included specifications that the plant's design is to meet and exceed provincial and federal water quality parameters. AECOM Canada Limited was the successful proponent of the RFP process in September 2017.

The RVWTP design was completed in late 2019. In February 2020 the City issued a tender for site earthworks to begin construction on the future facility. While earthworks were being completed, the City also procured components and services for the second phase of construction for the plant. This included pre-purchasing the UV Disinfection equipment (May 2020), prequalification for General Contractors (September 2020), securing a contract for Electrical, Instrumentation & Controls Equipment Supply (December 2020), and securing a contract for a General Contractor (February 2021). The

design was submitted to Interior Health for their review and approval, with a Construction Permit for the facility received in June 2021.

In spring 2021, the second phase of construction began on the plant with the General Contractor, Maple Reinders Constructors Limited. The plant reached substantial completion in late 2023 and residents in the legacy Lakeview Irrigation District began receiving treated water from the plant in November 2023. On December 20, 2023, the entire combined Rose Valley Water Service Area was receiving water from the newly completed plant, which included the former Sunnyside/Pritchard and the West Kelowna Estates water systems. In total the project cost $75,000,000 to complete the treatment plant and the two transmission mains. The commissioning of the plant and the newly connected service areas is anticipated to take upwards of a couple of years to adjust to seasonal changes in water quality and changes in the distribution system.

Manganese

On May 10th, 2019, Health Canada included a new Maximum Acceptable Concentration (MAC) of 0.12 mg/L for manganese in the Guidelines for Canadian Drinking Water Quality. The MAC is intended to protect all Canadians. It is based on the most vulnerable/sensitive population (e.g. infants and young children). Health Canada also established a new Aesthetic Objective (AO) for manganese of 0.02 mg/L. The aesthetic objective is intended to minimize the occurrence of discolored water complaints based on the presence of manganese oxides and to improve consumer confidence in drinking water quality. Prior to 2019 there was not a maximum allowable concentration or aesthetic objective for manganese.

Larratt Aquatic Consulting Limited has been monitoring and testing the Rose Valley Reservoir for Lakeview Irrigation District and the City of West Kelowna for over 40 years. Following the release of the new guidelines, Larratt Aquatic expanded testing for manganese to include quarterly sampling, at a minimum, in Rose Valley Reservoir. Manganese levels in the reservoir were noted to exceed the guidelines in 2019 and again in ensuing years. With Larratt Aquatic Consulting's submission of their annual report to the City in June of 2020, the City was made aware that manganese levels in the reservoir were rising and future treatment for manganese should be considered. City staff believed that this was being addressed in the design of the future water treatment plant, but the design of the plant should have revisited the treatment processes with the newly collected data. The following budget (2021) staff included a project in the 10 Year Capital Plan for Rose Valley Source Water Improvements for $2,000,000 in the 2029 year.

DISCUSSION

In 2024 the Rose Valley source water continued to undergo changes to water composition and quality. Algae bloom treatment in the reservoir was suspended, given the excellent algae removal achieved by the new plant. Turbidity levels were higher than recorded and water temperatures increased. Impacts from the McDougall Creek wildfire exacerbating

existing issues in the water source, which led to increased turbidity and manganese concentrations.

Summer 2024 Water Discoloration

In early July 2024, discolored water began to be observed in the water being supplied to residents. By July 10th, city staff began investigating whether manganese, among other possibilities, was responsible for the discoloration. On July 23rd, the City received test results from samples taken on July 20th that manganese entered the distribution system at higher than the MAC levels. City staff spoke with Interior Health on July 24th and shared that a sample from water entering the distribution system had exceeded the MAC. City staff then began investigating to complete the appropriate corrective actions.

It was at this time that it was identified that the treatment facility did not adequately treat dissolved manganese. As a result, the treated water leaving the plant with dissolved manganese oxidized with the dose of chlorine, causing the water to turn a brownish colour. Initial messaging on July 23rd, 2024, incorrectly noted the discoloration was an aesthetic concern, appearing as turbidity from velocity reaching higher than typically experienced speeds in the distribution system. At that time, the system was experiencing the highest flows since the plant was in operation, and water was being distributed to two additional service areas. The flushing program was also underway to remove sediment that has accumulated in the mains, which also causes a brownish colour to the water.

Once testing indicated that the discoloration was related to manganese, messaging was updated on July 25, 2024, in consultation with Interior Health. Staff worked with their consulting team and Interior Health to develop messaging for the public, establish an immediate interim solution, and plans for a permanent solution. It was a challenging summer for customers as they were provided discolored water at times, sent mixed messaging, and asked to flush their water lines repeatedly.

When manganese levels exceed the MAC, Health Canada provides guidance to water suppliers and regulators to rectify the risks. Excerpts from the guidelines are provided below.

Health Canada, Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Manganese:

An exceedance of the MAC should be investigated and followed by the appropriate corrective actions. Depending on the location and extent of the exceedance(s), investigation to determine its cause may include the following:

- *continue monitoring manganese at appropriate locations until levels are below the MAC.*
- *confirm source water concentrations;*
- *verify treatment plant operations and treated water concentrations;*
- *review distribution system operation and maintenance activities to determine if hydraulic release occurred;*

- *verify distribution system water quality (e.g., pH, oxidation/reduction potential (ORP), chlorine residual, turbidity) to determine if chemical release occurred.*

Based on the results of the investigation and the significance and extent of the manganese exceedance, corrective actions may include the following:

- *notify communities and other appropriate authorities;*
- *issue a "do not consume" advisory;*
- *consider treatment plant adjustments;*
- *conduct targeted and tailored distribution system maintenance activities according to best practices, which may include unidirectional flushing, ice pigging and swabbing.*[1]

Interim Solution for Manganese Removal

An interim solution was enacted on August 2nd, 2024, to provide a dose of chlorine prior to treatment. This dose oxidized the manganese and allowed it to be removed through the Dissolved Air Flotation and filtration processes of the plant. The interim system initially worked well and removed manganese but required manual testing to confirm manganese levels. Over the weekend of September 14th and 15th, 2024 the Rose Valley Reservoir began its fall overturn, which resulted in increasing manganese levels entering the distribution system. This resulted in public concerns due to increased color, and taste and odor. The water supplied during that period was within treated water requirements for manganese (0.12mg/L) and colour but exceeded the aesthetic objective for manganese. The chlorine dosage was increased the following Monday September 16th and water quality in the distribution system improved.

On October 15th, 2024, manganese levels in the Rose Valley Reservoir returned to below the Aesthetic Objective levels. The interim chlorine dosing system was turned off. Manganese concentrations are not expected to be a concern until seasonal low dissolved oxygen conditions develop, which is possible in March 2025 and is expected in summer 2025. In the interim, City staff will continue to monitor manganese levels in the source water and implement the interim improvements, as needed, if levels increase. Refer to Table 1 for a summary of test results for manganese concentrations at various locations in the distribution system.

Table 1: 2024 Manganese Testing

Rose Valley Water Service Area							
Location	**13-May-24**	**09-Jul-24**	**24-Jul-24**	**31-Jul-24**	**08-Aug-24**	**07-Oct-24**	**28-Oct-24**
Rv Trails	0.00478		0.1080	0.0755	0.0059	0.0003	0.0058
Thacker	0.00328		0.0443	0.0612	0.0045	0.0005	0.0056
Bridgeview			0.0833	0.0302	0.0044	0.0002	0.0052
Shannon Way	0.00174		0.0599	0.0360	0.0061	0.0002	0.0046
Tallus Res			0.0634	0.0660	0.0395	0.0027	0.0019

[1] 2 Health Canada, Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Manganese

Lakeview Cove			0.0492	0.1080	0.0056	0.0007	0.0051
2201 Stevens Rd		0.0573	0.0912	0.0682	0.0044	0.0005	0.0056
Menu	0.00572	0.0543	0.0603	0.0666	0.0030	0.0004	0.0054
Pritchard	0.00224		0.1270	0.1020	0.0090	0.0007	0.0041
Sunnyside PRV				0.0951	0.0080	0.0008	0.0082
Boucherie PS - Inlet			0.0735				
Boucherie PS - Outlet			0.0626				
Voignier	0.01200				0.0064	0.0006	0.0011
Upper Boucherie			0.0648	0.0515	0.0243	0.0010	0.0025
Blackwood	0.00392	0.1070	0.1680	0.1650	0.0073	0.0003	0.0046
McPhail			0.0845	0.1040	0.0177	0.0003	0.0045
Horizon	0.00585		0.0857	0.1320	0.0050	<0.0002	0.0040
Pettman			0.1300	0.1610	0.0118	0.0003	0.0044

Tests exceeding the MAC=0.12mg/L

Tests exceeding the AO= 0.02 Mg/L

Disinfection By-Products

Disinfection by-products (DBPs) are chemicals that form when chlorine is used for disinfecting drinking water to prevent disease. The chlorine reacts with decaying organic matter, like leaves or vegetation, to form DBPs. Two of the most common types of DBPs found in chlorinated drinking water are trihalomethanes (THMs) and haloacetic acids (HAAs). When chlorine is added to water prior to treatment, the chlorine will react with the organic matter and produce disinfection by-products. Adding chlorine after treatment will cause less disinfection by-products because most of the organic matter has been removed from the water.

Health Canada, Disinfection By-Products in Drinking Water:

"Some studies have suggested that long-term exposure to consistent high levels of THMs or HAAs might increase the risk of cancer. Experts agree that any health concern from these DBPs come from exposure over many years. The benefits of disinfecting drinking water with chlorine are much greater than the potential health risks of being expose to higher levels of THMs and HAAs." [2]

Disinfection by-products are measured quarterly, and regulators require water suppliers to complete a yearly average of the four test results. Singular measurements can exceed the guidelines, but the yearly average is required to be within the MAC. Since the completion of the plant, disinfection by-products have significantly been reduced and are within the yearly average of acceptable levels.

[2] Health Canada, Canadian Drinking Water Quality, Disinfection by-products in drinking water.

Provided below are two graphs showing the historical performance of the trihalomethane disinfection by-products and this past year with the Rose Valley Water Treatment Plant functioning and the temporary additional of pre-chlorination during the summer to oxidize manganese. There are two key conclusions supported by the data in the below graphs:

- The new WTP is successfully removing the disinfection by-product precursors that are natural present in the Rose Valley WTP source water. During the first year of a treatment facility operation everything is not fully optimized, however the new treatment plant still produced THM compliant water. The disinfection by-products were reduced by 50% or more.
- Pre-oxidation with chlorine is not a recommended long-term approach for the treatment of manganese. As shown in the Rose Valley Water Trihalomethane graph the disinfection by-products exceeded the guidelines during the completion of pre-chlorination for the manganese removal. The practice of pre-chlorination resulted in a measurable increase in the disinfection by-products experienced during the other annual samples collected during the operation of the new water treatment plant.

Figure 2: Annual THM Averages

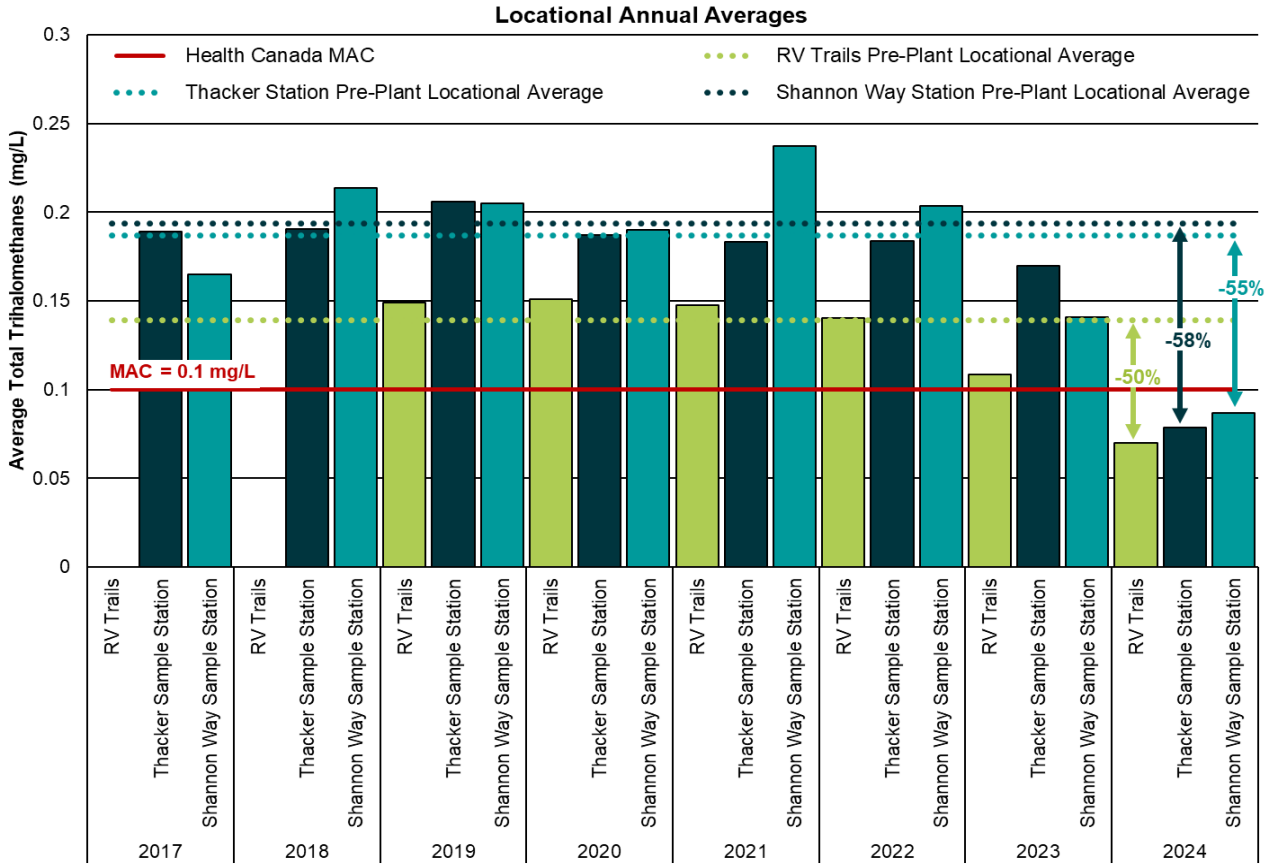
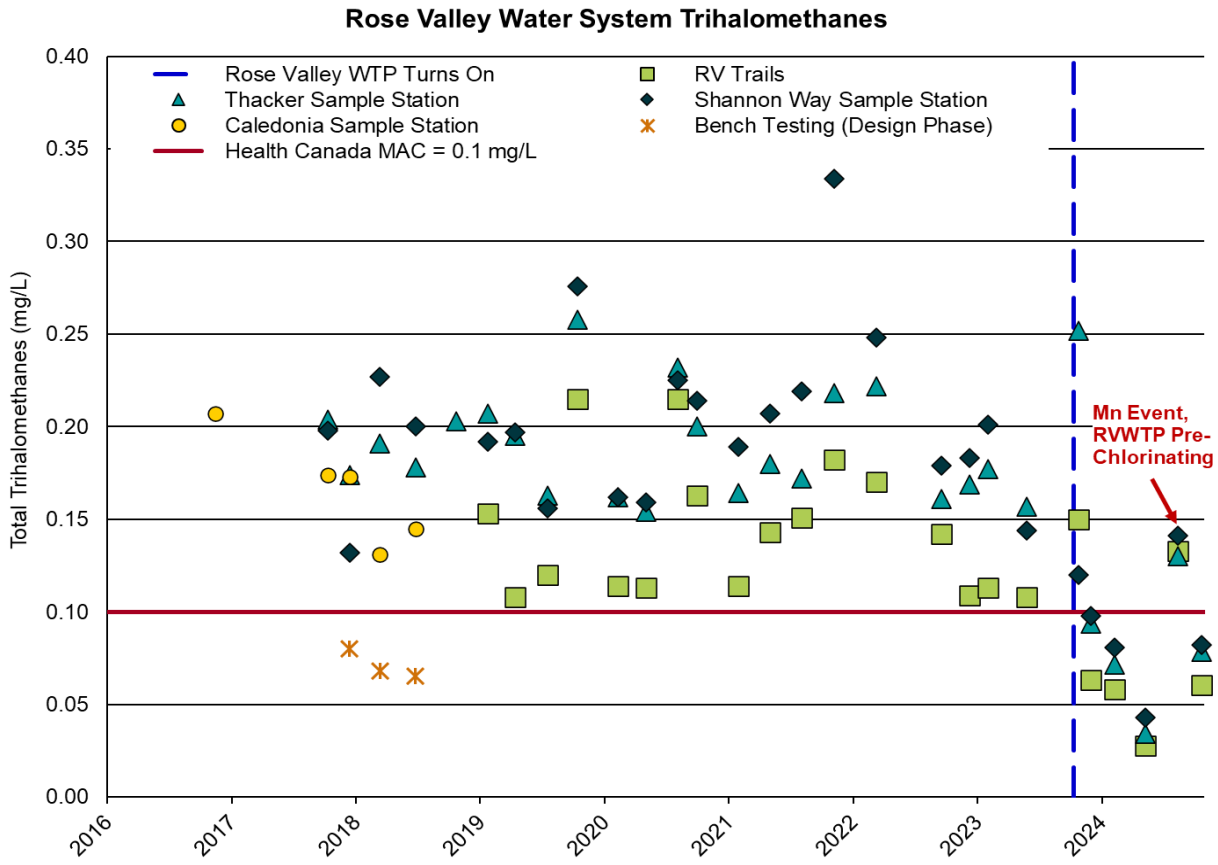


Figure 3: Individual THM Results



Pretreatment with chlorine is not an ideal pretreatment process because of the interaction with chorine and organic matter, which causes disinfection by-products. Treatment plant staff are required to constantly check manganese levels and adjust the chorine dosage as the conditions change. Preventing the source water from containing dissolved manganese, or other oxidizing agents, should be considered to lower the risk of the system exceeding MAC of disinfection by-products.

With a slight adjustment to the treatment process, the Rose Valley Water Treatment Plant was able to treat and supply the water while meeting the Federal and Provincial Guidelines. Preliminary dosing with chlorine, although not ideal, still met the guidelines for disinfection by-products. Without the water treatment plant, the Rose Valley Water Service area would have experience lengthy Water Quality Advisories, Boil Water Notices, and even possibly a Do Not consume order in 2024.

Recommended Improvements

Source water quality improvements are recommended to help improve water quality in Rose Valley Reservoir. Improvements were originally in the 2021 10 Year Capital Plan in the 2029 year. By advancing this project, source water quality will improve in the reservoir

to help mitigate the impacts from the McDougall Creek Wildfire. The funding will also be used to add a chemical oxidant near the point of diversion from the Rose Valley Reservoir.

Manganese is naturally released from the sediments in the bottom of the Rose Valley Reservoir once the oxygen level in the water adjacent to the sediment decreases and approaches zero. The magnitude of the oxygen depletion in the bottom of the reservoir varies from year to year and is impacted by a host of naturally occurring situations such as algae blooms. The condition of reduced dissolved oxygen in the water at the bottom of the reservoir can occur in the summer once the reservoir stratifies. The stratification of a water body such as the Rose Valley Reservoir is a natural occurrence once a density difference occurs. To disrupt the natural stratification and the reduced oxygen in the bottom of the reservoir aeration and mixing it typically practiced. It is planned to improve the aeration in the Rose Valley Reservoir.

The Rose Valley Reservoir is a water body that is influenced by many factors. Given this, aeration is expected to help reduce the levels of dissolved manganese in the source water but may not be a definitive treatment solution. To provide a measured and predictable level of treatment for manganese, Potassium Permanganate, an oxidizing agent, is planned to be added to the water after it is drawn from the intake. This will allow the manganese to oxidize while the water is travelling in the mains to the treatment facility, where it can be removed by the dissolved air flotation and filtration processes in the plant. Using potassium permanganate as an oxidizing agent will not cause disinfection by-products. The approximate cost the aeration and chemical dosing improvements at the Rose Valley Reservoir is $2,500,000.

AECOM Canada Limited has completed preliminary design work on the aeration and potassium permanganate improvements. Detailed design is planned to be completed over the winter, with construction to follow in spring 2025, pending Council's approval for funding. The improvements are planned to be completed before summer 2025.

Water Credit

Since the completion of the RVWTP, customers of the Rose Valley Water Service Area have endured several instances of water being delivered that did not meet quality and colour parameters that are expected from water that is provided from a treatment facility. In addition to the discoloration due to manganese, City staff have completed a flushing program throughout the Rose Valley Water Service Area. The flushing program also stirs up sediment in the water mains and, as a result, customers were provided water that needed to be flushed from the system. In acknowledgement of customers being required to flush their systems repeatedly, the City will be issuing a one-time credit of $50 with their January water utility bill. This is to reimburse customers for water usage that was required to clear the distribution system. Based on 8,500 accounts, the cost of the credit is approximately $425,000 and will be funded from the Rose Valley Water Reserve.

CONCLUSION

Bringing online a water treatment plant of this magnitude can be challenging and take one to two years to improve and fine tune as part of the commissioning process. Source water quality will change throughout the year and the Rose Valley Reservoir will overturn twice a year. This will require staff to monitor and adjust plant processes. The Sunnyside/Pritchard and West Kelowna Estates systems have a new source water, which requires operational changes to the distribution system and treatment plant. Chlorine dosing is currently being adjusted to ensure all areas in the system maintain a chlorine residual, while minimizing the total amount of chlorine that is added to the water as it leaves the plant.

The Rose Valley Water Treatment Plant has improved the quality of water the City is providing to its customers and allows the flexibility of adjusting treatment processes to accommodate changes in the source water. Water Quality will continue to improve as the City refines its treatment processes and source water quality. Between August 4, 2016, and Nov. 15, 2023, the legacy Lakeview (955 days), Sunnyside/Pritchard (681 days) and West Kelowna Estates Systems (729 days) endured a total of 2,365 combined days of water quality advisories, boil water notices or do not consume orders, the latter required due to the McDougall Creek Wildfire, with the majority of these required due to source water fluctuations or its effects within the distribution system. All water quality advisories since the opening of RVWTP within the Rose Valley Water Service area were required due to watermain flushing. There were precautionary notifications for reconstituting infant formula requiring a different water source due to manganese, From August 1 to October 15th.

Customers have historically not received high quality of drinking water from the Rose Valley Source, so it is imperative that the City builds trust with our customers. This can be achieved by delivering the best possible product and by communicating changes in water quality with the public in a transparent and accurate manner. Improvements are being made in the way West Kelowna communicates both internally and with its customers. All testing for 2023 has been added to the City's website and test results for 2024 are planned to be shared in the coming weeks. The City will strive for continuous advancements as we improve water quality for users within West Kelowna.

FINANCIAL IMPLICATIONS

The recommended motion would advance the source water improvements for the Rose Valley source. The works were originally placed in the 2021 10 Year Capital Plan for 2029. In subsequent budgets, the works were moved to 2031 in the 10 Year Capital Plan. Funding for these improvements would be provided from the Rose Valley Water Reseves.

Alternate Recommendation to Consider and Resolve:

There is not an alternative recommendation, but Council could defer this approval until the 2025 Capital Budget Process. This could risk the improvements not being completed prior to summer 2025 when manganese levels are expected to be near MAC and required to be removed from the drinking water source.

REVIEWED BY

Warren Everton, Director of Finance/CFO

Trevor Seibel, Deputy CAO/Deputy Corporate Officer

APPROVED FOR THE AGENDA BY

Ron Bowles, Chief Administrative Officer

PowerPoint: Yes ☒ No ☐