EPCOR WATER SERVICES

Appendix F-1

Business Case

GOLD BAR WASTEWATER TREATEMENT PLANT ODOUR CONTROL IMPROVEMENTS PROJECT

May 31, 2024

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1.0 OVERVIEW

1. The Gold Bar Wastewater Treatment Plant (GBWWTP) is known to generate odours as a natural part of the overall wastewater conveyance and treatment from municipal, commercial, and industrial sources within Edmonton and surrounding areas. EWS has made a commitment to the regulator Alberta Environment and Protected Areas (AEPA) to continuously improve odour control at this facility and maintain quality of life in the surrounding areas by actively managing the odour sources within the GBWWTP. The total project cost is $21.3 million, with $7.7 million spent by 2024 as part of the current PBR and the remaining $13.6 million spent in the 2025-2027 PBR term.

2.0 BACKGROUND

2. The GBWWTP provides sanitary and combined wastewater treatment for Edmonton's residents, businesses, and some industrial customers. The primary objective of the facility is to treat and recover resources from the wastewater safely and reliably, while protecting the North Saskatchewan River (NSR) from contamination in compliance with environmental regulations enforced by AEPA.

3. The main contributor to odour generation at the GBWWTP is hydrogen sulfide (H_2S), which is produced by normal biological activity in wastewater (sewage). Extended travel times within the collection system can also contribute to increased H_2S generation. The combination of a large, geographically dispersed population and low flows in combined sewers during dry weather can also result in highly odorous wastewater on arrival at the plant.

4. EPCOR has committed to implement an odour monitoring and control strategy that aims to minimize the emission of odours from the site, while informing actions and potential improvements using continuous monitoring. EPCOR regularly engages with residents that live near the GBWWTP through an established Community Liaison Group (CLG), by hosting and attending neighbourhood events, and offering tours of the plant. In the past, many of these touchpoints included both formal and informal discussions around EPCOR's odour mitigation efforts. AEPA has also established air quality guidelines through the Alberta Ambient Air Quality Objectives (AAAQO), which identifies the H_2S 1-hour average release objective as 10 parts per billion (ppb) or 14 µg/m3. AEPA and EPCOR participate in regular discussions to review the ambient air quality near GBWWTP and the progress of the odour monitoring and control strategy.

5. Efforts to mitigate and reduce odours at the plant have been ongoing since the early 1970's, with a focus in the past 8 years to better understand and monitor the major sources of odour so that they can be prioritized for management. Over $35 million in capital has been spent on odour control improvements including adding new containment covers, installing additional foul air treatment capacity with three new carbon scrubbers and two new chemical scrubbers. Additionally, an ambient air quality monitoring station (AAQMS) has been installed outside of the fence line south of the facility to monitor the overall odour levels leaving the site and to improve the understanding of odour management needs.

6. Several assessment studies have also been undertaken to identify the top sources of odour as well as to develop improvement plans for containment and treatment. These assessments included modeling of odour and H2S emissions for both a base case and future case (after completing improvements). The most recent Odour Assessment and modelling results are shown in Table 2.0-1.

Table 2.0-1
Odour Assessment (Maximum 1-hour H_2S Concentrations in µg/m^3)

Sources Group Description	Base Case	Future Case
Diversion Structure	24.38	0.00
Exhaust Fans Combined	17.51	1.75
Primary Clarifiers Combined	9.31	3.55
Scrubbers Combined	1.09	0.57
Vents Combined	0.98	0.98
Bioreactors Combined	0.06	0.06
Secondary Clarifiers Combined	0.07	0.07
Boilers and Flares Combined	0.03	0.03

7. Table 2.0-1 shows that in the base case, the key contributors to odour exceedance of the AAAQO are the diversion structure, the exhaust fans, and primary clarifiers 5-8 (which are located outdoors). Impact from exhaust fans is being addressed by making changes to the ventilation of specific areas of the plant, while the other two sources are being addressed by this project.

8. The future case results presented in Table 2.0-1 demonstrate expected site odours after capture and treatment of the sources mentioned above. The model suggests that these capture and treatment improvements will bring the site into compliance with the AAAQO requirements for a 1-hour average H2S concentration.

3.0 JUSTIFICATION

9. EWS has committed to its stakeholders to minimize odour issues by actively managing sources within the GBWWTP. This effort is one of the shared outcomes identified through extensive public engagement and presented in the Gold Bar Integrated Resource Plan (GB IRP) submitted to Utility Committee in 2019. These odour control improvement projects are to manage and control emissions from the facility to minimize the impact on neighbouring communities and to comply with the AEPA regulatory requirements. Effectively controlling odours is crucial to meet regulatory standards and to safeguard EWS's reputation with the public and regulatory bodies. Failure to manage odours could potentially harm EWS's reputation and trust among stakeholders and customers.

4.0 PROJECT SCOPE

10. The project scope of work for this upcoming PBR will address the foul air generated at the Diversion Structure and Primary Clarifiers 5-8, which were identified as the most significant remaining sources of odour generation at the facility. The project will focus on providing odour capture at these two sources using the following means:

- Installation of fabric rollover covers to enclose the air headspace over Primary Clarifiers 5-8. A series of duct connections will allow for removal of the foul air from underneath the covers, which will be conveyed to one or more of the existing scrubbers. Figures 4.0-1 and 4.0-2 below show details for the covers and ductwork.

Figure 4.0-1
Primary Clarifiers 5-8 Proposed Covers

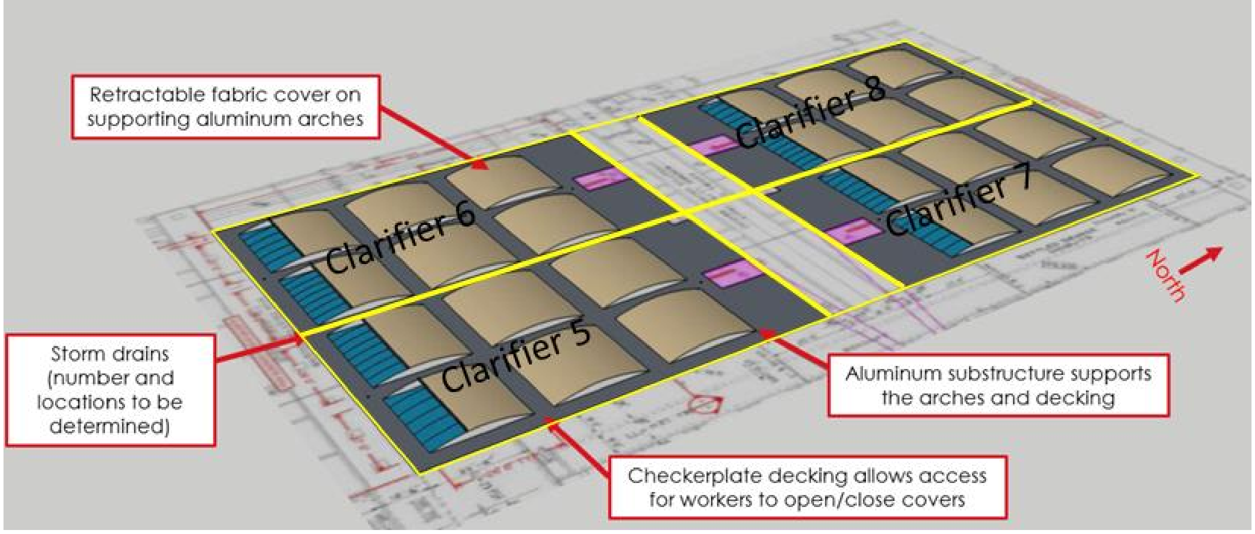
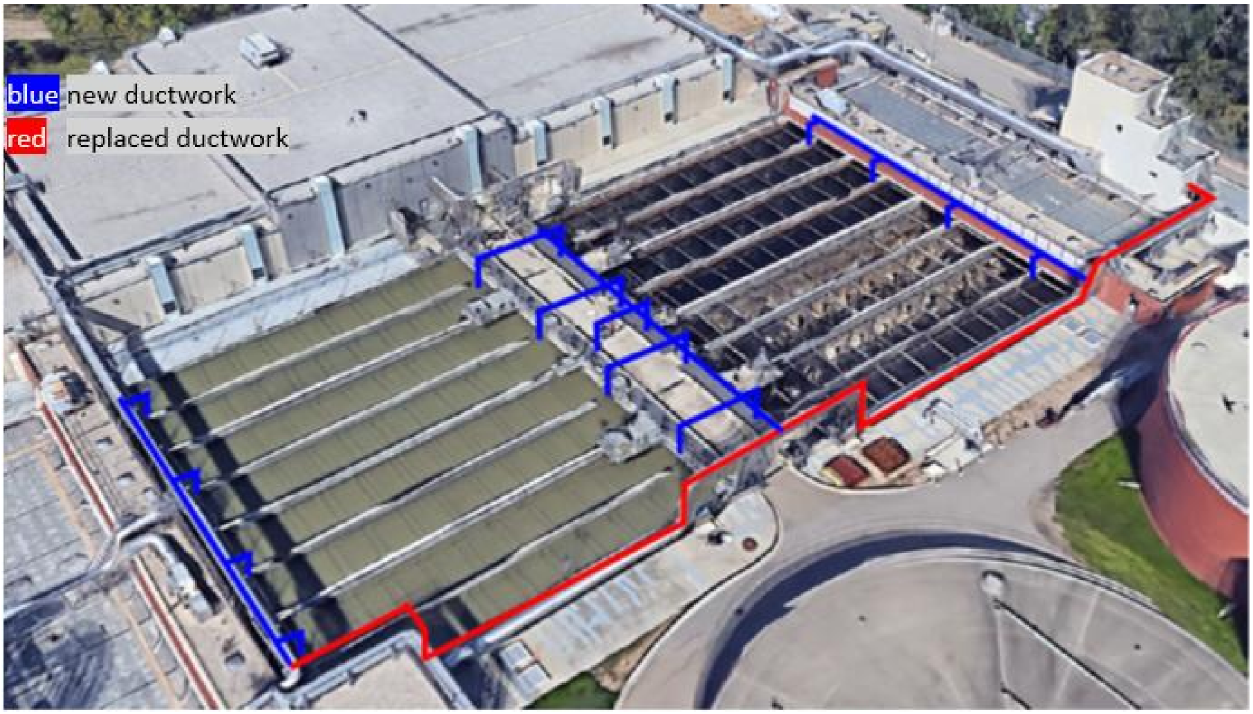
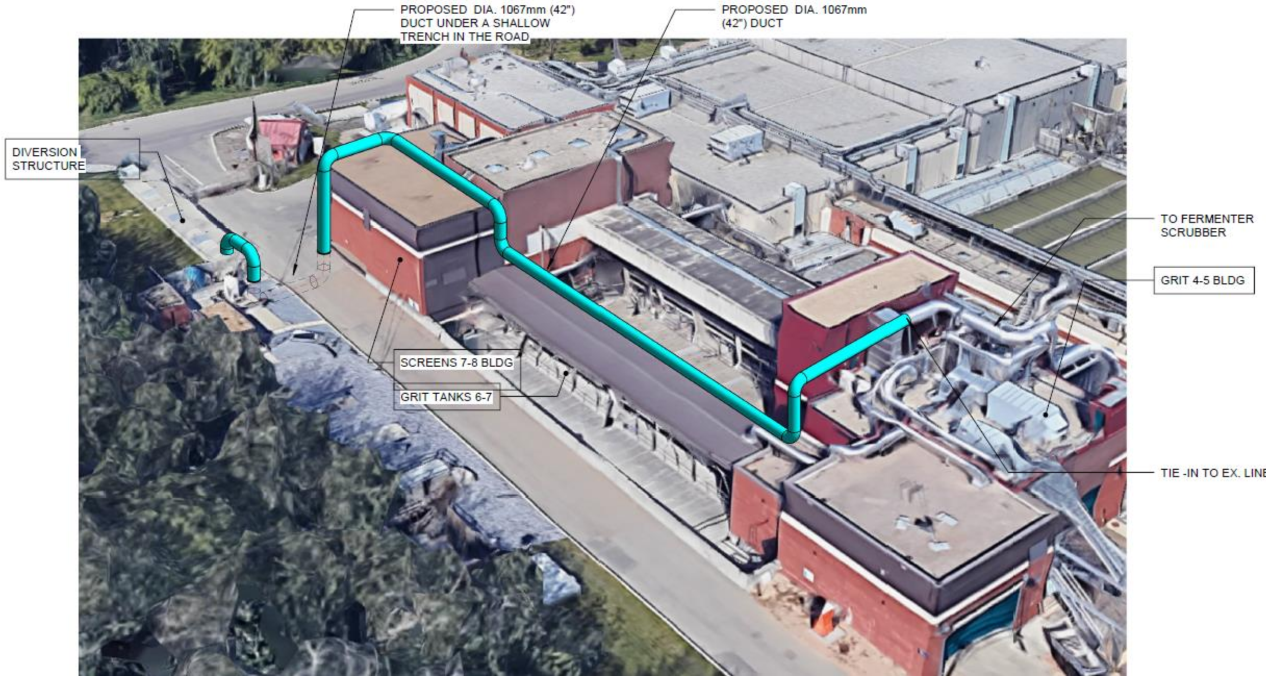


Figure 4.0-2
Primary Clarifiers 5-8 Tentative Duct Connections



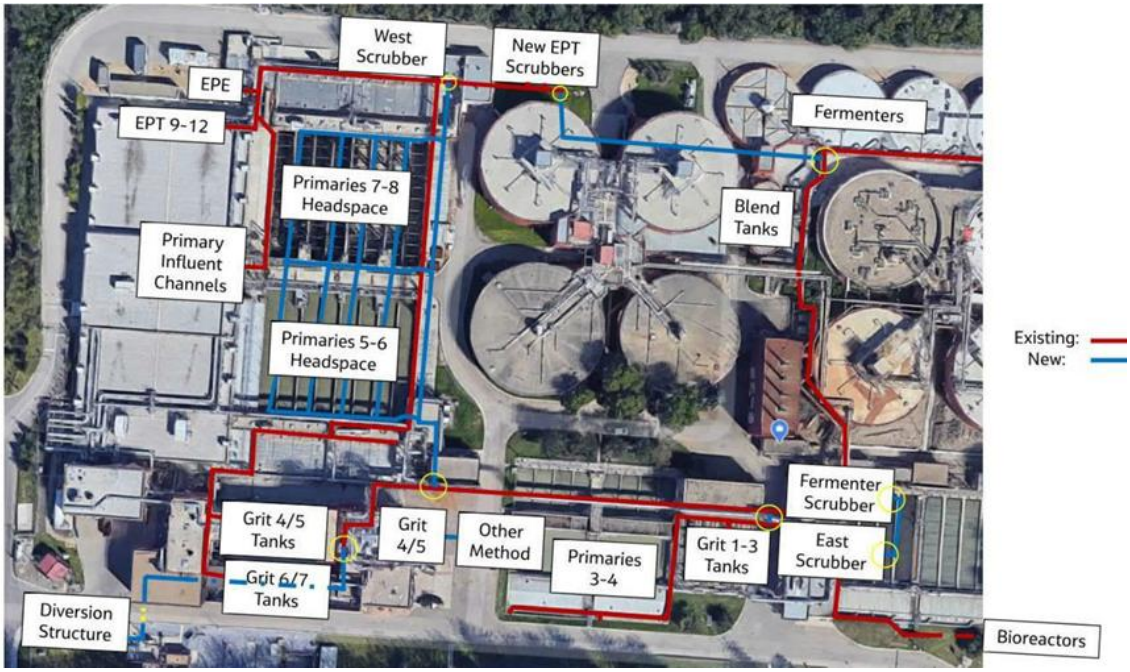
- Installation of ductwork to capture foul air from the Diversion Structure, which will be conveyed into the centralized duct network, where it will be treated by one or more of the existing scrubbers. Figure 4.0-3 below show the ductwork from the Diversion Structure.

Figure 4.0-3
Diversion Structure Tentative Duct Connections



11. As shown in Figure 4.0-4, the project scope also includes additional ducting for redundancy between scrubbers for maintenance purposes. This will ensure operational continuity by enabling loads from all odour sources to be re-routed to other scrubbers during maintenance. This will enhance the overall reliability and efficiency of the odour control system.

Figure 4.0-4
Overall Ductwork Concept



5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 – Do Nothing

12. The first alternative is to do nothing. EWS has made a commitment to the surrounding community and park users to manage odours by actively managing sources within the GBWWTP, and doing nothing would not meet this commitment. It would also lead to ongoing potential exceedance of the AEPA AAAQO for H_2S and is therefore not recommended.

5.2 Alternative 2 – Liquid Phase Chemical Dosing System

13. A second alternative, a liquid phase chemical dosing system, implemented at the headworks of the facility, has been trialed and proven unsuccessful. In addition, odorous compounds are already released in gas phase before flows enter the facility, so the treatment would have limited effectiveness. This alternative was rejected.

5.3 Alternative 3 – In-situ gas phase ionization treatment unit

14. A third alternative is to install an in-situ gas phase ionization treatment unit that collects air from the atmosphere, induces ionization, and injects the pressurized reactive air into the headspace of a channel. This sometimes can create positive pressure and makes it difficult to achieve a seal in the channel, resulting in escaping odour emissions. The complex nature of the diversion structure however makes it impossible to achieve appropriate contact of the foul air with the injected ionized air. This has been trialed and proven to be unsuccessful. This alternative was rejected.

5.4 Alternative 4 – Capture and treatment for Diversion Structure and Primary Clarifiers

15. Alternative four is to add modifications and duct work for the Diversion Structure and Primary Clarifiers and treat the foul air at the existing scrubbers. This is the current proposed solution as it utilizes existing infrastructure and established odour treatment methods proven successful at GBWWTP, making it the only feasible solution to meet the objective.

6.0 COST FORECAST

16. The project cost forecast is largely based on prior experience of executing similar projects on site. It is also assumed that consultants and contractors will be used to complete the scope. Projected costs for this project are shown in Table 6.0-1.

Table 6.0-1
Odour Control Improvement Project Capital Expenditure Forecast ($ millions)

	2024 and Prior	2025	2026	2027	Total
Total Capital Expenditures	7.7	10.2	3.4	-	21.3

7.0 KEY RISKS AND MITIGATION PLANS

17. Table 7.0-1 provides the key risks and mitigation plans associated with this project.

Table 7.0-1
Key Risks and Mitigation Plans

Risk	Mitigation Plan
1. Health and Safety Risks – Confined space entry and hazardous energy isolation are some of the associated risks.	EWS follows standard processes to reduce or eliminate these risks, including but not limited to: • Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum.

	• Procuring qualified contractors with experience working in these conditions • Including safety systems and safety performance in evaluation criteria for the selection of contractors • Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages • Developing a hazard registry specific to the required tasks and implementing best practices like job-site hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards. • Conducting regular site visits and formal, documented inspections during construction
2. Environmental Risks – Silica dust during construction, and removal and disposal of construction debris	EWS conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Appropriate delineation of construction area, including necessary dust control and debris management measures will be employed to mitigate relevant risks.
3. Financial Risks – Actual contractor bids may vary from the estimates. Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing. Further change orders or unknown conditions that cannot be seen until demolition is complete.	EWS manages financial risks by conducting preliminary design and allocation of contingency funds appropriate for the design level. The financial risks will become more evident as further design is completed. To mitigate cost escalations, thorough planning and proactive measures are essential. This can include detailed cost estimates during the planning phase, contingency budgets, and a comprehensive risk identification and analysis. Contracts should be clear with provisions for addressing unforeseen cost increases. Regular monitoring, strong relationships with contractors and suppliers, and experienced project managers are important to reduce the likelihood of cost increases. Value engineering to evaluate alternative materials, construction methods, or design modifications can also help to mitigate price increases.
4. Reputation Risks – Work conducted is in close proximity to Gold Bar residents. Additionally, external stakeholders (e.g. public, other asset owners) can be affected by some tasks that occur (e.g. excavation, equipment crossings).	External stakeholders and EPCOR Communications and Public Engagement will be consulted prior to starting these tasks. Community engagement will be conducted to address stakeholder concerns.

8.0 RESOURCES

18. This project will follow a design-bid-build delivery strategy, hiring consultants from existing master servicing agreements to support the design and stakeholder engagement efforts. Contractor will be hired from existing master service agreements. Internal resources will be used to support design, construction coordination, and commissioning efforts.

EPCOR WATER SERVICES

Appendix F-2

Business Case

CLOVER BAR EWMC GROUNDWATER TRANSFER PROJECT

May 31, 2024

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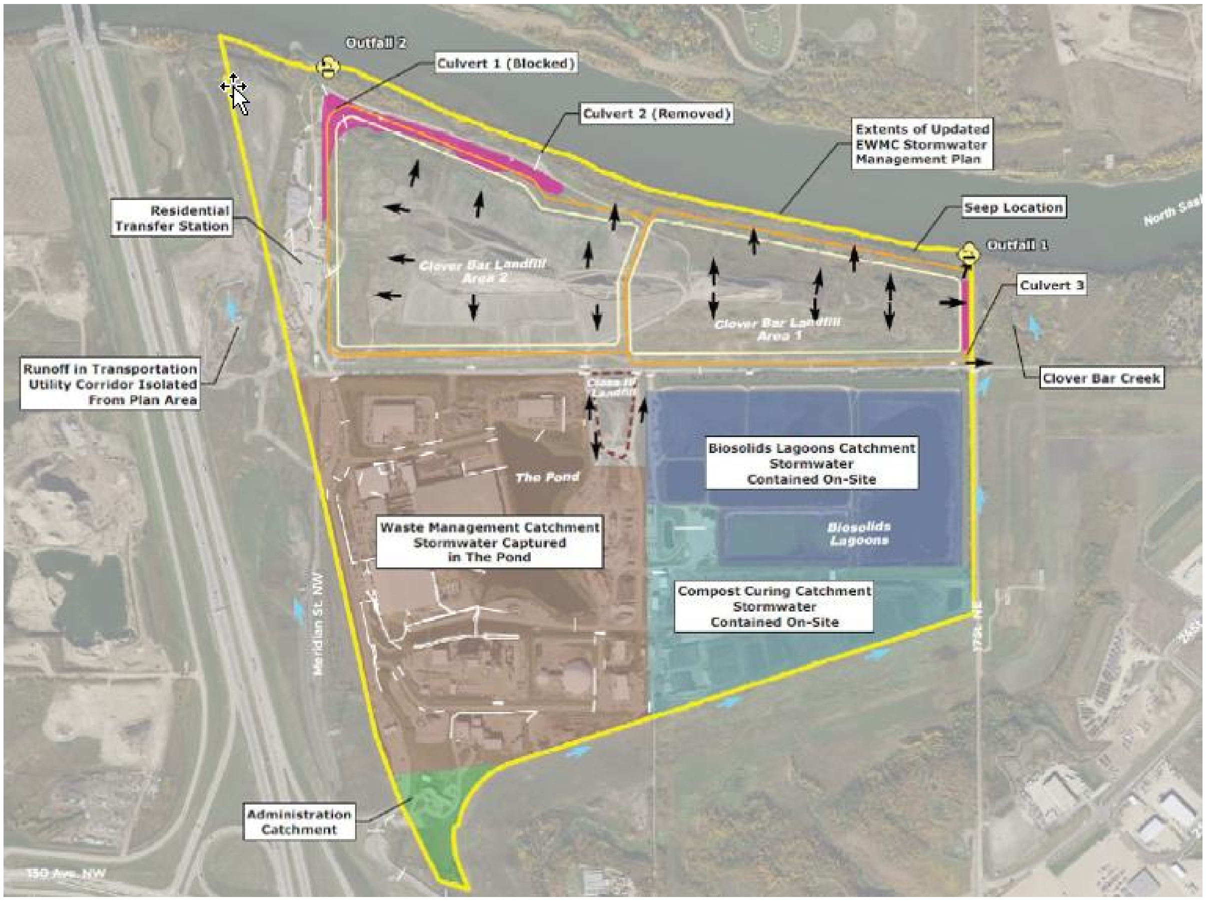
1.0 OVERVIEW

1. The City of Edmonton (COE) has an agreement with EPCOR to receive and treat groundwater and landfill leachate from the Edmonton Waste Management Center (EWMC) site as operationally feasible at the Gold Bar Wastewater Treatment Plant (GBWWTP) and Cloverbar Biosolids Resource Recovery Facility (CBBRRF). In order to have sufficient capacity and system redundancy to accommodate these groundwater flows, EWS will be constructing an approximately 2.5 km, 250 mm pipe segment from the CBBRRF to connect to a sanitary manhole located along the west riverbank of the North Saskatchewan River (NSR) immediately south of Hermitage Park. The project is preliminarily forecasted to have a total cost of $11.9 million, with $3.8 million spent during the current PBR, and $8.1 million during the 2025-2027 PBR term.

2.0 BACKGROUND

2. The EWMC is a COE owned waste processing facility used to manage and process the collection of waste such as garbage, food scraps, recycling, electronic waste, landfill gas and biosolids. The waste materials in the landfill causes contamination to occur when water from rainfall passes through the waste, creating leachate that carries pollutants like heavy metals and organic compounds. This leachate can then percolate into groundwater or run off the landfill surface. Historically, this groundwater was collected and discharged into the NSR through two COE private outfalls, built specifically for the landfill site, as shown in Figure 2.0-1. However, the impacted groundwater fails to meet the Water Quality Guidelines for Alberta Surface Waters. In order to maintain their approval to operate under the Environmental Protection and Enhancement Act (EPEA), the COE has been working with Alberta Environment and Protected Areas (AEPA) to find an alternative plan for managing the groundwater from the site.

Figure 2.0-1
Overview of EWMC



3. An agreement between the COE and EPCOR was implemented in 2017 as part of the Drainage transfer, that EWS will allow the transfer of impacted groundwater and leachate flows to the CBBRRF and GBWWTP for treatment, as operationally feasible. COE confirmed that the combined maximum flow is expected to be approximately 2.1 Megaliters Per Day (MLD), as stated in the EPCOR/EWMC Site Agreement. A detailed review of key water quality parameters was undertaken, and it was determined that no adverse impacts would be expected if controlled volumes of water from the EWMC groundwater system is discharged into the wastewater collection system and conveyed to GBWWTP for treatment.

4. There are currently three pipelines between CBBRRF and the GBWWTP used to convey flows between the two facilities. These flows primarily include digested sludge from GBWWTP to CBBRRF and supernatant return from CBBRRF to GBWWTP. Conveyance of these flows are critical to the wastewater treatment process and cannot be interrupted. Although the current infrastructure can manage the additional groundwater flow from the EWMC in the short term,

the system would lack redundancy and is insufficient to accommodate these streams back to GBWWTP on a continuous basis. Consequently, additional infrastructure is required to effectively manage the additional flow.

3.0 JUSTIFICATION

5. EWS' current conveyance infrastructure between CBBRRF and GBWWTP has sufficient capacity to handle typical bidirectional flows of digested sludge and supernatant, however it lacks sufficient redundancy to consistently accommodate additional EWMC flows of groundwater and leachate, especially during any substantial outage of the existing process.

6. Without adding piping capacity, it will be operationally challenging to convey the impacted groundwater flows from EWMC to the GBWWTP for treatment and will limit the ability to accommodate any future increases in system capacity to match increased flows between CBBRRF and GBWWTP. The volume of the groundwater flow is approximately similar to the supernatant flow and can double the required return flows from current state. Using existing conveyance infrastructure for the additional flows means that frequent operational interventions to manipulate pumps, valves and conveyance lines within challenging spaces would be required to manage the flows. If there were an outage of the conveyance system, flows would need to be either stopped and stored or temporarily redirected, which may result in regulatory violations.

7. As a result, this project is necessary to build capacity of the conveyance infrastructure to enable the transfer of groundwater to the wastewater collection system for treatment at the GBWWTP. The proposed pipeline segment provides assurance that there are separate, available conveyance paths for conveyance of sludge, supernatant, and impacted groundwater as well as required redundancy for inspections and maintenance activities.

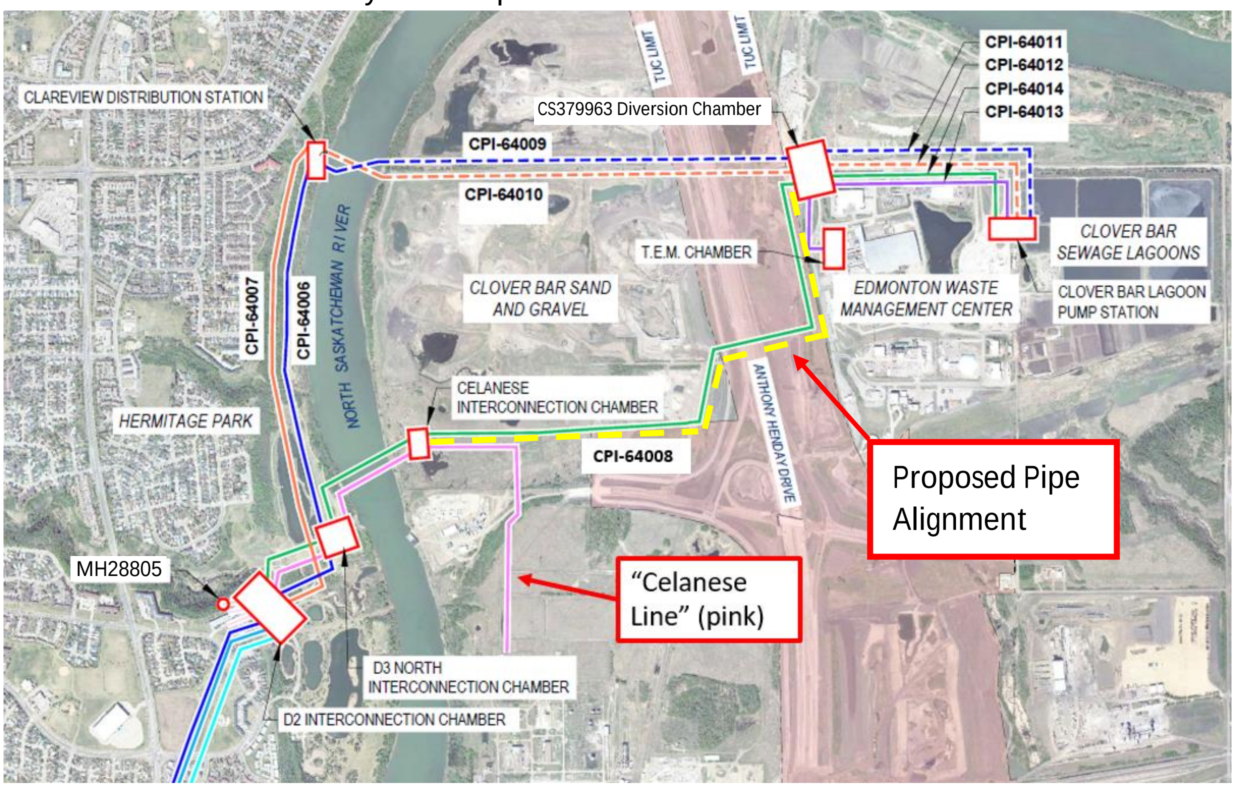
4.0 PROJECT SCOPE

8. The scope of this project is to construct a pipe to connect CBBRRF and the EWMC to the wastewater collection system in east Edmonton. The pipe will be constructed to connect the T.E.M Diversion Chamber and D2 Interconnection Chamber, as highlighted in yellow on Figure 4.0-1.

9. There is an opportunity to place back into service an existing pipe that extends from the old Celanese plant to Manhole D2 (shown in pink). This high density polyethylene (HDPE) piping was installed in 1997 in partnership with the COE to convey flows from the Celanese plant and

has not been in operation since the plant was decommissioned in 2007. This unused pipe is installed in the same right of way as the existing sludge line (shown in green). To reduce overall cost and construction scope, the plan is to repurpose this Celanese pipe, using the existing river crossing as the new flow path. This approach would then require the construction of approximately 2.5 km of pipe to the T.E.M Diversion Chamber. The Celanese pipe will be inspected in the fall 2024 to confirm condition and suitability for repurposing. Due to the age of the pipe and pipe material used in original construction it is unlikely that the pipe will not be suitable for this new use.

Figure 4.0-1
System Map between MH D2 and CBBRRF



5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 – Do Nothing

10. A do nothing approach would mean not adding any permanent modifications to the existing system. Temporary pumping and piping can be used by the COE to transfer groundwater from the EWMC to CBBRRF. Use of such temporary equipment and connections will increase operational cost and safety risk. Also, the existing conveyance system can handle the additional

flow for short durations but will not be able to maintain redundancy for the multiple streams of bidirectional flows. This will result in violation of the site agreement between EPCOR and the EWMC and potentially frequent violation of the COE's regulatory approval conditions.

5.2 Alternative 2 - Use Existing Conveyance Infrastructure

11. Using only the existing conveyance infrastructure would involve installing a permanent connection to the existing pipe to GBWWTP to allow the transfer of the groundwater flows. As mentioned above, existing conveyance is designed to accommodate two major streams of flow for digested sludge and supernatant and is not sufficiently redundant to allow an additional major return stream. Depending on the nature of the connection, the system will experience competing hydraulic demand and interruptions to regular flows. This will result in violation of the site agreement between EPCOR and the EWMC and potentially frequent violation of the COE's regulatory approval conditions.

5.3 Alternative 3 - Upsize Existing Conveyance Infrastructure

12. Existing conveyance infrastructure could be upgraded to allow additional capacity. This would involve upsizing one of the existing pipe routes from CBBRRF to the collection system at Manhole D2, to allow the transfer of the groundwater flows in addition to the supernatant flows. The scope of this approach would require upsizing multiple segments of piping but would still not achieve the desired redundancy for the flow streams and the system would be vulnerable during planned and unplanned outage. Depending on the nature of the connection, the system would still experience competing hydraulic demand and interruptions to regular flows. This will result in violation of the site agreement between EPCOR and the EWMC and potentially frequent violation of the COE's regulatory approval conditions.

5.4 Alternative 4 – Add New Pipe Segment

13. The addition of a new pipe segment would ensure the availability of the three pipes dedicated to transferring sludge from GBWWTP, and returning supernatant and groundwater to the GBWWTP, preventing any impact between the processes. It would also provide redundancy, facilitating inspections, cleaning and both planned and emergency rehabilitation activities. If feasible, repurposing the unused Celanese pipe river crossing would shorten the overall length,

offering the most direct route to the wastewater collection system and avoiding any new river crossings.

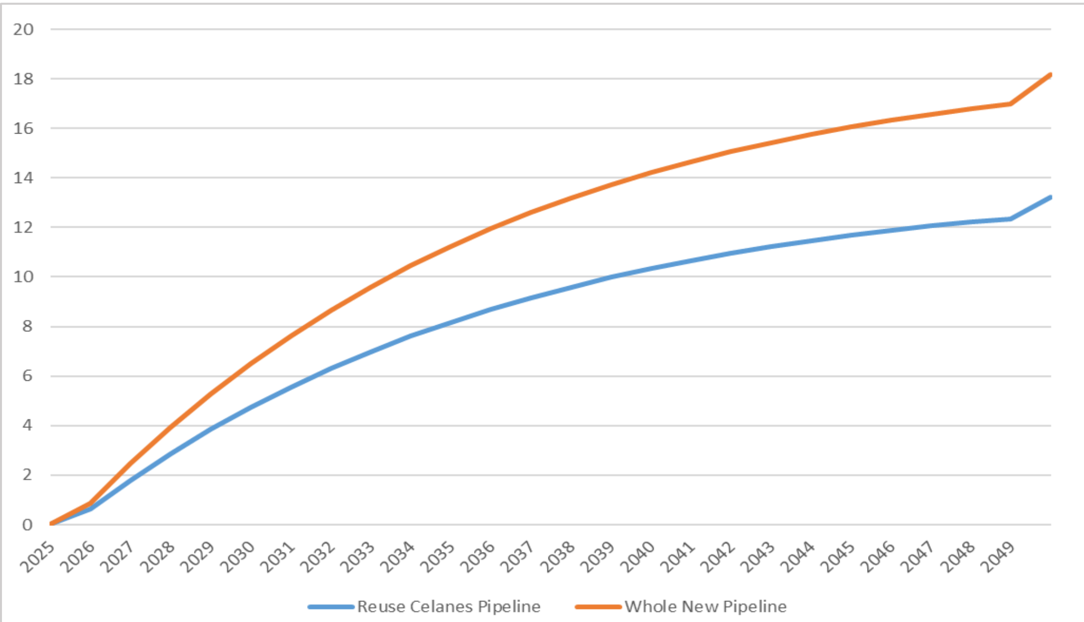
5.5 Net Present Value (NPV) Analysis

14. A 25-year NPV calculation was completed for all options with an acceptable risk level and is shown in Table 5.0-1. A chart displaying the cumulative revenue requirement is also provided in Figure 5.0-1.

Table 5.5-1
25-Year NPV Revenue Requirement Summary ($ millions)

25-Year Summary	NPV Revenue Requirement
Alternative 4.1 – Reuse Celanese Pipeline	13.2
Alternative 4.2 – Entirely New Pipeline	18.2

Figure 5.5-1
Cumulative Revenue Requirement by Year ($ millions)



6.0 COST FORECAST

15. EWS has forecast total program capital expenditures during the 2025-2027 PBR term at $8.1 million, with a total project cost of $11.9 million. The cost estimates shown in Table 6.0-1 are based on historical information such as past inspection costs, past design costs and past construction costs of similar open cut projects that occurred within the last few years.

Table 6.0-1
CB EWMC Groundwater Transfer Project Capital Expenditure Forecast ($ millions)

	2024 and Prior	2025	2026	2027	Total
Total Capital Expenditures	3.8	8.1	-	-	11.9

16. Geotechnical investigations will be required for the length of the pipe and will be completed by external resources.

17. The cost estimate also assumes that the Celanese pipe section and the associated river crossing can be repurposed as a conveyance asset for supernatant and groundwater return. This will be confirmed during an inspection planned for late 2024. If this repurposing is not feasible an additional river crossing would be required which would have a significant impact to the costs and timing for this project. This risk is unlikely based on the age and pipe material.

7.0 KEY RISKS AND MITIGATION PLANS

18. Table 7.0-1 summarizes the key risks and mitigation plans associated with this program.

Table 7.0-1
Key Risks and Mitigation Plans

Risk	Mitigation Plan
1. Health and Safety Risks – Confined space entry and ground disturbance are some of the associated risks.	EWS follows standard processes to reduce or eliminate these risks, including but not limited to: • Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum • Procuring qualified contractors with experience working in these conditions • Including safety systems and safety performance in evaluation criteria for the selection of contractors • Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages • Developing a hazard registry specific to the required tasks, and implementing best practices like job-site hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards • Conducting regular site visits and formal, documented inspections during construction
2. Environmental Risks – Associated risks include silica dust during construction, removal and disposal of construction debris, and impacts to groundwater quality.	EWS conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Appropriate delineation of construction area, including necessary dust control, ventilation and debris management measures will be employed to mitigate relevant risks. Appropriate permits will be approved by AEPA. It is anticipated that the impacted groundwater quality will improve and conveyance requirements will diminish over time. However, based on water quality data, the required time for this to happen is expected to exceed the asset life for new conveyance infrastructure. Further modeling to project future water quality is recommended to be carried out during design. In addition, an operational plan on the future groundwater transfer will be developed and agreed upon between the COE and EPCOR during the design phase.

Risk	Mitigation Plan
3. Execution Risks – There are risks during design, procurement and construction that can affect scope and schedule. These include procurement delays, geotechnical variations, condition of existing infrastructure, complex design solutions for tying into connection points, buried anomalies discovered during construction, pipeline right of ways, crossing under roadways, potential river crossing etc. Also, if ground disturbance activities impact corridors outside of existing right of ways, then it could result in additional coordination and permitting requirements with associated time delays.	A plan will be developed during design for obtaining regulatory approvals and proximity agreements to better understand and minimize this risk. Additionally, the structural integrity of existing infrastructure and viable connection points will need to be verified during the design phase of the project and the proposed pipeline routing will need to be confirmed to limit potentially costly impacts during construction. Conducting geotechnical and integrity assessments early during the design and determining pipeline size and route early in the project, will mitigate these execution risks. The project currently has ample time allowance for planning, design, execution and stakeholder engagement to deal with potential unexpected delays within reason.
4. Financial Risks – Actual contractor bids may vary from the estimates. Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing.	EWS manages financial risks by conducting preliminary design and obtaining manufacturer's quotes for establishing the project budget. To mitigate cost escalations, thorough planning and proactive measures are essential. This can include detailed cost estimates during the planning phase, contingency budgets, and a comprehensive risk identification and analysis. Contracts should be clear with provisions for addressing unforeseen cost increases. Regular monitoring, strong relationships with contractors and suppliers, and experienced project managers are important to reduce the likelihood of cost increases. Value engineering to evaluate alternative materials, construction methods, or design modifications can also help to mitigate price increases.

8.0 RESOURCES

19. All activities related to project management, drafting, construction coordination and inspection, and as-built recording, will be undertaken internally by EWS. Construction and geotechnical assessments will be completed by external resources.

EPCOR WATER SERVICES

Appendix F-3

Business Case

DIGESTER IMPROVEMENTS PROGRAM

May 31, 2024

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1.0 OVERVIEW

1. The Digester Improvements are intended to improve the solids digestion process at Gold Bar Wastewater Treatment Plant (GBWWTP), ensuring it can continue to handle wastewater solids loading safely and reliably. The project will initiate major rehabilitation and upgrades to Digester 6 during the 2025-2027 PBR term, along with replacement of systems and components that are end of life or have failed. The upgrades aim to reduce biogas-handling risks, restore digester capacity, improve digester performance, and align with the requirements of the GBWWTP. Preliminary estimate for the total project cost is at $20.7 million, with $14.0 million to be spent during the 2025-2027 PBR term and the remaining spend during the future PBR term.

2.0 BACKGROUND

2. The GBWWTP treats wastewater by removing contaminants using a series of treatment stages. The biologically active solid contaminants removed in each stage require additional treatment. Digesters are used to treat these biosolids and prepare them as source of nutrients for land application. GBWWTP has eight digesters that break down and stabilize the solids prior to them being pumped to the Clover Bar Biosolids Resource Recovery Facility. Biogas is generated during this digestion process, which contains primarily methane and carbon dioxide.

3. It is normal for digesters to gradually foul and lose treatment capacity with continued operation. Regular cleaning, rehabilitation, and upgrades are conducted for each digester to restore their operating capacity. Digesters 1 through 4 have previously been upgraded and Digester 6 is the next asset scheduled for upgrade work to restore its treatment capacity, while also enhancing safety, reliability, and efficiency of operation. Digesters 7 and 8 are currently scheduled for cleaning and rehabilitation following the upgrades to Digester 6.

4. One component of the Digester 6 upgrade will include the replacement of the current gas mixing system with a roof mounted mechanical (linear motion) mixing system. This retrofit has been successfully implemented previously in Digester 3, with implementation in Digester 4 currently underway. The mixing system greatly improves site and operational safety by removing the need to handle biogas for mixing and provides a system that can be more easily isolated during maintenance activities.

5. Additional upgrades to Digester 6 also include changing the design and mode of operation of the digester from conventional to a submerged roof design. This allows the digester to be filled

to the underside of the roof instead of needing headspace of 10-15% as required with conventional operation. An internal standpipe is installed to receive the overflow from the main vessel. Thus, the digester receives solids feed into the main vessel and is drawn from the bottom of the internal standpipe. This approach has proven successful in maximizing capacity and minimizing operational issues in in Digesters 1-3, with upgrades to Digester 4 currently underway.

3.0 JUSTIFICATION

6. Digester 6 is approaching end of life and is starting to exhibit subsystem failures. These include issues with biogas piping, internal concrete protection, external roof membrane, associated safety equipment, sludge piping, and other ancillary systems. The mixing system is obsolete and frequently plugs with debris, leading to inefficient and lower capacity treatment through the unit. In addition, the unit has very little usable capacity left due to fouling. Failure of the subsystem components could lead to sludge or biogas release to site, environment, and could lead to public safety risks if the release was high volume or long duration.

7. Through upgrades to Digester 6, mixing efficiency and capacity will be increased, and the associated gas compression and handling system will be decommissioned, resulting in improved safety for plant personnel.

8. The Gold Bar Integrated Resource Plan (GB IRP) identified the lack of ability to expand the footprint of the plant as a confining factor and as such, the existing footprint and processes must be used as effectively as possible to maintain treatment capacity. The rehabilitation of Digester 6 is therefore required to maximize available solids treatment capacity. Across the eight digesters, a capacity gain of 10% is equivalent to 80% of a new digester. Therefore, these upgrades provide the most cost-effective approach to the continued servicing of wastewater for Edmonton, within the GBWWTP footprint.

4.0 PROJECT SCOPE

9. The scope for this project includes design and construction for structural rehabilitation and mechanical and electrical upgrades. The proposed scope of work includes the following:

- Shut down, isolation and cleaning of the digester
- Partial demolition of existing obsolete piping, mixing system, and structural elements as required by design
- Installation of new exterior access ports

- Upgrades including foam control measures, internal overflow standpipe, modifications for the submerged roof, modifications to meet the latest digester gas code, and upgrade of other ancillary support systems such as process control and instrumentation
- Rehabilitation including replacement of gas mixers, gas proofing, gas collection and distribution piping, roofing membrane, associated sludge distribution and recirculation piping, biogas safety equipment
- Conversion to Linear Motion mixing system.
- Leakage control including high density polyethylene lining of the upper headspace area, and spray applied liner on the lower walls and floor cone of the digester.

10. Once the digester upgrades and conversion to the mechanical mixing are completed, the associated gas compression and handling systems, located outside of the digester, will be decommissioned.

5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 – Do Nothing

11. One alternative considered is to do nothing. Continuing to operate Digester 6 in its current state will lead to safety risks such as biogas release, and operability risks which would result in high costs to operate unreliable and inefficient equipment. In addition, doing nothing would lead to the eventual failure of the unit and inability to maintain current service level for wastewater treatment. This is not an acceptable outcome and was therefore rejected.

5.2 Alternative 2 – New Digester

12. A second alternative is to demolish Digester 6 and build a new digester in place. However, high level estimates indicate that the cost of replacement is expected to have a capital cost of more than $40 million and this is a much more costly alternative relative to the preferred alternative. In addition, this option results in the demolition of a large number of the reusable assets that can be returned to service after rehabilitation.

5.3 Alternative 3 – Cleaning Only

13. A third alternative is to clean Digester 6 to restore capacity back into the system and delay rehabilitation and upgrades until the next cleaning cycle in approximately 20 years. While

cleaning would be an effective way to restore capacity and defer the cost of capital improvements to the next PBR term, Digester 6 is at its end of life with several internal components in poor condition or that have become obsolete, and there is a risk that it would be unable to be put back into service safely once cleaning is completed. This has been experienced previously with other digesters that were of similar age, related to components like gasproofing, leakage protection, gas mixing system, pumps, heat exchangers etc. If Digester 6 were to remain out of service, it would prevent other digesters from undergoing regular cleanings as solids treatment capacity could not be maintained. For these reasons, this option has been excluded from further assessment.

5.4 Alternative 4 – Rehabilitate and Upgrade

14. A fourth alternative is to rehabilitate and upgrade Digester 6. Capacity improvements and rehabilitation will provide required levels of treatment and increase system reliability within the existing footprint, with minimal impact to the site and nearby residents. This is the preferred option.

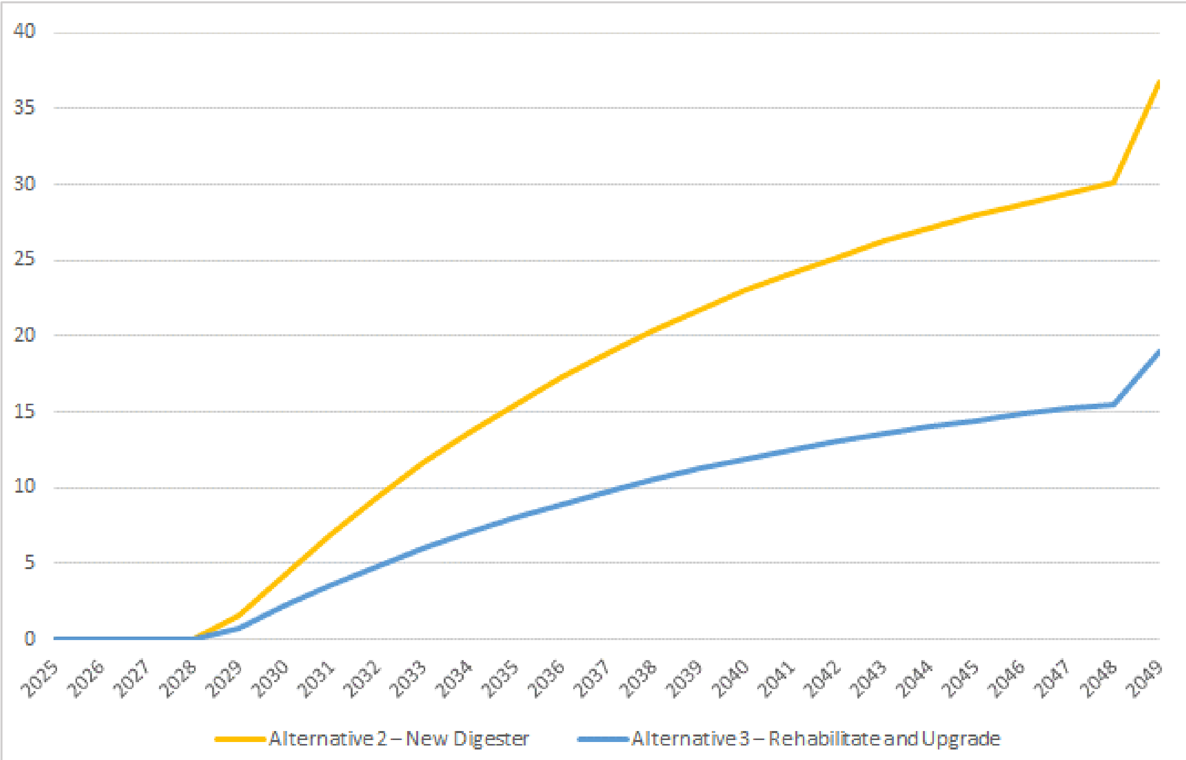
5.5 Net Present Value (NPV) Analysis

15. A 25-year NPV calculation was completed for all options with an acceptable risk level and is shown in Table 5.0-1. A chart displaying the cumulative revenue requirement is also provided in Figure 5.0-1.

Table 5.5-1
25-Year NPV Revenue Requirement Summary ($ millions)

25 Year Summary	NPV Revenue Requirement
Alternative 2 – New Digester	36.7
Alternative 3 – Rehabilitate and Upgrade	19.0

Figure 5.5-1
Cumulative Revenue Requirement by Year ($ millions)



6.0 COST FORECAST

16. The project cost forecast is based on the currently estimated cost for completing similar upgrades on Digester 4 and allowing for the known differences in the two systems. The project will apply learnings and efficiencies developed during the Digester 3 and Digester 4 upgrades. Project costs are shown in Table 6.0-1.

Table 6.0-1
Digester 6 Upgrades Project Capital Expenditure Forecast
($ millions)

	2024 and Prior	2025	2026	2027	2028 and Beyond	Total
Total Capital Expenditures	0.1	1.8	6.9	5.2	6.7	20.7

7.0 KEY RISKS AND MITIGATION PLANS

17. Table 7.0-1 provides key risks and mitigation plans associated with this project.

Table 7.0-1
Key Risks and Mitigation Plans

Risk	Mitigation Plan
1. Health and Safety Risks – Confined space entry, ground disturbance, hot-work, and hazardous energy isolation are some of the associated risks.	EWS follows standard processes to reduce or eliminate these risks, including but not limited to: • Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum • Procuring qualified contractors with experience working in these conditions • Including safety systems and safety performance in evaluation criteria for the selection of contractors • Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages • Developing a hazard registry specific to the required tasks, and implementing best practices like job-site hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards • Conducting regular site visits and formal, documented inspections during construction
2. Environmental Risks – Silica dust during construction, removal and disposal of construction debris, working within the river valley	EWS conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Appropriate delineation of construction area, including necessary dust control, ventilation and debris management measures will be employed to mitigate relevant risks. Appropriate permits will be approved by AEPA.
3. Financial Risks – Actual contractor bids may vary from the estimates. Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing. Further change orders or unknown conditions that cannot be seen until demolition is complete	EWS manages financial risks by conducting preliminary design and obtaining manufacturer's quotes for establishing the project budget. The financial risks will become more evident as further design is completed. A competitive procurement strategy will also be implemented to ensure the best value is achieved. To mitigate cost escalations, thorough planning and proactive measures are essential. This can include detailed cost estimates during the planning phase, contingency budgets, and a comprehensive risk identification and analysis. Contracts should be clear with provisions for addressing unforeseen cost increases. Regular monitoring, strong relationships with contractors and suppliers, and experienced project managers are important to reduce the likelihood of cost increases. Value engineering to evaluate alternative materials, construction methods,

Risk	Mitigation Plan
	or design modifications can also help to mitigate price increases.
4. Quality Risks – this is the risk that construction is not performed to a sufficiently high standard, in which case for example, leaks could develop or the mixer may not function appropriately.	Examples of how quality risks are managed are: • Rigorous contractor selection process that considers experience, safety performance, and past performance on similar projects. • Comprehensive and clear technical specifications for the work and equipment/materials • Applying lessons learned from the Digester 3 and 4 Upgrades project • Inspection and testing plan to ensure only quality products and workmanship are accepted • Contractor, strong specs, using lessons learned from Digester 3 and 4 Upgrades.
5. Reputation Risks – Work conducted is in close proximity to Gold Bar residents. Additionally, external stakeholders (e.g. public, other asset owners) can be affected by some tasks that occur (e.g. excavation, equipment crossings).	External stakeholders and EWS's Communications and Public Engagement team will be consulted prior to starting these tasks. Community engagement will be conducted to address stakeholder concerns.

8.0 RESOURCES

18. This project is expected to hire external consultants to complete design and QA/QC during construction. An external contractor is expected to complete the construction work. Internal resources will be needed to support the project. Engineering will be done externally, while internal staff will provide reviews and feedback. Internal staff are also typically relied upon to prepare the assets for major work (e.g. shutdown, purging of gases, hazardous energy isolation). Contractors with specialized skills and previous experience will be utilized for construction and specific tasks. Supply Chain will be consulted to ensure the purchase orders and contracts are issued in accordance with company policy. A regulatory review will be conducted to ensure necessary approvals are in place for the work. This project is expected to be delivered using a traditional Design Bid Build method, which was used successfully for the previous four digester upgrades.

EPCOR WATER SERVICES

Appendix F-4

Business Case

ELECTRICAL BUILDINGS AND UTILITY RACK PROJECT

May 31, 2024

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1.0 OVERVIEW

1. The Electrical Building (EB) and Utility Rack projects will relocate and replace existing major 600V electrical distribution and control system interface equipment from existing high-risk locations to new dedicated EBs at the Gold Bar Wastewater Treatment Plant (GBWWTP). The series of projects will replace electrical equipment at or near end of expected life. In addition, the projects will rectify issues with electrical equipment located in areas classified as hazardous and/or corrosive, are exposed to moisture, and/or are in tunnels that are at risk of unexpected inundation from process upsets. This will address existing code-compliance deficiencies while also improving the reliability and longevity of the relocated replacement equipment. The planned phases of the total project spend is estimated at $71.8 million, with $41.6 million of the spend in the 2025-2027 PBR term. Of the costs outside this PBR term, approximately $15.6 million will be spent ahead of 2025, while the remaining $14.3 million will be spent in a future PBR term. Future phases of the project have not been planned or estimated yet.

2.0 BACKGROUND

2. In 2018, an electrical code compliance review of the GBWWTP identified numerous instances where major electrical distribution equipment is installed in locations that pose a risk to safety and plant operations. As an example, 600V motor control centers (MCCS) installed in areas which are classified as hazardous and/or corrosive, are exposed to moisture, and/or are in tunnels that are at risk of unexpected inundation from process upsets. It was also noted that electrical equipment installed in these locations have been prematurely failing due to corrosion or moisture, putting at risk both property and personnel.

3. In 2019, as part of developing the GBWWTP Integrated Resource Plan (IRP), an Electrical Long-Range Plan was completed. This was prepared to support EWS in planning major upgrades and expansions required in the GBWWTP's electrical distribution system to address capacity, asset lifecycle, code compliance, and technology modernization challenges that will be encountered through the year 2056. The IRP included recommendations for constructing a series of above ground EBs on site dedicated to housing the 600V electrical equipment.

4. Based on area classification, flood risk, corrosive locations, asset age, future plant development and space constraints, it is estimated that approximately 400 vertical MCC sections require replacement and relocation, representing a total combined demand load of ~7,500 kVA. Once ranked, the work was consolidated in the ELRP and prioritized to balance the spending and effort over future PBR periods.

- EB-1, EB-2, & Utility Rack Extension: Replacement and relocation of high-priority MCCs that are currently located in high-risk areas (hazardous, corrosive, tunnels), and/or are near end of expected life. These projects are currently in detailed design with construction planned during the 2025-2027 PBR term.
- EB-3: Replacement and relocation of high-priority MCCs that are currently located in medium risk areas (hazardous, corrosive, tunnels), and/or are near end of expected life. Construction of this project is expected in the 2028-2031 PBR term, but a siting review study is currently underway to determine most cost-effective location.
- EB-4, EB-5, & EB-6: Replacement and relocation of remaining high priority MCCs and others that are below grade and expected to be reaching end-of-life by this time. These projects are not included in the current scope and will be prioritized in future PBR terms based on capital availability and One Water Planning's risk-based analysis.

5. Cabling for the current electrical infrastructure is largely routed through trays in the underground tunnels. Many of these trays are overloaded and there is little space for routing additional trays. To minimize treatment interruptions, redundant cabling needs to be run from the new distribution equipment to the devices requiring power before the original cabling can be demolished and the existing utility rack needs to be extended to the new EB's 1 and 2.

6. These projects will relocate existing major 600V distribution equipment from high-risk areas, including hazardous locations, corrosive locations, and locations which are at increased risk of flooding due to process upsets, into new dedicated EBs. This will address existing code-compliance issues while also improving the reliability and longevity of the relocated replacement equipment. New substations will simplify and optimize the architecture of the plant's 600V distribution system and provide a location from which to supply future plant expansions.

3.0 JUSTIFICATION

7. The electrical equipment is not only housed in high-risk areas, much of it is also nearing their expected end of life. Failure of the electrical equipment in these areas would affect many of the primary treatment facilities, as they would lose power and capability, thus resulting in partially treated wastewater flowing into the North Saskatchewan River (NSR). These projects will reduce the risk of failure of the electrical equipment, resulting in operations that are more reliable. Failure of this equipment would result in significant disruption to the wastewater treatment process.

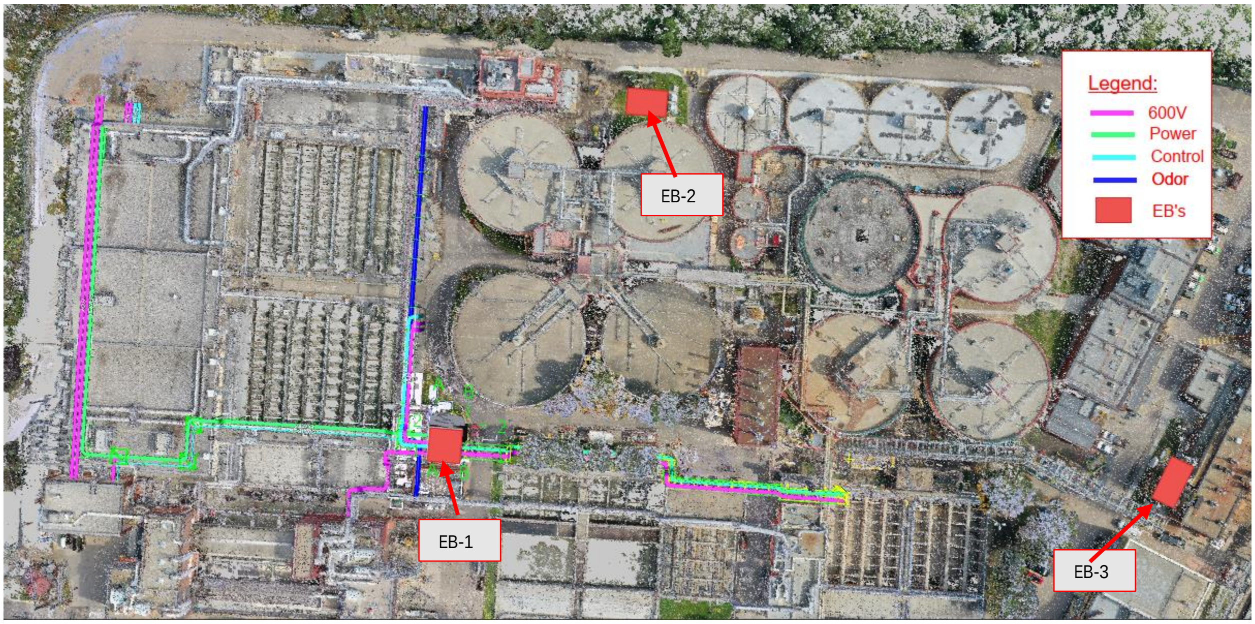
8. Additionally, the electrical equipment serving the central control room (including the Delta V plant control system), building heat boilers, secondary aeration Blowers 1 & 4, Maintenance Building, Administration Building, Operations Centre and numerous centrally located process equipment, utilizes a single radial feed topology, roughly 50% less reliable than the redundant dual feed secondary selective topology, which is plant standard. Failure of this equipment could result in a significant and lengthy disruption to the wastewater treatment process.

9. Extension of the utility rack greatly improves the constructability of the first two EBs and relieves trays that are overloaded beyond the cable thermal requirements per Canadian Electrical Code and the structural design of the support systems. Beyond this, the rack extension aids the plant's overall strategy of intensifying treatment processes while remaining in the existing footprint. Integrating a modular utility rack network would facilitate the relocation of many existing utilities, and any new utilities or assets as required.

4.0 PROJECT SCOPE

10. Projects EB-1, EB-2 and EB-3 will each provide a new two-story building to house new 600V switchgear, two new 13.8kV-600V transformers, and a floor dedicated to replacement 600V MCCs. Figure 4.0-1 below shows the general location for EB-1 and EB-2, as well as the existing utility rack (shown in yellow) and the conceptual extension to the west (shown in green). The location of EB-3 is not shown as it is yet to be confirmed.

Figure 4.0-1
Tentative Siting for EBs and Utility Rack



11. For Project EB-1, the building will be used to house replacement electrical equipment as follows:

- Tunnel B: Classified as Zone 2 (Hazardous) and Category 2 (Corrosive); flood risk; equipment near end-of-life (estimated 2026). Replacement of this equipment is high priority due to risk of accidental flooding, failure or explosion and associated consequences, including but not limited to injury or death and prolonged power interruption.
- Tunnel C: Classified as Category 2 (Corrosive); flood risk; some equipment near end-of-life (estimated end-of-life ranges from 2026 to 2043). Replacement of this equipment is considered a medium priority due to risk of accidental flooding or failure and associated consequences, including but not limited to prolonged power interruption.
- Auxiliary Control Room: Classified as Zone 2 (Hazardous) and Category 2 (Corrosive).
- Equipment near end-of-life. The 600V distribution equipment in this room currently sub-feeds numerous other facilities in the primary treatment areas of the plant. Replacement of this equipment is high priority due to risk of accidental flooding, failure or explosion and associated consequences, including but not limited to injury and prolonged power interruption. The arrangement of the auxiliary control room makes it challenging to declassify this area and the space is very congested with less-than-ideal working conditions.

- Future Projects: Transformer capacity and spare 600V breakers (or space for future breaker additions) in the new switchgear will be made available to accommodate future operational requirements.

12. For Project EB-2, the building will be used to house replacement electrical equipment as follows:

- Blend Tank Gallery: Classified as Zone 2 (Hazardous) and Category 2 (Corrosive); flood risk. The 600V distribution equipment in this room currently sub-feeds the electrical distribution equipment that services the fermenters and digester square #1. The design of this space, and various significant openings, make it infeasible to declassify. Replacement and relocation of this equipment is a high priority due to the high risk of an accident and prolonged power interruption due to the equipment location.
- Fermenter Gallery: Classified as Zone 2 (Hazardous) and Category 2 (Corrosive); flood risk. The design of this space, and various significant openings, make it infeasible to declassify. Replacement and relocation of this equipment is a high priority due to the high risk of an accident and prolonged power interruption due to the equipment location.
- Future Projects: Transformer capacity and spare 600V breakers (or space for future breaker additions) in the new switchgear will be made available to accommodate future operational requirements.

13. For Project EB-3, the building will be used to house replacement electrical equipment as follows:

- Operations Center: Process areas within this facility are classified as category 2 (Corrosive). The existing MCC at the Operations Center is installed in a process area, near process equipment, and is expected to reach end-of-life by the year 2041 (not accounting for potential early retirement due to corrosion). As such, it is considered a medium-to-low priority for replacement and relocation.
- Blower Building #1: This facility is classified as Category 2 (Corrosive) area. The identified MCCs are currently installed below ground (basement level) and have an expected end of life by the year 2030 (MCC-50521E) and the year 2043 (MCC-14106); however, they are installed in process areas that are at risk of flooding and premature failure due to corrosion. Blower Building #1 currently sub-feeds the Maintenance Building. As such, replacement and relocation of this equipment is considered a medium to high priority.
- Penthouse #2: This building is classified as Category 2 (Corrosive) area, located above ground. The MCC installed in this place has an expected end of life by the year 2040 (not

accounting for potential early retirement due to corrosion). The Area Classification Review [Stantec, 2018] recommends declassification of the building by the installation of a proper ventilation system; this is a feasible and low-cost alternative to replacement and relocation. Therefore, replacement and relocation of the equipment installed in this area has a low level of priority.

- Gallery 3 (Tunnel K): This underground space is classified as Category 2 (Corrosive) and has a risk of flooding. The MCC installed in this place has an expected end of life by the year 2037 (not accounting for potential early retirement due to corrosion). The design of these areas and various significant openings make it nonviable to declassify these spaces (from Category 2 to "normal'); additionally, even if the space were declassified, the equipment would still be at risk due to flooding, leaks, etc. Therefore, the replacement and relocation of the equipment installed in this area has a medium level of priority.
- Future Projects: Transformer capacity and spare 600V breakers (or space for future breakers) in the new EB-3 switchgear will be made available to accommodate supply of future known projects. Note that each of these projects are assumed to include dedicated electrical rooms, as required, to house electrical equipment and MCC's associated with the facility; therefore, EB-3 would only be used as the source for 600V supply feeders, i.e., no space allocated for future MCCs.

14. EB-3 is currently undergoing an early siting study, examining the most economical and constructible location, foundation configuration, topology etc., near or in, Blower Building #1. The project will validate the siting and design basis during this 2025-2027 PBR term and is currently planned for implementation during the following PBR.

15. For Project Utility Racks West, the EBs are the driver for expanding it immediately but, it is designed with the intention of relocating and allowing intensification of the following:

- Electrical and communications circuits and electrical conduits: Enable the construction of future EBs; for example, EB-1 and EB-2 will be constructed in the next four years and the 600V power cables have no designated available routing through this congested area of the plant. Future planned developments to the electrical distribution in this area will also benefit from the utility rack.
- Natural gas piping: Removal of natural gas piping from the tunnel systems will ensure compliance with safety standards and reduce ventilation requirements. The tunnels contain non-rated electrical equipment, which currently do not meet code requirements. Also, improved utility access in this part of the plant would minimize the need for temporary lines and connections in the future.

- Buried fiber network: The buried fiber network for the plant is mostly undocumented and can pose challenges with ground disturbance work on the west side of the Plant. Relocation can improve access to the network and avoid accidental interference in the future.
- Foul air ducting: Current strategy for odour control near the headworks of the plant includes covering primary clarifiers 5-8 and connecting ductwork from these new sources to the scrubbers currently being commissioned. There is limited available space on the ground for the new infrastructure and the positioning of new ductwork will need to be evaluated to understand if the proposed utility rack system must accommodate them.
- Glycol lines: Locating glycol heating on a utility rack could improve serviceability and maintainability.

16. EBs 4, 5, and 6 are future planned buildings identified in the ELRP and are out of scope for this 2025-2027 PBR period. They will be put forward as separate projects in future PBR periods.

5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 – Do nothing

17. One alternative considered is to do nothing. Doing nothing will result in likely failure of the electrical equipment in the near future. Many of the primary treatment facilities would lose power in this situation resulting in partially treated wastewater flowing into the NSR, and replacement/repair of the failed gear could take months. This is not an acceptable outcome, so this option was rejected.

5.2 Alternative 2 – Gradual Implementation Approach

18. A second alternative is to take a more gradual approach to the implementation of the EBs. An extended timeline would help to distribute the costs over future PBR terms, thereby reducing the immediate financial burden on rate payers. While this would have a near term positive impact on rate payers, postponing necessary changes will lead to further degradation, increasing the risk of asset failure before the projects are implemented, resulting in the loss of the facility. As with Alternative 1, failure would cause the primary treatment facilities to lose power resulting in partially treated wastewater flowing into the NSR, and replacement/repair of the failed gear could take months. To reduce this risk, much of the end-of-life equipment would still require replacement in the PBR term and would need to be once again placed in an area that

would limit its lifespan. This limited lifespan would lead to premature risk of failure and higher capital costs in the long term.

5.3 Alternative 3 – Upgrade Electrical Switchgear in Place

19. A third alternative is to upgrade the electrical switchgear in place. In this option, temporary switchgear would be purchased and installed in a location close to the existing switchgear. Loads would be transferred to this temporary gear and then the existing gear would be demolished and replaced with new switchgear. Once the new switchgear was commissioned the loads would be transferred to the new switchgear and eventually the temporary gear would be disposed of. While this option does not result in the need for a new building, the new equipment would remain in their existing hazard-exposed locations which could result in shorter life spans due to these conditions. In addition, the utility rack would still be required to run the redundant cables.

5.4 Alternative 4 – New Buildings and Utility Rack

20. The fourth alternative, to construct new buildings and equip them with new switchgear, is considered the best option. Immediate capital costs are higher for this option due to the need for new buildings, however improved conditions in the buildings increases the lifespan of these assets and over the long term, leading to an overall reduction in capital cost. Given that about half of the existing equipment is end of life, there would be little early financial write offs associated with this alternative.

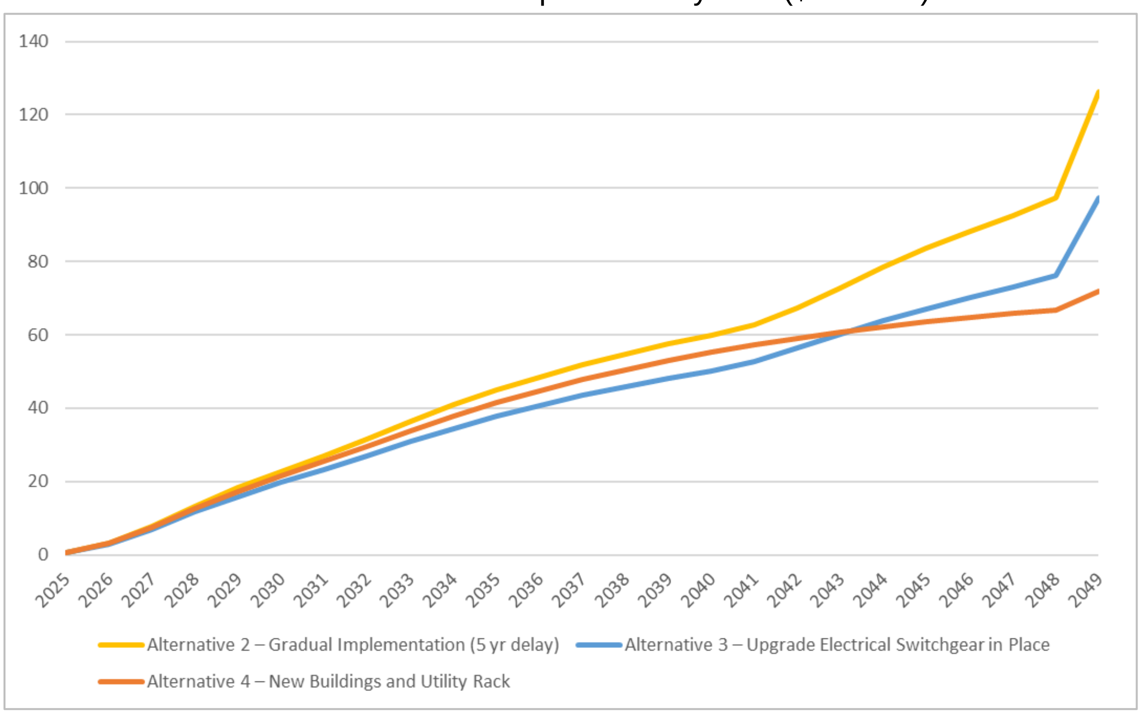
5.5 Net Present Value (NPV) Analysis

21. A NPV calculation was completed for all options with an acceptable risk level and is shown in Table 5.0-1. A chart displaying the cumulative revenue requirement is also provided in Figure 5.0-1.

Table 5.5-1
25-Year NPV Revenue Requirement Summary ($ millions)

25-Year Summary	NPV Revenue Requirement
Alternative 2 – Gradual Implementation (5-year delay)	
Capital Cost	125.8
Operating Cost	0.6
Total	126.4
Alternative 3 – Upgrade Electrical Switchgear in Place	
Capital Cost	95.8
Operating Cost	1.5
Total	97.3
Alternative 4 – New Buildings and Utility Rack	
Capital Cost	71.7
Operating Cost	0.3
Total	72.0

Figure 5.5-1
Cumulative Revenue Requirement by Year ($ millions)



6.0 COST FORECAST

22. The cost forecast is derived from the construction and engineering estimates from the ELRP. Projected costs are shown in Table 6.0-1.

Table 6.0-1
EBs and Utility Rack Projects Capital Expenditure Forecast ($ millions)

	2025	2026	2027	Total
Total Capital Expenditures	18.1	17.8	5.7	41.6

23. Table 6.0-2 provides the estimated capital expenditure for the EBs and Utility Rack projects by sub-project for the 2025-2027 PBR term.

Table 6.0-2
EBs and Utility Rack Projects Capital Expenditure Forecast by Project ($ millions)

Project	2023 and Prior	2024	2025	2026	2027	2028	2029 and Beyond	Total
1. Auxiliary Control Room Electrical Upgrades (EB-1)	1.3	3.1	10.9	7.2	0.00	0.00	0.00	22.5
2. 600v Electrical Bldg. (EB-2)	1.4	0.2	4.0	10.6	5.7	0.00	0.00	21.9
3. 600v Electrical Bldg. (EB-3)	0.1	0.0	0.0	0.0	0.0	0.6	14.1	14.7
4. Utility Rack West	0.9	8.6	3.1	0.00	0.00	0.00	0.00	12.6
5. Total Capital Expenditures	3.7	11.9	18.1	17.8	5.7	0.5	14.1	71.7

7.0 KEY RISKS AND MITIGATION PLANS

24. Table 7.0-1 provides the key risks and mitigation plans associated with these projects.

Table 7.0-1
Key Risks and Mitigation Plans

Risk	Mitigation Plan
1. Health and Safety Risks – Confined space entry, ground disturbance, hot-work, and hazardous energy isolation are some of the associated risks. Process safety risks can also arise during complex plant shutdowns.	EPCOR follows standard processes to reduce or eliminate these risks, including but not limited to: • Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum • Procuring qualified contractors with experience working in these conditions • Including safety systems and safety performance in evaluation criteria for the selection of contractors • Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages

	• Developing a hazard registry specific to the required tasks, and implementing best practices like job-site hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards • Conducting regular site visits and formal, documented inspections during construction To mitigate risks associated with working on high voltage switchgear, EWS employs hazardous energy isolation procedures to eliminate the risk of injury from conducting this type of work. Process shutdowns are planned using a planning process and multiple work packages are incorporated as needed. EWS also has Process Hazard Analysis procedures to identify specific mitigations required for each outage.
2. Environmental Risks – Associated risks include silica dust during construction, removal and disposal of construction debris, and working within the river valley	EPCOR conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Appropriate delineation of construction area, including necessary dust control, ventilation and debris management measures will be employed to mitigate relevant risks. Appropriate permits will be approved by AEPA.
3. Financial Risks – Actual contractor bids may vary from the estimates. Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing. While the impacts of the COVID-19 pandemic have eased, there still may be cost escalations and equipment procurement issues for specialty items.	EPCOR manages financial risks by conducting preliminary design and obtaining manufacturer's quotes for establishing the project budget. The financial risks will become more evident as further design is completed. A competitive procurement strategy will also be implemented to ensure the best value is achieved. EWS may need to adjust procurement timing depending on market conditions. To mitigate cost escalations, thorough planning and proactive measures are essential. This can include detailed cost estimates during the planning phase, contingency budgets, and a comprehensive risk identification and analysis. Contracts should be clear with provisions for addressing unforeseen cost increases. Regular monitoring, strong relationships with contractors and suppliers, and experienced project managers are important to reduce the likelihood of cost increases. Value engineering to evaluate alternative materials, construction methods, or design modifications can also help to mitigate price increases.
4. Reputation Risks – Work conducted is in close proximity to Gold Bar residents.	Community engagement will be conducted to address stakeholder concerns.

8.0 RESOURCES

25. This project will be executed in a traditional design bid build delivery method. Design will be completed by a consulting engineering company selected from current Master Service

Agreement (MSA) holders. Construction will be completed by a contractor selected through a competitive process. Development and building permits will be required.

EPCOR WATER SERVICES

Appendix F-5

Business Case

UV DISINFECTION SYSTEM UPGRADES PROJECT

May 31, 2024

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1.0 OVERVIEW

1. The Ultraviolet (UV) Disinfection System Upgrades Project is focused on upgrading the UV disinfection system at the Gold Bar Wastewater Treatment Plant (GBWWTP) to a new UV system with low pressure high efficiency lamps. The current UV4000 disinfection system from Trojan Technologies is no longer manufactured and is extremely energy intensive compared to modern systems. The total spend of this project is currently estimated at $15.1 million, with $13.5 million spent over the 2025-2027 PBR term. About $0.2 million of this will be spent prior to the 2025-2027 PBR term, with the remaining $1.4 million to be spent in future PBR terms.

2.0 BACKGROUND

2. The GBWWTP currently has an UV4000 system in place to provide disinfection to the wastewater effluent, as required by EPCOR's approval to operate enforced by Alberta Environment and Protected Areas (AEPA). This system was originally supplied by Trojan Technologies in 1995 but is no longer manufactured.

3. The existing UV system has five flow channels. The first four channels of the system were installed in 1995, while the fifth channel was installed in 2006 and commissioned in 2011. Each of the initial four UV channels has 180 medium pressure lamps while the fifth channel has 176 lamps. Each channel can convey flows up to 140 million litres per day (MLD). Figures 2.0-1 and 2.0-2 show the flow schematic of the disinfection facility and the cross section of a channel.

Figure 2.0-1
Flow Schematic of the Disinfection System at GBWWTP

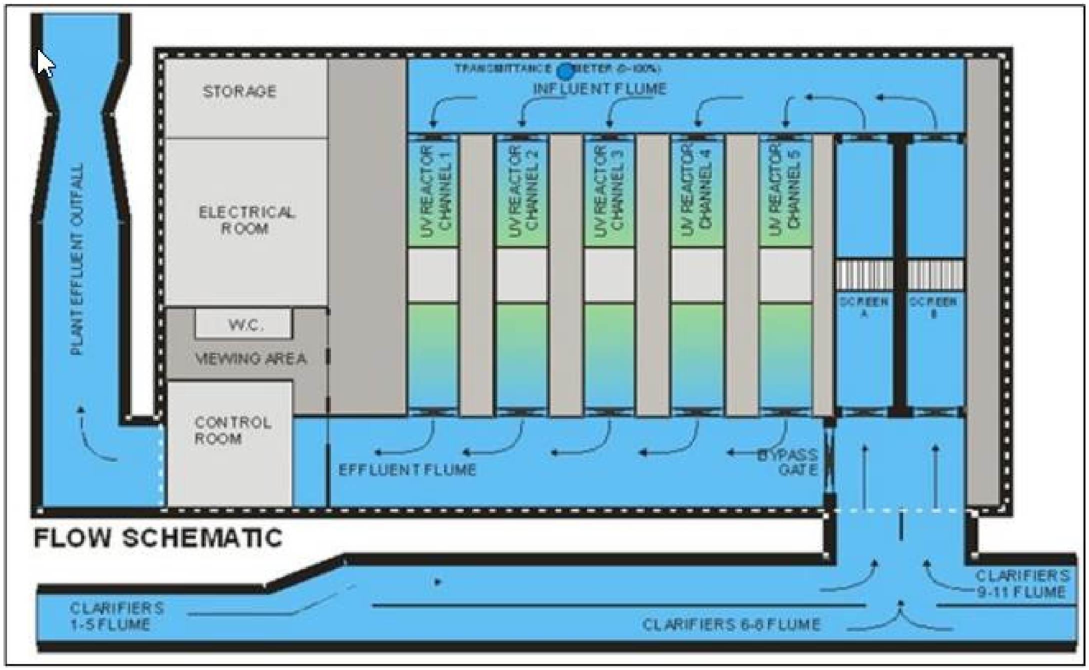
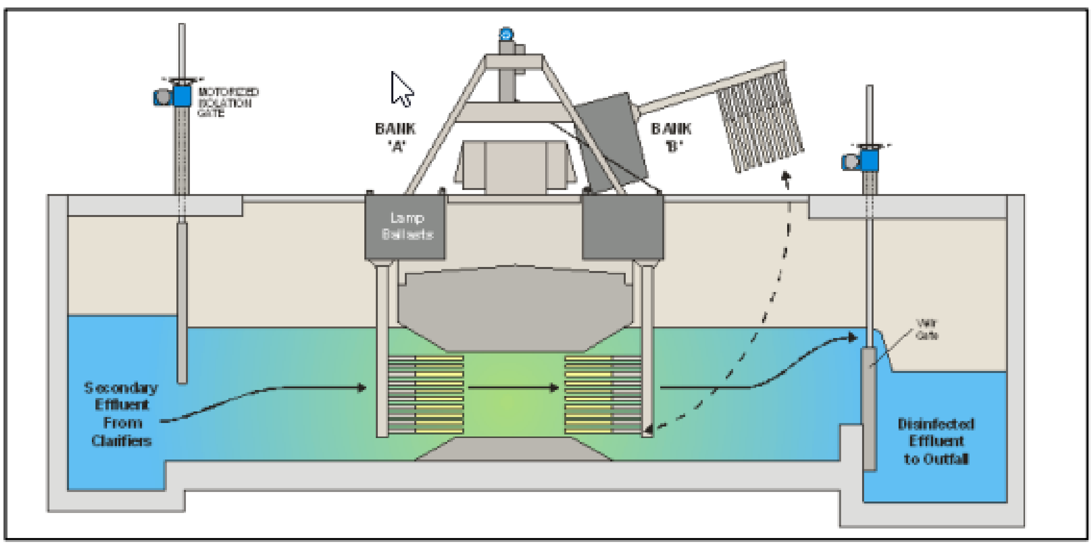


Figure 2.0-2
UV Channel Cross Section



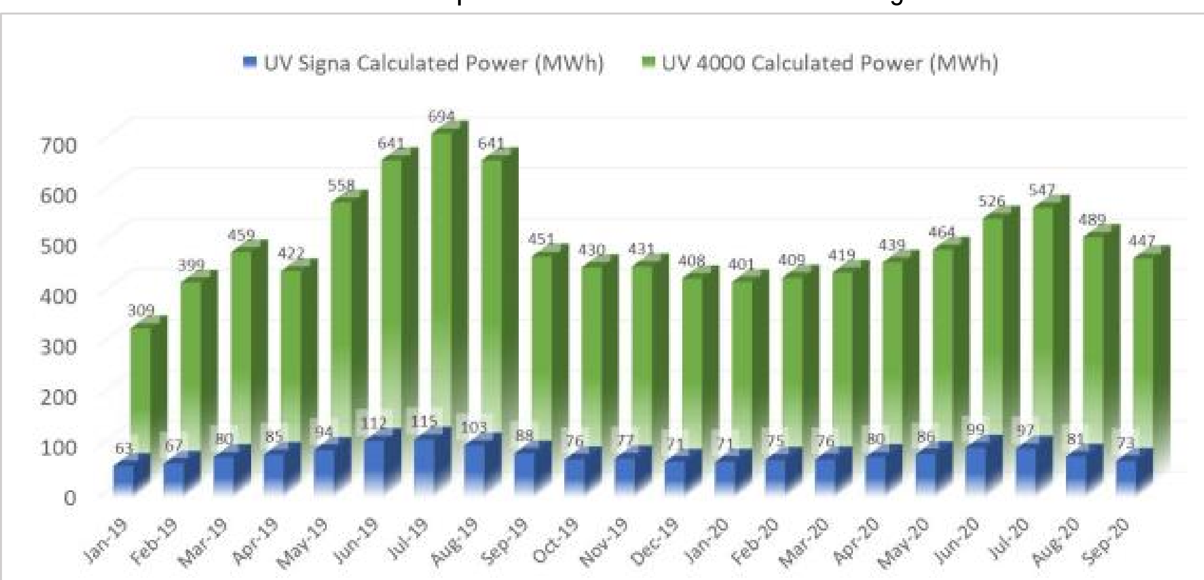
4. In 2017, EWS completed a scoping study to review current and future disinfection requirements and to assess upgrade options for disinfection. This study proposed upgrading to a new UV system equipped with low pressure lamps which have a much higher efficiency than the current system's medium pressure lamps. The proposed lamps also have a larger turndown range allowing for reduced power consumption during lower demand situations.

3.0 JUSTIFICATION

5. The UV4000 system that is currently in place has reached end of life and is no longer manufactured by the supplier. It is getting increasingly challenging to source parts and components to properly maintain this critical process system. Effluent disinfection is a mandatory part of the wastewater treatment process and ensures the protection of the aquatic habitat and recreational use of the NSR. It is impossible to operate the system for much longer in its current configuration and an upgrade must be completed soon.

6. Electricity is the largest energy source on site as well as the largest operating cost and greenhouse gas contributor. According to previous Energy Audits, the disinfection system accounts for more than 12% of the overall electricity consumption by the wastewater treatment operation, which is the third highest consumption by any process category. Thus, the UV system upgrades and UV control improvements have been identified as two of the most impactful Energy Conservation Measures for the wastewater treatment operation. Based on plant operating conditions between January 2019 and September 2020, an average annual savings of approximately $428,000 was estimated if the system is upgraded to a low-pressure UV system. The power consumption data for both the existing UV4000 system and the low-pressure UV system from Trojan Technologies (UV Signa™) is shown in Figure 3.0-1.

Figure 3.0-1
Power Consumption Data for UV4000 and UV Signa™



7. Upgrading the existing UV system to the proposed modern system also offers solutions to several challenges associated with the current control software.

- The current system does not have software logic that runs on the Distributed Control System (DCS) platform. GBWWTP is forced to accept Programmable Logic Controller (PLC) controls and use methods to interface the DCS with the PLC provided by Trojan. Additional hardware and resources are required for interfacing between the two systems.
- The software currently provided by Trojan Technologies does not allow access to the logic to see how it determines dosing rate and other key information and is very difficult to update.

4.0 PROJECT SCOPE

8. The scope of work will upgrade the existing UV system to a new UV system that is equipped with low pressure high efficiency lamps along with the associated control system. The design UV treatment of 60% and peak flow of 700 MLD for the proposed system were selected based on historical analysis of the existing data and the forecast maximum flow data to the year 2050.

9. All five channels are proposed to be upgraded, each equipped with four banks, one acting as a standby. Existing gates can be reused, although modifications within the channels, such as narrowing and benching at the bottom, may be required for retrofitting. Sufficient electrical capacity exists for equipment power. Additional concrete pads are required for new power distribution centers and retrofitting the proposed walkway at the bottom of the stairs. During construction, each channel can be completed individually to ensure plant operation, with isolation possible using existing inlet and outlet isolation valves.

5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 – Do Nothing

10. As the current UV4000 system is no longer manufactured by Trojan, it is getting increasingly challenging to source spare parts and supplies to maintain the system, which is of particular concern considering most of the components of the system have reached end of useful life. This alternative is not feasible.

5.2 Alternative 2 - Replace with a Similar Medium Pressure System

11. The current UV system, with medium pressure lamps, is not energy efficient. Electricity is the largest energy source on site as well as the largest operating cost and greenhouse gas contributor, which can all be reduced by upgrading to a more modern system. Also, maintaining the controls for the current UV system is challenging as the current system does not have software logic that runs on the DeltaV platform, making it difficult and costly to integrate and maintain. This alternative is thus not recommended.

5.3 Alternative 3 - Upgrade and Modernize to Low Pressure System

12. A new UV system with low pressure lamps will have a much higher efficiency than the current system's medium pressure lamps. The low-pressure lamps have a larger turndown range allowing for reduced power consumption when required. UV disinfection is best applied to secondary and tertiary effluents since the transmissivity of the water is better than primary effluents, thus requiring lower inputs of UV energy per unit volume of effluent. As a result, such a system would have much lower capital, operating, and maintenance costs than ozone and Peracetic Acid (PAA) disinfection. This is the recommended alternative.

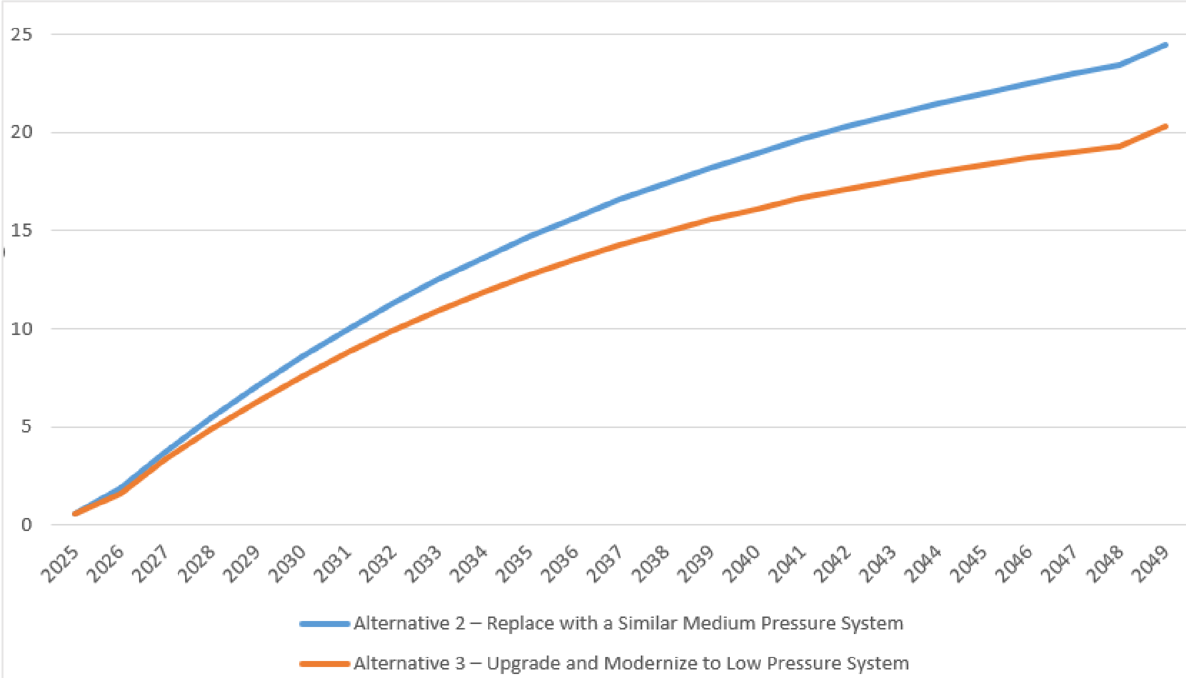
5.4 Net Present Value (NPV) Analysis

13. A 25-year NPV calculation was completed for all options with an acceptable risk level and is shown in Table 5.0-1. A chart displaying the cumulative revenue requirement is also provided in Figure 5.0-1.

Table 5.4-1
25-Year NPV Revenue Requirement Summary ($ millions)

25-Year Summary	NPV Revenue Requirement
Alternative 2 – Replace with a Similar Medium Pressure System	
Capital Cost	15.1
Operating Cost	8.6
Total	23.7
Alternative 3 – Upgrade and Modernize to Low Pressure System	
Capital Cost	16.2
Operating Cost	3.8
Total	20.0

Figure 5.4-1
Cumulative Revenue Requirement by Year ($ millions)



6.0 COST FORECAST

14. The cost forecast was developed based on the low pressure system. While capital costs are assumed to be similar between the medium pressure systems and low pressure systems, medium pressure systems have higher power consumption and increased operating costs and are therefore not recommended. Three UV suppliers were engaged to provide quotations and proposals with their low pressure technologies, which formed the basis of the cost estimation.

15. The estimated costs for the UV Disinfection System Upgrades Project for the 2025-2027 PBR term are provided in Table 6.0-1.

Table 6.0-1
UV Disinfection System Upgrades Project Capital Expenditure Forecast ($ millions)

	2024 and Prior	2025	2026	2027	2028 and Beyond	Total
Total Capital Expenditures	0.2	0.6	6.4	6.5	1.4	15.1

7.0 KEY RISKS AND MITIGATION PLANS

16. Table 7.0-1 outlines the risk and mitigation plans associated with this project.

Table 7.0-1
Key Risks and Mitigation Plans

Risk	Mitigation Plan
1. Health and Safety Risks – Confined space entry, ground disturbance, hot-work, and hazardous energy isolation are some of the associated risks.	EWS follows standard processes to reduce or eliminate these risks, including but not limited to: • Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum • Procuring qualified contractors with experience working in these conditions • Including safety systems and safety performance in evaluation criteria for the selection of contractors • Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages • Developing a hazard registry specific to the required tasks, and implementing best practices like job-site hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards • Conducting regular site visits and formal, documented inspections during construction
2. Environmental Risks – Silica dust during construction, removal and disposal of construction debris, working within the river valley	EWS conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Appropriate delineation of construction area, including necessary dust control, ventilation and debris management measures will be employed to mitigate relevant risks. Appropriate permits will be approved by AEPA.
3. Financial Risks – Actual contractor bids may vary from the estimates. Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing. Further change orders or unknown conditions that cannot be seen until demolition is complete	EWS manages financial risks by conducting preliminary design and obtaining manufacturer's quotes for establishing the project budget. The financial risks will become more evident as further design is completed. A competitive procurement strategy will also be implemented to ensure the best value is achieved. To mitigate cost escalations, thorough planning and proactive measures are essential. This can include detailed cost estimates during the planning phase, contingency budgets, and a comprehensive risk identification and analysis. Contracts should be clear with provisions for addressing unforeseen cost increases. Regular monitoring, strong relationships with contractors and suppliers, and experienced project managers are important to reduce the likelihood of cost increases. Value engineering to evaluate alternative materials, construction methods,

	or design modifications can also help to mitigate price increases.
4. Quality Risks – this is the risk that construction is not performed to a sufficiently high standard, in which case for example, leaks could develop or the mixer may not function appropriately.	Examples of how quality risks are managed are: • Rigorous contractor selection process that considers experience, safety performance, and past performance on similar projects. • Comprehensive and clear technical specifications for the work and equipment/materials • Applying lessons learned from the Digester 3 and 4 Upgrades project • Inspection and testing plan to ensure only quality products and workmanship are accepted • Contractor, strong specs, using lessons learned from Digester 3 and 4 Upgrades.
5. Reputation Risks – Work conducted is in close proximity to Gold Bar residents.	Community engagement will be conducted to address stakeholder concerns.

8.0 RESOURCES

17. This project is expected to hire external consultants to complete design and QA/QC during construction. An external contractor is expected to complete the construction work. Internal resources will be needed to support the project.

EPCOR WATER SERVICES

Appendix F-6

Business Case

PRIMARY EFFLUENT (PE) CHANNEL UPGRADES PROJECT

May 31, 2024

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1.0 OVERVIEW

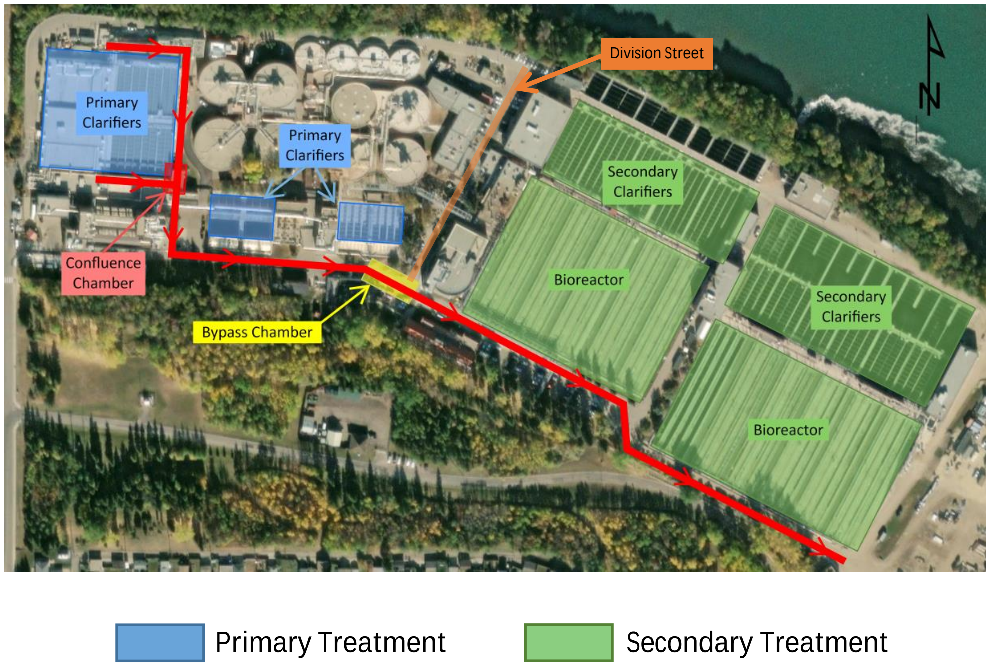
1. The Primary Effluent (PE) Channel Upgrades Project will continue the phased upgrade and rehabilitation work to the PE channel system at Gold Bar Wastewater Treatment Plant (GBWWTP). This work was initiated in 2019 and will span over several PBR terms. The scope of work for this project in the 2025-2027 PBR term includes completion of Phase 1 and initiation of Phase 2. The total forecasted spend for this project is expected to be $51.1 million, with $14.8 million to be spent during the 2025-2027 PBR term. About $7.6 million will be spent prior to the 2025-2027 PBR term, while the remaining $28.7 million is to be spent in future PBR terms.

2.0 BACKGROUND

2. GBWWTP consists of channels and chambers that convey wastewater from the entrance of the plant through treatment processes, then to the outfalls back into the North Saskatchewan River (NSR). Within the plant, PE channels move effluent from the primary clarifiers where primary treatment occurs to the Bioreactors for secondary treatment, as shown in Figure 2.0-1. The red line indicates the flow of the primary effluent, starting from the primary clarifiers shown in blue on the west side of the plant (west of Division Street). The flow moves along the south side of the plant through the Bypass Chamber to the Bioreactors shown in green on the east side of the plant (east of Division Street).

3. The Confluence Chamber and the Bypass Chamber shown in Figure 2.0-1, shown in red and yellow respectively, are key components of the conveyance infrastructure. The Confluence Chamber receives flow from Primary Clarifiers 5-12 and distributes flow into two downstream PE channels. This chamber marks the starting point of flow in the PE channel system and is a single point of failure without any readily available means of isolation. Flows leaving the Confluence Chamber then move to the Bypass Chamber, which is also a single point of failure for downstream process.

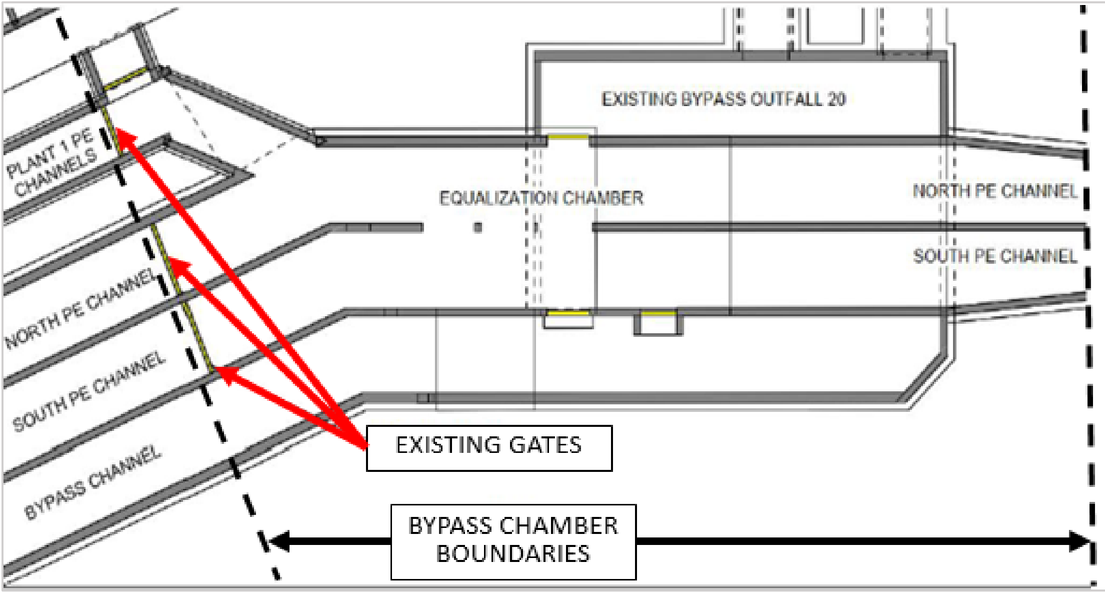
Figure 2.0-1
PE Channel Path



4. The central sections of these channels and chambers were constructed in the 1950's. In 2016, an inspection of the PE channels found them to be deteriorated and in need of rehabilitation. Because isolation of the inspected portions of the PE channels was not possible, the channel inspections were completed through available ports and openings with the channel running live with constant flows.

5. There are several channels that congregate at the Bypass Chamber. As shown in more detail in Figure 2.0-2, the North PE and South PE channels, as well as primary effluent from Clarifiers 1 to 4 (shown as Plant 1) connect with the Bypass Chamber and can be isolated using existing isolation gates in the current configuration. A fourth channel carries emergency plant bypass flows from the headworks area of the plant, which is then directed underneath the North and South PE channels to the NSR via Outfall 20. This emergency bypass path is used when incoming flows are higher than plant capacity during high flow events. However, once the flows enter the chamber, there is no means to isolate the North or the South streams leaving the chamber.

Figure 2.0-2
Current Configuration of the Bypass Chamber



6. Detailed early planning work identified the key drivers for this project to be the following:
   - Maintain current flow capacity in the PE channel system during any inspection and rehabilitation work.
   - Allow safe isolation and entry to the existing PE channels for inspection and rehabilitation work as needed.
   - Eliminate single point of failure locations (e.g., Confluence Chamber and Bypass Chamber).

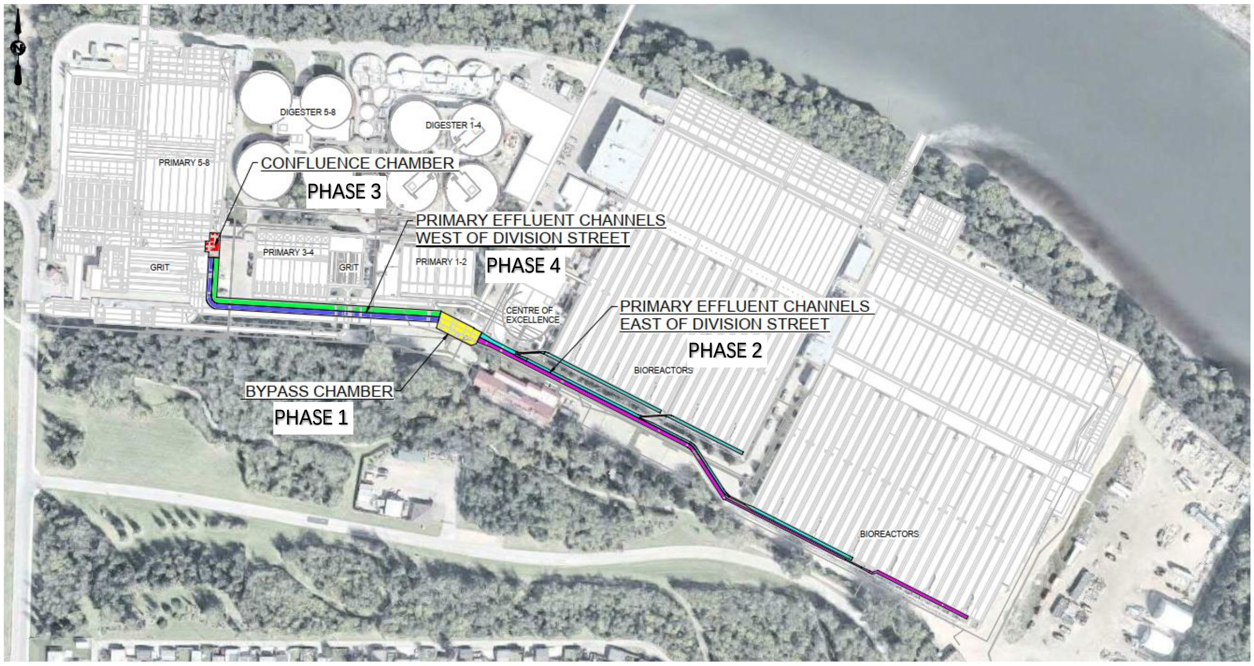
7. Early planning confirmed that the overall scope of work could not be delivered in a single PBR term. The rehabilitation work must be completed while maintaining full treatment process capacity, making it impossible to complete the work at once. Consequently, the project was separated into different phases.

8. Inspection of the Confluence Chamber found it to be in better condition than the Bypass Chamber, due primarily to the age and the configuration of the Bypass Chamber. Hence it was determined that the first phase of rehabilitating the PE channel system would be to upgrade the Bypass Chamber. This would eliminate this single point of failure and resolve issues with the most degraded part of the system.

9. Figure 2.0-3 shows the proposed phases of the PE Channel Upgrades. In the figure, the blue and green lines represent the PE channels upstream of the Bypass Chamber (Phase 4) and

the light blue and pink lines represent the PE channels downstream of the Bypass Chamber (Phase 2).

Figure 2.0-3
Phases of PE Channel Upgrades



10. The sequence of the project phases was determined based on understanding of current conditions of the infrastructure, outage requirements and operational considerations. For the upcoming PBR, the scope of the project includes completing Phase 1 upgrades and installing isolations and new channel sections to facilitate completion of Phase 2 rehabilitation.

3.0 JUSTIFICATION

11. To perform periodic inspections and required rehabilitation, it is necessary to stop flows into portions of the chambers and channel sections of the wastewater conveyance infrastructure. This is achieved by using a gate system located upstream of the relevant section. The Bypass Chamber and Confluence Chamber represent single points of failure in the PE channel system and are impossible to safely enter and rehabilitate. It is thus necessary to install gates within the chamber structures to manage flows. Other sections of the PE channel present similar issues and have never been isolated, inspected, or rehabilitated since construction. Failure of any part of this conveyance infrastructure would result in a failure to provide secondary and tertiary treatment to the city's sewage. This could potentially result in large volume of undisinfected and

nutrient laden wastewater entering the NSR resulting in regulatory violation and potential environmental harm.

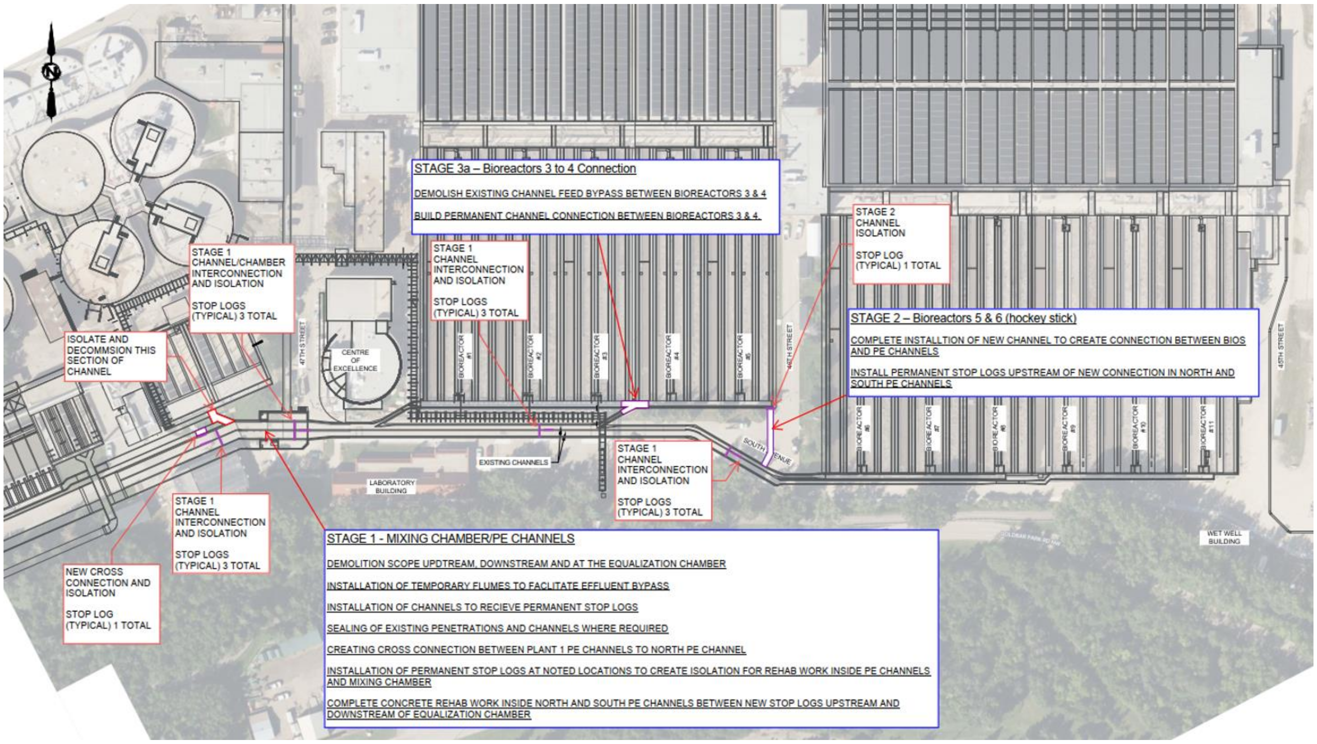
12. Creating the ability to isolate flows means that GBWWTP operations will be able to safely complete necessary upgrades and maintenance work to the rest of the PE channel system. The upgrade to the Bypass Chamber is part of a group of projects that will upgrade the entire PE channel system in future PBR periods. The channels downstream of the Bypass Chamber cannot be upgraded until the gate system in the chamber is installed, as there is no existing mechanism to safely alternate flows between the downstream PE channels.

4.0 PROJECT SCOPE

13. The scope for the PE Channel Upgrade project during the 2025-2027 PBR term will include upgrades to the Bypass Chamber (Phase 1) and adding new isolation and channel sections between Bioreactor trains, which will facilitate the future rehabilitation of the PE channels downstream of the Bypass Chamber (Phase 2). Detailed design, construction, and commissioning of this scope is currently planned to be completed during this period.

14. Work for following PBR terms is expected to include detailed design, construction, and commissioning of all remaining components of the system (Phases 2, 3 and 4). Figure 4.0-1 shows the proposed stages of work for Phases 1 and 2 during the 2025-2027 term.

Figure 4.0-1
Proposed PE Channel Upgrades during 2025-2027



15. The scope of work and construction sequencing is in the following main areas: Bypass Chamber (Phase 1), and North and South PE Channels between Bioreactors 1 to 6 (preparation of Phase 2).

16. The scope of work at the Bypass Chamber (Phase 1 of the overall project) includes demolition upstream, downstream and at the Bypass Chamber to allow access and facilitate upgrades, installation of temporary flumes to facilitate effluent bypass, installation of steel support channels to receive permanent stop logs, sealing of existing penetrations and channels where required, creating a cross connection between Plant 1 PE Channel to the North PE Channel, and installation of permanent stop logs as required to create isolation for rehab work inside the PE Channels and Bypass Chamber.

17. North and South Channel interconnection includes interconnecting PE Channels between Bioreactors 5 and 6 and between Bioreactors 3 and 4. Between Bioreactors 5 and 6, the scope includes installation of new channel to create connection between Bioreactors and the North PE Channel and installation of permanent stop logs upstream of the new connection in North and

South PE Channels. Between Bioreactors 3 and 4, the scope includes demolition of existing channel feed bypass and building a permanent channel connection between Bioreactors 3 and 4.

18. Finally, the project will complete concrete rehab work inside North and South PE Channels between new stop logs upstream and downstream of bypass chamber, cleanup roadways, and complete landscaping in all areas of construction.

19. The project will complete design and procurement through 2023 and 2024. Construction will follow through in 2024 and 2025 with the upgraded sections going into service by 2026.

5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 - Delay or Defer PE Channel Upgrades

20. The existing design of the PE Channels requires all flows to be stopped or diverted to access and maintain the infrastructure. As such, there has not been any rehabilitation or upgrades performed on the channels or chambers since they were constructed. As evidenced by inspection, the channels have degraded over time due to lack of maintenance. There is no protective coating at present on the concrete walls or columns within the channel to protect against water infiltration and corrosion-related deterioration. There is also no redundancy for the PE Channel to feed all Bioreactors. If there is a failure, leak or collapse in the PE Channel system, plant employees would not be able to inspect or resolve the issue without having to divert flows around the area of concern, which is impossible during an emergency given the magnitude of the flows. Also, such a failure would result in an extended outage of the secondary treatment process, causing environmental damage and violation of GBWWTP's approval to operate, triggering regulatory action. Delivering this project at a reasonable pace is thus critical for the continued operation of the facility and delaying or deferring this work poses an unacceptable level of risk to plant operations. This alternative was rejected.

5.2 Alternative 2 – Accelerate PE Channel Upgrades

21. This alternative involves delivering this project at an accelerated pace and completing the upgrades sooner than proposed in the current plan. Although the identified upgrades are critical in nature, it is impossible to accelerate the work due to outage requirements. There are novel components to the construction aspect of this project that involve keeping the conveyance infrastructure in operation while completing the upgrades. This method of construction is

needed to avoid large scale flow bypass, which was earlier deemed infeasible due to the scale of temporary pumping and piping required. The proposed scope and schedule will allow the validation of this method of construction and help with future planning for the remaining components of the project. It is possible to divert PE flows to the NSR through Outfall 30 avoiding the Bypass Chamber and downstream channels, allowing for the accelerated isolation and rehabilitation of those sections. However, this would eliminate secondary treatment and disinfection from the wastewater for the duration of construction, which would violate GBWWTP's approval to operate resulting in environmental impacts and regulatory action. Thus, this alternative was rejected.

5.3 Alternative 3 – New PE Channels

22. A third alternative would be to construct new channels to replace the existing PE Channels. However, early evaluations determined that this alternative is not applicable to all sections of the PE channel and had poor viability due to space and constructability constraints. A new channel was considered for the sections feeding the bioreactors but the channel would have to be built deeper than existing channels to allow process tie-in points, posing major constructability challenges and cost implications. This alternative would also involve greater disruption during construction compared to rehabilitation, to build additional conveyance capacity that is not needed nor will be in continuous use, which may result in faster degradation. In addition, building new channel infrastructure would require a much higher capital expenditure, directly impacting the rate payers. Rehabilitation offers a more sustainable and cost-effective solution by leveraging existing assets. Given the logistical challenges and higher costs associated with building new infrastructure, this alternative was excluded from further assessment.

5.4 Alternative 4 – Sequential Upgrade to the PE Channel System

23. Implementing the project as proposed includes installation of gate system on the upstream and downstream side of the Bypass Chamber, providing the ability to shut down various parts of the system and allow the subsequent phases of the project to proceed. Without upgrading the Bypass Chamber, no future channel rehabilitation is possible, which is not an acceptable scenario. This work was considered the most appropriate and immediate requirement and as such this scope was selected as Phase 1 of the project. Delivering the next phase of the project involves rehabilitating PE Channels east of the Diversion Street. This requires outage of the 11 Bioreactor trains that are supplied by these channels. Due to process demand, it is not

possible to allow outage of more than one or two trains at once. Thus, completing the necessary preparation, by incorporating required isolation and new channel sections, was deemed prudent for delivery within the upcoming construction scope. The sequential upgrade plan and proposed timeline allows for rehabilitation of the most critical parts of the PE Channel infrastructure, while providing necessary means to facilitate future work on the entire system. Validation of the construction approach will also allow for better planning and delivery of future phases of this project.

6.0 COST FORECAST

24. The project will be delivered using the Integrated Project Delivery (IPD) method. The project team includes members of the owner, designers, contractors, and sub-contractors. The cost forecast was updated using information provided by the IPD team during the project validation stage.

25. Table 6.0-1 provides the capital expenditure forecasts for the project by phase.

Table 6.0-1
PE Channel Upgrades Project Capital Expenditure Forecast by Project Phase ($ millions)

Project Phase	2024 and Prior	2025	2026	2027	2028 and After	Total
1. Phase 1 Upgrades and Phase 2 Preparation (Bypass Chamber and PE Channel interconnections between Bioreactors 1 to 6)	7.6	12.1	1.7	-	-	21.4
2. Future Phases 2-4 Upgrades (PE Channel sections east and west of division street and Confluence Chamber)	-	-	-	1.0	28.7	29.7
3. Total Capital Expenditures	7.6	12.1	1.7	1.0	28.7	51.1

7.0 KEY RISKS AND MITIGATION PLANS

26. It is anticipated that there will be risks during design, procurement, and construction that can affect the scope, cost, and schedule of this project. These include material delivery delays, fabrication delays, design changes to meet operating parameters, and construction delays.

27. Table 7.0-1 provides key risks and mitigation plans associated with this project.

Table 7.0-1
Key Risks and Mitigation Plans

<table>
<tr><th>Risks</th><th>Mitigation Plan</th></tr>
<tr><td>1. Health & safety risks – Confined space entry, ground disturbance, hot-work, and hazardous energy isolation are some of the associated risks. Additionally, removing the existing concrete and mechanical components, and installing an HDPE liner will be a large undertaking.</td><td>EWS follows standard processes to reduce or eliminate these risks, including but not limited to:
• Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum.
• Procuring qualified contractors with experience working in these conditions
• Including safety systems and safety performance in evaluation criteria for the selection of contractors
• Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages
• Developing a hazard registry specific to the required tasks and implementing best practices like job-site hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards.
• Conducting regular site visits and formal, documented inspections during construction</td></tr>
<tr><td>2. Environmental Risks – associated risks include:
• Removal and disposal of construction debris (i.e. dispose construction waste to designated location).
• Leakage of bypass pumps (i.e. provide secondary containment to mitigate potential environment release).</td><td>EWS conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Appropriate delineation of construction area, including necessary dust control, ventilation and debris management measures will be employed to mitigate relevant risks.</td></tr>
<tr><td>3. Financial risks – Actual contractor bids may vary from the estimates. Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing. Further change orders or unknown conditions that cannot be foreseen.</td><td>EWS manages financial risks by conducting preliminary design and obtaining manufacturer's quotes for establishing the project budget. The financial risks will become more evident as further design is completed. A competitive procurement strategy will also be implemented to ensure the best value is achieved.
To mitigate cost escalations, thorough planning and proactive measures are essential. This can include detailed cost estimates during the planning phase, contingency budgets, and a comprehensive risk identification and analysis. Contracts should be clear with provisions for addressing unforeseen cost increases. Regular monitoring, strong relationships with contractors and suppliers, and experienced project managers are important to reduce the likelihood of cost increases. Value engineering to evaluate alternative materials, construction methods, or design modifications can also help to mitigate price increases.</td></tr>
</table>

4. Reputation risks – Work conducted is near Gold Bar residents. Park and trail users may observe ongoing construction activities and express their concerns.	Community engagement will be conducted to address stakeholder concerns.
5. Construction risks – May anticipate ground disturbance, archaeological or paleontological finds.	Locate and mark utility lines prior to excavation (click Alberta one call).

8.0 RESOURCES

28. This project is being delivered using the IPD method. Procurement, negotiation, and formation of the IPD team was completed earlier in 2023. Subsequent project validation has been completed by the IPD team. Resources as required will be allocated by the IPD team throughout the life of the project.

EPCOR WATER SERVICES

Appendix F-7

Business Case

PLANT PIPE REHABILITATION AND UPGRADE PROGRAM

May 31, 2024

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1.0 OVERVIEW

1. The Plant Pipe Rehabilitation and Upgrade Program is for replacement and upgrades to critical process and utility pipes at the Gold Bar Wastewater Treatment Plant (GBWWTP). During the 2025-2027 PBR term, this program will include projects to upgrade the potable water piping and repair deficiencies in sludge lines within the facility. The estimated capital cost is $9.2 million in the 2025-2027 PBR term.

2.0 BACKGROUND

2. The GBWWTP relies on a network of piping to carry out its processes effectively to treat wastewater before it is discharged back into the environment. These piping systems are essential for transporting both process streams and utilities throughout the facility.

3. The potable water piping network is comprised of approximately 3,000 m of piping of various materials including polyvinyl chloride (PVC), cast iron, asbestos-cement, and steel, ranging anywhere in age from less than 5 years to more than 50 years old. Potable water is used for process demands like cooling, straining, mechanical seals, hydrant use, and domestic and laboratory applications. The daily potable water consumption at the plant is more than 1,000 m^3/day. Sections of the existing network are undersized and vulnerable to overpressure and the aging cast iron and asbestos cement pipes are susceptible to leaks.

4. The secondary sludge pipes carry biologically active solid material called activated sludge and have been problematic for some time due to the corrosive nature of the process, with multiple leak events occurring over the last 10 years. The focus of the capital program includes the removal of epoxy lined carbon steel piping connecting the secondary process and replacement with stainless steel. These repairs and replacements have been prioritized to address the oldest and most problematic sections of piping first. Consequently, most of the sludge piping in eight out of eleven treatment trains have been upgraded to stainless steel. Continuing with this approach, the next area that requires upgrades is the return activated sludge (RAS) and waste activated sludge (WAS) piping in trains 9-11, which remain entirely carbon steel.

3.0 JUSTIFICATION

5. Piping infrastructure within the GBWWTP facility serves critical roles in maintaining operational efficiency. Issues with aging pipes, poor materials and/or pipe sizing make the network susceptible to leaks, failures and pressure spikes.

6. Water flow velocities and high pressures experienced in the potable water pipes in their current operating condition cause rapid changes in pressure, generating a pressure wave that travels through the network. This can result in pipe bursts, leaks, or damage to valves and fittings. The potable water pipe upgrades will reduce the likelihood of high velocities and pressure surges in the system that cause water main breaks. It will also enhance the overall reliability and redundancy of the system and decrease the likelihood of process interruptions.

7. Due to the deteriorated condition of the RAS and WAS piping, there have been ongoing issues with numerous leaks and failures. Figure 3.0-1 shows holes found in the existing piping infrastructure. Repairing these issues is challenging due to operational constraints. Isolations and outages are limited to a few hours due to treatment process demand, and any work exceeding 8 hours requires draining a Secondary Tank. This process can only occur between April and October to prevent freezing. Further, only one secondary train may be brought down for repair at a time while maintaining the capacities outlined in the operations plan. This leaves very little flexibility to coordinate emergency repairs. Additionally, the original carbon steel piping material is unsuitable for the purpose, as it is prematurely failing due to accelerated corrosion. Replacing the carbon steel with stainless steel will address ongoing failures and leaks, ensuring the piping system's resilience in the long term.

Figure 3.0-1
Holes in RAS/WAS Piping System

8. Replacements and upgrades of the existing piping network is essential to maintaining the reliability and integrity of the wastewater treatment system.

4.0 PROJECT SCOPE

9. The project scope includes upgrades to the potable water supply system, as well as replacements of the RAS/WAS piping system.

4.1 Potable Water Upgrades

10. The potable water network upgrade scope includes the following:

- Replacement of approximately 700 m of end of life unlined cast iron and asbestos cement piping.
- Proposed three additional hydrant locations to ensure full site coverage.
- Replacement of undersized pipes to ensure adequate flows (Mains will be upsized to meet plant demands and 100 L/s fire flow requirements, tunnel piping will be upsized to maintain target velocities below 1 m/s).

- Add approximately 350 m of looping to dead end runs to increase redundancy and reduce pressure surges.

11. The project scope for potable water upgrades is broken into three phases. Phases 1 will be executed in 2024, Phase 2 in 2025 and Phase 3 will be designed in 2026-27 and executed in the subsequent PBR.

  - o Phase 1: Installation of looped connection in the south-west part of the plant. This upgrade increases flow access on site and adds redundancy in case of an outage.
  - o Phase 2: Installation of pressure reducing valves (PRVs) and check valves on service lines into GBWWTP. This upgrade reduces the high pressures, reducing stress on pipes and bringing water pressure down to normal levels. This also brings the sites into compliance with the requirement for check valves on looped services.
  - o Phase 3: Further looping upgrades and additional hydrant installations. These upgrades bring the GBWWTP water network to its final state, adding hydrants where there are currently none and increasing flow at hydrants that are below capacity. This also has the effect of increasing the capacity of the water network for future on-site upgrades at GBWWTP.

4.2 RAS/WAS 9-11 Piping Upgrades

12. The RAS/WAS piping replacement scope includes the following:

- Demolish existing carbon steel piping transferring RAS from clarifiers 9, 10, and 11 to their respective bioreactors and replace the piping in stainless steel.
- Demolish existing carbon steel piping transferring WAS from the Secondaries 9-11 RAS header to the dissolved air floatation (DAF) header and replace in stainless steel.
- Redesign of the RAS and WAS systems for the Secondaries 9, 10, and 11 so that they don't operate on common headers, which makes isolation and maintenance extremely challenging.

5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 – Emergency Repairs to Address Failures

13. For both the potable water piping system and the RAS/WAS pipes at the GBWWTP, maintaining the status quo of only dealing with emergency failures is not recommended. The potable water distribution system is susceptible to pressure surges and contains sections of

piping over 50 years old that are prone to leaks. The likelihood of failures poses risks to plant operations, site safety, and the environment, as chlorinated water could potentially enter the North Saskatchewan River through on-site drains and impact aquatic habitat. Further, long-duration live repairs are infeasible under most circumstances for the secondary sludge pipes, greatly increasing the operational impacts from failures. The system can only be taken offline for less than 8 hours without downstream impacts on effluent quality. Given these challenges, maintaining the status quo could eventually lead to a catastrophic failure and is not a viable option for ensuring the reliability and safety of the wastewater treatment plant.

5.2 Alternative 2 – Spot Repairs/Minor Rehabilitation

14. This alternative involves rehabilitating sections of piping with repair and temporary patches, possibly through the removal of piping spools or cutting out sections for replacement with new piping. Once existing problem areas are addressed, a proactive approach may be adopted to identify and rehabilitate potential trouble spots before leaks occur, necessitating additional funds and outages for investigative work. Depending on the timeline for a full system replacement, multiple rehabilitation projects may be necessary to maintain the system's integrity. However, this approach does not guarantee a reduction in the likelihood of risks, as new leaks can still develop on old piping. Moreover, there's no guarantee that newly installed piping sections will be reusable once the system piping is eventually replaced, as the design, piping alignment, and pipe material may change. This is not an efficient use of capital funds, particularly if a replacement is slated within the next five years. This alternative is therefore not recommended.

5.3 Alternative 3 – Deferral

15. Deferring the upgrades and replacements outlined in the project scope to a future PBR term is not advisable due to existing vulnerabilities in the networks. These vulnerabilities include susceptibility to pressure surges and aging sections that are deteriorating to the point of experiencing leaks and failures. Given that some storm drains at GBWWTP flow directly to the North Saskatchewan River, a failure in the system could lead to the release of chlorinated water, harming the environment and violating EWS's approval to operate.

16. In addition, if potable water upgrades were deferred, it would be recommended to conduct extensive condition assessments of underground cast iron and asbestos cement piping to ensure that this piping is still in serviceable condition. Assessments are expected to be of

considerable cost on top of the associated upgrade cost. This alternative is thus not recommended.

5.4 Alternative 4 – Pipe Replacements and Upgrades

17. Replacements and upgrades to the potable water pipes and RAS/WAS pipes provides the best mitigation to reduce the likelihood of leaks, failures, and unexpected outages due to aging and pressure surges. This alternative involves executing Phases 1 and 2 of the potable network upgrades to install looped connection in the south-west part of the plant and installing PRVs and check valves on service lines into GBWWTP. For secondary trains 9, 10 and 11, this involves demolishing existing carbon steel piping carrying RAS and WAS and replacing with stainless steel, while redesigning to facilitate isolation and maintenance. This is the recommended alternative.

6.0 COST FORECAST

18. The forecasted capital expenditures for Plant Pipe Rehabilitation and Upgrades for the 2025-2027 PBR term are provided in Table 6.0-1.

Table 6.0-1
Pipe Rehabilitation and Upgrade Program Capital Expenditure Forecast 2025-2027 ($ millions)

	2025	2026	2027	Total
Total Capital Expenditures	5.3	2.1	1.8	9.2

19. Table 6.0-2 provides the estimated capital expenditure by sub-project for the 2025-2027 PBR term.

Table 6.0-2
Pipe Rehabilitation and Upgrade Program Capital Expenditure Forecast by Project ($ millions)

Project	2025	2026	2027	Total
1. Potable Water Upgrades	2.8	0.1	0.1	3.1
2. RAS/WAS 9-11 Piping Upgrades	2.5	2.0	1.7	6.3
3. Total Capital Expenditures	5.3	2.1	1.8	9.2

7.0 KEY RISKS AND MITIGATION PLANS

20. Piping replacement may involve activities such as excavation. These activities have been carried out in previous years, and lessons learned are incorporated so that each subsequent project can be done better and safer.

21. The key risks associated with this project and EWS's plans to mitigate these risks are summarized in Table 7.0-1.

Table 7.0-1
Key Risks and Mitigation Plans

Risk	Mitigation Plan
1. Health and Safety Risks – Confined space entry, ground disturbance, hot-work, and hazardous energy isolation are some of the associated risks.	EPCOR follows standard processes to reduce or eliminate these risks, including but not limited to: • Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum. • Procuring qualified contractors with experience working in these conditions • Including safety systems and safety performance in evaluation criteria for the selection of contractors • Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages • Developing a hazard registry specific to the required tasks and implementing best practices like job-site hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards. • Conducting regular site visits and formal, documented inspections during construction
2. Environmental Risks – Spills (to water or ground) are a risk. Landscaping, trees, and animals may also be affected by some activities related to this scope. Additionally, there is risk associated with silica dust during construction, removal, and disposal of construction debris, working within the river valley	EPCOR conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Risks associated with spills are mitigated by using spill control measures and emergency response procedures. Risks to landscaping, tree, and animals are mitigated by consulting with environmental specialists during the execution of the work to ensure these risks are appropriately managed. Appropriate delineation of construction area, including necessary dust control, ventilation and debris management measures will be employed to mitigate relevant risks. Appropriate permits will be approved by AEPA.
3. Execution Risk – Pipe and pipeline replacement typically involves activities such as excavation.	These activities have been carried out in previous years, and lessons learned are incorporated so that each subsequent project can be done better and safer.

4. Government/Regulatory Risks - City and Provincial regulations apply to certain tasks of the program.	A regulatory review will be conducted prior to the work to ensure we are compliant with applicable regulations.
5. Financial Risks – Actual contractor bids may vary from the estimates. Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing.	The activities in this program have been previously carried out, and a general understanding of the tasks and costs have been developed. Project costing is typically reviewed to ensure it aligns with assumptions and expectations. To mitigate cost escalations, thorough planning and proactive measures are essential. This can include detailed cost estimates during the planning phase, contingency budgets, and a comprehensive risk identification and analysis. Contracts should be clear with provisions for addressing unforeseen cost increases. Regular monitoring, strong relationships with contractors and suppliers, and experienced project managers are important to reduce the likelihood of cost increases. Value engineering to evaluate alternative materials, construction methods, or design modifications can also help to mitigate price increases.
6. Reputation Risk - External stakeholders (e.g. public, other asset owners) can be affected by some tasks that occur (e.g. excavation, equipment crossings).	These external stakeholders and EPCOR Communications and Public Engagement will be consulted prior to starting these tasks. Community engagement will be conducted to address stakeholder concerns.

8.0 RESOURCES

22. The project is expected to use both internal and external resources. Internal resources are typically relied upon to prepare the assets for major work. The delivery method for the project will be determined during development of design for the project. It is currently planned to engage with Water Distribution and Transmission to assist with scoping and design for the potable water components. It is expected that a competitive procurement strategy will be used among current Master Service Agreement holders to obtain a contractor for execution.

EPCOR WATER SERVICES

Appendix F-8

Business Case

SLUDGE AND SUPERNATANT PIPELINE REHABILITATION PROGRAM

May 31, 2024

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1.0 OVERVIEW

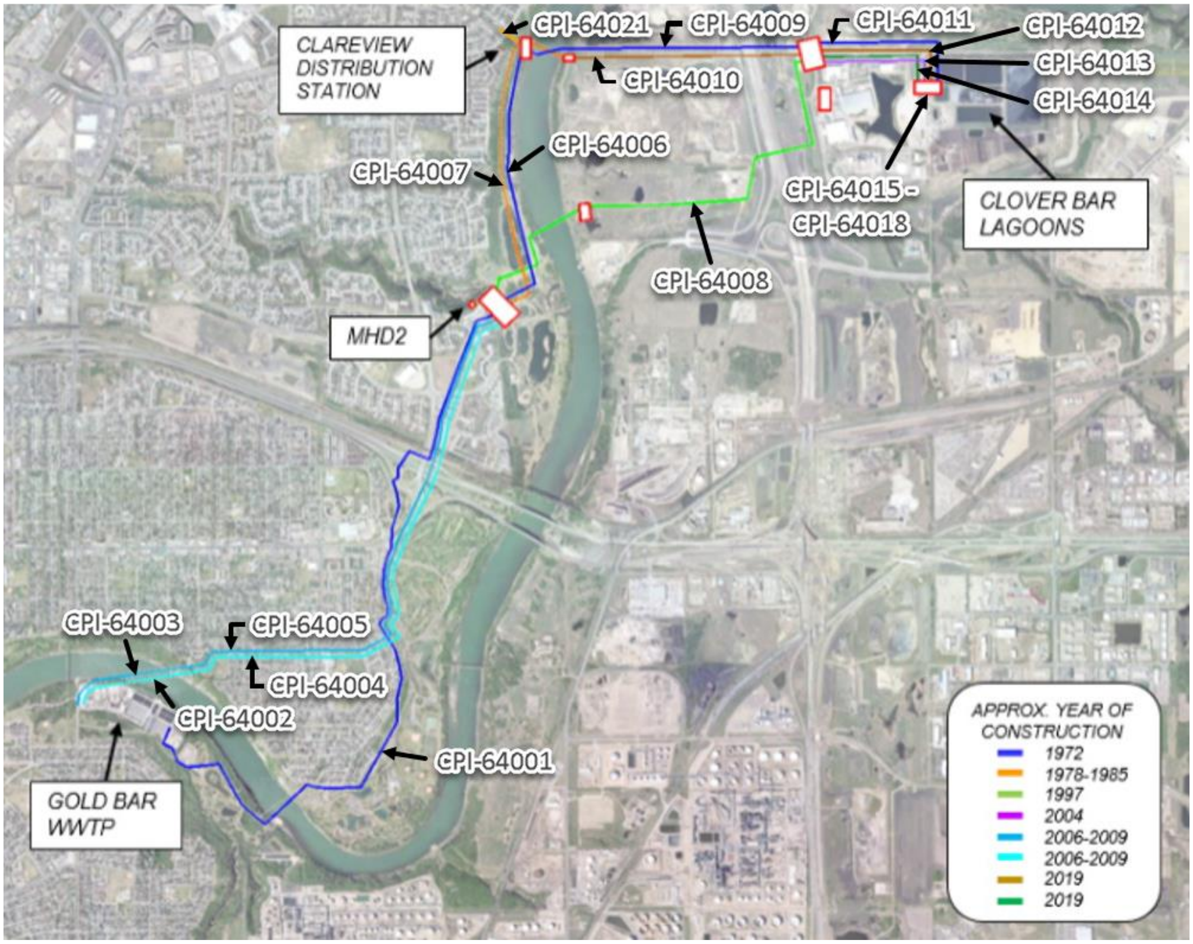
1. The Sludge and Supernatant Pipeline Rehabilitation Program is for major inspections, cleaning, repairs, rehabilitation, and upgrades for the pipeline assets and supporting infrastructure used to transfer sludge and supernatant between the Gold Bar Wastewater Treatment Plant (GBWWTP) and the Clover Bar Biosolids Resource Recovery Facility (CBBRRF). The estimated capital cost is $6.4 million in the 2025-2027 PBR term. An additional $7.3 million is estimated to be required in 2028 to complete the projects started in 2025-2027.

2.0 BACKGROUND

2. The GBWWTP produces digested sludge as a by-product of treating wastewater. The digested sludge is transferred by pipes to the CBBRRF where it is stored and dewatered prior to land application. Supernatant, a nutrient rich liquid waste stream separated from the digested sludge at the CBBRRF, is transferred by pipe from the facility back to the GBWWTP for further treatment. The pipe sections between GBWWTP and Hermitage Park area are used to transport digested sludge and the pipe sections within the CBBRRF site are dual purpose, transferring either digested sludge or supernatant. The dual-purpose pipe sections are designed to operate bi-directionally and have the capability to carry either waste stream depending on the process needs or pipeline availability.

3. The first sections of these pipes were built in 1972 and have expanded continually since then. There is 33.6 km of sludge and supernatant piping between GBWWTP and CBBRRF. The pipes are located primarily in or near the river valley and pass through several environmentally sensitive areas. The system has several major crossings including five river crossings and three crossings beneath each the Anthony Henday Freeway, and Yellowhead Freeway/CN Rail corridors. Figure 2.0-1 shows the layout of the piping system.

Figure 2.0-1
Sludge / Supernatant Pipe System Layout



4. The sludge and supernatant pipelines require regular cleaning, inspection, rehabilitation, and upgrades to extend the useful asset life and mitigate operational risks. In 2015, the GBWWTP developed a Sludge/Supernatant Pipeline Inspection Program. This program specified a phased approach for cleaning and inspection of the pipelines to assess their condition and identify any needed repairs, rehabilitation, or upgrades to ensure the integrity of the pipe.

5. Since 2016, more than 10 km of pipe has been inspected including sections CPI-64001, CPI-64006, CPI-64009, CPI-64011, CPI-64007, CPI-64010, CPI-64012 and CPI-64008. CPI-64010 and CPI-64012 have been rehabilitated with 2.5 km of pipe replaced along their sections and spot repairs have been completed on CPI-64006.

6. In 2020, an overall Pipeline Master Plan was developed for the piping system. The plan considered the current and future overall layout, the number and size of pipes to meet volume

and redundancy requirements, material type, and monitoring options. An Asset Management Plan was also developed that focused on the needs and investments required for the sustainability of the existing pipeline assets to reduce the risk of failure.

7. The Asset Management Plan completed a condition assessment using both observed defects and deterioration models based on age and material type to produce a condition rating for each pipe. The sludge and supernatant pipeline system is comprised of 21 pipes, which were further segmented into a total of 45 segments based on either criticality or other attributes. The resulting condition ratings were used to develop the Likelihood of Failure (LOF) for each segment. Along with the LOF scores, Consequences of Failure (COF) were also completed across five consequence categories using the EPCOR Risk Matrix. The consequence categories include Health and Safety, Environment, Regulatory, Reputation, and Financial. A theoretical risk score was then calculated for each pipe and the results are shown on the matrix in Figure 2.0-2.

Figure 2.0-2
Sludge/Supernatant Pipeline Asset Risk

Consequence		Likelihood: 1 Remote	2 Rarely	3 Very Unlikely	4 Unlikely	5 Likely	6 Almost Certain
6	Severe		1	3			
5	Major						
4	Significant			1			
3	Moderate		5	21	6		
2	Minor		2	5	1		
1	Slight						

8. EWS expects that continued investment will be required to support cleaning, inspection, and rehabilitation of the pipeline assets. Inspections will be prioritized based on the risk

assessment, and replacement of segments will be identified through these inspections. Major segments that remain to be inspected include CPI-64002, CPI-64003, CPI-64004 and CPI-64005. Also, inspection and rehabilitation of pipeline supporting infrastructure including valve chambers will be conducted as part of this program.

3.0 JUSTIFICATION

9. The sludge and supernatant pipes require regular cleaning, inspection, rehabilitation, and upgrades to realize the desired flow capacity, expected asset life and mitigate operational risks. Without an investment in proactive rehabilitation, over time the system will become fouled and be at increased risk of failure. In addition, repairing or replacing failed piping is more costly and more disruptive to operations compared to proactive rehabilitation to maintain performance and extend service life.

10. The risk categories associated with these assets are the following:

- Health and Safety Risks – Failure of the pipes within chambers and restricted spaces can cause liquids and gases to be released, posing a safety risk to EWS staff, especially as they are pressurized pipes.
- Environmental Risks – Pipe failure could cause a spill of untreated waste to the local environment or to the river.
- Government/Regulatory Risks – A plant process upset, or regulatory non-compliance could result in fines or impact EPCOR's approval to operate.
- Reputation Risks – Disruption of service could impact EPCOR's reputation.
- Financial Risks – Emergency repairs of failed pipes can be considerably more costly than proactive renewal.

4.0 PROGRAM SCOPE

11. Approximately 18 km of pipe used for transferring sludge and supernatant will be cleaned, inspected, and prioritized for rehabilitation in the 2025-2027 PBR term as shown in Table 4.0-1. The program intends to rehabilitate the assets based on a small quantity of defects (e.g. 2-3 defects per segment).

Table 4.0-1
Pipe Inspection and Rehabilitation Priorities

GB Pipe Number	Size (mm)	Material	Length (km)	Asset # (Start)	Asset # (End)	Estimated Risk
64004	250	C.Steel	4.2	473637	474374	Medium-High
64005	250	C.Steel	4.2	473636	473403	Medium-High
64006	200	C.Steel	2.0	374268	376877	Medium-High
64008	250	C.Steel	3.5	376801	378786	High-Medium
64009	200	C.Steel	1.9	374869	375575	Medium-High
64010	200	C.Steel	1.9	374859	379989	Medium-High
64011	200	C.Steel	1.15	379971	375765	Medium-High
64015	200	C.Steel	Header	CB Biosolids Basins	-	Medium-Low
64016	200	C.Steel	Header	CB Biosolids Basins	-	Medium-Low
64017	200	C.Steel	Header	CB Biosolids Basins	-	Medium-Low
64018	300	C.Steel	-	CB Biosolids Basins	-	Medium-Low
64021	200	C.Steel	0.07	361843	-	Medium-High

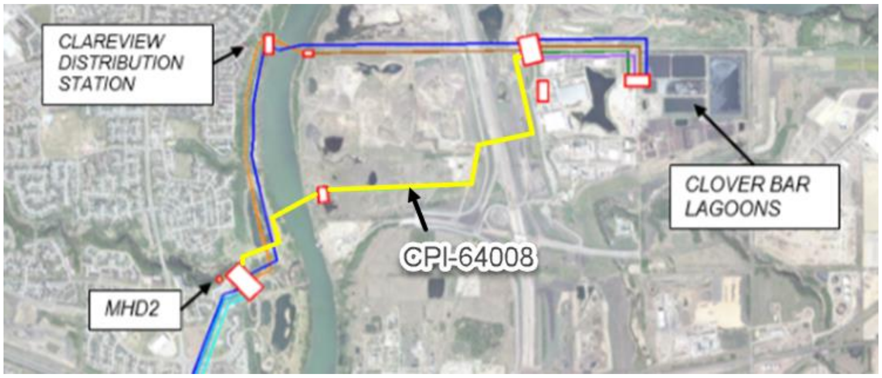
12. In addition to the scheduled inspections, pipeline segment CPI-64008 is currently being considered for rehabilitation during the 2025-2027 PBR term, based on its age, material, and usage.

4.1 CPI-64008 Rehabilitation

13. CPI-64008 is a 250 mm carbon steel pipe installed in 1997 to provide conveyance capacity between GBWWTP and CBBRRF. The pipe extends from Maintenance Hole D2, crosses under the North Saskatchewan River and Anthony Henday Drive, and ends at a diversion chamber adjacent to the Edmonton Waste Management Center. Its total length is approximately 3.5 km.

14. It is mostly used for sludge conveyance and is crucial for continued operation. The pipeline has not yet been inspected, but based on usage and past experience is anticipated to have up to 10 locations along its segment that may require rehabilitation and repair. The location of this pipe is shown in yellow in Figure 4.1-1.

Figure 4.1-1
CPI-64008 Location



5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 – Do Nothing

15. One alternative is to run the pipelines to failure; however, this creates operational and environmental risks that are unacceptable. Pumping digested sludge to the CBBRRF is critical to the safe operation of the GBWWTP, as there is no storage at the GBWWTP. There are also regulatory, reputational, environmental, and financial impacts associated with the spill and cleanup of a pipe rupture and release of supernatant or digested sludge to surrounding land or the North Saskatchewan River. This alternative does not mitigate any risk and therefore is not recommended.

5.2 Alternative 2 – Isolate and Remove from Service

16. This alternative is to isolate a pipeline segment and remove it from service and regular operations. If this is done when there is a potential for failure, it can mitigate some of the environmental or regulatory risks associated with spillage. However, taking a pipeline segment out of service can still result in issues with regular operations at GBWWTP, as there is no storage for digested sludge. While this alternative may be evaluated on a case-by-case basis, overall this alternative is not feasible and therefore not recommended.

5.3 Alternative 3 – Spot Repairs with Planned Rehabilitation and Replacement

17. Spot repairs and planned rehabilitation works are appropriate measures to manage any issues and defects detected during pipeline inspections. This alternative includes regular cleaning

and inspection of the pipeline segments to provide detailed condition information which can be used for prioritization of rehabilitation work. A full replacement will be required in some cases where the frequency and severity of the defects are more substantial and spot repairs are not practical or cost effective. This is the recommended alternative.

6.0 COST FORECAST

18. The forecasted capital expenditures for the 2025-2027 PBR term are provided in Table 6.0-1.

Table 6.0-1
Sludge and Supernatant Pipeline Rehabilitation Program Capital Expenditure Forecast
($ millions)

	2024 and Prior	2025	2026	2027	2028 and Beyond	Total
Total Capital Expenditures	0.1	1.4	3.3	1.7	7.3	13.8

7.0 KEY RISKS AND MITIGATION PLANS

19. Pipe replacement typically involves construction activities such as excavation. Past experiences in similar work have provided valuable lessons, which are now integrated into our approach to ensure that each subsequent project is executed more efficiently and safely.

20. Table 7.0-1 provides a summary of the key risk associated with executing this program and EWS's plans to mitigate these risks.

Table 7.0-1
Key Risks and Mitigation Plans

Risk	Mitigation Plan
1. Health and Safety Risks – Confined space entry, ground disturbance, hot-work, and hazardous energy isolation are some of the associated risks.	EWSS follows standard processes to reduce or eliminate these risks, including but not limited to: • Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum. • Procuring qualified contractors with experience working in these conditions • Including safety systems and safety performance in evaluation criteria for the selection of contractors • Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages • Developing a hazard registry specific to the required tasks and implementing best practices like job-site

	hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards. Conducting regular site visits and formal, documented inspections during construction
2. Environmental Risks – Spills (to water or ground) are a risk. Sludge and Supernatant pipelines run through the North Saskatchewan River valley and so any spills or unintended leaks will have high consequences and scrutiny. Landscaping, trees, and animals may also be affected by some activities related to this scope. Additionally, there are risks associated with silica dust during construction, removal, and disposal of construction debris, working within the river valley	EWS conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Risks associated with spills are mitigated by using spill control measures and emergency response procedures. Risks to landscaping, tree, and animals are mitigated by consulting with environmental specialists during the execution of the work to ensure these risks are appropriately managed. If the existing alignment in Hermitage Park is to be reused, then tree removal, and management of trees become areas of consultation. Appropriate delineation of construction area, including necessary dust control, ventilation and debris management measures will be employed to mitigate relevant risks. Appropriate permits will be approved by AEPA.
3. Financial Risks – Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing.	The activities in this program have been previously carried out, and a general understanding of the tasks and costs have been developed. Project costing is typically reviewed to ensure it aligns with assumptions and expectations.
4. Government/Regulatory Risks - City and Provincial regulations apply to certain tasks of the program. It is expected that the following regulations and approvals will apply: • City of Edmonton River Valley Bylaw • Alberta Environment & Parks Approval to Operate • Alberta Transportation Ministerial Consent • Alberta Pipeline Act • City of Edmonton Parkland Access Permit	A regulatory review will be conducted prior to the work to ensure we are compliant with applicable regulations.
5. Reputation Risks - Work conducted is near Gold Bar residents. Additionally, external stakeholders (e.g. public, other asset owners) can be affected by some tasks that occur (e.g. excavation, equipment crossings).	External stakeholders and EPCOR Communications and Public Engagement will be consulted prior to starting these tasks. Community engagement will be conducted to address stakeholder concerns.

8.0 RESOURCES

21. The project is expected to use both internal and external staff. Internal staff are typically relied upon to prepare the assets for major work. Contractors will be utilized for specific tasks such as pipeline rehabilitation. Supply Chain will be consulted to ensure the purchase orders and contracts are issued in accordance with company policy. A regulatory review will be conducted to ensure necessary approvals are in place for the work. Agreements will depend on which areas

of the pipeline require rehab as it is anticipated that several crossing agreements may be required with other stakeholders that have assets nearby, as well as a parkland access permit.

EPCOR WATER SERVICES

Appendix F-9

Business Case

EXPAND FLARE CAPACITY PROJECT AT GOLD BAR WASTEWATER TREATMENT PLANT

May 31, 2024

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1.0 OVERVIEW

1. The Expand Flare Capacity Project is to construct a new building, new flares, and associated equipment. This will provide the Gold Bar Wastewater Treatment Plant (GBWWTP) with reliable and redundant biogas flaring capacity as the existing flares cannot safely process all potential biogas produced in the wastewater treatment process during needed maintenance activities. The total project spend is currently estimated at $11.2 million, with $7.7 million of the spend in the 2025-2027 PBR term.

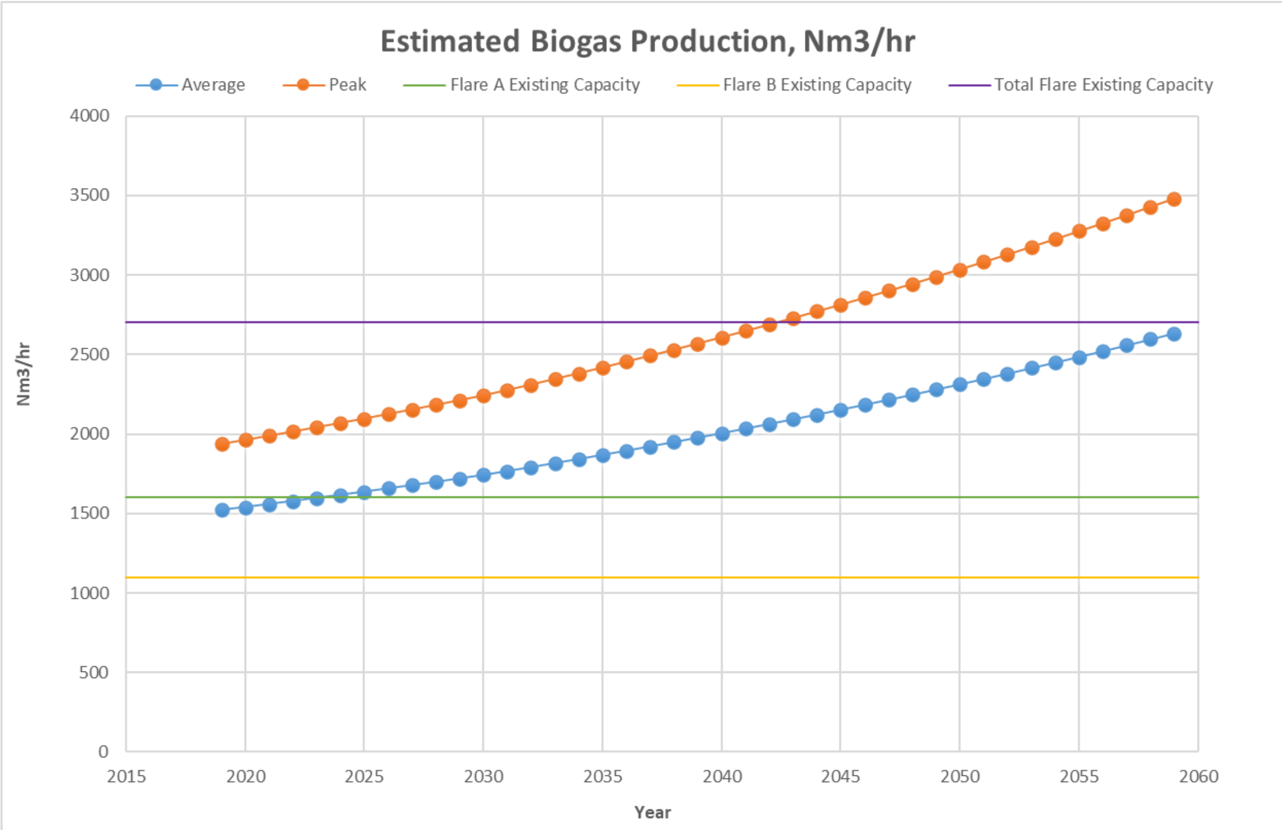
2.0 BACKGROUND

2. Biogas is a product of the wastewater treatment process and is a blend of methane, carbon dioxide, hydrogen sulfide, water vapour, and traces of other gases. The biogas is generated in anaerobic digesters and either utilized to provide heat and energy on site through boilers or flared. There is no biogas storage on site and the flares are primarily used to control biogas pressures and volumes within the anaerobic digester's headspace. For safety purposes and to minimize explosion risks, the emergency flaring system must always maintain sufficient capacity to permit the disposal of the entire biogas production volume.

3. Methane is a very potent greenhouse gas. One tonne of methane released into the atmosphere is equivalent to 28 tonnes of carbon dioxide, based on the Global Warming Potential (GWP) for 100-year time horizon (IPCC, 2014). Facilities that handle, process, or produce methane greatly reduce their climate change impact by flaring as opposed to venting methane. By flaring the methane, it is burned and converted into carbon dioxide which is a much weaker greenhouse gas. Combustion of biogas or biomethane, produced from fresh organic materials, does not increase the amount of carbon dioxide in the atmosphere, as the carbon is circulated in short cycles. This contrasts with carbon dioxide which is released during the combustion of fossil fuels after millions of years of storage underground.

4. The existing flares at GBWWTP were installed circa 2004-2008. The system is now approaching its design capacity and, due to its age has increasing operational, and maintenance needs. A study was completed in 2019 to review the capacity of the existing infrastructure as well as evaluate the future biogas projections and capacity requirements up to 2060. The results are shown in Figure 2.0-1. The red and blue dots are based on modelling and predicted data, whereas the capacities are based on actual measured data.

Figure 2.0-1
Estimated Hourly Biogas Production and Observed Capacities of Existing Flares



5. As shown in Figure 2.0-1, there is a lack of sustainable capacity to meet peak demands by individual flare units in the current installation. The capacity available is insufficient to accommodate shutdowns for maintenance or repairs and there is a risk of an uncontrolled release if there is a critical failure of any one of the flares. This risk can be managed for short durations by controlling biogas pressure and limiting biogas production upstream in the digesters, in case of a failure in the flare system. It is however recommended to install additional flaring assets in the near term to provide sufficient capacity for planned and unplanned shutdowns of portions of the flare system without risk of venting methane.

3.0 JUSTIFICATION

6. A failure in the biogas pressure control system, including the flares, could result in uncombusted biogas being released to the environment from the digesters. The digesters have pressure safety systems that would release the gas into the atmosphere instead of overpressuring the vessels, avoiding any explosion risk. Operating controls including solids feed to the digesters can also be adjusted to reduce biogas production pressure in such case. The release of biogas is a hazard to people, the environment, the wastewater treatment process, and is a prohibited practice (per Alberta Environment Approval 639-03-06 and Digester Gas Code CSA B149.6). As such, GBWWTP is required to have sufficient flaring capabilities within its direct control at all times. The system must be large enough to maintain sufficient flaring capacity, to completely prevent venting of biogas during any planned or unplanned shutdown of at least one flare unit.

7. The existing flares require regular preventive maintenance, which involves shutting them down for a period. The work typically involves disassembly, inspection, and replacement or reconditioning of parts (e.g. flame arrestors, thermal safety valves, thermocouples, burner nozzles). While one flare is being maintained, the plant is dependent on the remaining unit for full service. While this is possible for short periods of time, it can be only be done during lower demands and there is a major safety and environmental risk to the facility due to the lack of full redundancy.

4.0 PROJECT DESCRIPTION

8. The scope for the Expand Flare Capacity project includes construction of a new building to house the new flare and associated equipment. Due to existing site conditions and current code requirements on spacing and location, a new building is required for the new equipment to address minimum clearances from digesters, other flares, and other combustible gases. The facility will be built within a part of the space currently occupied by the abandoned Primary 1 and 2 clarifier structures. Structural modifications (e.g. micropiles) will be required within the clarifier structure to accommodate the new construction as the existing infrastructure was built in 1954 and is of unknown capacity.

5.0 ALTERNATIVES CONSIDERED

5.1 Alternative 1 – Defer Upgrades

9. The first alternative is to defer the upgrade to the flare system to a later time and continue to use the existing equipment. However, there is not sufficient redundancy with the existing installation and any one of the existing flares is not capable of processing the plant's total biogas production on its own. There is a risk that a failure in the flare system could result in an un-combusted biogas release and in the worst case, a major safety incident.

5.2 Alternative 2 – Temporary Flare

10. The second alternative is to install a temporary flare to increase the plant's capacity to process biogas. This was originally considered during flare maintenance work, to temporarily install the spare capacity while a flare is taken out of service. This would involve a temporary tie-in to the biogas piping system, and a temporary control set-up to integrate the flare into the regular plant operations. This arrangement was not considered practical during the flare maintenance work, as it involves a great deal of coordination over a short period of time. The work steps required to implement this (including modifications to biogas piping, installation of temporary bypass piping, and bypassing automated safety system controls) are high risk. Other risks are introduced when trying to integrate a temporary system into the plant's control system for the biogas, which could detrimentally affect other areas of the operating plant. Any errors in that integration could result in a biogas release or explosion. This alternative was evaluated and confirmed to be high risk and therefore, this alternative was rejected.

5.3 Alternative 3 – Upgrade Existing Flares

11. Some consideration was also given to upgrading or modifying the existing flares in place to increase capacity. The candle stick flare is already the largest size available from the manufacturer (Varec Biogas). The enclosed burner flare is available in one size larger, and the existing nozzles could be bored out to slightly increase its capacity. However, this involves taking the flare out of service for an extended period and relying only on one flare to handle all of the biogas produced on-site. This presents the same challenges and risks experienced during maintenance work currently, but at a much greater scale and with a limited potential increase in

capacity. This option was rejected, as it does not provide sufficient additional capacity to warrant the risks involved with forgoing redundancy during construction and installation.

5.4 Alternative 4 – Build New Flares

12. The fourth alternative, to build a new flare facility, was considered the best option based on its ability to provide necessary redundancy and sustained capacity. In addition, there would not be any decrease in flare capacity during construction as the two existing flares could continue to operate, which presents the lowest risk during construction.

6.0 COST FORECAST

13. The cost forecast is based on conceptual design and engineering cost estimates. Table 6.0-1 shows the projected costs for this project.

Table 6.0-1
Expand Flare Capacity Project Capital Expenditure Forecast ($ millions)

	2024 and Prior	2025	2026	2027	Total
Total Capital Expenditures	3.4	6.2	1.6	-	11.2

7.0 KEY RISKS AND MITIGATION PLANS

14. Table 7.0-1 summarizes the key risks and mitigation plans associated with this project.

Table 7.0-1
Key Risks and Mitigation Plans

Risk	Mitigation Plan
1. Health and Safety Risks – Ground disturbance, hot-work, and hazardous energy isolation are some of the associated risks. Working near biogas piping presents health and safety risks to workers in the event of a release. The release of biogas to the environment is a concern during construction and commissioning. Working with other utilities (e.g. electricity, natural gas, water) also presents risks to the workers.	EPCOR follows standard processes to reduce or eliminate these risks, including but not limited to: • Ensuring site specific safe work plans and procedures are developed that are compliant with regulatory requirements, at minimum • Procuring qualified contractors with experience working in these conditions • Including safety systems and safety performance in evaluation criteria for the selection of contractors • Completing process hazard analysis, constructability reviews and risk assessments as part of the design and construction stages • Developing a hazard registry specific to the required tasks, and implementing best practices like job-site

	hazard assessments and daily toolbox meetings to ensure workers are aware of these hazards • Conducting regular site visits and formal, documented inspections during construction
2. Environmental & Regulatory Risks – Associated risks include release of biogas to atmosphere, silica dust during construction, and removal and disposal of construction debris.	EPCOR conducts Process Hazard Analysis to identify risks and implement appropriate mitigation measures for Environmental risks. Appropriate delineation of construction area, including necessary dust control, ventilation and debris management measures will be employed to mitigate relevant risks. Appropriate permits will be approved by AEPA. The release of biogas to the environment is mitigated through Process Hazard Analysis (PHA), recommendations, and emergency response procedures, prior to starting high risk activities. Additionally, City and Provincial regulations apply to certain tasks of the project (e.g. City of Edmonton River Valley Bylaw, Alberta Environment & Parks Approval to Operate). A regulatory review is conducted prior to the work to ensure we are compliant with applicable regulations.
3. Financial Risks – Actual contractor bids may vary from the estimates. Materials and skilled labour are subject to market variability. There are also project unknowns that may affect costing. While the impacts of the COVID-19 pandemic have eased, there still may be cost escalations and equipment procurement issues for specialty items.	The activities in this program have been previously carried out, and a general understanding of the tasks and costs have been developed. Project costing is typically reviewed to ensure it aligns with assumptions and expectations. To mitigate cost escalations, thorough planning and proactive measures are essential. This can include detailed cost estimates during the planning phase, contingency budgets, and a comprehensive risk identification and analysis. Contracts should be clear with provisions for addressing unforeseen cost increases. Regular monitoring, strong relationships with contractors and suppliers, and experienced project managers are important to reduce the likelihood of cost increases. Value engineering to evaluate alternative materials, construction methods, or design modifications can also help to mitigate price increases.
4. Reputation Risks – Work conducted is in close proximity to Gold Bar residents. Additionally, external stakeholders (e.g. public, other asset owners) can be affected by some tasks that occur (e.g. excavation, equipment crossings).	External stakeholders and EPCOR Communications and Public Engagement will be consulted prior to starting these tasks. Community engagement will be conducted to address stakeholder concerns.

8.0 RESOURCES

15. Engineering will be done externally, while internal staff will provide reviews and feedback. Internal staff are also typically relied upon to prepare the assets for major work (e.g. shutdown, purging of gases, hazardous energy isolation). Contractors with specialized skills and previous experience will be utilized for construction and specific tasks. Supply Chain will be consulted to

ensure the purchase orders and contracts are issued in accordance with company policy. A regulatory review will be conducted to ensure necessary approvals are in place for the work. This project is expected to be delivered under a Construction Manager at Risk contract.