

Executive Summary

City of Saskatoon

Capital Development and Expansion Plan (2020 – 2050) – WTP Report

Prepared by:

AECOM Canada Ltd.
200 – 2100 8th Street East
Saskatoon, SK S7H 0V1
Canada

T: 639 638 8150
F: 306 700 2428
www.aecom.com

Prepared for:

City of Saskatoon
1030 Avenue H South
Saskatoon, SK S7M 1X5

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Revision History

Rev #	Date	Revised By:	Revision Description
A	April 1, 2021	Chris Turner	Draft Report
1	August 17, 2021	Chris Turner	Final Report

Quintin Tuchscherer, P.Eng.
Senior Project Management Engineer
City of Saskatoon
1030 Avenue H South
Saskatoon, SK S7M 1X5

August 17, 2021

Project #
60618229

Dear Quintin:

**Subject: Capital Development and Expansion Plan (2020 – 2050) – WTP
CDEP Report – Final**

Attached is the final version of the Capital Development and Expansion Plan (CDEP) Report as the final deliverable which incorporates all seven previously submitted Technical Memoranda.

Sincerely,

AECOM Canada Ltd.



Kevin Ness, P.Eng.
Project Manager
kevin.ness@aecom.com

CT:ves
Encl.

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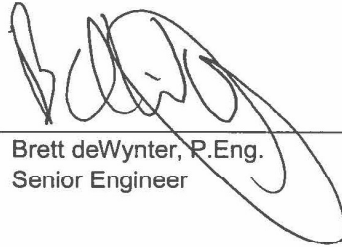
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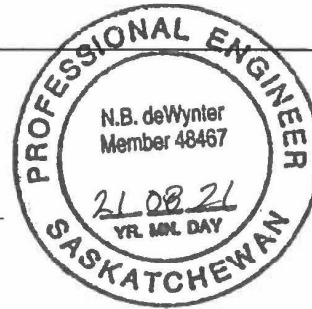
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Authors

Report Prepared By:


Brett deWynter, P.Eng.
Senior Engineer





Project Manager





Chris Turner, P.Eng.
Project Engineer



Report By: Reviewed



Simon Breese, M.A.Sc., P.Eng.
Vice President / Technical Director,
Water Treatment, Americas



ASSOCIATION OF PROFESSIONAL ENGINEERS
& GEOSCIENTISTS OF SASKATCHEWAN

CERTIFICATE OF AUTHORIZATION

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NUMBER C1667

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SIGNATURE

Mech. 11454 Kevin Ness

Executive Summary

The City of Saskatoon Water Treatment Plant (WTP) has been a cornerstone of the community for over 100 years, providing a reliable supply of safe drinking water to support growth in the City.

Over the course of time, there have been numerous improvements and upgrades completed at the plant, and the City has undertaken previous Master Planning efforts to identify and prioritize these improvement projects with the aim of maintaining the firm capacity of the plant as plant infrastructure ages.

However, several of the facilities at the plant are presently at or approaching the end of their useful life. As demands for safe drinking water are projected to continue to grow in the City, and peak summer demands already occasionally exceed to reach the rated **firm** capacity of the existing plant, an update to the City's Master Plan is needed, and comes at a critical juncture.

With this Master Plan, the Capital Development and Expansion Plan (CDEP: 2021), the City has significantly broadened the scope of the planning effort, to not only rationalize how best to maintain the existing plant, but to identify the preferred approach to sustaining a reliable supply of safe drinking water out to a long term capacity of 450 ML/d. This is significant, as it is approximately twice the capacity of the existing plant, and enough to meet projected demands for the next 50 years.

With much of the existing plant infrastructure in need of refurbishment, this CDEP has aimed to balance refurbishment needs of the existing plant against the need to develop new treatment capacity, either through expansion of the existing plant, construction of a second plant, or combination of both. Thereby, this CDEP identifies the preferred long term staged approach to upgrading and expansion to keep pace with growing demands.

This CDEP report is the culmination of this planning effort and identifies the recommended path for future investments in the City's drinking water supply and treatment infrastructure. The recommendations presented herein build upon the findings of a series of Technical Memoranda, analyzing various aspects of the existing infrastructure to allow the development of a holistic plan. These Technical Memoranda are as follows:

- **TM No.1: Water Demand Projections and Conservation** developed population growth and water demand projections for a variety of scenarios, based upon the implementation of water conservation strategies currently under consideration by the City. These projections allow WTP capacity milestones to be linked to future milestone dates for the purposes of capital planning;
- **TM No.2: Water Treatment Plant Assessment** studied the existing water treatment plant in depth, identifying any treatment performance and obvious condition issues, and identifying upgrade options to meet future capacity milestones;
- **TM No.3: Reservoir Storage Analysis** undertook an assessment of treated water storage throughout the City's water system, and established a plan for future treated water storage needs. A key finding was that the existing treated water storage at the Avenue H site is insufficient for managing treatment flow rates, and expansion of the existing reservoir is recommended if possible;
- **TM No.4: Water Treatment Plant Upgrade Options** analyzed various alternatives for upgrading and expansion of the existing water treatment plant (WTP1), as part of the long term strategy to meet an ultimate demand of 450 ML/d, either entirely from the existing plant, or in combination with a new, second WTP (WTP2). The memorandum presents these alternatives in detail, complete with capital cost estimates for the renewal of the existing infrastructure and solutions to increase in the treated water capacity. The capacity improvements are organized in 50 ML/d increments;

- **TM No.5: Greenhouse Gas Emissions** developed long term estimates of GHG emissions for each of the proposed long term water treatment plant solutions, for use in decision making. Energy sustainability and the reduction of greenhouse gases (GHGs) is a key goal for the City;
- **TM No.6: New Water Treatment Plant** was prepared to complement TM No. 4, by analyzing alternatives for establishing a WTP2 at a new site, on the east side of the South Saskatchewan River. WTP 2 would support the staged development of total production capacity up to 450 ML/d using WTP1 only, WTP2 only (i.e. with WTP1 eventually being decommissioned once WTP2 was on-line), or a split between WTP1 and WTP2;
- **TM No.7: Decision Modelling:** The various options available to address the existing treatment facility deficiencies and the future capacity needs were evaluated based on a Triple Bottom Line decision modeling methodology, balancing technical, environmental, and social factors against the life cycle cost of the alternatives. This methodology was used to select the preferred alternative for the long-term water supply plan.

The results of the analyses and recommendations for each Technical Memorandum are summarized in Section 2 of this report.

Key Factors Influencing the Master Plan

A master plan for a municipal drinking water treatment facility must incorporate the institutional experience from the past, while addressing potential challenges that are reasonable to expect in the future. The impact of these potential future challenges needs to be quantified and a plan established that provides a reasonable balance of additional capital expense relative to the level of risk reduction. Some of the key items influencing Saskatoon's CDEP include:

- **Climate Change Driven Impact to Raw Water Quality** is a known challenge for water utilities and is already being experienced across Canada. The speed and magnitude of climate change driven impacts are beyond the control of the City, but the tools to respond to these types of events need to be included in the master plan. The recommended approach for both WTP1 and WTP2 is planning for the addition of intermediate ozonation to the treatment process train. Ozone is a strong oxidant that provides protection against many of the typical challenges associated with a changing climate seen by other utilities. Intermediate ozonation is included in the recommendations for the future water treatment process.
- **Changes in the Regulatory Landscape**, which are also beyond the control of the City, but could directly impact the requirements at the plant. During the completion of the master plan, global trends in drinking water quality standards were reviewed, and assessed for their potential impact on the City. Based on this assessment, there are no significant changes expected to the drinking water quality requirements in the future, however, a robust multi-barrier treatment approach as currently practiced by the City needs to be maintained. The recommended addition of intermediate ozone in the future will also provide the City resiliency against future drinking water regulation changes.
- **Growth in Water Demands** directly impacts the need for treatment capacity improvements. Investments in water conservation and the implementation of demand management approaches are typically a minimal expense compared to the capital cost of capacity upgrades. An aggressive focus on water conservation and demand management is recommended as these items will allow the City to delay expensive capacity increase capital projects;
- **The Condition of the Existing Facilities**, which includes components that are at or beyond their useful life. Failure of a critical piece of infrastructure will challenge the City's ability to keep pace with demand, and it is critical that the planning effort take stock of the age and condition of the existing infrastructure, and develop a practical plan for rehabilitation and renovation of aging assets;

A Sustainable Path for the Future

The analysis and assessments completed during the preparation of the CDEP has clearly determined that continuing to invest in the existing water treatment plant is the best next step for the City. The City has significant embedded investment at the existing site that is continuing to provide value. This value is far greater than any efficiencies gained with the construction of a new modern facility at the WTP2 site.

Although it was deemed technically feasible to re-construct WTP1 in a staged fashion to eventually allow buildout to 450 ML/d, all co-located at WTP1, it was recognized that to do so would present an intolerable level of risk to ongoing operations, and this approach was not selected despite having the lowest overall projected cost.

As such, while it is recommended that the initial focus of capital investments should be into the existing WTP1, the recommended long-term strategy will be the eventual development of WTP2, with both WTP1 and WTP2 operating in tandem to support long-term demands, and enhance the overall reliability of the system.

Once the capacity at WTP1 reaches full design capacity, the focus would switch to the development of WTP2. Based on the analysis completed during the completion of this study, optimum design capacity for WTP1 is somewhere between 200 – 300 ML/d. The resulting eventual development of WTP2 on the east side of the South Saskatchewan River would have the capacity of 150 – 250 ML/d. The evaluation methodology used during this work resulted in two alternatives receiving almost identical scores:

- **Alternative B:** Refurbish and develop WTP1 to a firm capacity of 300 ML/d, then begin the staged development of WTP2 to an eventual capacity of 150 ML/d;
- **Alternative C:** Refurbish and develop WTP1 to a firm capacity of 200 ML/d, then begin the staged development of WTP2 to an eventual capacity of 250 ML/d;

Further work is needed to finalize the preferred approach amongst these two alternatives, including the completion of additional engineering work to refine cost estimates. For planning and budgeting purposes, Alternative C offers a more conservative approach for both the capacity at WTP1 and the associated capital investments so this option is recommended for the initial basis of the long term plan. If future work determines the optimum sustainable capacity at WTP1 is greater than 200 ML/d this will allow for development of WTP2 to be delayed, which will benefit the City capital requirements but does not change the overall long-term treatment solution.

The present value of the total capital investment required for Alternative B and C are 2021 \$686 Million and \$741 Million respectively. This is a significant amount of future investment, and it is stressed that peak day demands on WTP1 are already above the rated firm capacity of the plant, so the plant currently operates with reduced levels of redundancy to meet these peak day demands. It is therefore recommended that further planning and engineering be initiated as soon as practically possible to support the successful implementation of this magnitude of capital investment.

There are a number of key decisions which must be confirmed in order to develop the framework for the upgrades to the existing WTP1 and construction of the new WTP2. The steps that are required to resolve these key decisions are described below. Some are stand alone tasks, but some are interrelated and would be done in parallel.

- Confirm that the proposed capacity increase for Avenue H Reservoir is viable, given the need to acquire land around the present site which is presently occupied by residential homes;
- Complete a Detailed Structural Condition Assessment at WTP1;
- Undertake Pilot Testing for the WTP2 and Challenge Testing for Capacity Verification at WTP1;
- Complete Staffing and Work Area Planning Studies for WTP1;

- Undertake a WTP2 Site Selection Study to confirm the suitability of the selected site for future development;
- Confirm the ultimate firm capacities of both WTP1 and WTP2 for design purposes;
- Evaluate water conservation requirements to support the demand projections used in this work
- WTP2 Fill Main Connections Study to confirm fill main and primary main requirements
- Implement a public consultation programme to solicit feedback from the City's customers

Immediate Next Steps

The function of the existing water treatment plant is presently encumbered by the limited treated water balancing storage available at the WTP1 site. The analysis included in TM No 3 determined that an increase to the Avenue H Reservoir storage volume by 30 ML is required for Alternative B, and it is preferred for treatment Alternative C to reduce the risks of process upsets and or utilizing emergency storage to address demand fluctuations. However, the analysis showed that Alternative C could still be considered even without increase to the existing Avenue H reservoir capacity.

The construction of 30 ML of additional storage at the Avenue H site adjacent to the existing treatment plant is critical for the decisions related to the future improvements at the WTP1 site. The potential challenges associated with providing an additional 30 ML of storage are understood but need to be resolved as soon as possible. Once it is confirmed if the recommended additional storage at Avenue H can be provided, the preferred alternative for the development of WTP1 can be confirmed.

Advancement of the Avenue H storage project is the critical next step to improve the function of WTP1 and for the guidance of the sustainable long-term capacity at the WTP1 site.

Short Term Next Steps

The design and planning of major capital investments on existing functioning municipal treatment plant sites takes time and effort. Given the need for improvements, in parallel with the advancement of the Avenue H Reservoir storage project, further development of the treatment improvements required at the WTP1 should be undertaken immediately. The upgrades, which are determined to be highest priority, include:

- RHF-PER-01: Backwash Equalization Storage
- LLPS-PER-01: Low Lift Pump Station Upgrade
- BAS-PER-01: Chlorine Contact Basin
- AWL-PER-01: 1964 Plant Applied Water Line
- CGS-PER-01: Sodium Hypochlorite Storage and Dosing Systems
- PPS-PER-01: Potassium Permanganate Storage and Dosing Systems
- AHS-PER-01: Ammonium Hydroxide Storage and Dosing
- RHF-PER-02: Backwash Clarification
- FAC-PER-01: Power Supply Upgrades
- BWS-PER-01: Backwash Supply Equipment

If the recommended Avenue H storage project is able to be advanced, assessment of the WTP1 site should be completed to optimize the treatment capacity. Maximizing the capacity based on the efficient use of capital will allow the development of WTP2 to be delayed. In addition to the specific projects noted above condition assessment improvements and capacity increases should also be planned at the WTP1. Once a comprehensive conceptual plan

is developed the production of a capital implementation plan is needed. This plan should address the functional requirements associated with maintaining the operation of the existing plant as well as exploring alternate contractor procurement methods. The focus of the capital implementation plan is to allocate risk appropriately to efficiently plan spend capital.

In the short term it is estimated that \$75 Million should be invested in at the existing water treatment plant for Stage 0 and Stage 1 upgrades. Following this an additional \$264 Million is the estimated investment required for renewal and upgrades at the WTP1 site.

Planning for the Future

Development of the WTP2 site is part of the recommended future potable water supply for the City of Saskatoon. To support this further development of the engineering plans for WTP2 should be completed. Additional engineering will more clearly define the infrastructure required and will support the production of more accurate capital cost estimates.

A capital plan such as this is necessarily a forward-thinking undertaking, and must try to predict how forces such as population growth, water conservation measures, climate change, and emerging contaminants will impact the plan in years to come. This is not an exact science, and it is therefore recommended that the City continue to revisit the CDEP on a 5-year basis, to ensure that the plan remains current and sensible in the face of change.