Calgary

Memo

August 20, 2025

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RE: **Westview stormwater treatment guidance**

Disclaimer: This memo outlines requirements specific to our source water protection and is intended to supplement, not replace, our standard pond design guidance. All regular design requirements remain in full effect and should be applied, where appropriate, in conjunction with the information provided here.

Introduction

The City of Calgary's goals for its long-term Source Water Protection are based on proactively preventing, reducing, or mitigating key source water quality risks, as part of a multi-barrier approach to providing safe, clean, high quality drinking water. The Source Water Protection Policy requires proactive management of cumulative risks to protect the quality of Calgary's water sources prior to withdrawal from reservoirs and rivers for city and regional customers.

Stormwater management has been identified as a key risk in the City's Source Water Protection Plan (SWPP), and the City is committed to taking a principled approach to avoid introducing any new stormwater discharges near our primary drinking water sources. However, in cases where avoidance is not technically or operationally feasible, it is essential that robust mitigation measures be implemented to minimize risk. Work is underway to provide a clearer definition of appropriate geographically targeted stormwater management objectives suitable to different Drinking Water Protection Zones (DWPZ). Meanwhile, given the inherent complexities of managing stormwater in these sensitive areas, development within the DWPZ can be evaluated on a case-by-case basis to ensure alignment with source water protection objectives.

This memo provides stormwater treatment guidance for the Westview development by recommending a multi-tiered approach that incorporates both secondary and tertiary interception techniques. This strategy is intended to effectively manage known contaminants while also addressing potential unknowns and emerging risks.

Key Considerations

1. Stormwater Pond Design, Operations & Tertiary Interception:

   The pond should include a high-efficiency sediment forebay (or equivalent) to facilitate the removal of sediment and pollutants, thereby minimizing contamination risks. It must have sufficient storage capacity with a minimum 1,000 m³ of storage per hectare of the serviced catchment, allowing it to accommodate a 1:100 year 24-hour storm without discharge as was previously communicated. It will be validated as part of the Staged Master Drainage Plan. This capacity ensures the system is robust enough to manage high-intensity storm events that may exceed typical design thresholds. Furthermore, the pond and its outlet structure must comply with the Coach Creek Low Energy

Release (LER) flow targets to control runoff, prevent erosion, and reduce sediment delivery to Coach Creek and the Bow River. This approach also increases runoff residence time, enhancing the removal of sediments and associated sorbed contaminants. Additionally, the pond must be equipped with a remotely actuated valve to promptly halt outflow to Coach Creek in the event of a spill or adverse water quality condition. The system should also incorporate SCADA-enabled real-time water level monitoring and sampling ports to facilitate effluent quality measurement.

Where feasible, stormwater monitoring and controlled release should be considered, particularly during high-flow conditions in the receiving environment. This approach may support a 1-$\log_{10}$ pathogen reduction credit, as discharging during peak flows offers improved dilution and higher flow velocities, thereby helping to mitigate water quality risks and strengthen overall environmental protection. The treatment train may also consider integrating an Oil & Grit Separator (OGS) to mitigate hydrocarbon releases.

Secondary interception will involve a filtration process primarily aimed at pathogen removal, while also serving as a cost-effective solution for capturing dissolved metals and limiting nutrients such as total phosphorus (TP). On the tertiary interception front, it is crucial to clarify that this approach is designed to address more complex and emerging challenges over time, such as ESOCs and potential future uncertainties regarding unanticipated contaminants. As the landscape of environmental pollutants evolves, new substances may emerge that are not effectively managed by traditional stormwater systems. Tertiary interception, enabled through a future connection to the sanitary system when warranted, offers a proactive mechanism to address uncertainties in water quality. This additional layer of protection enhances the overall resilience and adaptability of the system, helping safeguard the water treatment plant against evolving risks.

2. Log Reduction Targets:

While the public health guidelines for stormwater use (Government of Alberta, 2021) state log reduction targets for pathogens for stormwater end uses, it does not account for the end use risks associated with discharging stormwater into a DWPZ. In the case of Westview, pathogen risk represents the most significant threat to drinking water safety and warrants particular attention. Dr. Norman Neumann, School of Public Health, University of Alberta, assisted in the development of the stormwater use guidelines with Alberta Health. Applying the same risk-based principles for the scenario of discharging stormwater into a DWPZ, he recommends The City implement a source water protection standard that requires all future development of stormwater infrastructure to meet a minimum log reduction target (LRT) of 2-$\log_{10}$ for viruses, of 2-$\log_{10}$ for protozoa and of 2-$\log_{10}$ for bacteria. Therefore, City is requiring stormwater treatment design to incorporate the above recommendation.

To support a cost-effective and risk-informed approach, it is recommended that the consultant develop a decision-risk matrix to identify the most viable treatment options. Treatment strategies must be tailored to the differing characteristics of bacteria, viruses, and protozoa. Protozoa, for example, require physical removal, as standard monitoring techniques do not distinguish between live and dead organisms. Bacteria and viruses may require additional disinfection or treatment. Furthermore, naturalized stormwater systems such as wetlands can inadvertently increase protozoa concentrations due to wildlife activity in riparian areas, thereby elevating public health risks. As such, system designs that promote protozoa increases within sensitive areas should be avoided.

3. TSS and Nutrient Reduction:

Rainfall analysis indicates that background conditions in the Bow River fluctuate significantly during storm events. Therefore, it is not practical to base stormwater treatment targets on long-term mean background values at Bearspaw. The table below presents total suspended solids (TSS) and total phosphorus (TP) values derived from monitoring during rainfall events at the Bow River (Bearspaw).

Based on this analysis, a precautionary target of 25 mg/L for total suspended solids (TSS) is recommended for treated stormwater discharge at all times. It is assumed that nutrient reduction, particularly total phosphorus, will occur as a co-benefit of TSS removal. For nutrient treatment, costly chemical methods such as metal salts are not recommended at this stage. Instead, piloting more cost-effective alternatives is encouraged to evaluate performance and feasibility. It is expected that a minimum nutrient (TP) removal efficiency of 85% will be achieved. To ensure the protection of drinking water sources, only NSF-certified materials should be considered, as these are verified to be safe and free from harmful leaching.

Date	Rainfall at Calgary (mm)	Turbidity	Mean TSS (mg/L)	Min TSS (mg/L)	Max TSS (mg/L)	TP (mg/L)
6/21/2013	76	998	3,067	2,992	3,076	0.38
6/20/2014	62	89	72.2	38.2	103	0.04
6/22/2015	26	13	8.82	0.86	10.2	0.01
7/17/2016	98	16	11	9.27	16	0.01
6/10/2017	34	28	19	17.2	24.5	0.03
6/24/2018	30	51	36	9.41	71	0.05
6/22/2019	77	77	60	27.4	107	0.04
5/23/2020	54	73	56	38.2	82.3	0.04

4. Cross-Connection and Infiltration prevention:

   To prevent future complications, proactive measures should be implemented during the development phase to avoid cross-connections. Early attention to this issue will help mitigate risks and reduce the need for costly retrofits. While cross-connections are a common pathway for sewage to enter the stormwater system, infiltration remains a largely overlooked and challenging source to identify. Designing the sanitary system to eliminate any leakage is a critical early step in mitigating sewage intrusion into stormwater in the future.

Summary of Recommendations:

1. *Storm Pond Design & Tertiary Interception:* Ensure the stormwater pond is oversized to accommodate more than 1:100-year storm events. As much as practically possible, implement a system for monitoring and releasing stormwater during high-flow conditions, and have a design consideration of enabling a connection from the pond outlet to the sanitary system for additional protection from unknown/emerging contaminants and/or future reuse for sanitary flushing. Consider integrating OGS to mitigate hydrocarbon releases.
2. *Pathogen Treatment:* Aim for at least 2-$\log_{10}$ reduction in pathogens with a focus on prioritizing this over other contaminants due to the high risk to the water treatment plant. A decision-risk matrix should be developed by consultant to assess the most viable treatment methods. This may include appropriate filtration and backwashing.

3. *TSS and Nutrients:* Set a reasonable target for TSS at 25 mg/L (precautionary target). For nutrients, avoid targets that necessitate expensive treatments like metal salts. Sand iron filters should be included in the evaluation of options. Consider where the treatment systems for (2) *Pathogen Treatment* and (3) *Nutrients* can be combined. As part of the options consider a recirculation system that would allow treated effluent to either (a) be used for irrigation purposes, or (b) be discharged into the receiving water bodies, or (c) be returned into the pond system when neither (a) nor (b) is active.
4. *Cross-Connection Prevention:* Take proactive measures to prevent cross-connections and sanitary infiltration into the storm system at the installation stage, ensuring long-term reliability and minimizing the risk of future issues.
5. *Source Control:* Integrate Low Impact Development (LID) practices to reduce stormwater runoff (i.e., as in minimizing runoff from landscaped areas and whatever is needed to meet LER objectives) and improve overall water quality by minimizing leaching of nutrients.
6. *Modeling and Analysis:* Provide modeling and analysis report indicating the long term and 1:100 year design event water quality performance for pathogens, TSS, nutrients (TP) and dissolved metals.

Sincerely,

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Attachments:

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