STORAGE SELECTION GUIDE

1 Introduction/Disclaimer

This document is intended to guide users in selecting the type of on-site stormwater detention storage for small greenfield development or redevelopment sites that require a Development Site Servicing Plan (DSSP) submission. The information in this guide does not replace the judgment of a Professional Engineer or an equivalent technical expert. Other storage types may be used that are not referenced in this document, but they may require additional review during the approval process.

2 Above Ground Storage

Before exploring underground on-site stormwater storage options, traplow and roof storage options should be considered. If these types of storage can be incorporated into the site, then they can be beneficial in many important considerations compared to underground stormwater storage such as cost, and ease of installation and maintenance.

2.1 Traplow Storage

Traplow storage is a good option for storing stormwater runoff where adequate surface space is available and can be graded to provide a ponded depth. Traplows shall not exceed a depth of 0.5 m and where possible, a maximum depth of 0.3 m should be used. The traplow should be placed away from infrastructure that may be damaged when submerged by water. Designers must ensure there is a minimum 0.3 m difference in elevation between the spill elevation of the traplow and the lowest point of any building opening including the top basement window wells. A dedicated emergency overland flow escape path from a traplow must be illustrated with arrows on the grading plan. The emergency escape path shall direct spills offsite towards a city road allowance.

2.2 Roof Storage

Roof storage is an effective way to store stormwater, without requiring ground surface area for traplows or underground options. However, roof storage areas can only capture flows from the roof itself; therefore, additional storage will be required for holding the runoff from the ground surface. To design roof storage, a structural and mechanical engineer should be involved, and at least 2 roof drains should be included in the roof storage design. In addition to the roof drains, an overflow path from the roof shall be designed for storm events larger than the 1:100 year event. At this stage in the design process, the site should be graded to ensure the overflows from the site are directed safely away from the buildings and towards the City system.

3 Pipe / Minor System

Regardless of the chosen storage system, the vast majority of sites require catchbasins and pipes to connect the on-site stormwater collection system to the off-site stormwater infrastructure. These on-site catchbasins and pipes can act as stormwater storage if a flow control device is installed at the downstream end of the system. Typical pipe sizing may be adequate to store the required volume, or pipes could be upsized to increase the stormwater storage volume of the system. The minor system must be compliant with the City of Calgary Standard Specifications, even if this infrastructure is utilized for storage instead of purely conveyance.

4 Underground Storage Specific Products

After considering any roof or surface storage, if the pipe system is not adequate to store the required stormwater volume due to size or elevation considerations, an underground stormwater storage product should be considered. Products from various product types and suppliers may be chosen for the underground storage. In the following sections, these products have been grouped into the following categories to understand the aspects to consider:

- **Concrete Storage**: Underground stormwater storage products that are created out of reinforced concrete (not including pipes and catchbasins).
- **HDPE Storage**: Underground stormwater storage products that are created out of High-Density Polyethylene (HDPE) (not including arched or modular storage).
- **Arched Storage**: Underground stormwater storage products that utilize an arched design to transfer loads into the surrounding aggregate backfill.
- **Modular Storage**: Underground stormwater storage products that are made up of individual units that can be interlocked to provide underground stormwater detention.

4.1 Site Restrictions

Designers need to consider their specific site restrictions when determining which underground storage product to use. The different product restrictions that should be considered are shown below as well as the typical limits of each product class. Other site constraints that should be considered but are not included in the table are the groundwater table levels and geotechnical conditions. If a high groundwater table is present, HDPE, Arched, and Modular storages may not be appropriate as they are intended to be used above the water table.

Product Class	Minimum Cover	Maximum Cover	Loading Capabilities	Setback Requirements*
Concrete Storage	0.4 – 0.7 m	3.8 – 4.0 m	CL-800 (Heavy Haul Truck/Semi)	1.2 – 1.5 m
HDPE Storage	0.75 m	1.5 m	H5 (Passenger Vehicle)	1 m
Arched Storage	0.45 – 0.6 m	2.1 – 4.8 m	HS-25 (Standard Highway Semi-Truck)	2.5 – 3.0 m
Modular Storage	0.6 m	3.4 – 7.7 m	HS-25 (Standard Highway Semi-Truck)	1 m

*The distance required between the edge of the storage tank and the edge of the building foundation.

When designing on-site stormwater storage, the consequences of the storage spilling during larger rain events or inlet control device blockages must be evaluated, and a safe emergency spill path provided. For most on-site stormwater collection systems utilizing underground storage, the spill path will be overland from the inlet locations. Similar to traplow storage, these should be indicated on the grading plan and directed towards additional inlets to the stormwater system (on site if possible) and the City system for rainfall events larger than the 1:100 year event.

Similarly, the inlet capacity should be considered as it may govern the rate at which stormwater enters the sewer system. Capture rating curves for typical inlet grates used within the City of Calgary can be found in the *2011 City of Calgary Stormwater Management & Design Manual* or provided by the manufacturer where non standard products are intended to be used.

4.2 Maintenance Considerations

The maintenance requirements of the underground stormwater storage throughout its life span will impact owners and must be considered. The table below shows the estimated inspection frequency for each underground storage product, as well as the expected life span. Maintenance should be performed as needed, based on the results of frequent inspections, to ensure the product's longevity. All product classes require a vacuum truck to properly perform this maintenance.

Product Class	Inspection Frequency	Life Span
Concrete Storage	Annually	100 years
HDPE Storage	Every 3 months	25+ years
Arched Storage	Twice annually	50 – 75 years
Modular Storage	Twice annually	50 – 60 years

4.3 Costs

Suppliers should be contacted to receive an estimated cost. Typically, concrete storage is the highest cost option, while the other storage classes are more cost-effective. However, the cost of the system is dependent on the site constraints, particularly the location of the storage. The cost of supply and installation should be considered along with the cost of maintenance throughout the products life span.

4.4 Installation Considerations

How on-site stormwater storage will be implemented needs to be evaluated to determine the required equipment and training needed to install the storage. Concrete storages require heavy equipment for installation, while the other storage product classes can be installed without heavy equipment. However, HDPE, Arched, and Modular storage have additional installation criteria due to the surrounding aggregate backfills. The backfill must be supplied and installed according to the manufactures instructions to avoid shifting the storages, which could result in failure.

4.5 Additional Considerations

Most underground storage product classes can provide additional benefits to a site, such as stormwater reuse or infiltration. These benefits may be utilized to achieve volume control targets if applicable. For information on how the product can be configured to achieve additional benefits, the supplier should be contacted.

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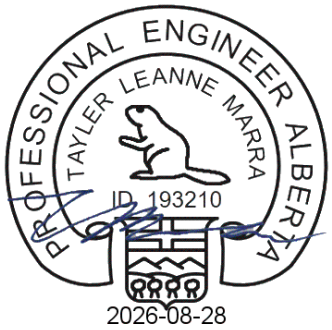

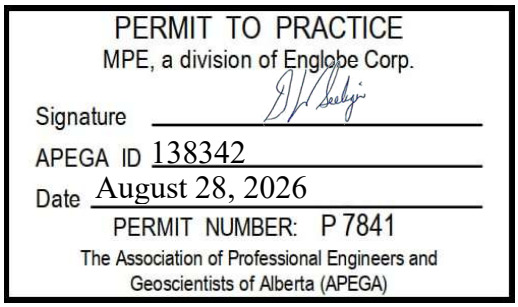

Tayler Marra, P.Eng.

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