LID Geotechnical and Hydrological Summary

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EPCOR Drainage hired geotechnical and hydrological experts to provide recommendations for local concerns regarding required setbacks from infrastructure and natural features, necessary geological and hydrology parameters, freeze/thaw cycles, clay content, geotextile use, compaction testing on soils with a high organic content and engineering controls. For additional information about LID Facility Design, please refer to the City of Edmonton's Volume 3 Design & Construction Standards.

Key findings from the geotechnical and hydrological experts are presented below:

1. Recommendations for local concerns

Required setbacks from infrastructure and natural features

- 0.5 m is the required setback from catch basins, ditches, sidewalks and pathways.
- 3 m is the required setback from buildings.
- 50 m is the required setback from the top of any natural or constructed slope greater than 2 m in height with a 6H:1V slope.
- The distance between the bottom of LID facility and top of the high groundwater level should be no less than 1.0m; the distance can be reduced to 0.6m if groundwater fluctuations are minimal.

Required geotechnical & hydrological parameters for LID function and site investigation

- LID facilities with an underdrain (bioretention basin, box planter and soil cells) can be installed on any type of soil.
- Bioretention gardens, (no underdrain), should only be installed over soil with an infiltration rate ≥15mm/hr.

Implications of freeze/thaw cycles on Edmonton and LID soils

- LID facilities can function normally in the winter if the facility's soil freezes while unsaturated which is why underdrains are required in soils with low infiltration rates (<15mm/hr).
- An underdrain should mitigate freezing issues associated with the freeze/thaw cycle. In addition to the underdrain, having a LID soil with low fines content (clay or other type of small particles), and ensuring the bottom of the facility is the required distance above groundwater can reduce the risk of freezing.

Suitability of the four standard LID in Edmonton's clay soil

- Soil with a high clay content is common in Edmonton. Clayey soils typically have an infiltration rate of <15mm/hr, and can swell when in contact with water.
- To reduce excess water content in these soils, only LID facilities with an underdrain should be built over clayey soils.
- Bioretention gardens designed with an isolated storage layer can be installed over any type of soil; however, they may not work as designed if the storage layer fills up as a result of multiple storm events occurring in a short period.

Use of geotextiles

- A filter layer of 100mm deep, washed gravel of size <13mm diameter is recommended over geotextiles as they have a reduced chance of becoming blocked and have a longer functionality.
- If required, a fabric liner can be used as the filter layer to separate the LID soil from the storage layer however, it may become clogged and costly to fix.

2. Engineering controls for specific conditions

Under circumstances where the setbacks to buildings or groundwater cannot be achieved, the following table presents engineering controls for specific cases. The minimum distance from buildings with engineering controls shall be 1.0 m:

Primary Condition	Secondary Condition(1)	Engineering Recommendation(2)	Notes
Cut back slope	Non-cohesive	- 0.75H:1.0V (Silts) - 1.5H:1.0V (Sands/Gravel)	- Sloughing is expected in cohesionless materials
	Cohesive	- 0.25H:1.0V	- Benches may be required for excavation over 1.5m depth
Groundwater less than 1m below base of LID facility		- Install an impermeable membrane around the entirety of the excavation	- Infiltration into the surrounding soils will not be possible - If groundwater is within excavation depth, potential buoyancy of backfill material will need to be considered during design
Adjacent to existing Building (Underground Basement Wall)	Foundation Exposed	- Waterproof basement wall (Self-Adhesive Bituminous Membranes) - Install a weeping tile - Install a dimple board	- Follows EPCOR/COE LID specs regarding subgrade preparation - Excavations to comply with AB HSE regulations - Sub-excavation should not be extended below the bottom of the basement's slab
	Foundation Not Exposed	- Impermeable membrane should be placed within the slope's excavation on the side of the existing building extending into at least half of the LID feature	
Adjacent to another type of on-grade structures (Fences, sidewalks, precast stairs, landscaping features (trees, planter), parking lots, etc.		- Install an impermeable membrane - Install a weeping tile - Clay caps could be installed when non- cohesive soils such as silts are present as an alternative for waterproofing (Geotechnical review might be required)	- Follows EPCOR/COE LID specs regarding subgrade preparation and grading - Excavations to comply with AB HSE regulations - Care should be taken to protect all types of existing structures surrounding the proposed temporary excavations. It is recommended that a monitoring system (survey control) for the existing structures is in place before construction.

Table Notes:
(1) Non-cohesive materials refers to gravels, sands, silts and granular fills
Cohesive materials refers to clays and clay fills
(2) Refer to section 3 for engineering controls descriptions

3. Description of Engineering Controls

The following tables outline the minimum required specifications for the recommended engineering controls. Waterproofing membranes, weeping tile, and dimple board must follow all applicable building and health and safety codes, guidelines and regulations.

Impermeable Membrane (20-mil low-density polyethylene liner, LLDPE)

The area where is liner is to be placed should be smooth and free of debris that could damage the liner. The liner should be installed according to manufacturer's specifications.

Property	Test	Frequency	Unit	Value
Thickness (min. avg.)	ASTM D-5199	Per Roll	mm (in)	0.50 (0.01969)
Sheet Density	ASTM D-1505	90,000 kg (200,000 lb)	g/ml	0.939
Carbon Black Content	ASTM D-1603 (3)	20,000 kg (45,000 lb)	%	2.0-3.0
Tensile Strength	ASTM D-6693	9,000 kg (20,000 lb)	N/mm (lb/in)	13 (76)
Elongation at Break	ASTM D-6693	9,000 kg (20,000 lb)	%	700
Tear Resistance	ASTM D-1004	20,000 kg (45,000 lb)	N (lb)	50 (11)
Puncture Resistance	ASTM D-4833	20,000 kg (45,000 lb)	N (lb)	124 (28)

Clay Cap Layer

A waterproofing alternative for silty sandy and low plasticity clay subgrade soils is to incorporate a 300 mm compacted clay cap using local common fill soils to minimize or reduce runoff water's infiltration into the system.

Property	Minimum Specification for Suitable Clay Sources
Clay (%)	Clay > 20%
Fine (Silt + Clay)	Fines > 30%
Liquid Limit (%)	LL > 30%
Plastic Index (%)	PI ≥ 10

Non-woven Geotextiles

A Type A non-woven geotextile as described in Section 4.5 of the City of Edmonton 2018 specification with an apparent opening size of at least 0.2mm and a grab tensile strength of 400 N is recommended.