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Memorandum

To:	Ghazwan Yousif (City of Mississauga)	**Date:**	May 29, 2021
Cc:			
From:	Andrew Fata	**Project #:**	17-549
Re:	**Lakeview Village FSR LID Design Principles**		

The following memo outlines the ROW LID design principles to be considered for Lakeview Village at detailed design. These principles were reviewed and generally accepted by the City through the Brightwater development FSR and detailed design submissions. While the detailed design of the LIDs will be completed at the subdivision design stage for Lakeview Village, we trust that this document provides sufficient detail regarding the general intent for the LID design.

Drawing LID-1 illustrates the proposed placement of the ROW bioretention features and includes the following table which calculates the Impervious Area to LID Area ratios. The proposed ROW LIDs will only treat drainage from the ROW itself (including boulevards). All development block drainage is proposed to be treated on-site. Similar to Brightwater, “urban” bioretention LIDs are proposed with concrete retaining walls to maximize the available treatment in the ROW and to provide sufficient support for the curb and sidewalk.

Conceptual details have been prepared by NAK (attached) to visualize the cross-section, plan view, and potential treatments of the bioretention features.

Bioretention Design Details

The proposed bioretention cells are quality control systems composed of discrete components. While each cell will vary in size and surface layout (i.e. bioretention cells, bioretention swales, tree pits, etc.), the components within each cell and their general orientation will be consistent across the subject lands. As shown in the cross-section below, the bioretention cells will consist of four discrete layers above a perforated outlet pipe; a "choker" layer, filter media, mulch, and surface ponding. The filter media provides the majority of the water quality improvement through the process of biofiltration and will limit the rate of exfiltration from the system.

The "choker" layer will be composed of tight soils with a low void ratio and small particle size to prevent fine particles from the filter media from entering the pipe bedding and clogging the outlet pipe perforations.

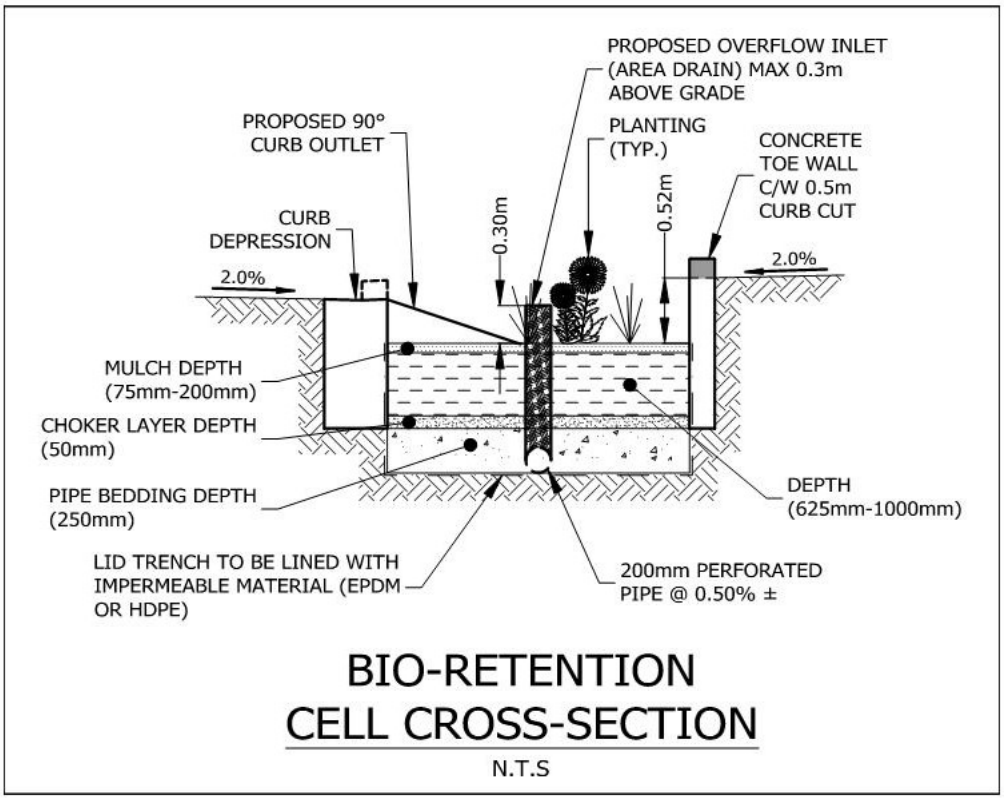

Figure 1:Typical Cross-Section of a Designed Bio-Retention Cell

Note that the depths of the layers noted below can vary and are subject to detailed design of each individual bioretention feature.

Surface Layer

The surface ponding layer will allow a maximum of 0.30m ponding. For long bioretention cells on roads with significant slopes, intermediate weirs may be required to promote the sufficient surface ponding storage.

Mulch

The 75 mm to 200 mm mulch layer will support plant growth by preserving soil moisture and will provide pre-filtration. The mulch depth will be specified at the detailed design stage based on the optimal depth for the chosen plant species. Downstream of the bioretention cell inlets, the mulch will be substituted by coarse decorative aggregate for pre-treatment and erosion protection (i.e. to prevent mulch from floating and migrating in surface flow).

Filter Media

The filter media of 625 mm to 1000 mm will be used within the bioretention cells to provide the majority of the TSS removal within each system. Filter media specifications have been outlined in consultation with resources from the Sustainable Technologies Evaluation Program (STEP) and additional academic resources.

The filter media will have a minimum hydraulic conductivity of 75 mm/hour (most conservative option) to ensure sufficient retention time for effective bio-filtration. The filter media will also have less than 15% fines (<0.05 mm by hygrometer). The bioretention design is illustrated in **Figure** 1**.** The infiltration rate through the filter media is the controlling system exfiltration rate and not the choker layer or the capture capacity of the pipe perforations. The proposed filter media will generally adhere to the STEP recommendations following consultation with the landscape architect regarding planting seclection. Typical composition for water quality treatment consiste of: 3 parts sand, 2 parts loamy topsoil, 1 part organic (i.e. compost, coconut coir, wood product, shredded paper).

Choker Layer

The choker layer is a layer of 10 mm to 13 mm aggregate (high performance bedding) designed to prevent fine-grained material from the filter media from migrating into the pipe bedding and clogging the pipe perforations. The depth of the choker layer will be 50mm to 100mm. The choker layer will be composed of either high-performance bedding (HPB) or 10-13 mm clear stone with a void ratio of 0.4.

Perforated Pipe

A 200 mm perforated pipe at the base of the bioretention cells will be provided for each to convey the exfiltration flows from the proposed bioretention cells. The perforated pipe will be laid within a bed of clear stone to minimize settling and to ensure that the area around the pipe perforations is free of any flow obstructions. The depth of the clear stone will be at minimum 25 mm in order to ensure coverage of the perforated pipe. The perforated pipe will connect to the storm sewer in the ROW.

Area Drain

Overflow inlets (200 mm) will be provided in the bioretention cells, which will capture the ponded water above 0.3 m depth on the surface and will drain directly to the perforated pipe beneath the feature to prevent surface overflow from the bioretention cells onto the ROW. The overflow inlets will also serve as inspection ports / monitoring wells for the bioretention feature. The overflow inlet is illustrated on the typical bioretention section on
Figure 1. The area drains will be protected by screens to prevent rodents and debris from entering the drainage system.

Storm Sewer Connection

The proposed perforated pipe will connect to the minor system on the ROW via a catch-basin strategically placed at the downstream end of each cell. This catch-basin will also intercept surface overflow from the LID in the event that larger storms overwhelm the bioretention surface storage / overflow capacity. Where possible, the downstream catchbasin will connect directly to a storm manhole in the municipal ROW. Otherwise, the catchbasin will have a direct connection to the municipal storm sewer. On ROWs where LIDs are present on both sides of the ROW, efforts will be made to ensure that the LID catch-basins are symmetrical on the ROW.

Impermeable Membrane

Where required, bioretention cells will be lined with an impermeable membrane to prevent infiltration per City of Mississauga recommendations (in areas where subsurface soil quality is not suitable for infiltration). An impermeable liner (HDPE or EPDM) will be used. To protect the impermeable liner from the stones and soils at the bottom of the cell, a compacted layer of sand or a geotextile will be provided above and underneath the liner. Drainage that enters the cells will be filtered as it percolates through the filter media and will discharge from the cell through a perforated pipe at the bottom of the cell.

LID Design Criteria

The target design criteria used for the ROW bioretention cells are listed below in Error! Reference source not found.. These criteria were established in the approved West Village FSR (August 2019) and are a compilation of the recommendations from the City, CVC and TRCA/CVC LID design guidelines that can be applied to the Lakeview subdivision.

Table 2 - LID DESIGN CRITERIA

Element	Design Criteria	Description	Conformance	Implication	Mitigation
Required Storage Volume	Filtration of 27mm event as per City requirements	The 27mm event is assumed to be 27mm of rainfall distributed over 4 hours in a Chicago storm distribution with maximum rainfall intensity of 53.59 mm/hr	The bioretention cells are designed to filter the 27mm 4 hour Chicago storm event	All bioretention features shall conform to the target.	
Contributing Area Ratio	Impervious contributed area to LID surface area should be in between 5:1 to 20:1; the City is willing to accept LIDs with ratios of up to 30:1.	Calculated as impervious area divided by LID bioretention surface area.	All the LIDs have of the site area have I/P ratios within the acceptable range	The LIDs with the lower I/P ratios will likely perform better than those with a higher I/P ratio.	The depth of filter media for the high I/P ratio LIDs will be 600mm or more to provide better infiltration performance..
Berm Height	Maximum 0.3 m berm	This maximum berm height is to limit the ponding depth / duration and to reduce fall hazards.	Maximum berm height will be 0.30 for the bioretention cells	All bioretention features shall conform to the target.	
Cell Depth	Minimum Total Depth 1.025 m to support shrubs and to treat ROW run-off	Total depth from invert at perforated pipe to top of surface ponding.	The cell depth will meet the requirements at all locations.	All bioretention features shall conform to the target.	
Allowable Ponding Depth	30 cm	Maximum depth of surface ponding.	The highest designed ponding depth is 30 cm	All bioretention features will conform to the target.	
Surface Drawdown Time	<4 hours	Duration of ponding on the surface of the bioretention cell.	4 hours or less will be targeted for	All bioretention features will conform to the target, +/- several hours.	

Element	Design Criteria	Description	Conformance	Implication	Mitigation
			the surface drawdown time.		
Cell Drawdown Time to Choker Layer	<48 hours	Duration of saturation of the media below the surface of the bioretention cell.	48 hours or less will be targeted for the filter media drawdown time	All bioretention features will conform to the target, +/- several hours.	
Percolation Rate	Less than the max flow through the perforated pipe.	Percolation rate of the native soil below the bioretention cell. Irrelevant as infiltration is not proposed due to soil conditions.	N/A	All bioretention features will conform to the target.	
Inlet Sizing	Inlet Capacity > 27mm Peak Flow	The inlet spillway must be sufficiently sized to accommodate the peak flow from the contributing catchment during the 27m event.	Inlets will be sized based on the STEP guidelines for inlet sizing. As the inlet width (curb cuts) can not be larger than 1m, several inlets may be required.	All bioretention features will conform to the target.	
Perforated Pipe	Minimum 200 mm diameter	Size of underdrain pipe	Provided	All bioretention features will conform to the target.	

Element	Design Criteria	Description	Conformance	Implication	Mitigation
Mulch Layer	Shredded hardwood bark	Mulch layer characteristics	Provided	All bioretention features will conform to the target.	
	75 mm depth				
	Void Ratio 0.7				
	Layer Permeability Co-efficient (k), 233 mm/hour		Provided	Though the mulch permeability may be higher or lower than the suggested, the LID performance will be governed by the filter media permeability co-efficient which is 75 mm/hour	
Filter Media Layer	0.600 m depth to support shrubs and to treat ROW run-off	Filter media layer characteristics	0.600 m depth proposed due to grading and servicing constraints	All bioretention features will conform to the target.	
	3 part sand, 2 part topsoil and 1 part organic soil components and additives		Provided	Filter media will have a composition of 60% coarse sand (2.0-0.05 mm diameter, fineness modulus of 2.8-3.1), 30% topsoil (pass through 50 mm screen), 10% organic matter and additives	
	Void Ratio 0.35 for Blend B			All bioretention features will conform to the target.	
	Cationic exchange capaciyu (CEC)> 10 meq/100g				
	pH 6.5-7.5				
	Phosphorus 12-40 ppm		Phosphorus level will be ensured to be within 12-30 ppm		
	Layer Permeability Co-efficient (k)[mm/hour] 75-250		Designed with 75 mm/hour Permeability co-efficient	Lowest allowable permeability co-efficient will be provided for ensuring better filtration / sufficient drawdown times.	

Element	Design Criteria	Description	Conformance	Implication	Mitigation
Choker Layer	50mmm to 100mm depth	To prevent migration of finer filter media into the underlying storage reservoir aggregate	Provided	All bioretention features will conform to the target.	
	Void Ratio 0.4	Choker layer characteristics			
	Permeability Co-efficient (k) 250 mm/hour				
Reservoir Layer	Void Ratio 0.4	Reservoir layer characteristics	Provided	All bioretention features will conform to the target.	
	Permeability Co-efficient (k) 1250 mm/hour				

The above design details will be revisisted at the subdivision stage of development. A PC SWMM model of all LID features will be completed to provide performance details. An operations and maintenance manual and implementation / E&SC plan specific to the LIDs will also be provided at detailed design.

We trust the foregoing memo describes the proposed LID bioretention cells proposed for the ROWs in the Lakeview Village Community.

Regards,
Urbantech® Consulting

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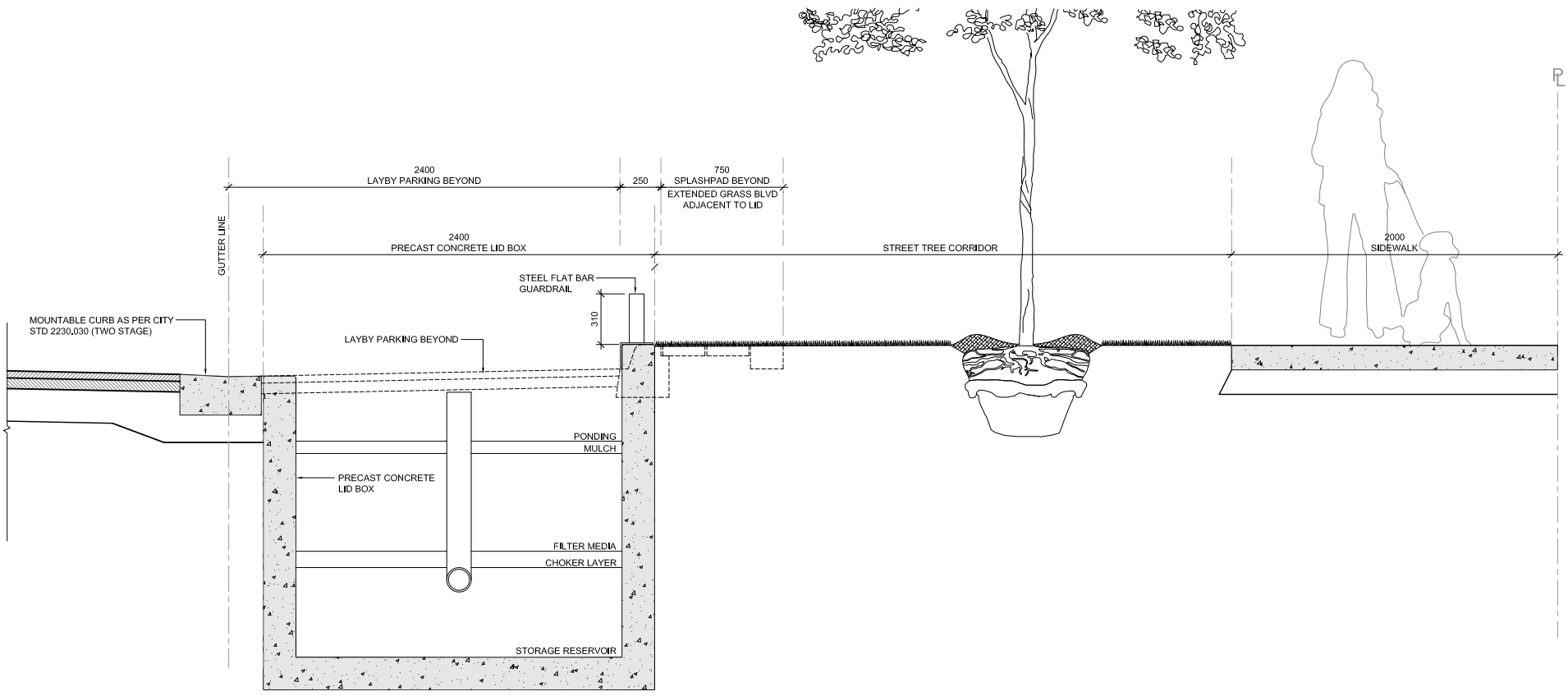
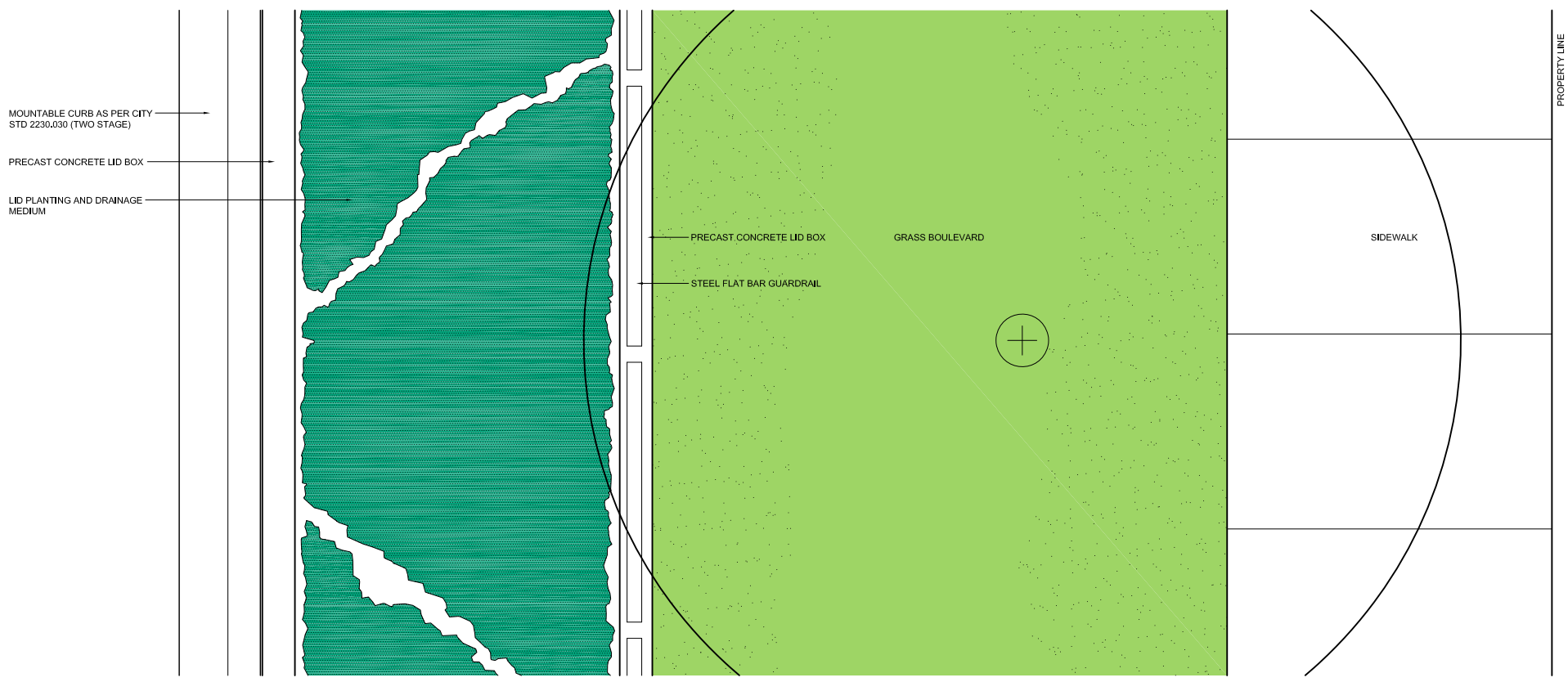
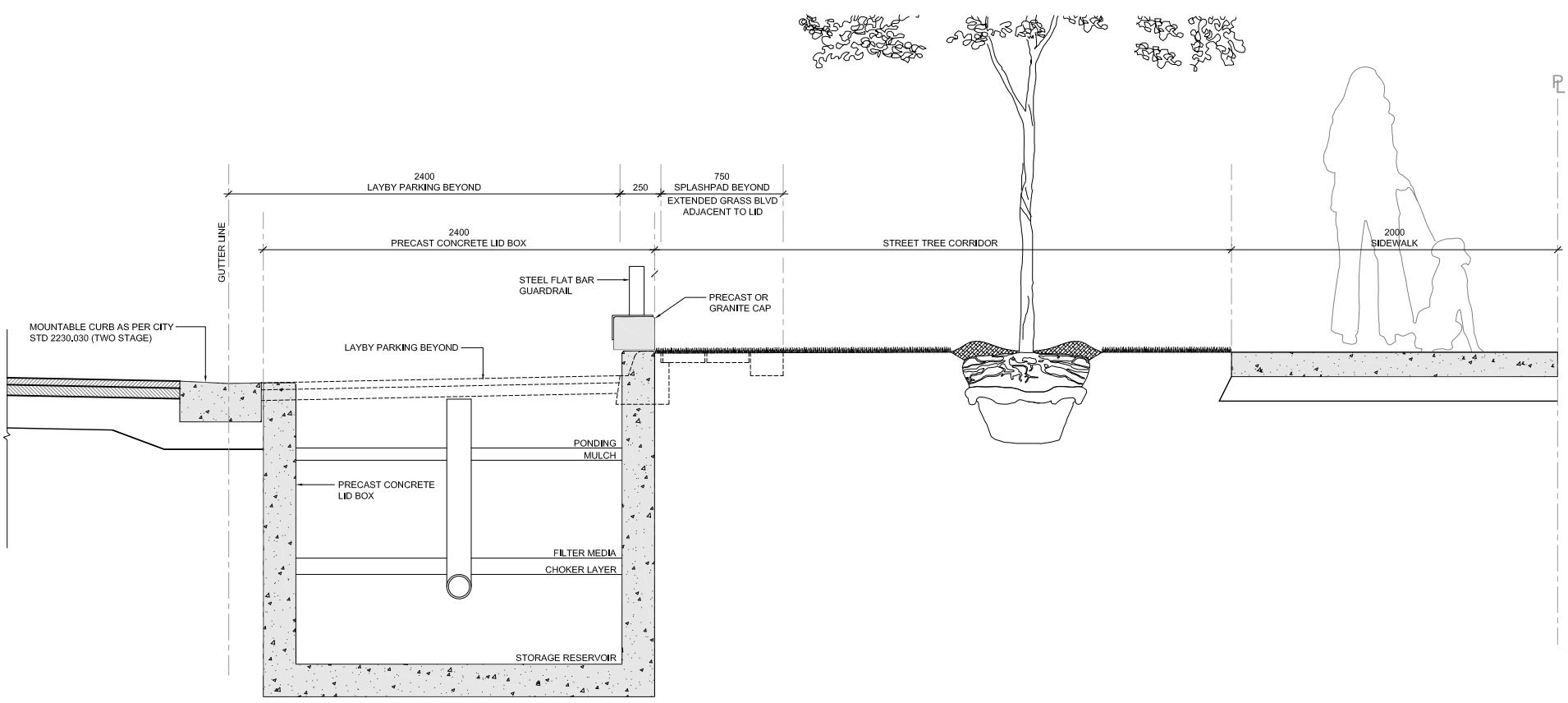
Senior Associate, Water Resources

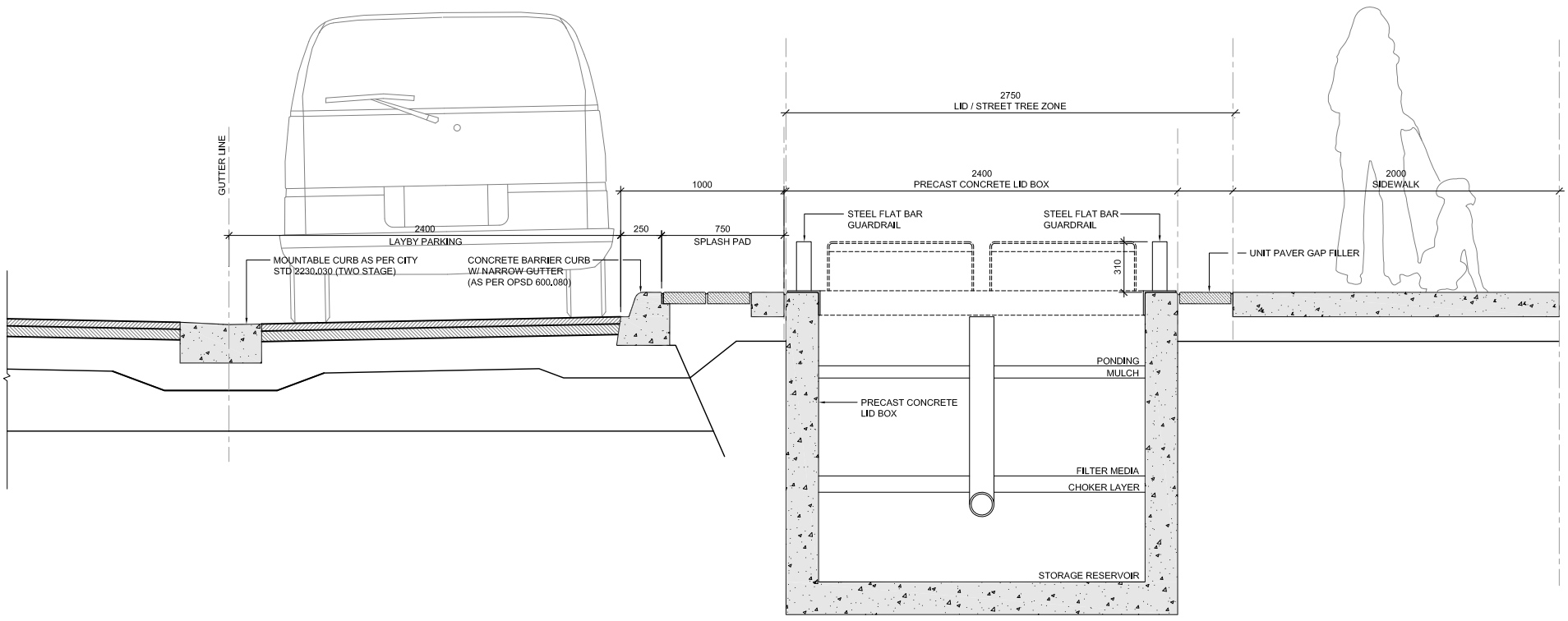


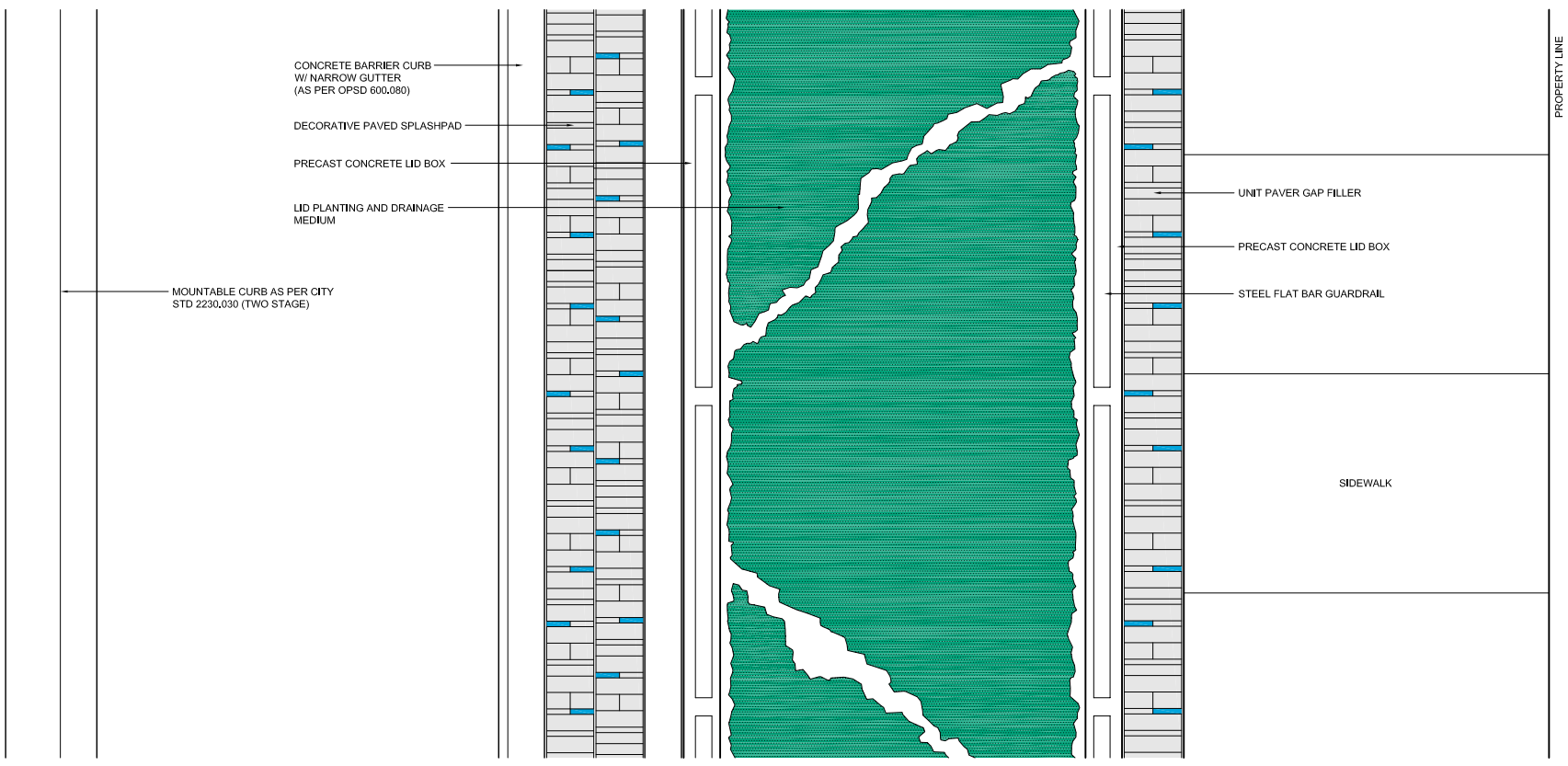


BOULEVARD SECTION 'A' - LID AT LAYBY BUMPOUT

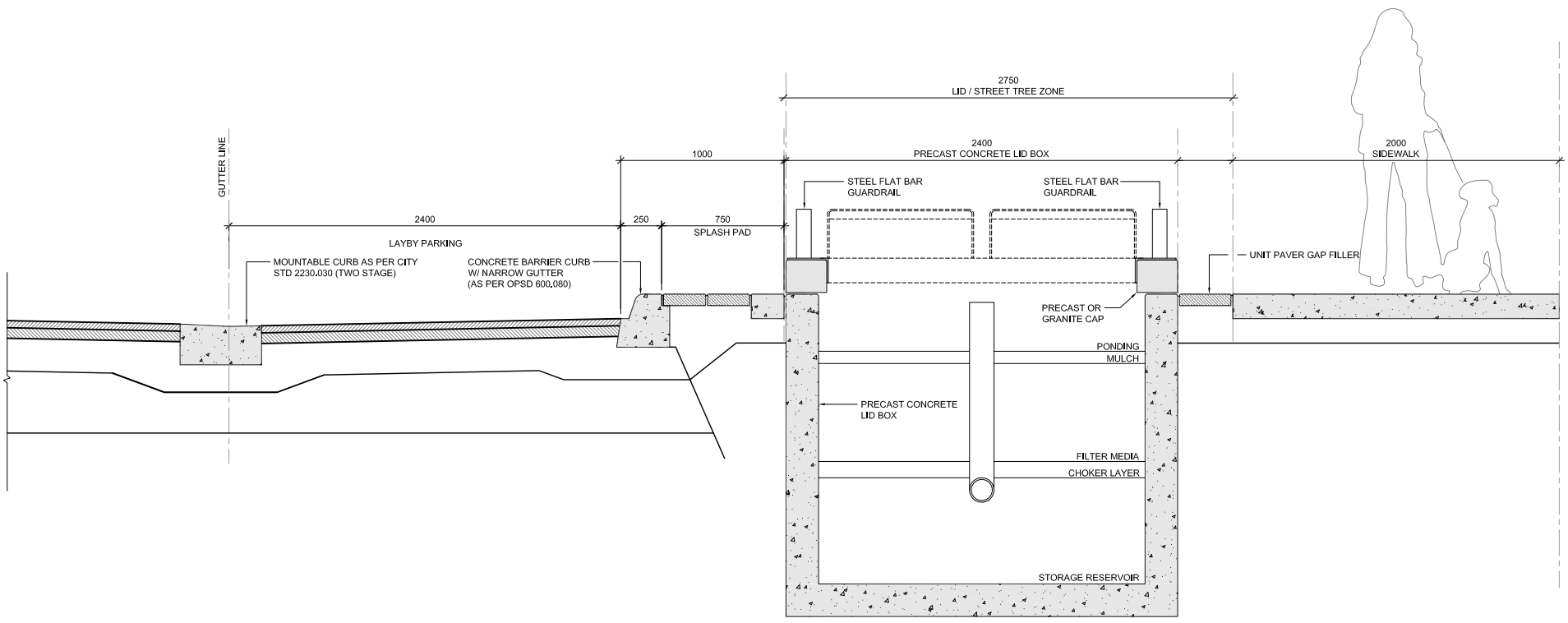


BOULEVARD SECTION 'A' - LID AT LAYBY BUMPOUT WITH PRECAST OR GRANITE CAP





BOULEVARD SECTION 'B' - LID ADJACENT TO STREET CURB AND SPLASHPAD



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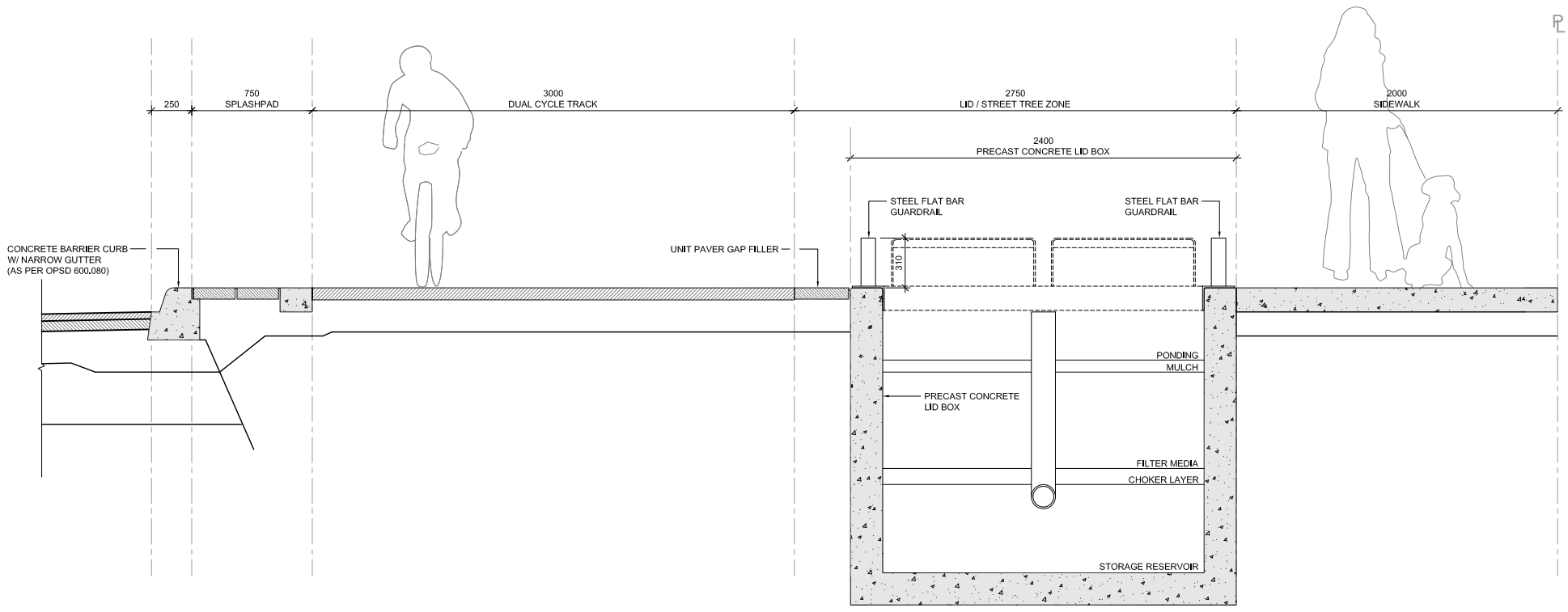
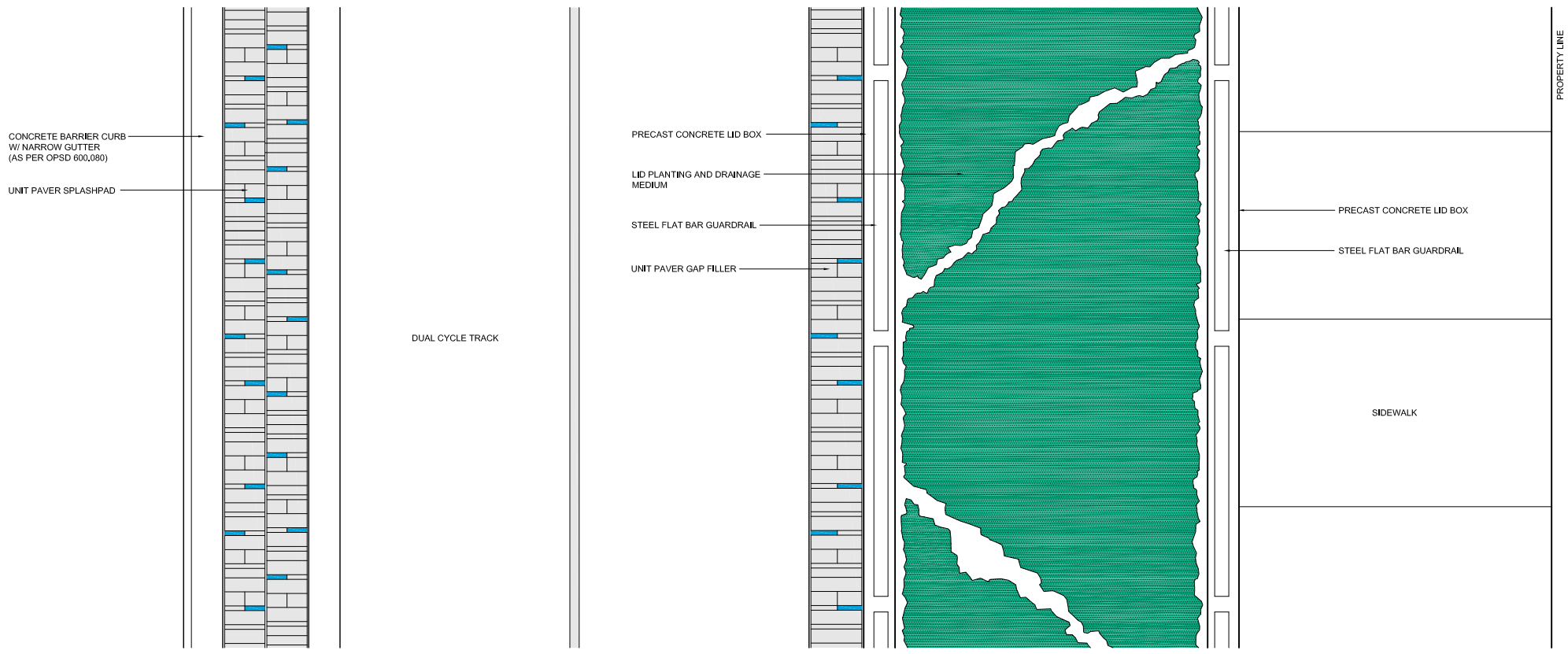
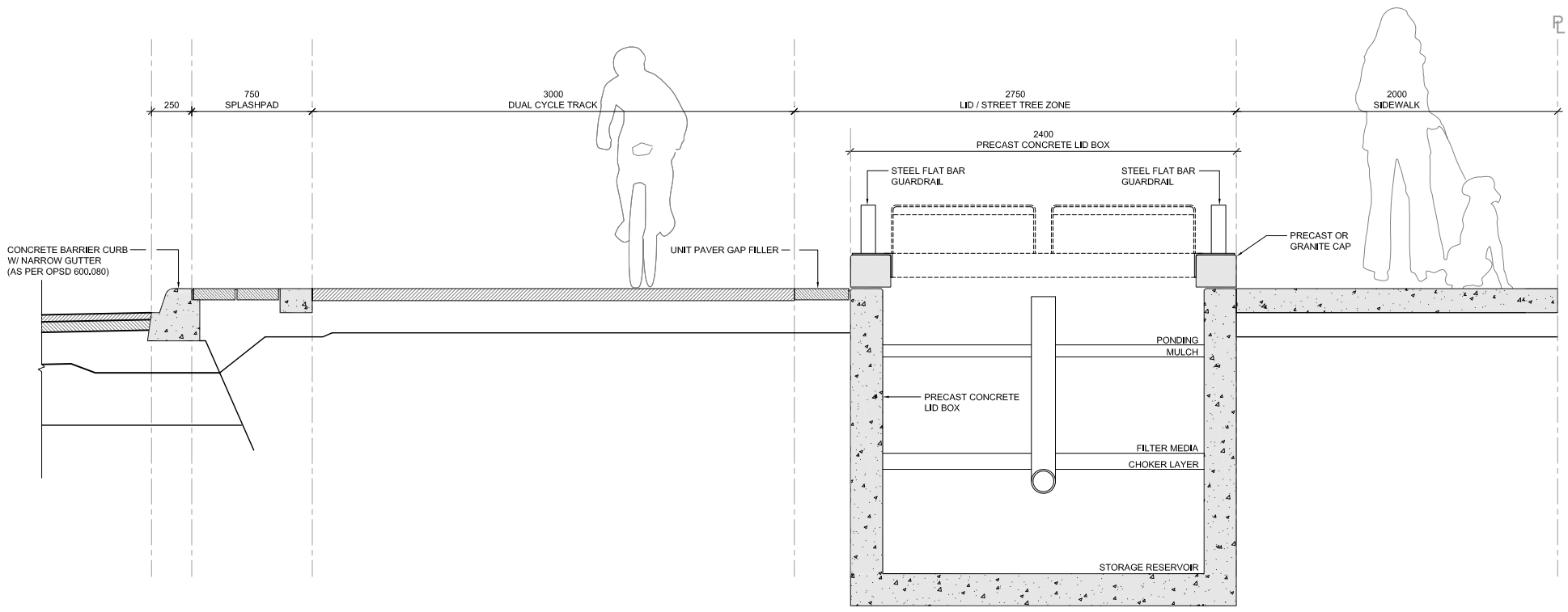
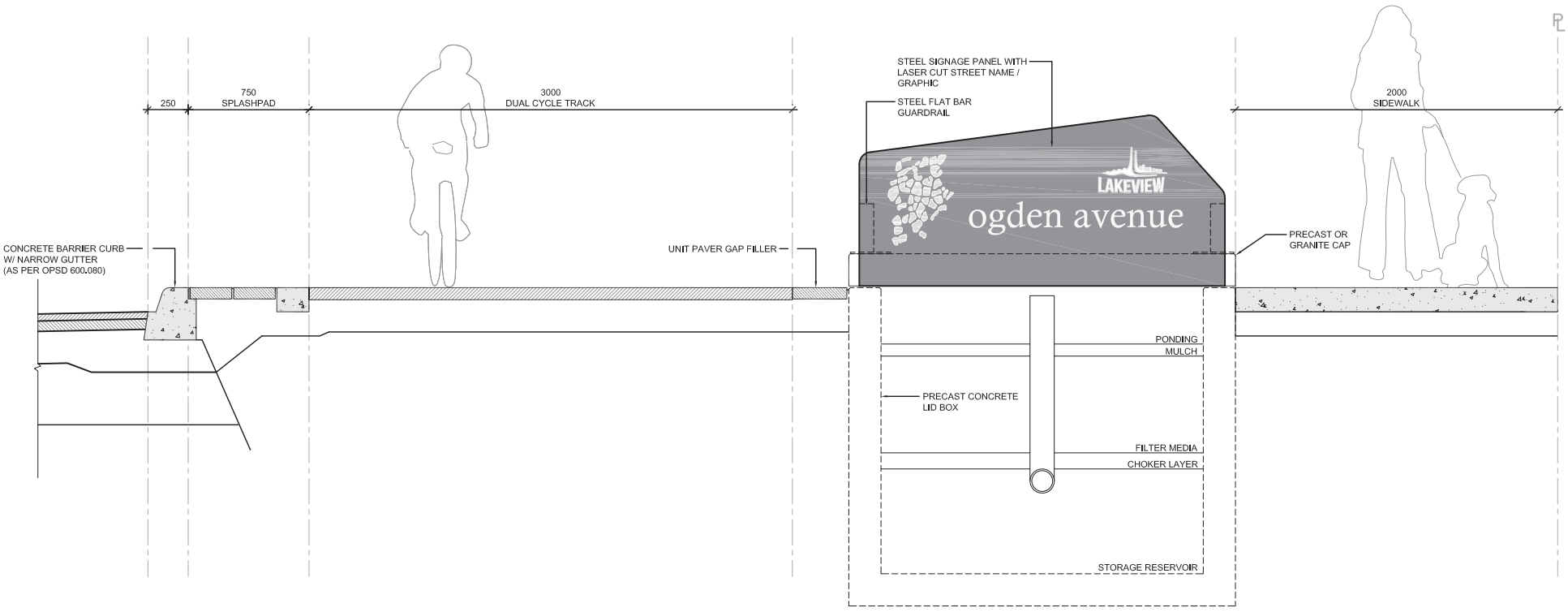




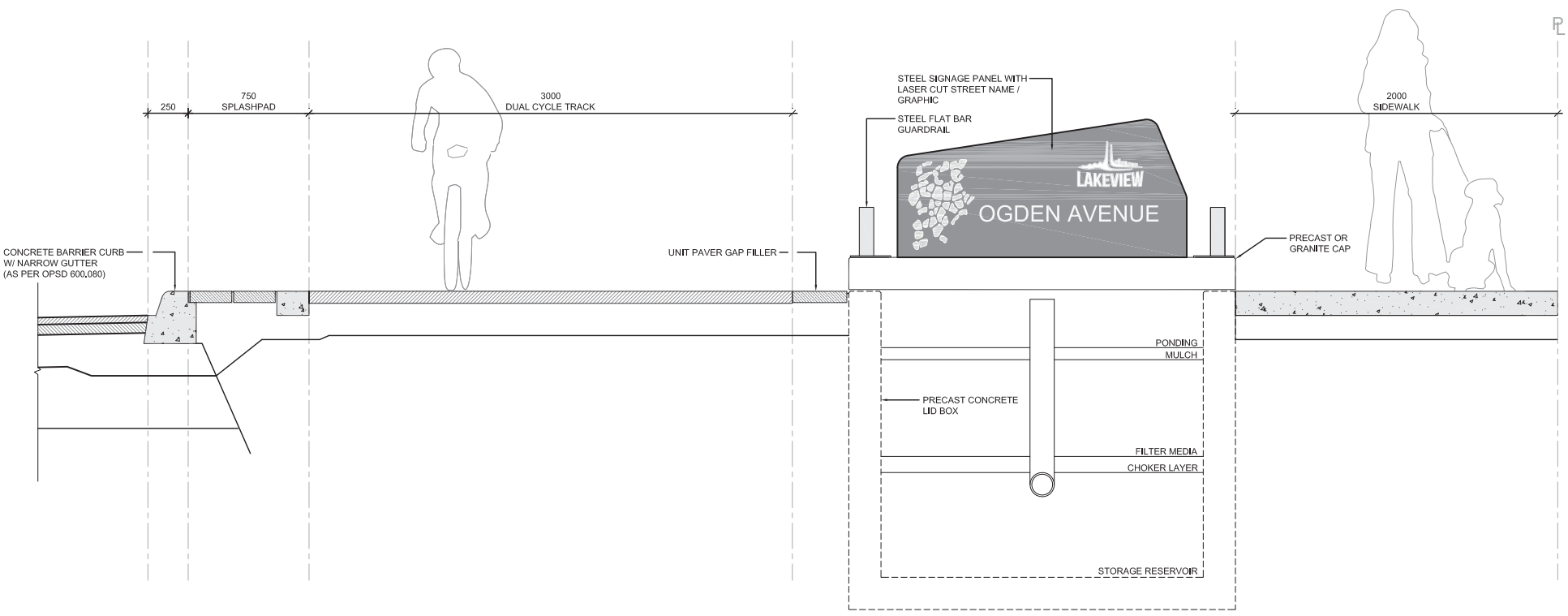
BOULEVARD SECTION 'C' - LID BETWEEN SIDEWALK AND CYCLE TRACK / INSERTED BETWEEN STREET TREES



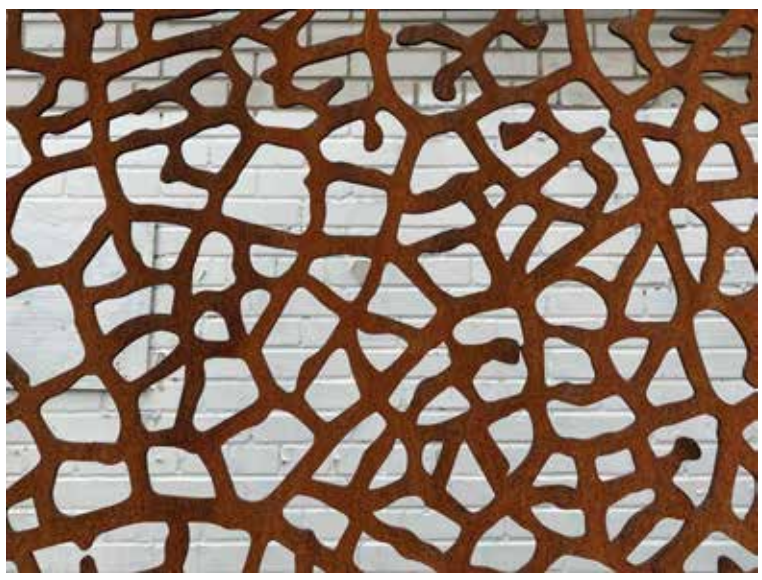
BOULEVARD SECTION 'C' - LID BETWEEN SIDEWALK AND CYCLE TRACK WITH PRECAST OR GRANITE CAP / INSERTED BETWEEN STREET TREES



INTERSECTION SIGNAGE PANEL AT LID - OPTION A



INTERSECTION SIGNAGE PANEL AT LID - OPTION B



NAK design strategies