



SURVIVABILITY OF NON-ESTABLISHED TREES – SUMMER STUDY

August 30, 2024

***This is an excerpt from a larger study completed on tree survivability. The following analysis was contributed by Gabrielle Abernethy.**

Tree Survivability – Rooting Area

- Tree Condition is compared against rooting area in two scenarios: vaulted and non-vaulted trees.
- Non-vaulted trees include all other planting location types: planting beds, back of walks, boulevards, medians, parks
- Vaulted tree subsurface types include tree pits, tree trenches and soil cells.
- Default rooting areas defined for the three types of vaults.

Rooting Area – COC guidelines

New 2024 development guidelines for minimum rooting area in 1m depth: 10m², 20m² and 30m² for small, medium and large species, respectively.

Most trees planted in ~1m depth.

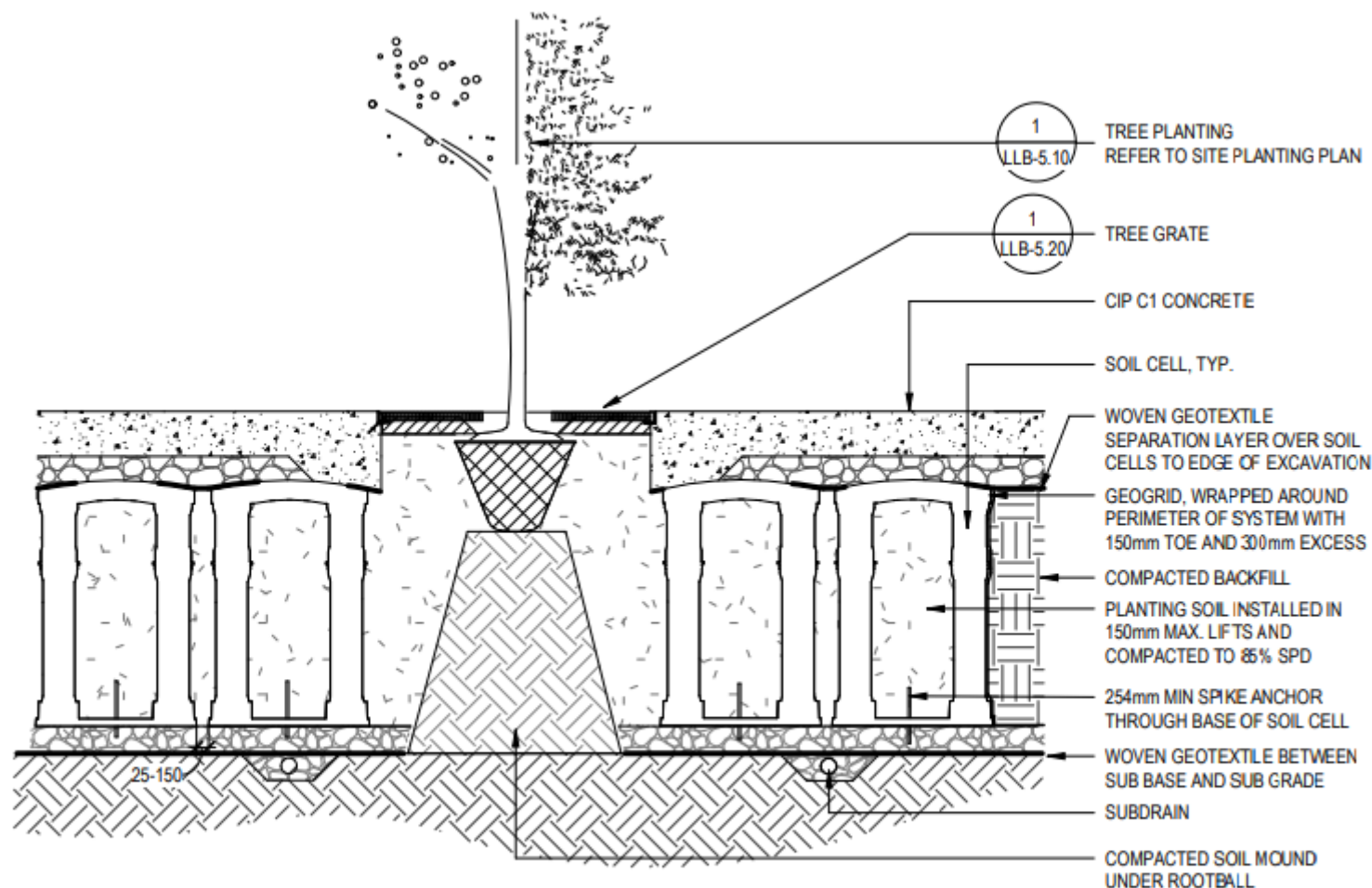
Table 4-2: Suggested Tree Soil Volume Calculation

Soil Volume Calculation for All Trees		
Soil Volume	Canopy Volume Cubic Meters	Soil Volume Cubic Meters
Small	< 500	10
Medium	500 - 700	20
Large	> 700	30
Calculation		
Canopy Volume = $(\pi(\text{Canopy Radius})^2) * (\text{Height} - 2 \text{ meters})$		

Rooting Area – Soil Cells

- Eau Claire redevelopment plan used as analogy to get relative planting dimensions expected from a soil cell install 1.25m deep.
- This particular example is designed for 3 plum trees (MATURE_SIZE = SMALL) in a 15m X 3m area soil cell. We assume each tree has access to 10mx3m or 2/3 of the rooting area.
- A default of 30m² is accessible. This aligns with the required soil volumes for large species trees.

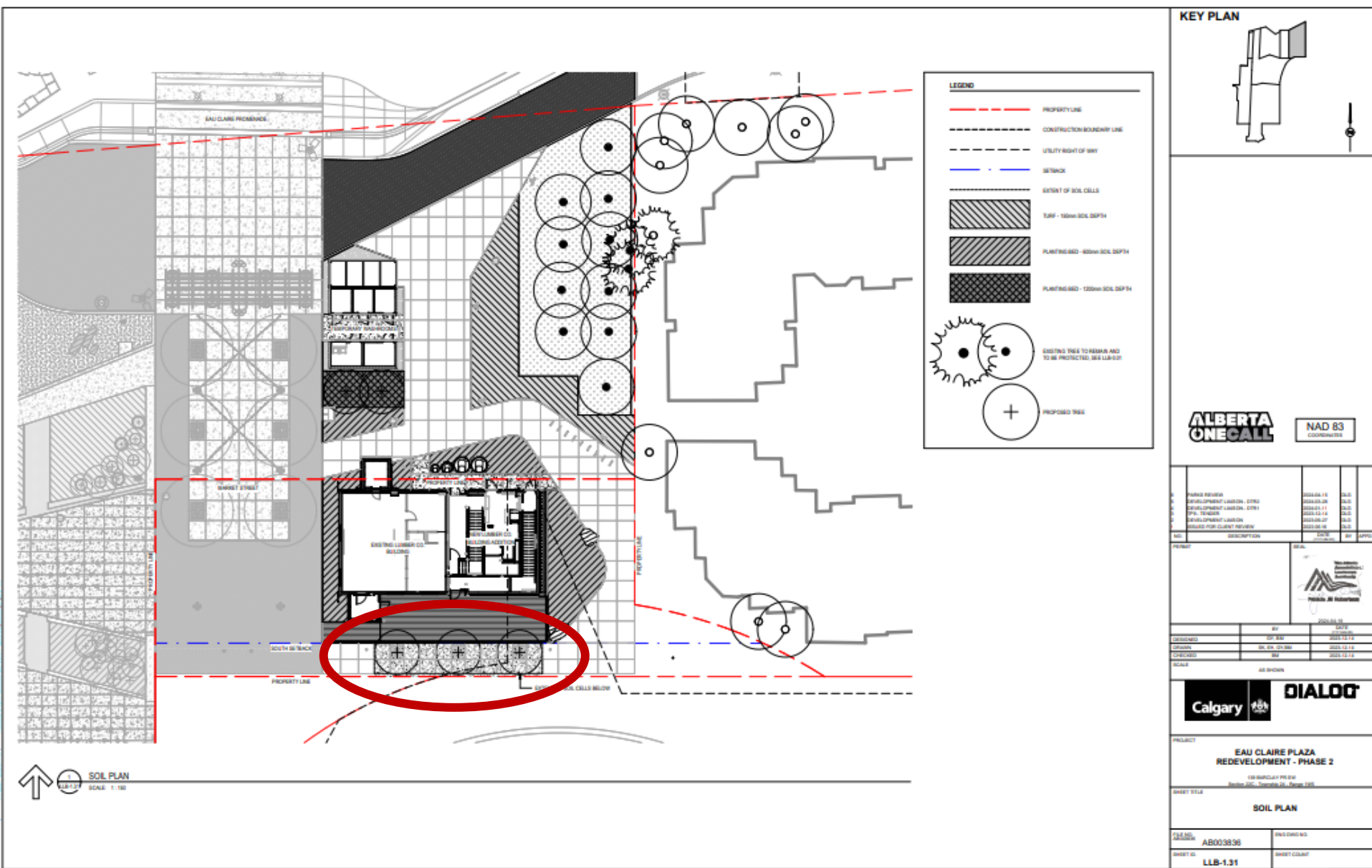
Rooting Area – Soil Cells



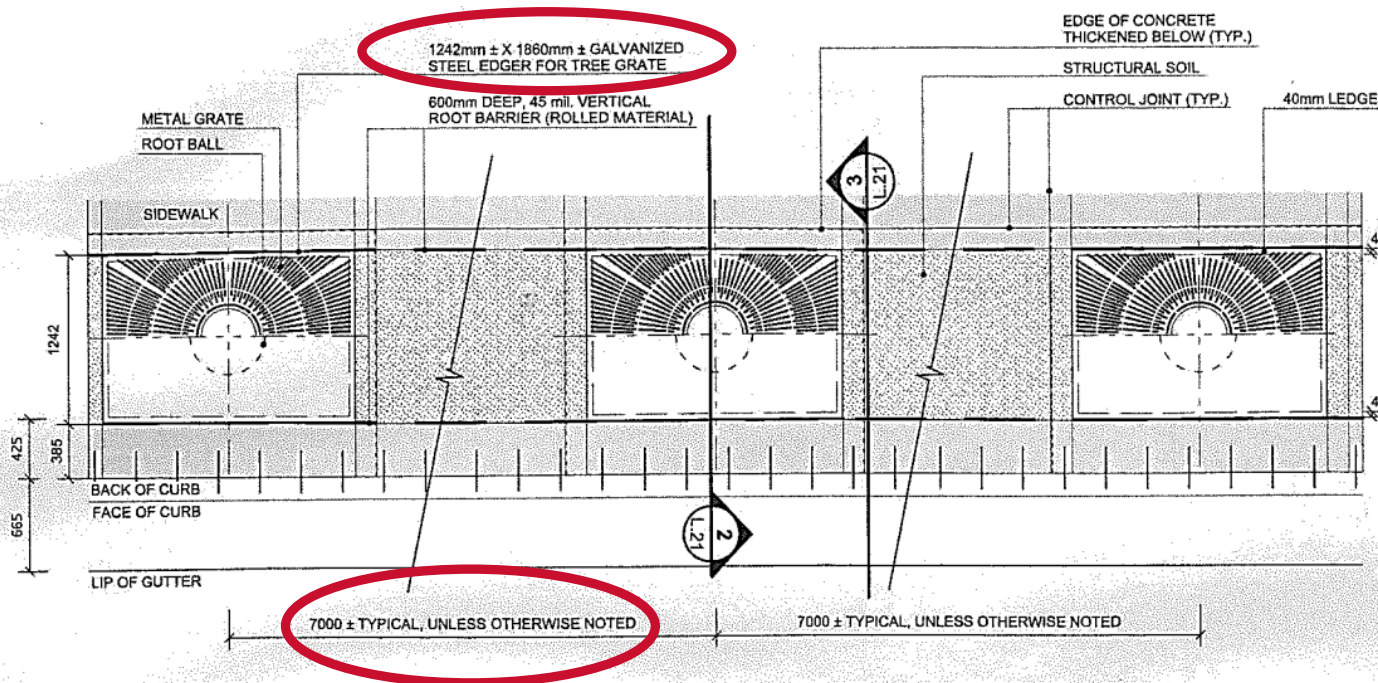
3
LLB-5.10

TREES IN SOIL CELLS UNDER CIP CONCRETE

SCALE: 1 : 25



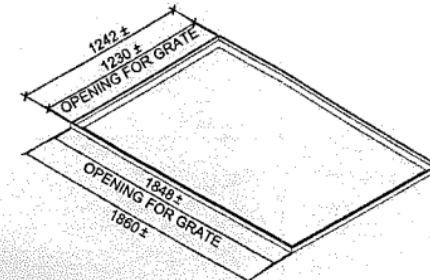
Rooting Area – Tree Trench



NOTE:

TREE GRATE TO CITY OF CALGARY STANDARD SPECIFICATIONS - ROADS CONSTRUCTION. GALVANIZED, NOT POWDER COATED.

EDGERS: GALVANIZED, NOT POWDER COATED. ENSURE GRATE THICKNESS AND ANGLE DEPTH ARE CONSISTENT.



STEEL EDGERS
AXONOMETRIC N.T.S.

1

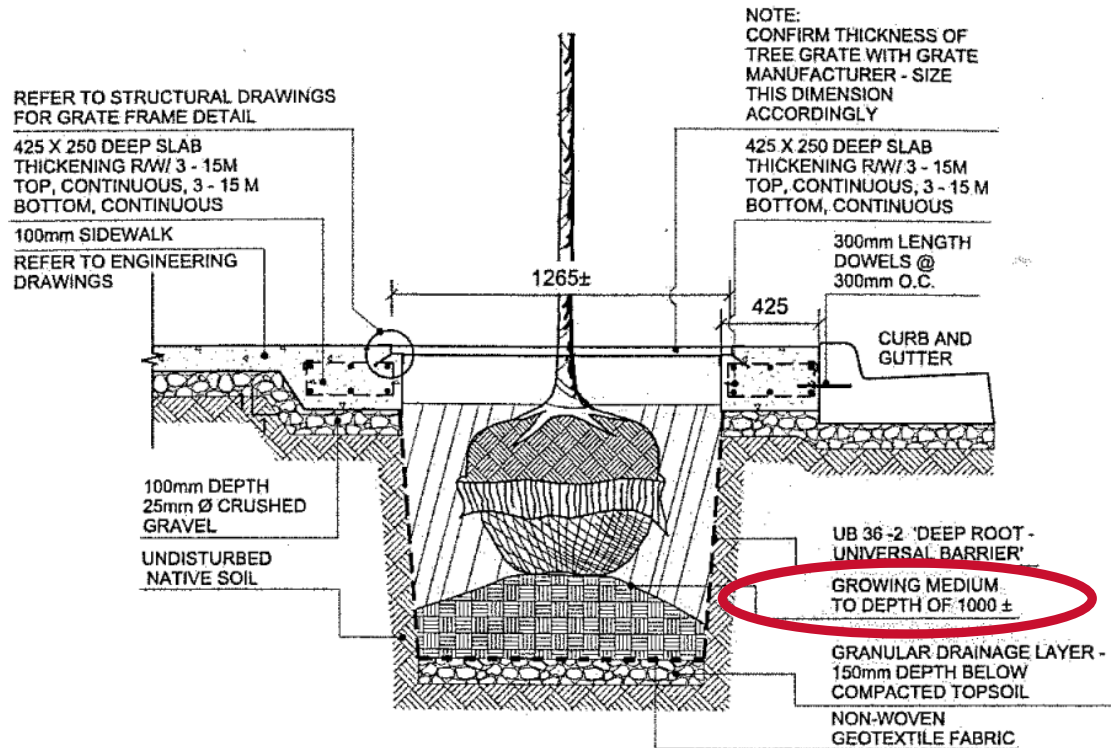
L.21

SQUARE TREE GRATE AND TREE TRENCH LAYOUT

PLAN • 1 : 30

16 Ave development plan used as analogy. Depth is 1 m. Rooting area is assumed to have overlap. $1.25\text{m} \times 10\text{m} = 12.5\text{m}^2$. Adequate for small sized trees. Moderately adequate for medium trees.

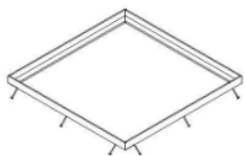
Rooting Area – Tree Trench



16 Ave development plan used as analogy. Depth is 1 m. Rooting area is assumed to have overlap. $1.25\text{m} \times 10\text{m} = 12.5\text{m}^2$. Adequate for small sized trees. Moderately adequate for medium trees.

Rooting Area – Vaults

Trojan Industries
product specifications
used for vaults.
Maximum dimension of
1.25x1.25m and 1m
assumed for rooting
area of 1.56m²



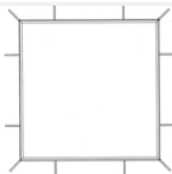
TGF 24×24 38mm Angle Frame

[View Drawing](#)



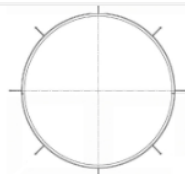
TGF 36×36 25mm Straight
Angle Frame

[View Drawing](#)



TGF 36×36 25mm Angle Frame

[View Drawing](#)



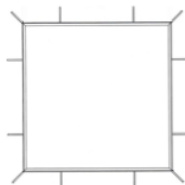
TGF 48 25mm Round Angle
Frame

[View Drawing](#)



TGF 48×36 38mm Angle Frame

[View Drawing](#)



TGF 48×48 25mm Angle
Frame

[View Drawing](#)



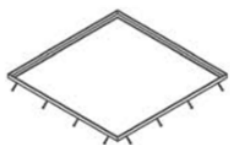
TGF 48×48 25mm Straight
Angle Frame

[View Drawing](#)



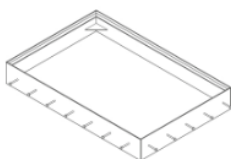
TGF 48×48 38mm Angle
Frame

[View Drawing](#)



TGF 48×48 44mm Angle
Frame

[View Drawing](#)



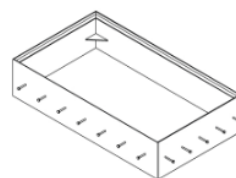
TWF 250 48×36

[View Drawing](#)



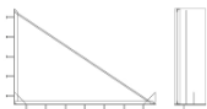
TWF 304 48×36 2 Piece

[View Drawing](#)

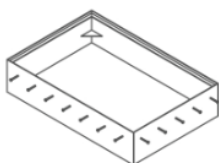


TWF 406 42×36

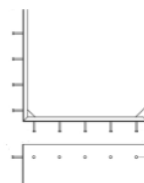
[View Drawing](#)



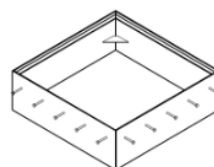
TWF 406 48×36 2 Piece



TWF 406 48×36



TWF 406 48×48 2 Piece

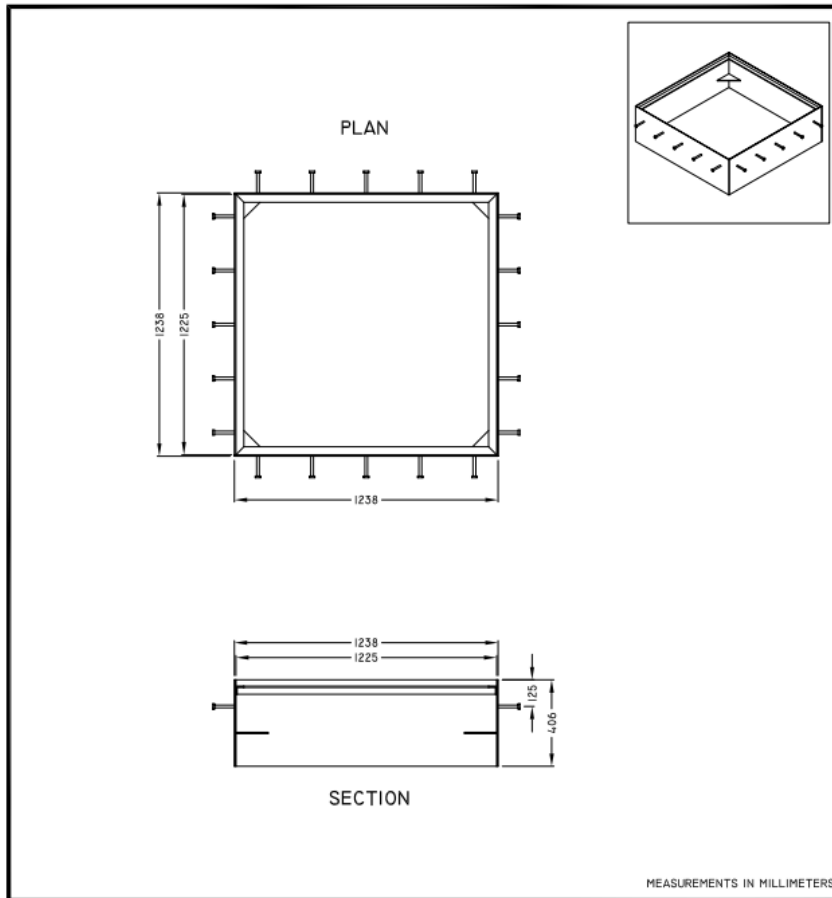


TWF 406 48×48

Rooting Area – Vaults

TREE WELL FRAME

TWF-406 4848



Trojan Industries
product specifications
used for vaults.
Maximum dimension
of 1.24x1.24m and 1m
assumed for rooting
area of 1.54m².

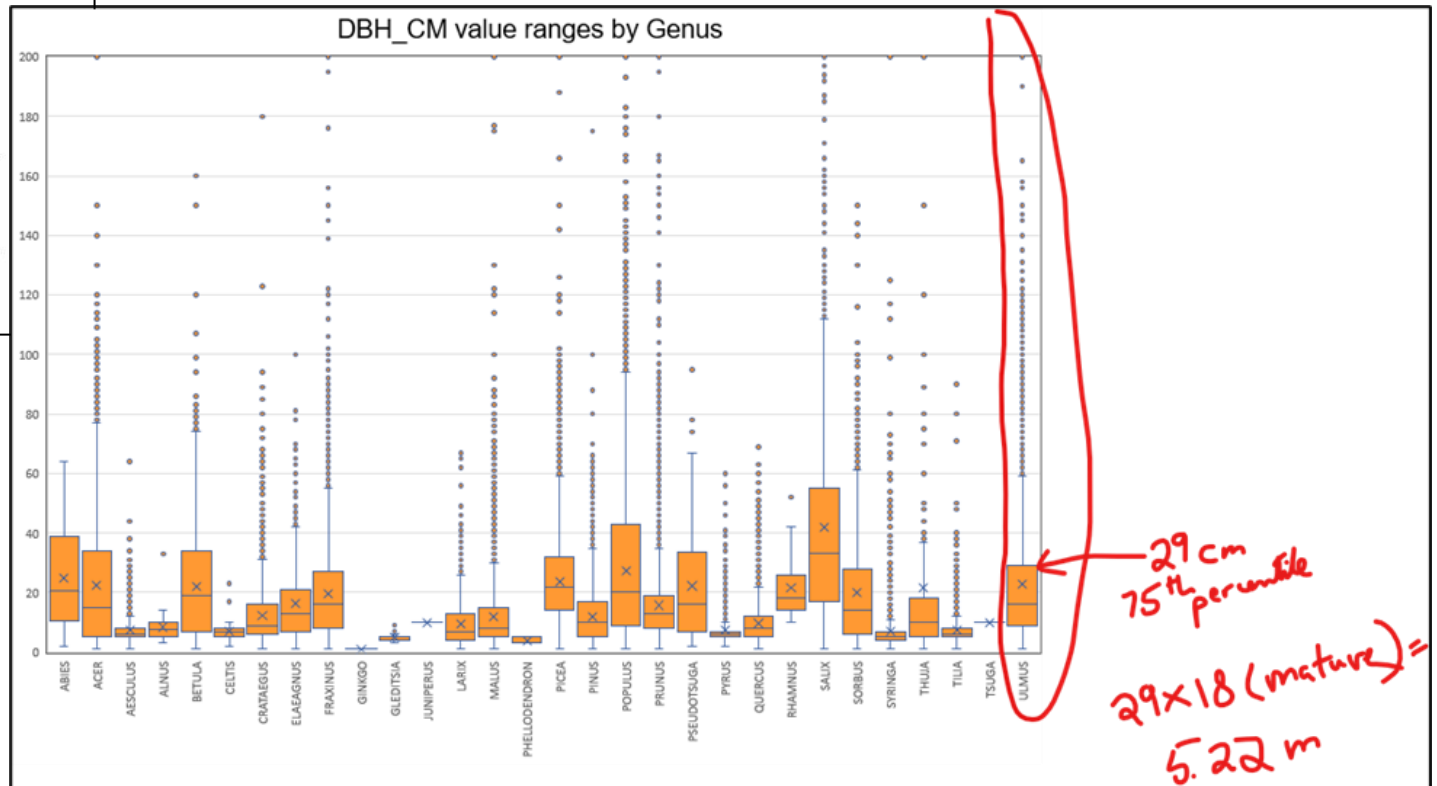
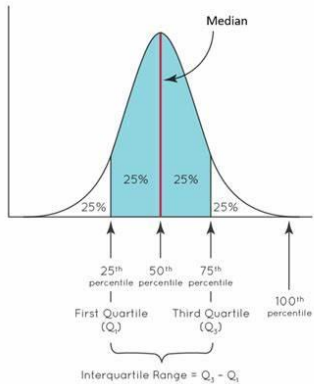
TROJAN INDUSTRIES INC.
CALGARY • EDMONTON, ALBERTA

Vault Default Rooting Area Summary

Type	Default Rooting Area Assigned
Soil Cell	30 m ²
Tree Trench	12.5 m ²
Vault	1.54 m ²

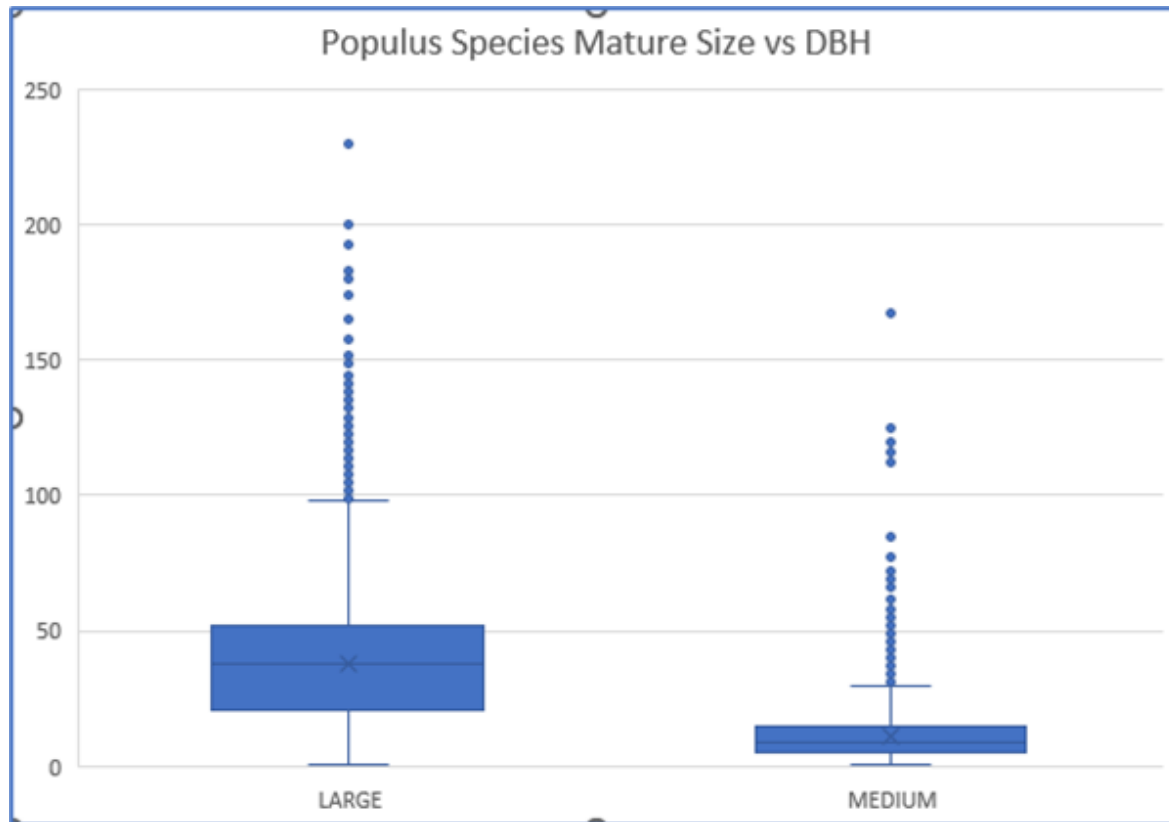
Optimal Rooting Area: Non-Vaulted Trees

Quartiles and Percentiles



DBH of mature species identified as 75th percentile of all public trees categorized by genus.

Optimal Rooting Area: Non-Vaulted Trees



Where there are notable 'medium' and 'large' species creating a large spread in the data, i.e. poplars, maples, and birch, the data is further refined.

Optimal Rooting Area: Non-Vaulted Trees

Table 1. Guidelines for determining tree protection zone radius for healthy, structurally sound trees (adapted from Matheny and Clark, 1998, and the British Standards Institute).

Species Tolerance to Construction Damage (from Appendix A)	Relative Tree Age	TPZ Multiplication Factor
High	Young	6
	Mature	8
	Overmature	12
Medium	Young	8
	Mature	12
	Overmature	15
Low	Young	12
	Mature	15
	Overmature	18

Source: Fite, K. & Smiley, E.T. (2016). *Best Management Practices - Managing Trees During Construction* (2nd Edition). International Society of Arboriculture.

The TPZ multiplication factor for low tolerance, overmature trees is used as a measure for optimal rooting area because in many urban settings, trees will stifle rooting to streets, sidewalks, driveways, etc. and extend further to pervious areas.

Optimal Rooting Area: Non-Vaulted Trees

Pop-up

test_1000trees_join (1)
ELM, PATMORE

test_1000trees_join - ELM, PATMORE

OBJECTID_1	715
GENUS	ULMUS
Mature_RootRad_meters	5.22
CID	11470
OID	715
Join_Count	1
TARGET_FID	715

1 of 1

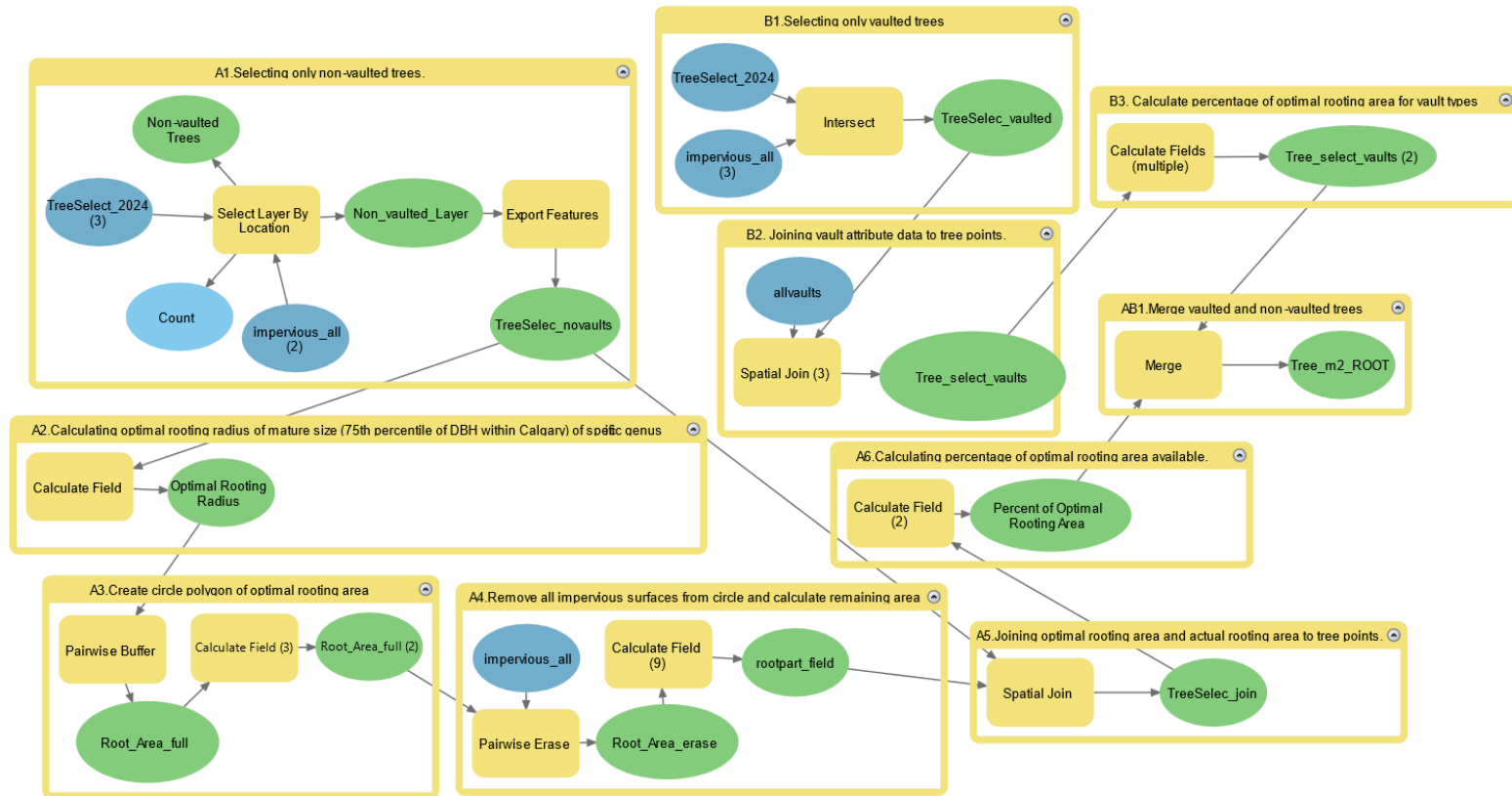
Map DEM_DSM Tree Survey 2024 Tree Survivability Survey 2024



GIS workflow:

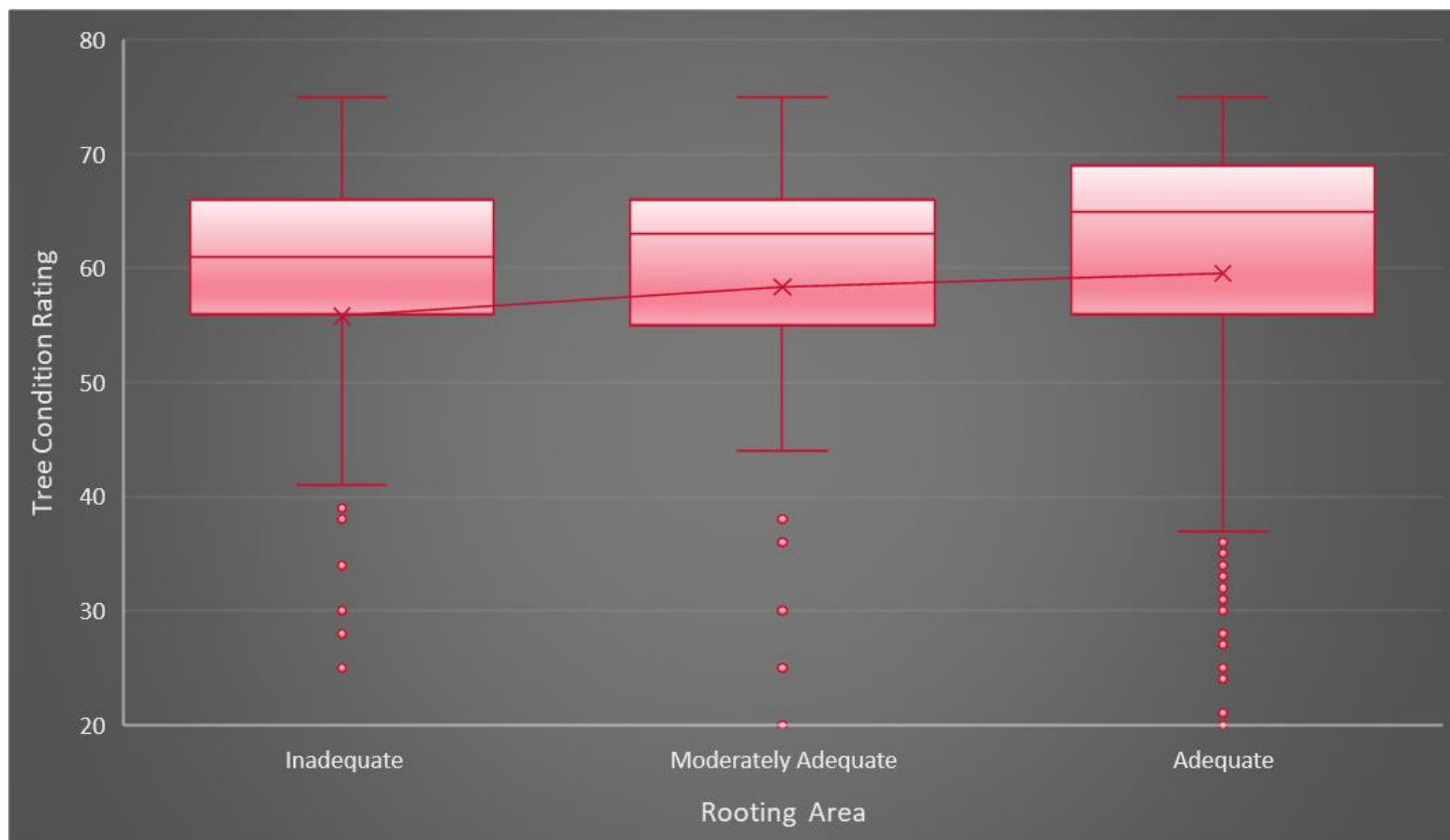
- Genus 75th percentile DBH is multiplied by TPZ of 18 to derive optimal rooting radius and area.
- Impervious surfaces removed.
- Remaining percent of rooting area calculated.

Optimal Rooting Area: GIS workflow



Vaulted and non-vaulted tree points and percentage of optimal rooting areas are combined for all study trees.

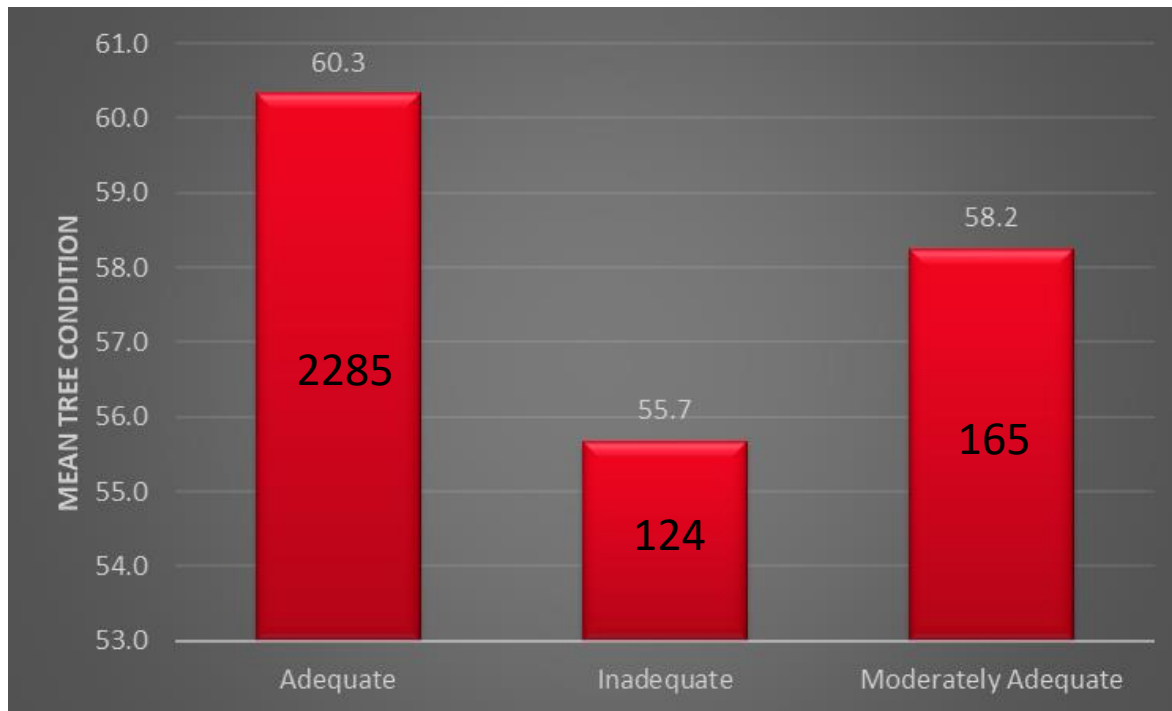
Comparison of Rooting Area to Tree Condition



(Inadequate is 0-20%), (Moderately Adequate >20-40%) and (Adequate >40%)

Mean Tree Condition vs Rooting Area

- 2285 Trees were surveyed to have Adequate rooting area
- 165 Trees were surveyed as Moderately Adequate
- 124 Trees were surveyed as Inadequate



Vault Types

