



re: Geotechnical Review – Rear Yard Lot Terracing
Proposed Residential Development – Conservancy Lands East
Borrisokane Road – Ottawa, Ontario

to: Caivan Communities – Hugo Lalonde – hugo.lalonde@caivan.com

date: September 25, 2024

file: PG5036-MEMO.40

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to provide a geotechnical review and recommendations with respect to the long-term stability of the terracing proposed along the property boundaries at the aforementioned subdivision.

Paterson reviewed the following drawings prepared by DSEL as part of the current memorandum:

- No. 20-1180 – Grading Plan – Sheet No. 93 to 94, Revision 15, dated May 24, 2024.

Background

It is understood that terracing is proposed along portions of the southern and northern property limits, beginning at the existing grade at the property limits and sloping up to the elevation of the proposed roadways. Paterson completed a slope stability analysis at each location where terracing was proposed to confirm that the resultant slopes would be stable under proposed conditions.

Based on the geotechnical investigation completed by others, the subsurface profile at the subject blocks generally consists of topsoil underlain by a very stiff to stiff silty clay crust, becoming firm and grey in colour by approximate depths of 2.8 to 3.0 m below the existing ground surface.

One (1) slope cross-section, representing a maximum 1.5H:1V, reinforced slope, was studied at each area in which terracing has been proposed. The cross-section locations (Sections A-A and B-B) are presented on Figure 3 and 4 – Proposed Terracing Plan.





Slope Stability Assessment

The slope stability analyses were carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favouring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsurface soil and groundwater conditions, a factor of safety greater than 1.0 is generally required for the failure risk to be considered acceptable. Minimum factors of safety of 1.5 and 1.1 is generally recommended for static and seismic analysis conditions, respectively, where the slope failure would comprise permanent structures.

The cross-sections were analyzed to determine if 1.5H:1V terracing could be supported at the subject site, taking into consideration proposed structures and the existing soil conditions.

Subsoil conditions at the cross-section were inferred based on the boreholes by others and general knowledge of the area's geology. The soil parameters used for the static analysis are presented in Table 1 below.

Table 1 - Effective Soil and Material Parameters (Static Analysis)			
Soil Layer	Unit Weight (kN/m³)	Friction Angle (degrees)	Cohesion (kPa)
Engineered Fill	19	35	2
Brown Silty Clay Crust	17	33	5
Grey Silty Clay	16	33	10
Granular Fill Material	22	38	0
Topsoil	18	33	5
Erosion Control Net	18	33	5

The total strength parameters for seismic analysis were chosen based on the boreholes completed by others and based on our general knowledge of the geology in the area. The strength parameters used for seismic analysis at the slope cross-sections are presented in Table 2 on the following page.



Soil Layer	Unit Weight (kN/m³)	Friction Angle (degrees)	Undrained Shear Strength (kPa)
Existing Fill	19	35	2
Brown Silty Clay Crust	17	-	60
Grey Silty Clay	16	-	25
Engineered Fill	22	38	0
Topsoil	18	33	5
Erosion Control Net	18	33	5

Static Loading Analysis

The results of the static analysis for Sections A-A and B-B are shown on Figures 1A and 2A, attached to the current memorandum. The results indicate the factors of safety for all locations exceed 1.5, based on a maximum 1.5H:1V slope, which is acceptable.

Seismic Loading Analysis

Analyses considering seismic loading were also completed. A horizontal acceleration of 0.16g, equivalent to 50% of the peak ground (seismic) acceleration (PGA=0.32g), was considered for the slope. The results of the seismic analyses are shown on Figures 1B and 2B. The results indicate that the factor of safety exceeds 1.1 for cross-sections A-A and B-B under seismic analysis conditions.

Geotechnical Review and Recommendations

The proposed terracing at the property boundaries is considered to be acceptable, from a geotechnical perspective. For permanent slopes with a 1.5H:1V slope profile, it is recommended that a nonwoven geotextile such as Terrafix 200r be placed over the engineered fill material located at the slope face, and beneath the topsoil and landscaping soils to promote long-term stability of the rear-yard slope face. The geotextile fabric should extend a minimum of 0.3 m beyond the top and toe of the slope face.

Further, an erosion control net, such as Fibramulch C32, or approved equivalent should be placed above the topsoil layer to prevent erosion of the slope while vegetation is established. The erosion control net should extend a minimum of 0.3 m beyond the top and the toe of the slope.



Vegetation growth along the slope should be promoted by carrying out hydroseeding or terraseeding along the slope face. Vegetation and tree planting along the slope face fill will further promote stability of the slope long-term through development of the root network.

This slope planting detail is illustrated on the attached sketch, appended to the memorandum.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

Mrunmayi Anvekar, M.Eng

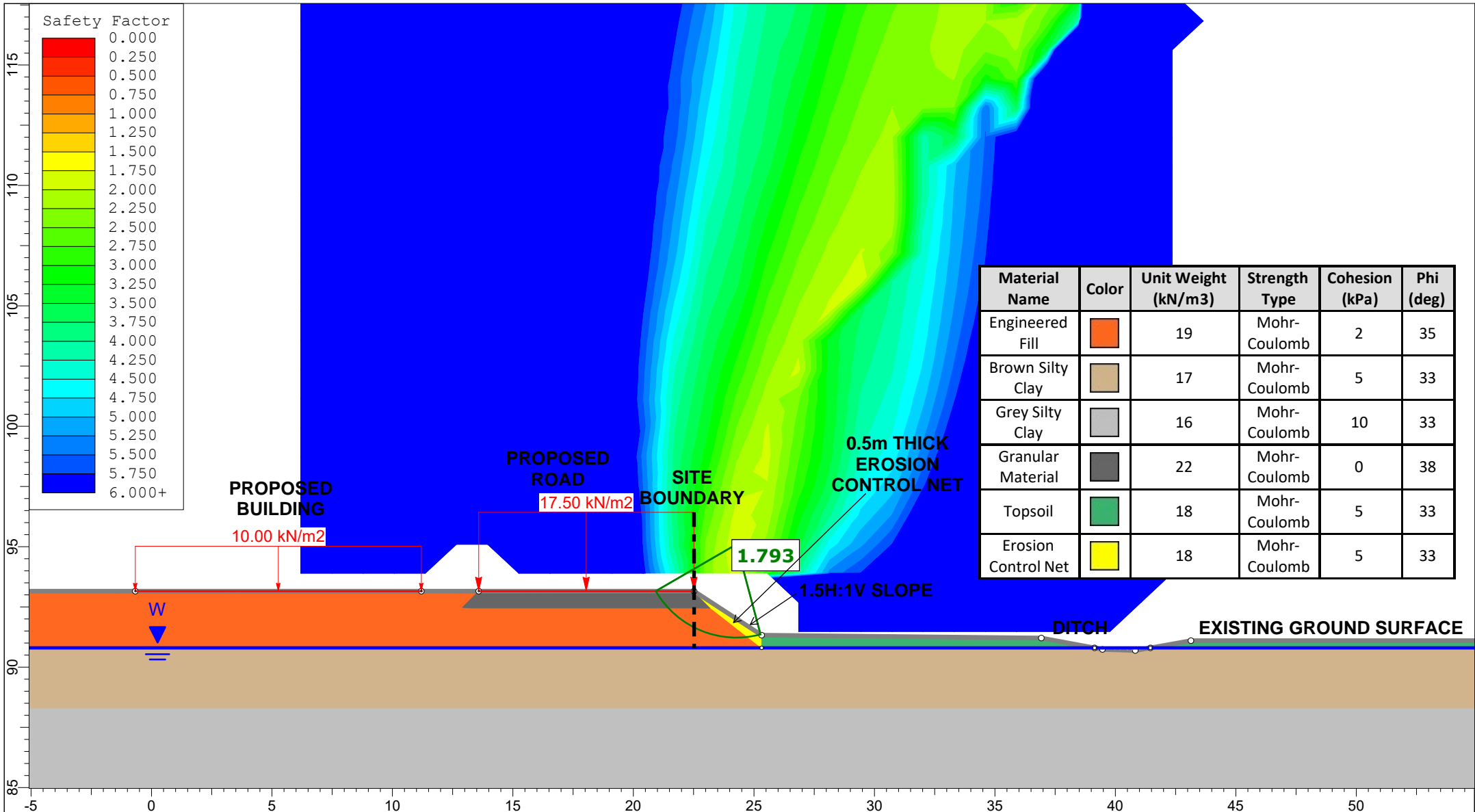


Kevin A. Pickard, P.Eng.

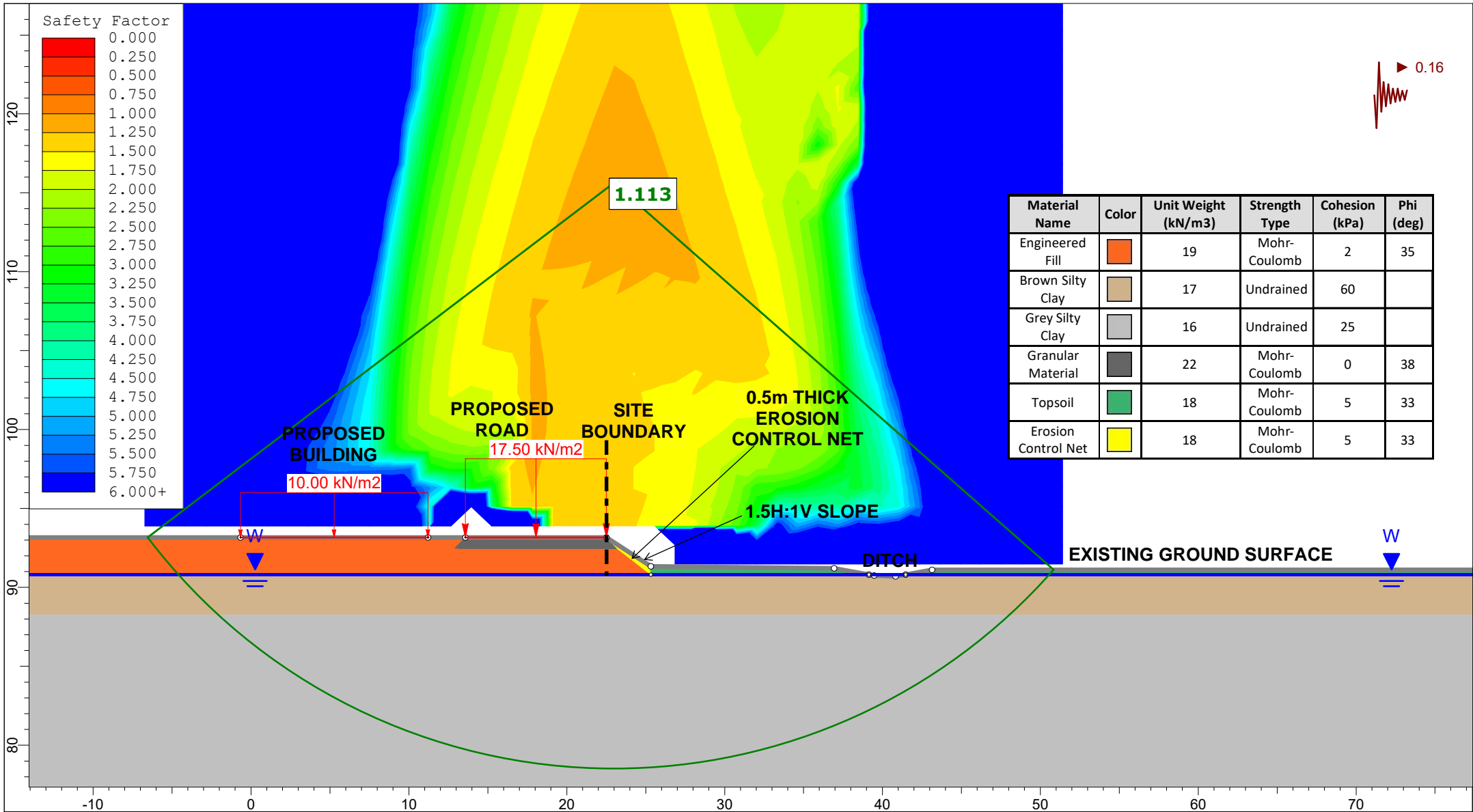
Attachments

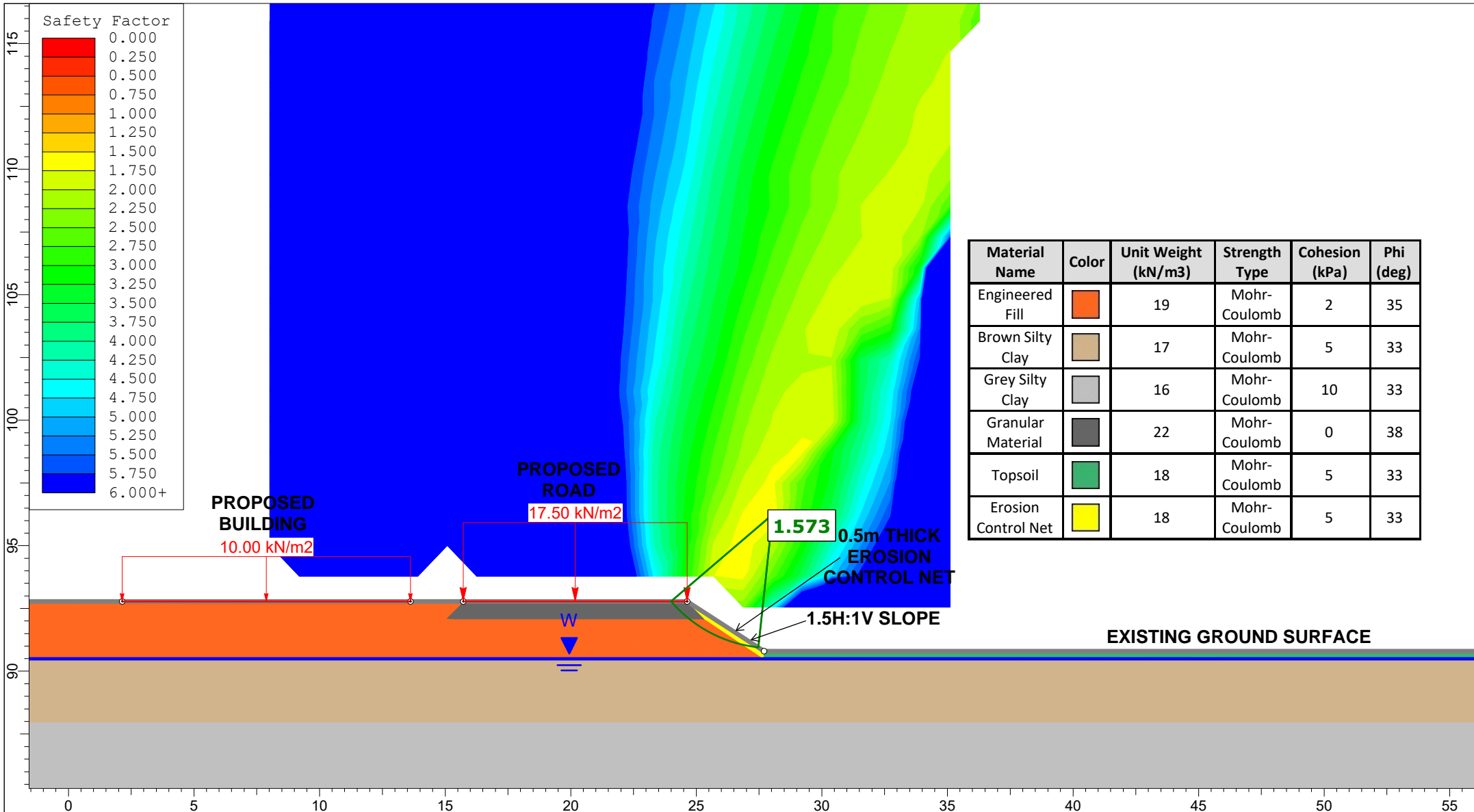
- Figures 1A & 1B – Section A-A – Slope Stability Analysis under Static & Seismic Condition
- Figures 2A & 2B – Section B-B – Slope Stability Analysis under Static & Seismic Condition
- Figure 3 – Proposed Terracing Plan – Section A-A
- Figure 4 – Proposed Terracing Plan – Section B-B
- Slope Seeding and Planting



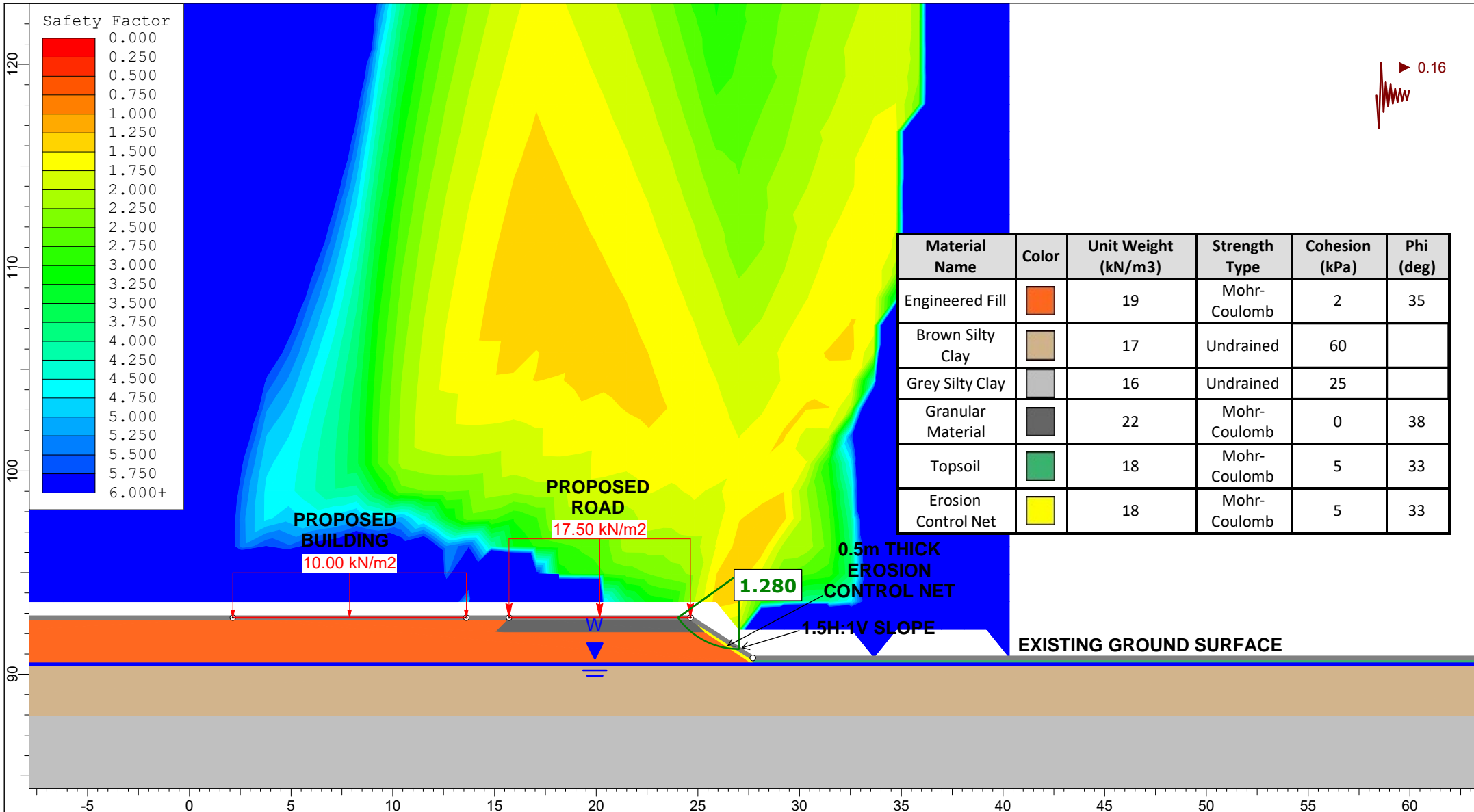


Project	PG5036 - Conservancy East, Borrisokane Road, Ottawa, ON		
Group	Figure 1A - Section A-A - Static Analysis		
Drawn By	MA	Company	Caivan Communities
Date	2024-09-25	File Name	Geotechnical Review - Lot Terracing





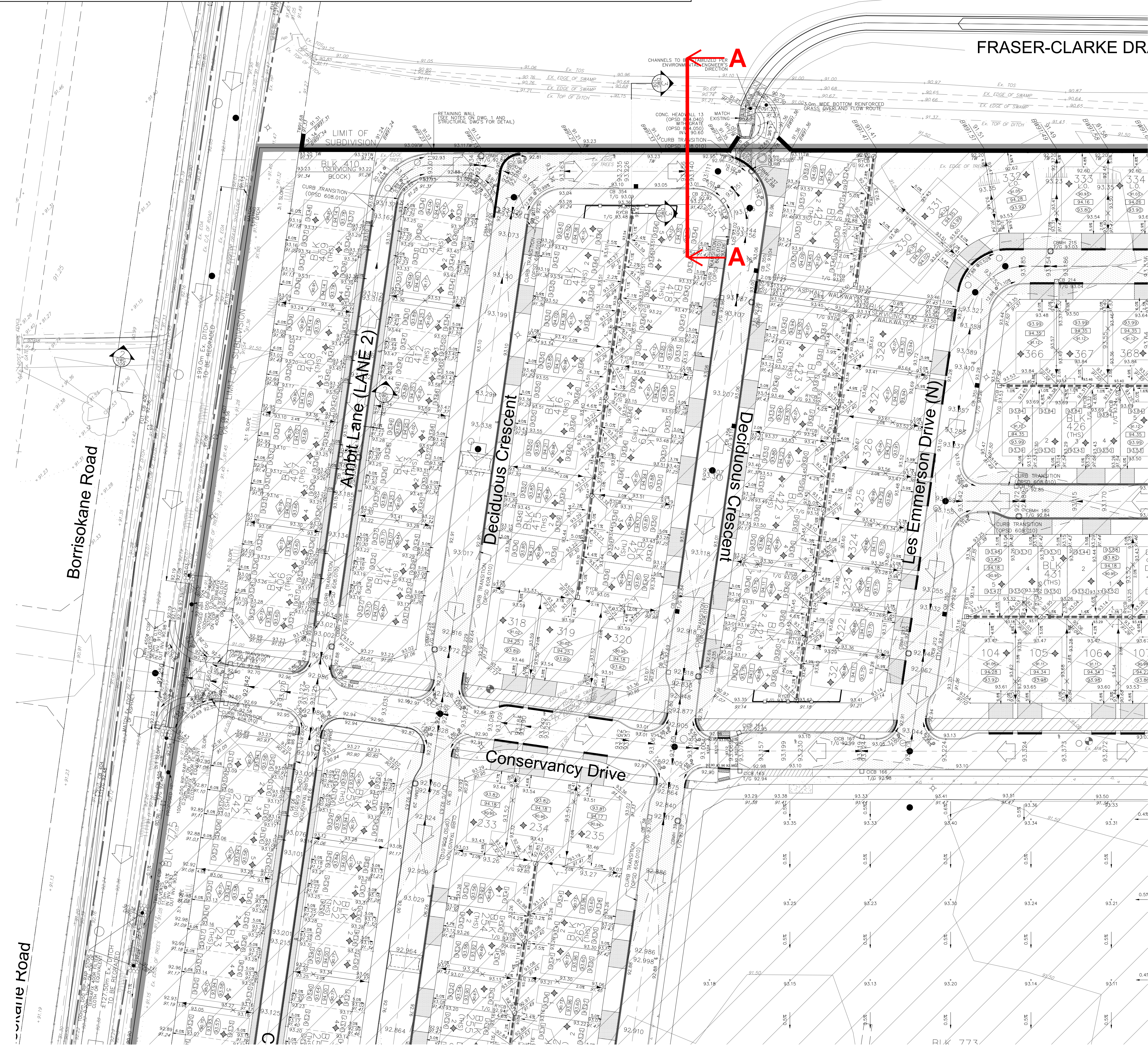
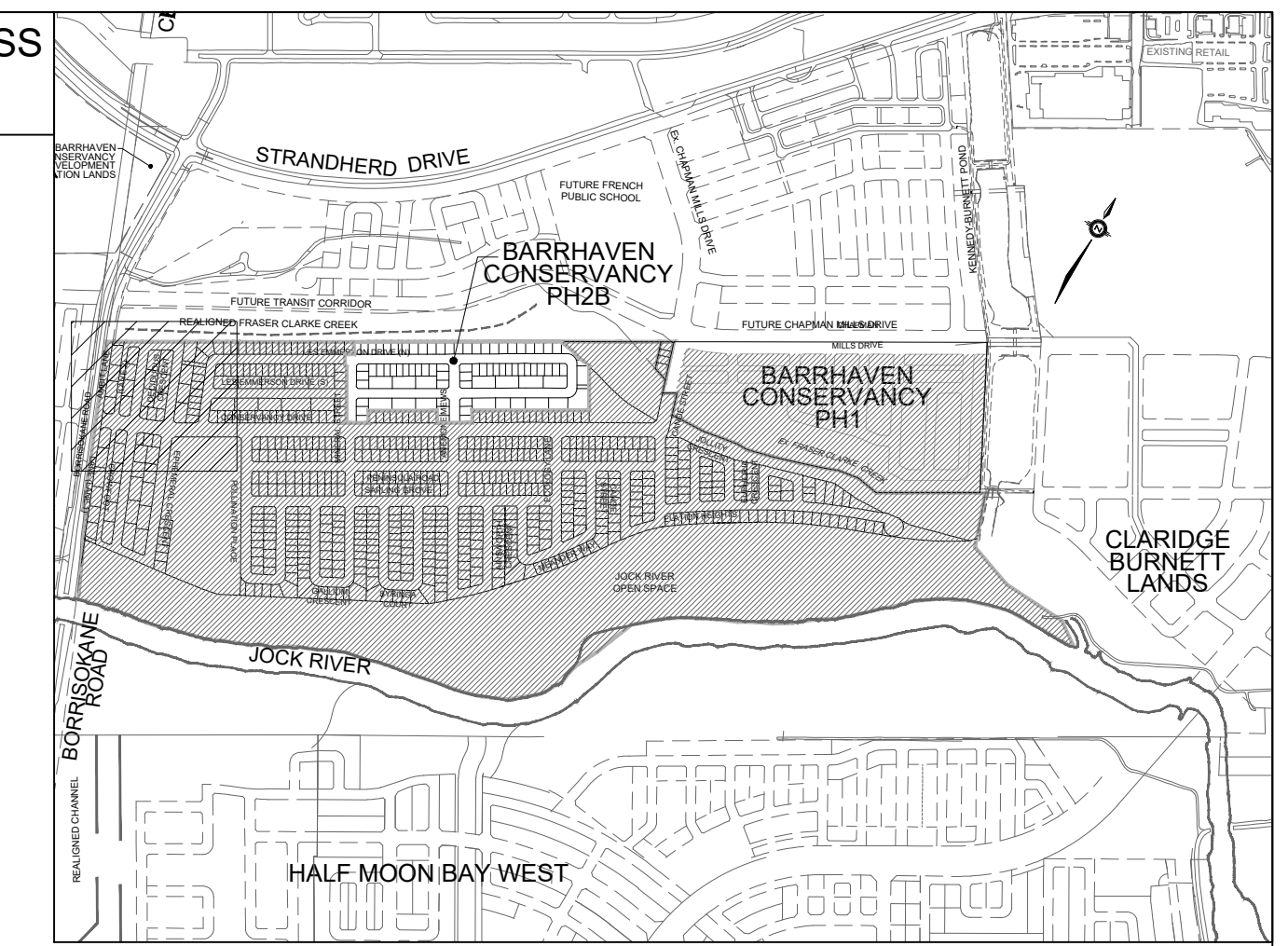
Project	PG5036 - Conservancy East, Borrisokane Road, Ottawa, ON		
Group	Figure 2A - Section B-B - Static Analysis		
Drawn By	MA	Company	Caivan Communities
Date	2024-09-25	File Name	Geotechnical Review - Lot Terracing



Project	PG5036 - Conservancy East, Borrisokane Road, Ottawa, ON		
Group	Figure 2B - Section B-B - Seismic Analysis		
Drawn By	MA	Company	Caivan Communities
Date	2024-09-25	File Name	Geotechnical Review - Lot Terracing

FIGURE 3 - PROPOSED TERRACING PLAN - SECTION A-A

ALL DWELLINGS ARE TO BE PROVIDED WITH SUMP PUMPS, UNLESS OTHERWISE NOTED. SEE DWG. 3 FOR SUMP PUMP DETAIL.



LEGEND

PROPOSED ELEVATION	103.45	OVERLAND FLOW DIRECTION	
EXISTING ELEVATION	102.73	EXTERNAL OVERLAND FLOW DIRECTION	
FUTURE ELEVATION	[93.900]	EMERGENCY OVERLAND FLOW DIRECTION	
PROPOSED SWALE GRADE	1.5%	RETAINING WALL AND ELEVATIONS	
HIGH POINT	102.16	CHAINLINK FENCE (1.5m UNLESS OTHERWISE NOTED)	
STREET CATCHBASIN		NOISE BARRIER (2.2m)	
CATCHBASIN WITH CLOSED LID		WOODEN POST AND RAIL FENCE	
TEE CATCHBASIN		CONSTRUCTION FENCE	
ELBOW CATCHBASIN		PROPERTY BOUNDARY	
HYDRANT, VALVE & VB		3:1 TERRACING MAXIMUM SLOPE	
VALVE & VC		PONDING AREA WITH SPILLWAY	
VALVE & VB		250% PVC PERFORATED PIPE (REFER TO CITY STD S29 FOR REAR YARD TRENCH AND PIPE DETAILS ONLY) (SUBDRAIN APPLIED FOR SLOPE LESS THAN 1.5%)	
BUILDING ENVELOPE		W.O.	
TOP OF FOUNDATION (TOF)		EXISTING SANITARY MAINTENANCE HOLE	
FINISHED FLOOR ELEVATION (FFE)		EXISTING STORM MAINTENANCE HOLE	
UNDERSIDE OF FOOTING ELEVATION (USF)		HYDRO SWITCHGEAR	
FRONT/REAR ENVELOPE ELEVATION (RFE)		HYDRO TRANSFORMER	
LOTS EQUIPPED WITH SUMP PUMP (REFER TO DETAIL DWG. 3)		STREET LIGHT STANDARD	
WALKOUT UNITS		TACTILE WALKING SURFACE INDICATOR (AS PER CITY OF OTTAWA STD. SC6)	
SLAB ON GRADE		LOW FLOW CHANNEL CLEANOUT (SEE FLUVIAL DESIGN DRAWINGS)	
HYDRO SWITCHGEAR		RVCA FLOODPLAIN BOUNDARY	
HYDRO TRANSFORMER		RVCA FLOODPLAIN 15m OFFSET	
STREET LIGHT STANDARD			
TACTILE WALKING SURFACE INDICATOR (AS PER CITY OF OTTAWA STD. SC6)			
LOW FLOW CHANNEL CLEANOUT (SEE FLUVIAL DESIGN DRAWINGS)			
RVCA FLOODPLAIN BOUNDARY			
RVCA FLOODPLAIN 15m OFFSET			

- NOTES:**
- ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE AUTHORITIES HAVING JURISDICTION.
 - CONTRACTOR TO VERIFY THE PRECISE LOCATIONS AND INVERT ELEVATIONS OF EXISTING UNDERGROUND SERVICES AND EX. UTILITIES PRIOR TO STARTING CONSTRUCTION.
 - ALL EXISTING ABOVE GROUND FEATURES, E.G. MH/CHAMBER COVERS, PEDESTALS, HYDRO AND LIGHT POLES, ETC. AFFECTED BY THE DEVELOPMENT TO BE ADJUSTED TO SUIT TO THE SATISFACTION OF PARTIES AFFECTED.
 - ALL EXISTING BUILDING, SHED, POST & WIRE FENCE, CHAIN LINK FENCE, TREE, UTILITY WIRE, POLE, CULVERT AND POOL WITHIN LOTS AND BLOCKS TO BE REMOVED, UNLESS OTHERWISE NOTED.
 - ALL EXISTING POST & WIRE FENCE, CULVERTS, UTILITY WIRE / POLES, TREES, SHRUBS ETC. WITHIN LOTS, BLOCKS AND ROADS TO BE REMOVED, UNLESS OTHERWISE NOTED.
 - PERMISSION REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE.
 - PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS FOR R/C/S LAYOUT & TYPICAL EASEMENT DETAIL REFER TO DRAWING No. 4.
 - A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS TO INSPECT ALL SUBGRADE SURFACES FOR FOOTING AND PAVEMENT STRUCTURES PRIOR TO CONSTRUCTION.
 - PERFORATED PIPE IS REQUIRED FOR SWALE SLOPE LESS THAN 1.5%. REFER TO CITY STD. S29, S30 FOR REAR YARD TRENCH AND PIPE DETAIL ONLY.
 - FOR CROSS SECTIONS 2-2 AND 3-3 REFER TO DRAWING No. 109.
 - ALL OUTLET CHANNEL ACCESS ROADS TO BE AT GRADE.

TOPOGRAPHIC INFORMATION
 TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-127-00, SURVEY DATED APRIL 10, 2018.

LEGAL INFORMATION
 M-PLAN PROVIDED BY J.D. BARNES, PROJECT No. 16-10-127-00, RECEIVED ON AUGUST 2, 2022, AND 16-10-127-00 (PH-2) DATED MAY 14, 2024.

ELEVATION NOTE
 ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE REFERRED TO THE PUBLISHED BENCH MARK No. 0011964U3710. ELEVATION=71.724m

No.	BY	DATE	DESCRIPTION
15	W.L.	24-05-24	REVISED PER UPDATED M-PLAN AND CUP DESIGN ON PHASE 2B
14	W.L.	24-03-12	REVISION ON PHASE 2B
13	W.L.	23-08-28	REVISED PARQUETTE GRADING PER CITY COMMENTS
12	W.L.	23-06-15	RETAINING WALL REMOVAL AT NORTHEAST END
11	W.L.	23-04-17	REVISED PER M-PLAN UPDATES
10	W.L.	23-04-14	UPDATES PER CUP COORDINATION
9	W.L.	23-03-23	GRADING REVISION AS PER CITY COMMENTS
8	W.L.	22-11-23	REVISED PER CITY'S CHANNEL/SERVICE RD/PATHWAY COMMENTS
7	W.L.	22-11-04	RETAINING WALL AND FLOODPLAIN PATHWAY/SERVICE RD UPDATES
6	W.L.	22-09-27	WATERMAN AND CUP UPDATES
5	W.L.	22-08-31	CITY COMMENTS AND TRANSPORTATION UPDATES
4	W.L.	22-08-10	REVISED STREET NAME & LOT 99 SIGHT TRIANGLE
3	W.L.	22-06-28	3rd SUBMISSION
2	W.L.	22-04-22	2nd SUBMISSION
1	W.L.	21-12-22	1st SUBMISSION

CITY OF OTTAWA

PROJECT No. 20-1180

GRADING PLAN

BARRHAVEN CONSERVANCY DEVELOPMENT CORPORATION

BARRHAVEN CONSERVANCY EAST PHASE 2, 3 & JOCK RIVER

DSEL

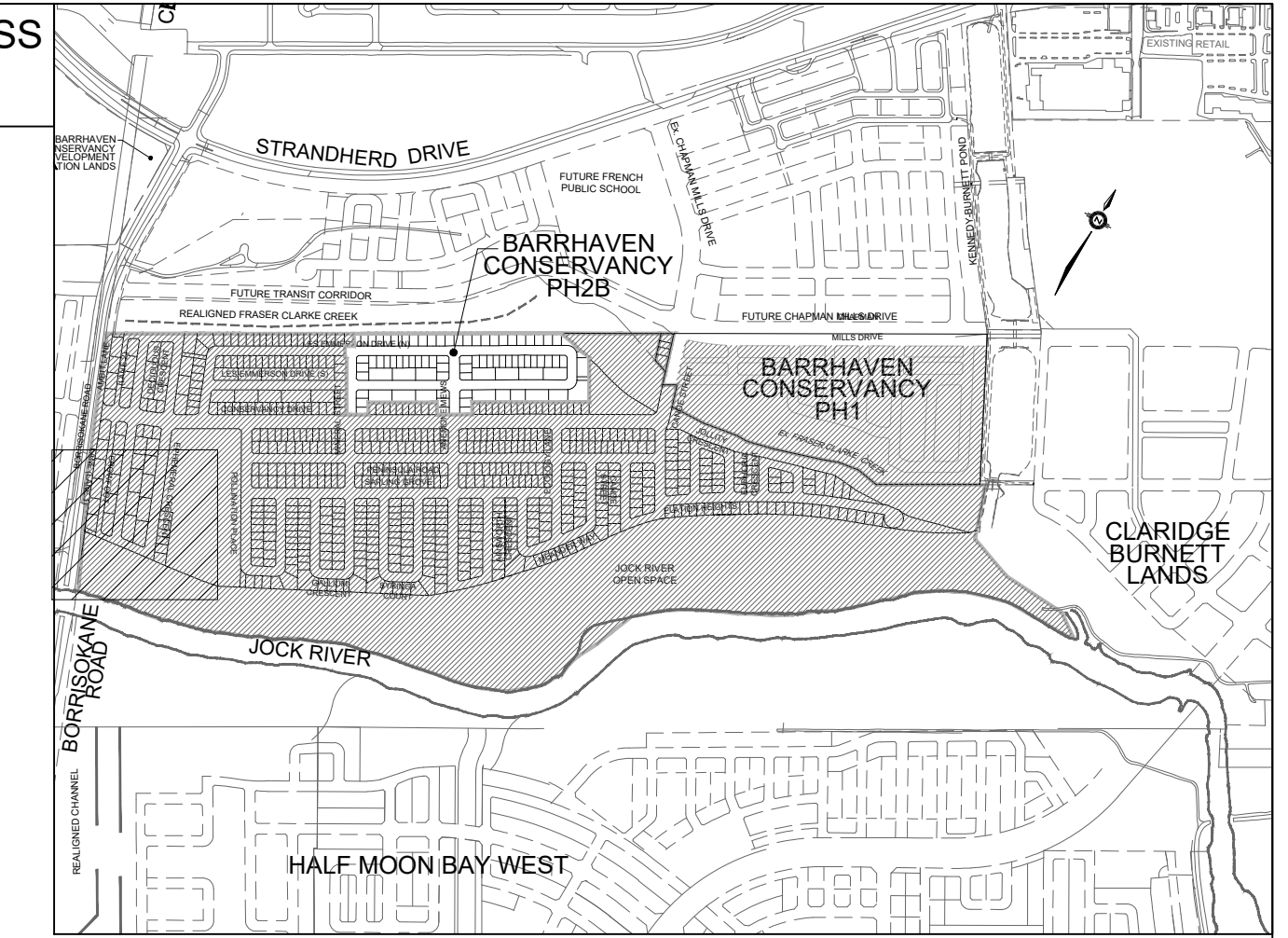
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DRAWN BY: A.K./R.A./V.W. CHECKED BY: W.L. SHEET No. 93
 DESIGNED BY: W.L. CHECKED BY: C.M.
 SCALE: 1:500 DATE: DECEMBER 2021

CITY PLAN No. 18754
 CITY FILE No. D07-16-20-0021

FIGURE 4 - PROPOSED TERRACING PLAN - SECTION B-B

ALL DWELLINGS ARE TO BE PROVIDED WITH SUMP PUMPS, UNLESS OTHERWISE NOTED. SEE DWG. 3 FOR SUMP PUMP DETAIL.



LEGEND

PROPOSED ELEVATION	103.45	OVERLAND FLOW DIRECTION	
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HIGH POINT	>102.16	CHAINLINK FENCE (1.5m UNLESS OTHERWISE NOTED)	
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CATCHBASIN MANHOLE		CONSTRUCTION FENCE	
TEE CATCHBASIN		PROPERTY BOUNDARY	
ELBOW CATCHBASIN		3:1 TERRACING MAXIMUM SLOPE	
HYDRANT, VALVE & VB		PONDING AREA WITH SPILLWAY ELEVATION	
VALVE & VC		250% PVC PERFORATED PIPE (REFER TO CITY STD S29 FOR REAR YARD TRENCH AND PIPE DETAILS ONLY) (SUBDRAIN APPLIED FOR SLOPE LESS THAN 1.5%)	
VALVE & VB		W.O.	
BUILDING ENVELOPE (TOP OF FOUNDATION (TOF))		EXISTING SANITARY MAINTENANCE HOLE	
FINISHED FLOOR ELEVATION (FFE)		EXISTING STORM MAINTENANCE HOLE	
UNDERSIDE OF FOOTING ELEVATION (USF)		FIREWALL	
FRONT/REAR ENVELOPE ELEVATION (USE)		RETAINING WALL (SEE NOTES ON DWG. 1 AND STRUCTURAL DWG'S FOR DETAIL)	
LOTS EQUIPPED WITH SUMP PUMP (REFER TO DETAIL DWG. 3)		100% W.L.	
WALKOUT UNITS		LOW FLOW CHANNEL CLEANOUT (SEE FLUVIAL DESIGN DRAWINGS)	
SLAB ON GRADE		RVCA FLOODPLAIN 15m OFFSET	
HYDRO SWITCHGEAR			
HYDRO TRANSFORMER			
STREET LIGHT STANDARD			
TACTILE WALKING SURFACE INDICATOR (AS PER CITY OF OTTAWA STD. SC6)			

DWG # 97

NOTES:

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- FOR CROSS SECTION 1-1 REFER TO DRAWING No. 109.
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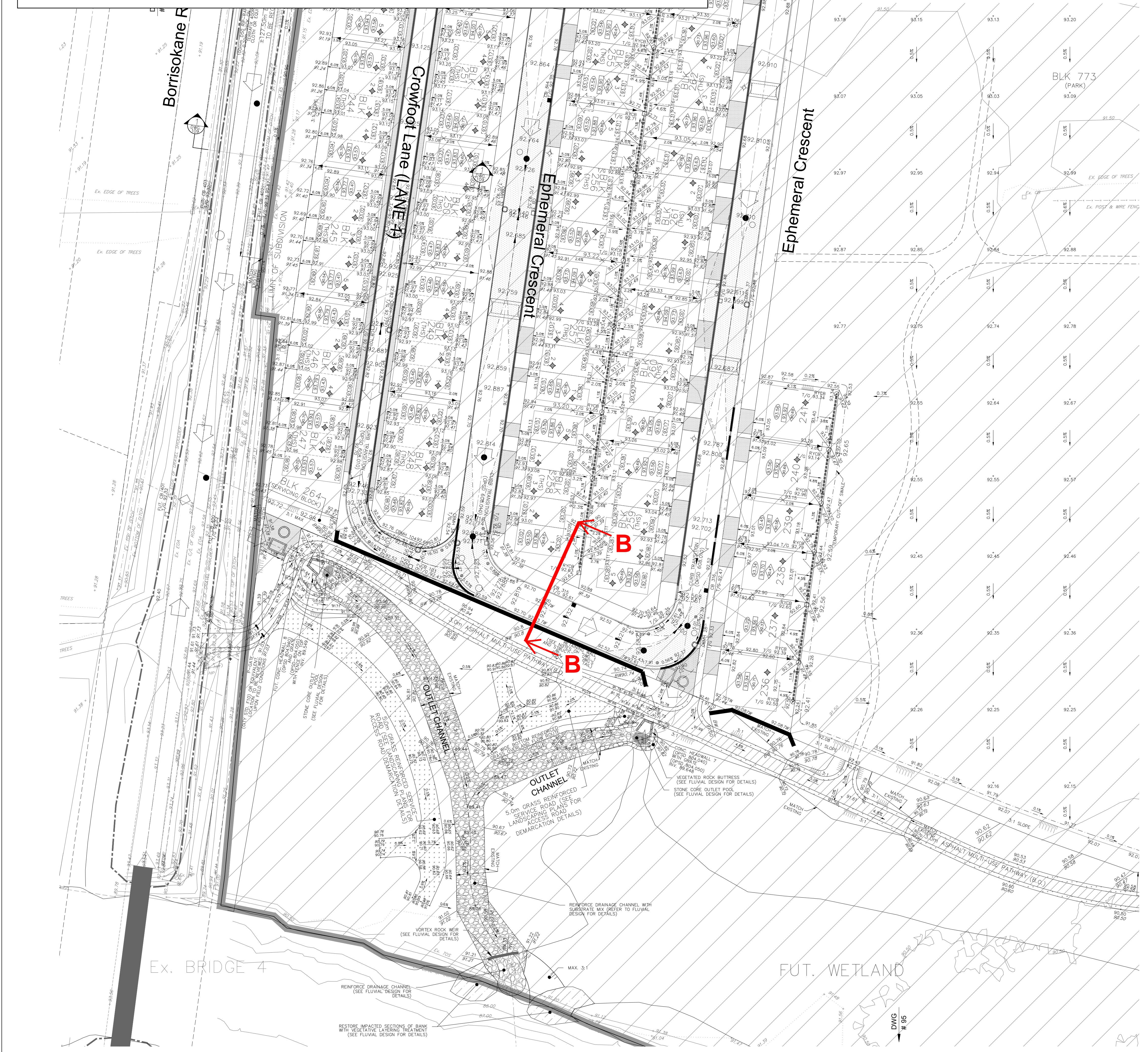
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3	W.L.	22-06-28	3rd SUBMISSION
2	W.L.	22-04-22	2nd SUBMISSION
1	W.L.	21-12-22	1st SUBMISSION

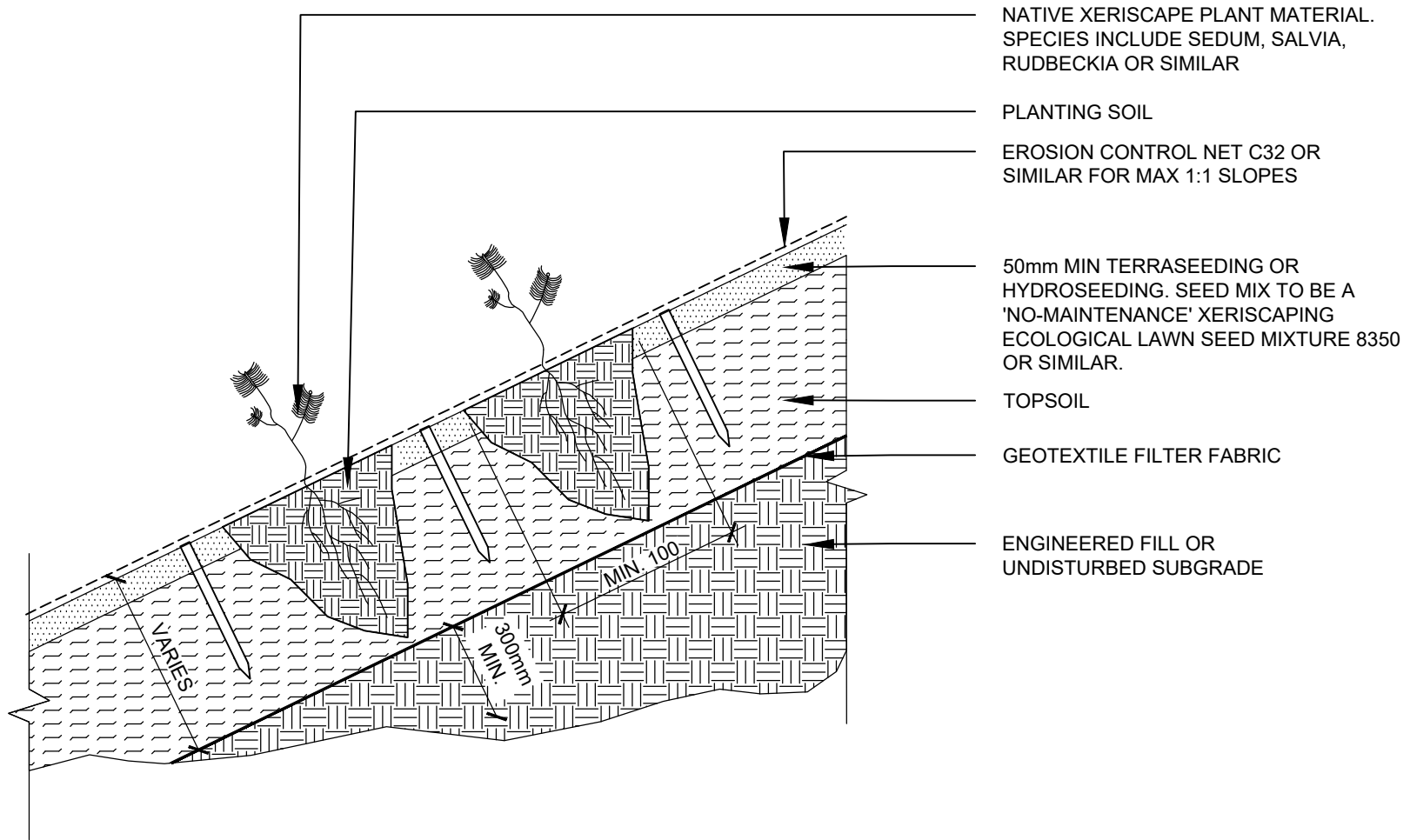
CITY OF OTTAWA

PROJECT No. 20-1180

GRADING PLAN

BARRHAVEN CONSERVANCY DEVELOPMENT CORPORATION	BARRHAVEN CONSERVANCY EAST PHASE 2, 3 & JOCK RIVER
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DESIGNED BY: W.L.	CHECKED BY: C.M.
SCALE: 1:500	DATE: DECEMBER 2021
	SHEET NO. 94





1
SK1

SLOPE SEEDING AND PLANTING

SCALE NTS