DEVELOPMENT PERMIT NO. DP-2024-05

Subject Property:	725 Canada Avenue
Legal Description:	LOT A (DD ED130010), SECTION 18, RANGE 6, QUAMICHAN DISTRICT, PLAN 5481
PID:	016-959-621
Property Owner:	1406559 BC Ltd.
Applicant:	Nilesh Tanna
File Number:	3060-20-DP-2024-05
DPA:	DPA 1 – Design Standards, DPA 3 – Natural Hazards
Proposal:	2-Storey Mixed Use Building

CONDITIONS OF PERMIT

General Conditions

1. This permit is issued subject to compliance with all City bylaws and provincial and federal laws.

2. This permit applies only to the subject property identified on this permit (the "Land").

Authorized Development

3. Authorized development on the Land is limited to the construction of a two storey mixed use building.

4. The Land must only be used and developed in accordance with this permit, including the following schedules:

SCHEDULE 1:	Architectural Plans
SCHEDULE 2:	Landscape Plans
SCHEDULE 3:	Geotechnical Report

Variances

5. This permit includes the following variances:

   (a) Zoning Bylaw No. 3166, 2017, Section 3.34.1, by waiving the requirement to provide a minimum of one (1) off-street loading space; and

   (b) Works and Services Bylaw No. 3158, 2017, Section 4.1, by waiving the requirement to provide works and services for the proposed development along the Canada Avenue frontage of the subject property, including extension of sewage collection and drainage works, construction of highway works, and a financial contribution in lieu of undergrounding overhead hydro and telecommunications utilities. For clarity, this does not include onsite stormwater management or water, storm, or sanitary sewer service connections and related infrastructure necessary for servicing the development.

6. The variances granted under this permit are for the authorized development only. The variances do not apply to future development or redevelopment of the Land.

Landscaping

7. Detailed landscape plans must be provided to the City with a building permit application. The detailed landscape plans must be consistent with the architectural and landscape plans in **SCHEDULES 1** and **2** of this permit.

8. A landscape security must be provided to the City prior to the issuance of a building permit. The amount of the security is 125% of the estimated cost of all landscaping, with the estimate to be approved by a Landscape Architect. The landscape security must be in a form acceptable to the City.

Public Art

9. Public art is proposed as an element of the development design. Prior to issuance of a building permit, the proposed design and installation method for the public art must be provided to the Director of Planning and Sustainability for consideration of approval. The Director may seek external advice on the proposed design (e.g. art panel). In order to secure the commitment to provide public art, a deposit must be made to the City prior to issuance of the building permit, with the deposit amount equivalent to 0.1% of the building permit construction value, as determined by the City's Building Official. If the public art is not installed prior to an application to the City's Building Official for occupancy of the building, the City may use the deposit for undertaking and installing public art elsewhere in Duncan.

10. As an alternative to including public art in the development design, a financial contribution for public art may be provided to the City. The financial contribution must be equivalent to 0.1% of the building permit construction value, as determined by the City's Building Official. If this option is selected, the financial contribution must be provided prior to issuance of the building permit.

Energy Efficiency

11. The development must be designed and constructed to meet Step 4 of the BC Energy Step Code.

Solar Energy

12. The development must be designed and constructed to include the installation of solar photovoltaic panels on the roof of the building sufficient to supply at least 10% of the energy requirements of the development.

13. A Section 219 *Land Title Act* covenant to secure the solar energy requirements must be registered on the title of the Land prior to issuance of a building permit.

Electric Vehicle Charging

14. The development must include at least one Level-2 electric vehicle charging station and at least two of the remaining parking spaces equipped with a regular outlet for potential electric vehicle charging.

Signage

15. Signage must conform to the City's sign bylaw, except as otherwise supplemented or authorized by this permit.

16. The maximum sign area of all fascia signs combined is 5 m^2 and the maximum number of fascia signs is four, provided that only one sign denotes the name of the business and the other signs are permitted to be the business logo or to denote the general nature of the business and the types of products or services offered.

17. Lettering and logos for fascia signs must be individual channel lettering signage. Only the individual letters or logos may be illuminated. Box ('can') signage is prohibited.

Lane Statutory Right-of-Way

18. A 1.0 m wide statutory right-of-way, including a reference plan, must be registered along the rear lane frontage of the Land prior to issuance of a building permit. The lane widening area must be paved.

Geotechnical

19. The Land must be developed in accordance with the geotechnical report in **Schedule 3** of this permit or as directed by a registered, qualified Professional Engineer or Geoscientist.

20. A Section 219 *Land Title Act* covenant, including the geotechnical report and save-harmless clause in favour of the City, must be registered on title of the Land prior to issuance of a building permit and include the following requirements:

    (a) installation and continued maintenance and operation of a high water level alarm;

    (b) posting of flood hazard egress procedures at building entrances and exits; and

    (c) all major fixed equipment, including major electrical switchgear, ventilation systems, heating systems, and hot water tanks that are integral to and necessary for the functioning of a building, pursuant to the BC Building Code, being located above the FCL, or otherwise protected and secured in accordance with the recommendations of a Professional Engineer or Geoscientist.

Development Permit Issuance and Expiry

16. This permit will expire two years from the date of issuance unless construction, in accordance with the terms and conditions of this permit, has substantially started. Construction is considered to be substantially started when a valid building permit for the authorized development has been issued and remains valid, and excavation or construction works associated with the authorized development have commenced to the satisfaction of the Director of Planning and Sustainability. Demolition does not constitute construction.

This permit was issued by Council on June 17, 2024

This permit expires on June 17, 2026

The City of Duncan

____

Corporate Officer

I HEREBY CERTIFY that I have read the terms and conditions of the Development Permit contained herein. I understand and agree that the City of Duncan has made no representations, covenants, warranties, guarantees, promises, or agreements (verbal or otherwise) with the registered property owner, other than those contained in this Permit.

______________________________	______________________________
Owner/Agent (signature)	Witness (signature)
______________________________	______________________________
Print Name	Print Name
______________________________	______________________________
Date	Date

SCHEDULE 1

Architectural Plans

IGEL ARCH

igel-arch.com

405 Prior Street,
Vancouver, BC
V6A 2G3

P 778.839.4260
E aigel@igel-arch.com

PROJECT:
DEVELOPMENT PERMIT

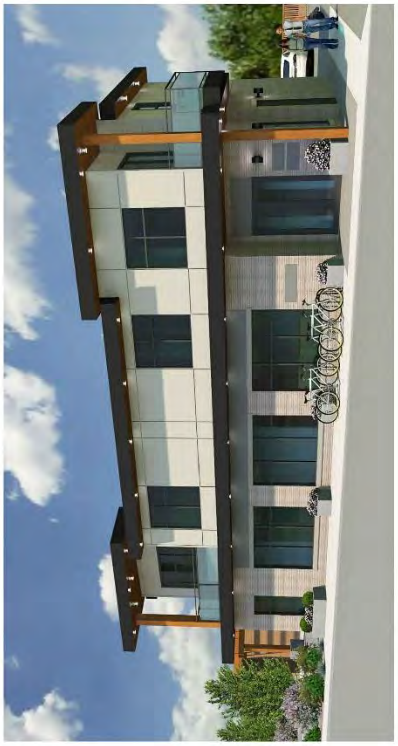
725 CANADA AVENUE,
DUNCAN, BC

SHEET TITLE:
3D RENDERINGS

PRINT DATE 04/25/24	PROJECT NO. 21151
SCALE AS SHOWN	
DRAWING NO. A0.1	REVISION

NORTH VIEW
SCALE: 1/4"=1'-0"

SOUTH VIEW
SCALE: 1/4"=1'-0"

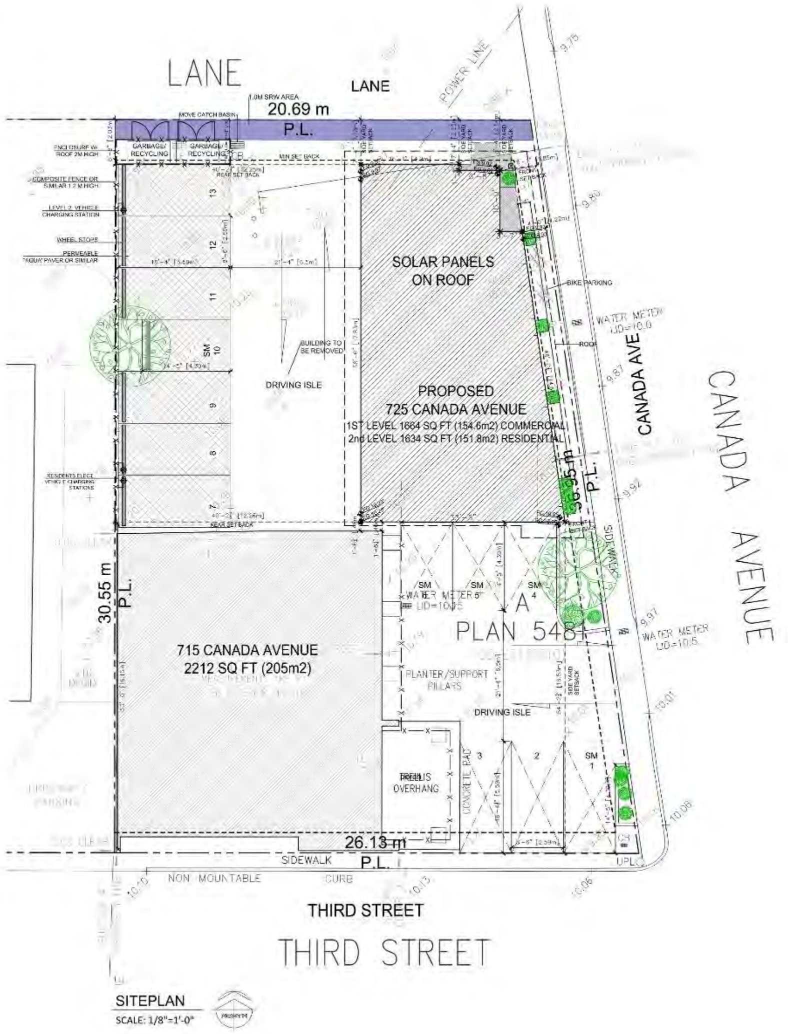


EAST (FRONT) VIEW
SCALE: 1/4"=1'-0"

WEST (REAR) VIEW
SCALE: 1/4"=1'-0"

ZONING INFORMATION

ADDRESS:	725 CANADA AVENUE, DUNCAN, BC		
PID:	016-959-621		
LEGAL DESCRIPTION:	Lot A (DD ED 130010), SECTION 16, RANGE 6, QUAMICHAN DISTRICT, PLAN 5481		
ZONE:	DTC-Downtown Comprehensive Zone		
SITE AREA:	855 SM / 9,203 SF		
PROPOSED BUILDING FOOTPRINT:	306.4 SM / 3,298 SF		
PROPOSED SITE COVERAGE:	42.2% (95% ALLOWED)		
SETBACKS:			
	ALLOWED	PROPOSED	
EAST (FRONT)	1.0M	1.2M	
SOUTH (SIDE)	0M	0M	
WEST (REAR)	0M	0M	
NORTH (SIDE)	2.0M	2.2M	
PARKING CALCULATIONS:			
PHARMACY RETAIL AREA:	155.7 SM (1 PER 30SM)	-	5.2 SPACES
TWO RESIDENTIAL UNITS:			2 PER UNIT
EXISTING OFFICE BUILDING:	205 SM (1 PER 30SM)	-	6.8 SPACES
TOTAL REQUIRED SPACES:			14 SPACES (13 PROVIDED)



IGELARCH

igel-arch.com

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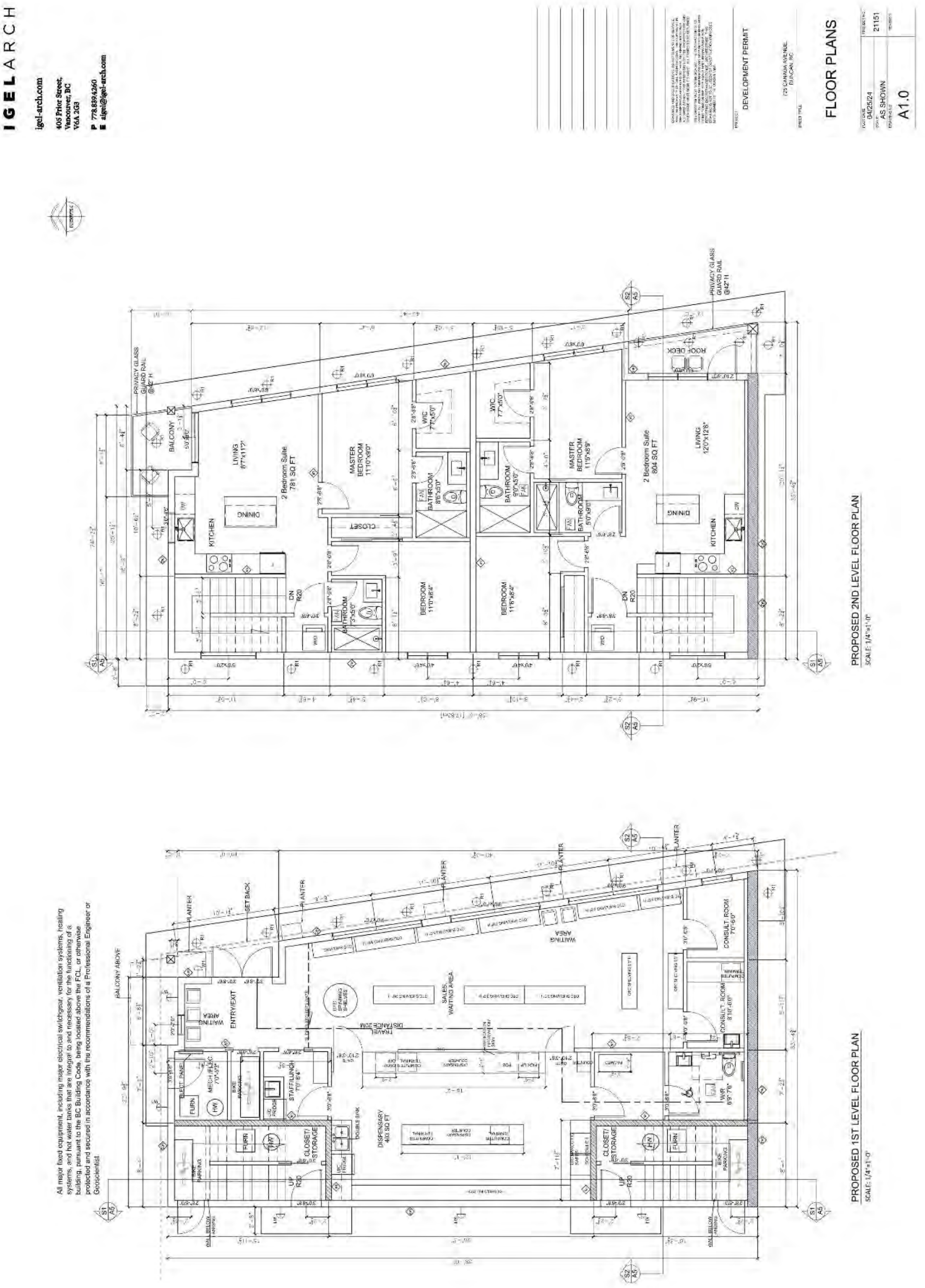
E aigel@igel-arch.com

PROJECT:
DEVELOPMENT PERMIT

725 CANADA AVENUE,
DUNCAN, BC

SHEET TITLE:
SITE PLAN

PLOT DATE: 04/25/24	PROJECT NO. 21151
SCALE: AS SHOWN	
DRAWING NO. A0.2	REVISION


IGEL ARCH
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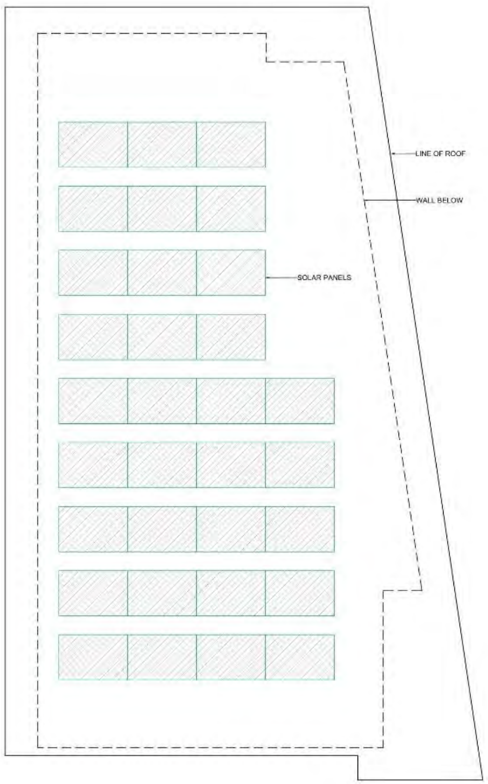
405 Prior Street,
Vancouver, BC
V6A 2G8
P 778.839.4260
E sigel@igel-arch.com
PROJECT
DEVELOPMENT PERMIT
725 CANADA AVENUE
DUNCAN, BC
SHEET TITLE
FLOOR PLANS
PLOT DATE
04/25/24
PROJECT NO.
21151
SCALE
AS SHOWN
DRAWING NO.
A1.0
PROPOSED 2ND LEVEL FLOOR PLAN
SCALE: 1/4"=1'-0"
PRIVACY GLASS GUARD RAIL @42"H
ROOF DECK
BALCONY
LIVING
2 Bedroom Suite 781 SQ FT
2 Bedroom Suite 804 SQ FT
MASTER BEDROOM
WIC
BATHROOM
DINING
KITCHEN
CLOSET
BEDROOM
DN R20
W/D
PROPOSED 1ST LEVEL FLOOR PLAN
SCALE: 1/4"=1'-0"
All major fixed equipment, including major electrical switchgear, ventilation systems, heating systems, and hot water tanks that are integral to and necessary for the functioning of a building, pursuant to the BC Building Code, being located above the FCL, or otherwise protected and secured in accordance with the recommendations of a Professional Engineer or Geoscientist.
BALCONY ABOVE
PLANTER
SET BACK
ENTRY/EXIT
WAITING AREA
SALES WAITING AREA
TRAVEL DISTANCE 20M
CONSULT. ROOM
W/R
DISPENSARY 403 SQ FT
STAFF/LUNCH
MECH. ROOM
ELECT. PANEL
FURN
HW
CLOSET/ STORAGE
UP R20
BIKE PARKING
DOUBLE SINK
COUNTER



PROPOSED ROOF/ SOLAR PANELS PLAN
SCALE: 1/4"=1'-0"

IGELARCH

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PROJECT
DEVELOPMENT PERMIT

725 CANADA AVENUE,
DUNCAN, BC

SHEET TITLE
FLOOR PLANS

PLOT DATE 04/25/24	PROJECT NO. 21151
SCALE AS SHOWN	
DRAWING NO. A1.1	REVISION

IGELARCH

igel-arch.com

405 Prior Street,
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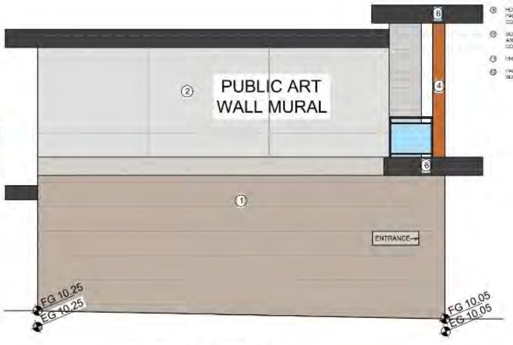
EXTERIOR FINISHES LEGEND

- ① PACIFIC PEARL BRICK VENEER CLADDING
- ② NAVAJO BEIGE HARDIE BOARD SIDING
- ③ NAVAJO BEIGE HORIZONTAL HARDIE LAP SIDING
- ③a WOOD IMITATION VERTICAL LAP SIDING
- ④ TIMBER POST
- ⑤ WOOD SOFFIT
- ⑥ DARK CHARCOAL PAINTED WOOD FASCIA
- ⑦ MATTE BLACK WALL SCONCE
- ⑧ STOREFRONT FRAMING W/ CLEAR GLAZING COLOUR: KAWNEER PERMAFLUOR - CHARCOAL
- ⑧a RESIDENTIAL SLIDING WINDOWS W/ CLEAR GLAZING COLOUR: KAWNEER PERMAFLUOR - CHARCOAL
- ⑨ HOLLOW METAL DOOR AND FRAMING WITH PAINTED FINISH COLOUR: CHARCOAL
- ⑩ SOLID CORE RESIDENTIAL ENTRY WOOD DOOR AND FRAMING WITH PAINTED FINISH COLOUR: CHARCOAL
- ⑪ PRIVACY GLASS GUARDRAIL TOP MOUNTED
- ⑫ PAINTED LIGHT GREY CONCRETE BLOCK (FIRE WALL), PUBLIC ART MURAL

EAST (FRONT) ELEVATION

SCALE: 1/4"=1'-0"



SOUTH (SIDE) ELEVATION

SCALE: 1/4"=1'-0"

BUILDING FACE: 1250.4 SQ.FT. (116.5 m2)
LIMITING DISTANCE: 6 m
ALLOWED UNPROTECTED OPENING: 30% 375.12 SQ FT(34.85m2) (BCBC 3.2.3.1.-B)
PROPOSED UNPROTECTED OPENING: 59SQ FT (5.5 m2)

WEST (REAR) ELEVATION

SCALE: 1/4"=1'-0"

BUILDING FACE: 565 SQ.FT. (52.5 m2)
LIMITING DISTANCE: 2.5 m
ALLOWED UNPROTECTED OPENING: 12% 67.8 SQ FT(6.3m2) (BCBC 3.2.3.1.-B)
PROPOSED UNPROTECTED OPENING: 67.5 SQ FT (6.2 m2)

NORTH (SIDE) ELEVATION

SCALE: 1/4"=1'-0"

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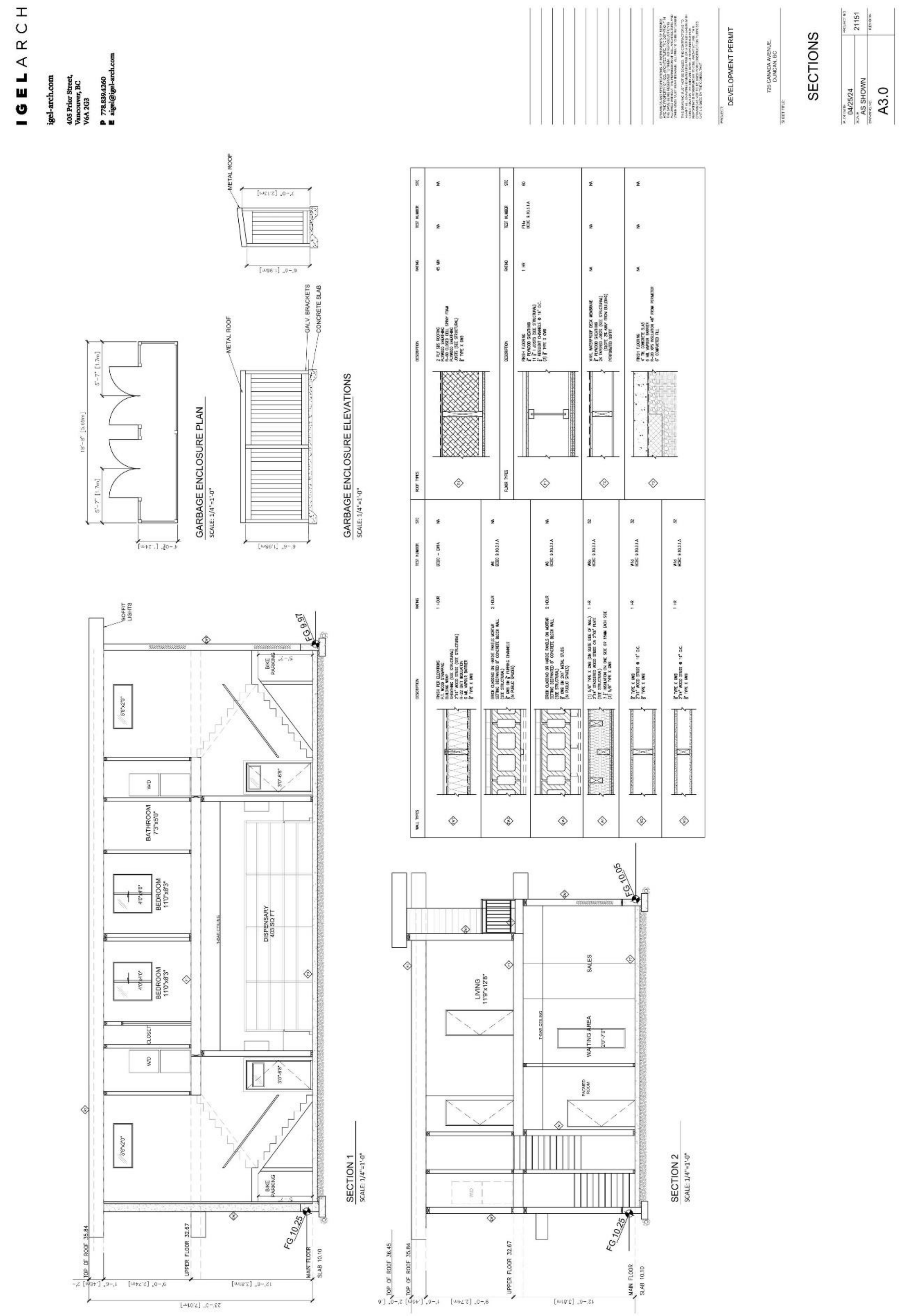
PROJECT:
DEVELOPMENT PERMIT

725 CANADA AVENUE,
DUNCAN, BC

SHEET TITLE:
EXTERIOR
ELEVATIONS

PLOT DATE: 04/25/24	PROJECT NO.: 21151
SCALE: AS SHOWN	
DRAWING NO.: A2.0	REVISION:


IGEL ARCH
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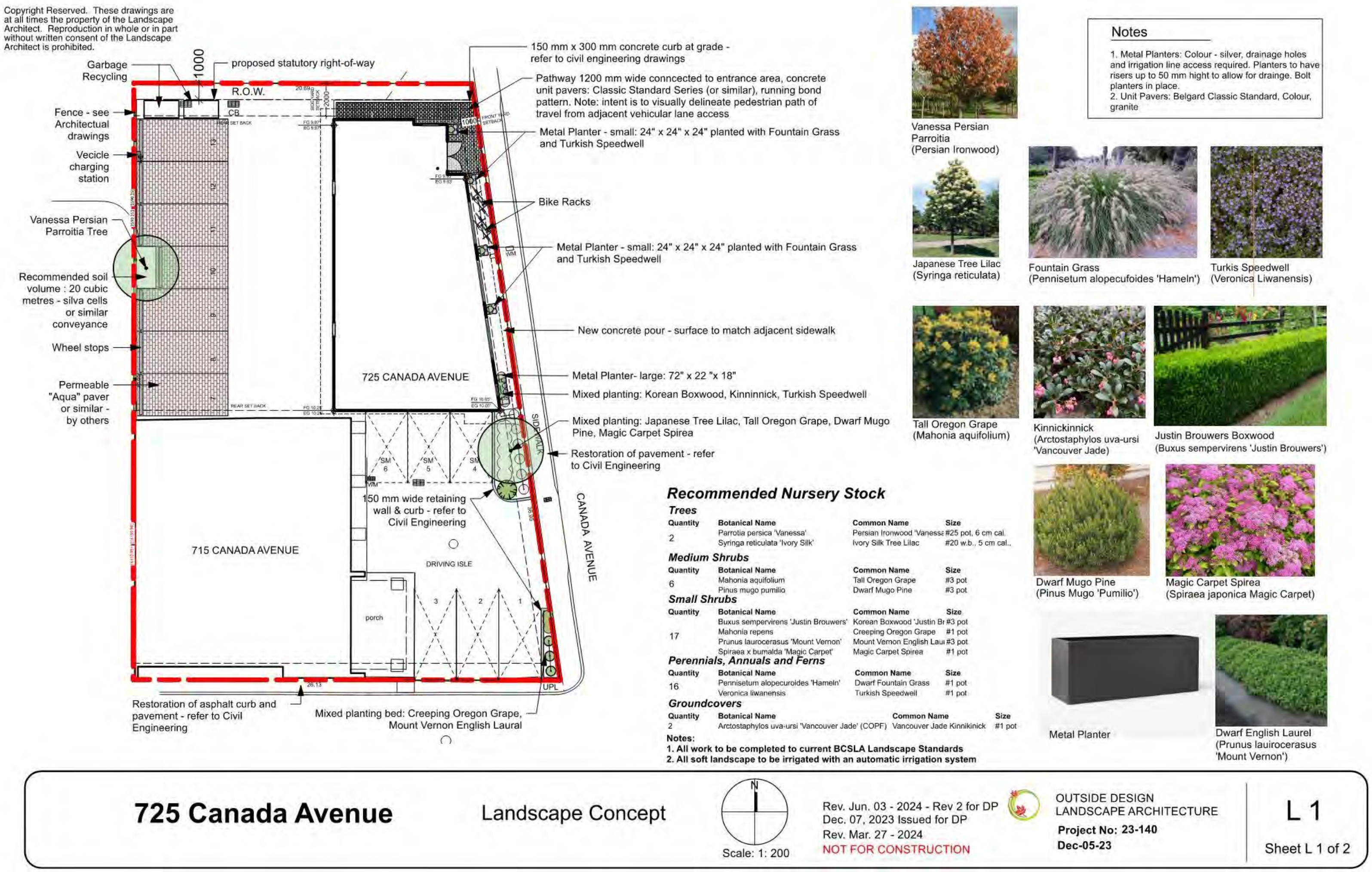
GARBAGE ENCLOSURE PLAN
SCALE: 1/4"=1'-0"
GARBAGE ENCLOSURE ELEVATIONS
SCALE: 1/4"=1'-0"
METAL ROOF
GALV BRACKETS
CONCRETE SLAB
SECTION 1
SCALE: 1/4"=1'-0"
SECTION 2
SCALE: 1/4"=1'-0"
BATHROOM 7'3"x5'0"
BEDROOM 11'0"x8'3"
DISPENSARY 403 SQ FT
LIVING 11'9"x12'8"
SALES
WAITING AREA
CLOSET
W/D
BIKE PARKING
SOFFIT LIGHTS
TOP OF ROOF 35.84
TOP OF ROOF 36.45
UPPER FLOOR 32.67
MAIN FLOOR
SLAB 10.10
FG 10.25
FG 9.97
FG 10.05
WALL TYPES
ROOF TYPES
FLOOR TYPES
PROJECT:
DEVELOPMENT PERMIT
725 CANADA AVENUE,
DUNCAN, BC
SHEET TITLE:
SECTIONS
PLOT DATE
04/25/24
SCALE
AS SHOWN
DRAWING NO.
A3.0
PROJECT NO.
21151
REVISION

SCHEDULE 2

Landscape Plans



Notes

1. Metal Planters: Colour - silver, drainage holes and irrigation line access required. Planters to have risers up to 50 mm hight to allow for drainge. Bolt planters in place.
2. Unit Pavers: Belgard Classic Standard, Colour, granite

Recommended Nursery Stock

Trees

Quantity	Botanical Name	Common Name	Size
2	Parrotia persica 'Vanessa'	Persian Ironwood 'Vanessa	#25 pot, 6 cm cal.
	Syringa reticulata 'Ivory Silk'	Ivory Silk Tree Lilac	#20 w.b., 5 cm cal.,

Medium Shrubs

Quantity	Botanical Name	Common Name	Size
6	Mahonia aquifolium	Tall Oregon Grape	#3 pot
	Pinus mugo pumilio	Dwarf Mugo Pine	#3 pot

Small Shrubs

Quantity	Botanical Name	Common Name	Size
17	Buxus sempervirens 'Justin Brouwers'	Korean Boxwood 'Justin Br	#3 pot
	Mahonia repens	Creeping Oregon Grape	#1 pot
	Prunus laurocerasus 'Mount Vernon'	Mount Vernon English Laui	#3 pot
	Spiraea x bumalda 'Magic Carpet'	Magic Carpet Spirea	#1 pot

Perennials, Annuals and Ferns

Quantity	Botanical Name	Common Name	Size
16	Pennisetum alopecuroides 'Hameln'	Dwarf Fountain Grass	#1 pot
	Veronica liwanensis	Turkish Speedwell	#1 pot

Groundcovers

Quantity	Botanical Name	Common Name	Size
2	Arctostaphylos uva-ursi 'Vancouver Jade' (COPF)	Vancouver Jade Kinnikinick	#1 pot

Notes:

1. All work to be completed to current BCSLA Landscape Standards

2. All soft landscape to be irrigated with an automatic irrigation system

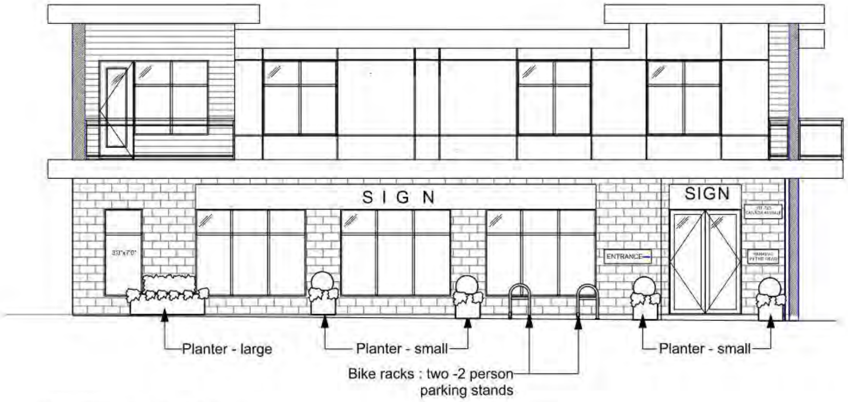
725 Canada Avenue

Landscape Concept

Rev. Jun. 03 - 2024 - Rev 2 for DP
Dec. 07, 2023 Issued for DP
Rev. Mar. 27 - 2024
NOT FOR CONSTRUCTION

OUTSIDE DESIGN
LANDSCAPE ARCHITECTURE
Project No: 23-140
Dec-05-23

L 1
Sheet L 1 of 2



1 L-2 East (Front) Elevation
Scale: 1:100

Bike Rack

Jun. 03, 2024 Issued Rev for DP
Dec. 07, 2023 Issued for DP

NOT FOR CONSTRUCTION

725 Canada Avenue

Elevation

OUTSIDE DESIGN
LANDSCAPE ARCHITECTURE
Project No: 23-140
Dec-05-23

L 2

Sheet 2 of 2

SCHEDULE 3
Geotechnical Report

RYZUK GEOTECHNICAL
Engineering & Materials Testing

6-40 Cadillac Ave, Victoria, BC, V8Z 1T2 Tel: 250-475-3131 E-mail: mail@ryzuk.com www.ryzuk.com

August 25, 2023
Revised: June 3, 2024
File No: 11762-1

Neel Tenna
821 Canada Avenue
Duncan, BC
V9L 1V2

Attn: Neel Tanna (By Email: nileshtannarx@gmail.com)

Re: Proposed Commercial Building
715 & 725 Canada Avenue – Duncan, BC

We completed a subsurface investigation at the referenced site on July 26, 2023, and submitted our August 25, 2023, report summarizing the results of our investigation and our associated recommendations related to the proposed development. From our recent correspondence and review of the City of Duncan's (City) Application Review letter, dated May 23, 2024, we understand that the City has recommended that this report be updated to specify a specific Flood Construction Level for the property. We also note that the 2024 British Columbia Building Code (BCBC) has come into effect as of March 8, 2024, following the submission of our original August 2023 report. The following report supersedes our original report. Our work in this regard has been completed in accordance with our proposal issued on July 21, 2023.

PROPOSED DEVELOPMENT

The site is bounded by commercial properties to the north/west, Canada Avenue to the east, and Third Street to the south. The site currently hosts two connected single level, at-grade commercial buildings on the north and south halves of the property, respectively, with paved parking at the site's northwest and southeast corners.

From our correspondence and review of Constance Nikiforova's Site Plan drawing, dated April 4, 2023 (which we have attached for reference), and Igel Architecture Ltd.'s architectural drawings, dated March 3, 2023, we understand that the proposed development would consist of the removal of the north building on 725 Canada Avenue and the construction of an at-grade, two storey building and a parking lot at the northwest corner of the property. The lower level of the proposed building would be used as commercial space, while the upper level would be used for residential purposes. The architectural drawings show that the main floor slab elevation of the commercial space is 10.07 m geodetic (m geo.). We understand the south building will be retained and possibly renovated/retrofitted.

INVESTIGATION PROCEDURE

Our geotechnical investigation consisted of an office-based desktop study and an on-site geotechnical subsurface investigation. Our desktop study included a review of available aerial/satellite imagery, surficial geological mapping, groundwater well logs taken from the British Columbia Groundwater Wells and Aquifers Registry, groundwater monitoring well information taken from Thurber Engineering Ltd.'s Phase 1 and 2 water level monitoring study of Ducan (as summarized in their Water Level Monitoring – Phase 2 memorandum, dated October 25, 2023), flood mapping, and historical file information from our past work in the area.

Our subsurface investigation consisted of advancing one test hole (TP23-01) to a desired depth of 21.9 m below ground surface (mbgs) in the rear parking lot of 725 Canada Avenue. TH23-01 was advanced using a track-mounted sonic drill rig supplied and operated by Drillwell Enterprises Ltd. Prior to any ground disturbance, a BC One Call was submitted, and the test hole location was cleared by a third-party private utility locator. To measure the groundwater level at the site, a ground monitoring well was installed down to a depth of about 4.5 m at the TH23-01 location. The location of TH23-01 is shown on the attached Test Hole Location Plan for reference.

Soils were visually logged using the Modified Unified Soil Classification System (MUSCS), and continuous soil sampling/testing was completed. Soil sampling consisted of collecting representative disturbed samples at regular intervals (and where soil conditions changed) to confirm the soil classification and for laboratory testing. Standard Penetration Testing (SPT) was undertaken to assess the relative density/consistency of the subsurface soils. SPT was generally completed at 1.5 m depth intervals from 1.5 mbgs to 15.25 mbgs and at 3.0 m depth intervals from 15.25 mbgs to 21.9 mbgs.

While not completed during our site investigation, the SPT Hammer Efficiency of the drill rig used was previously tested by Ryzuk Geotechnical on January 4, 2023, and was found to vary from 73.9% to 77.3%, with an average of 75.9%. Laboratory testing was limited to determining fines content for several cohesionless soil samples and an Atterberg Limit test for soil samples taken in the encountered silt and clay layers. The soil stratigraphy, in-situ testing, and laboratory results are shown in the attached Test Hole Log. The Atterberg Limit testing results are included attached separately.

SURFACE AND SUBSURFACE CONDITIONS

Surficial geology mapping indicated that the site's subsurface soils would consist of up to 1.5 m of a shore, deltaic, and fluvial deposit associated with the Salish Sediments over a deltaic deposit associated with the Capilano Sediments. Both deposits are composed of sands, gravels, silts, and clays. However, the older Capilano sediments are commonly terraced and predominately comprised of variable layers of sand/gravel. From our geological knowledge of the area, the density of the native sand and gravel in the vicinity of the property is typically loose to compact (as determined by SPT), although deposits of dense to very dense sand and gravel have been encountered as well. Accordingly, we expected that the subsurface soils may be susceptible to liquefaction. Our comments on liquefaction are summarized in the Liquefaction section of this report.

The Surficial geology mapping and our considerable experience with nearby projects also suggested that a layer of peat may be present near surface. A groundwater well located approximately 300 m north of the site showed a groundwater table of roughly 1 mbgs, while several groundwater monitoring wells located 500 m or more to the south showed a groundwater table ranging between roughly 2 mbgs to 5 mbgs. The underlying bedrock in the area is inferred to be of the Nanaimo Group, which consists of sedimentary rock.

During our investigation, the site topography was observed to be level to very gently sloping towards the northwest. The provided Site Plan shows that the geodetic elevation of the site is approximately 10 m. The surficial site terrain was generally observed to be paved outside the footprint of the existing building, and no significant cracking was noted on the asphalt surface or exterior of the existing buildings.

The subsurface conditions encountered were generally consistent with the anticipated conditions from our desktop study. From the surface, the subsurface stratigraphy observed during our investigation comprised approximately 100 mm of asphalt atop variable non-select fills down to about 1.2 mbgs. Below this layer, the subsurface stratigraphy consisted of the layers of mineral soil detailed in Table 1.

Table 1: TH23-01 Soil Stratigraphy

Depth Range (mbgs)	Soil Description
1.2 to 1.8	Silt – clayey, some sand, trace gravel, medium plasticity, very stiff, damp
1.8 to 3.7	Sand and Gravel Layers– some cobbles to cobbly, trace silt, compact, damp to moist
3.7 to 4.9	Peat – fibrous, moist
4.9 to 5.8	Clay – silty, trace organics, stiff, medium plasticity, moist
5.8 to 14.9	Sand and Gravel Layers – trace cobbles to cobbly, trace silt to silty, dense to very dense, moist
14.9 to 15.5	Silt – sandy, stiff, medium plasticity, moist
15.5 to 21.9	Sand – trace gravel, trace cobbles, trace silt, compact to dense, moist

The gradation and soil composition of the encountered sand and gravel layers were observed to be variable, which is characteristic of the Capilano sediments. These layers were noted to range between fine to coarse-grained and well graded. Additionally, the fines content of the sand and gravel layers ranged from trace fines to silty. We have attached the MUSCS Geologic Log Symbols and Abbreviations table for reference.

Based on the recorded SPT blow counts, the sand/gravel layers ranged in relative density from compact to very dense. The SPT blow counts, or N values, were corrected for hammer efficiency and field procedures to produce N_{60} blow count values. For the sand/gravel layers, the N_{60} values ranged between approximately 16 to 97, with an average value of about 54. No SPT were completed entirely within the encountered clay/silt layers; however, the consistency of the disturbed clay/silt layer samples was noted to be stiff to very stiff.

The results of the laboratory gradational analysis showed that the fines content (percent passing the #200 sieve or percent soil component with a particle size less than 0.075 mm) of the sand and gravel layers ranged from trace fines to silty. The Atterberg test results completed on the silt layer between 1.2 mbgs to 1.8 mbgs and the clay layer between 4.7 mbgs to 5.8 mbgs indicate that such consist of medium plasticity silt and clay, respectively. An Atterberg test was not completed on the silt layer between 14.9 mbgs to 15.5 mbgs; however, the disturbed sample of this layer was observed to have a soil behaviour similar to the upper silt layer.

Following our site investigation, we re-attended the site on August 1, 2023, to take a groundwater reading of the monitoring well installed at the TH22-01 location. The groundwater level was measured to be 2.99 mbgs, which is consistent with our desktop review. We note that the groundwater level will vary seasonally and during extreme precipitation events.

GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

Based on the results of our site investigation, we expect the proposed development to be feasible from a geotechnical perspective. However, the near-surface organic peat layer is considered highly compressible and would be subject to long-term decomposition/consolidation resulting in settlement of the overlying structures. Given that the project is still in its preliminary stage, the recommendations provided herein may be subject to change once building details, grading, and foundation loading are finalized.

Liquefaction

Liquefaction of coarse-grained soils (cohesionless soils) is characterized by the rapid loss of shear strength due to increased pore water pressures and subsequent reduction in vertical effective stress. This occurs from exposure of the cohesionless soil to cyclic loading associated with a seismic event, resulting in rapid material densification and subsequent increased pore water pressures. The susceptibility of granular soils to liquefaction generally decreases with increasing fines content and increases with decreasing densities. In general, liquefaction occurs in soils subjected to cyclic loading that meets the following criteria, although noted exceptions have occurred in the past:

- Saturated soil conditions. i.e., below the groundwater table;
- Loose to compact granular materials with the ability to densify;
- Poor drainage conditions that allow for pore water pressure to build up.

Fine-grained soils (cohesive soils) may also be subjected to cyclic softening/mobility due to seismic loading, resulting in a similar decrease in the material’s shear strength. The main consequences of cyclic softening are generally limited seismically induced settlement and lateral spreading/flow (cyclic mobility); however, we do not consider the latter to be a concern given the level to very gently sloping nature of the property and the encountered soil stratigraphy.

An assessment was carried out using the conventional CSR/CRR approach to assess the potential for seismically induced liquefaction of the coarse-grained soil. For our analysis, all soils were classified as granular except for the encountered non-select fill and silt/clay layers. Liquefaction triggering was analyzed following several accepted empirical methodologies (NCEER, 1997, and Idris & Boulanger,

2014) based on the SPT approach with corrected N$_{1(60)}$ values adjusted for fines content. For analysis purposes, a Peak Ground Acceleration (PGA) of 0.46 g and a design earthquake magnitude of 7.5 was used. The PGA considers a design seismic event with a 2% probability of exceedance in 50 years, adjusted for a Seismic Site Classification (Site Class) of 'D' in accordance with the current 2018 BC Building Code (BCBC). See the Seismic Considerations section of this report for details on Site Class.

The results of our analysis indicate that the encountered coarse-grained native soils are not at risk of seismically induced liquefaction. The upper non-select fill layer is not included in our liquefaction assessment as this material will be either removed during construction, or have deep foundations extend below such. It should be noted that we consider the SPT values shown at 21.3 mbgs are likely impacted by drilling disturbance, such as sloughing and/or heave, due to the depth of the test. In addition, these soils would be considered to have a high degree of confinement. Accordingly, we consider the liquefaction risk of the proposed development to be negligible. The analysis results of the liquefaction assessment for cohesionless soils have been attached for reference.

The susceptibility of the encountered silt/clay layers to cyclic softening/mobility during a design seismic event was evaluated based on the recommendations provided by Bray et al., as noted in the Greater Vancouver Liquefaction Task Force Report (May 2007) and the current Canadian Foundation Engineering Manual (CFEM 2006 – 4th Edition). The Atterberg test result indicates that the silt/clay layers in the upper 14.9 m are not susceptible to cyclic softening/mobility, as shown in Figure 1 below. The silt layer encountered between 14.9 mbgs to 15.5 mbgs was not included in this analysis; however, such was noted to have a similar soil behaviour to the upper silt layer, and we consider that possible cyclic softening/mobility of this layer would have minimal impact on the proposed development given its depth and limited thickness, i.e., we consider that safe egress of the building would be maintained following a design seismic event.

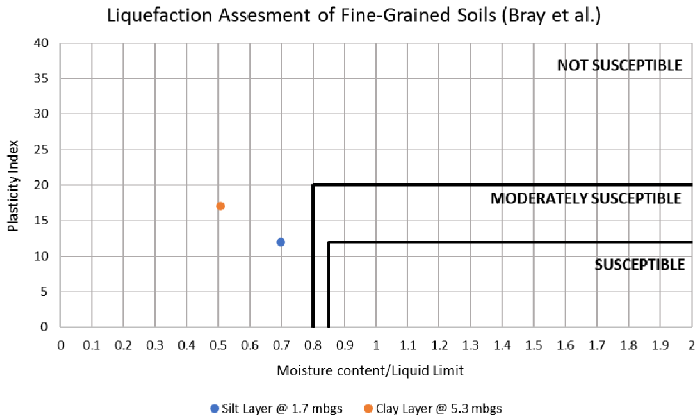


Figure 1: Liquefaction Assessment of Fine-Grained Soils (Bray et al.)

Seismic Considerations

As noted, the 2024 BCBC has come into effect. However, we know the seismic/earthquake design changes are deferred until March 10, 2025. We understand it is desired to obtain a building permit for the proposed development prior to the implementation of the seismic changes, and accordingly, our recommendations below reference the 2018 edition of the BCBC. If this project is permitted after March 10, 2025, our recommendations below should be updated.

The Duncan area is situated in a region of very high seismicity. Considerable earthquake risk exists, stemming from our proximity to the Cascadia subduction zone and numerous more local faults in southwestern BC and northwestern Washington State.

The current 2018 BCBC relies primarily on averaging the shear wave velocity of the upper 30 m of soil and/or rock (Vs^{30}) underlying the foundations for determining Site Class. For the most part, the higher the Vs^{30}, the more favorable the Site Class. Higher shear wave velocities are associated with denser materials such as bedrock, and the lower velocities are associated with softer materials such as peat and loose sands. As such, in accordance with the current BCBC, Site Class can be determined by averaging N_{60} in the upper 30 m of soil or by the undrained shear strength (S_u) for cohesive soils.

Given the results of our investigation, a Site Class of ‘D’ can be considered for the site, corresponding to a Vs^{30} ranging between 180 m/s and 360 m/s, given that cohesive soil samples were noted to be stiff to very stiff and that less than 3 m of peat was encountered. This assumes that the N_{60} in the upper 30 m of soil/bedrock will be greater than 15 and less than 50, given that the average N_{60} in the upper 21.9 m of soil is 45.

The 2015 National Building Code Seismic Calculator is attached, which indicates the response spectral acceleration for a referenced Site Class ‘C’, considering a 2% in 50-year probability of exceedance. These values should be adjusted for Site Class ‘D’ in accordance with the current BC

Settlement Considerations

There exists a risk of settlement to the proposed building and infrastructure (including utilities) due to the presence of the encountered near surface peat layer and underlying near surface clay layer with organics inclusions. From the test hole, this peat layer and peat layer with organics inclusions were noted to be roughly 2.1 m thick, starting from 3.7 mbgs. Organic material is highly compressible and prone to settlement due to increased net loading and decomposition regardless of loading. There also exists a risk of differential settlement below the proposed building if the presence, depth, and thickness of peat and clay with organic inclusions are variable across the site. As such, these layers cannot be relied on for building support and should be removed and replaced with engineered fill/concrete, or the building loads should be extended to depth below this layer with deep foundations.

Foundations

We note that structural plans have not been provided; however, given the presence and depth of the encountered peat layer and clay layer with organic inclusions, we expect that deep foundations would be the most practical foundation solution from a geotechnical perspective. Removing the peat/clay layers and lowering foundations or reinstating the design foundation grade using engineered fill and/or concrete is also technically feasible (rather than using deep foundations); however, we expect this would be a challenging solution.

Deep foundations would transfer building loads from the surface to the dense/very dense soil stratum below the peat/clay layers, thereby mitigating the risk of settlement. While various deep foundation types are feasible, we anticipate that either driven end bearing pipe (open) piles or helical piles would be the most economical. Drilled shaft piles are also feasible; however, we expect such would be challenging to install due to water ingress and are therefore not expected to be cost-effective. Displacement (closed end) piles are also expected to be challenging due to the required pile diameter to prevent buckling issues. The design of a piled foundation would also require a network of pile caps with grade beams to tie them together, as well as a raft slab.

Pipe piles would provide greater compressive and lateral capacity than helical piles, which would decrease the total number of required piles but would require larger equipment and would cause more site disturbance during installation. Helical piles can be installed with smaller equipment and limited site disturbance but provide less compressive/lateral resistance. The required spacing, location, and number of piles would be determined by the project's structural engineer in consultation with a qualified geotechnical professional. Additional design/installation details on the preferred foundation type can be provided upon request.

Radon Gas Considerations

The City of Duncan is one of the municipalities with a potential risk of radon gas. According to the requirements of the 2024 BCBC, an assessment should be carried out by others to determine if radon gas is present at the site. Mitigation of radon gas typically includes a thicker polyethylene vapor barrier (typically a minimum of 10 mils) below the lower floor slab and an active venting system consisting of drain rock. The vapor barrier would, at a minimum, be taped at the seams, and the active venting system vented to roof level into the atmosphere.

Methane Gas Considerations

If the peat is left in place and the building constructed above it, ventilation would need to be installed below the building slab to ensure that methane gas generated through decomposition does not accumulate.

Grade Supported Slab

Given the presence of highly compressible near-surface peat and clay with organic inclusions, we do not consider a grade supported slab to be feasible unless these layers are removed replacement with engineered fill or concrete. Therefore, the use of a suspended floor slab supported by deep foundations is recommended.

Flood Construction Level

Per EGBC Practice Guidelines, any areas used for habitation, business, or the storage of goods damageable by floodwaters should be constructed above the FCL. The FCL is defined as the minimum elevation of a concrete slab on grade or the underside of the wooden floor diaphragm (floor joists). The FCL does not mandate the elevation of non-habitable spaces, e.g., surface/underground parkades. The standard Design Flood is the flood with a 0.5% chance of being exceeded in any given year, otherwise referred to as the 200-year flood.

The Schedule A map (Flood Plain Management Area Map) included within the City of Duncan's Bylaw No. 3236 (2023) shows that the site's FCL is between 10.5 m and 11 m geo. (CGVD 2013). According to this bylaw, the applicable FCL is the higher of the two elevations, where a portion of the land falls between two FCL lines. Therefore, the FCL for this site is **11 m geo.**, which is roughly 1 m above the current site grade. We understand that at-grade construction is proposed and that the main floor slab elevation of the commercial space is 10.07 m geo, roughly 1 m below the site FCL.

Given that the proposed building main floor elevation is designed to be below the FCL, there is a risk of damage to the building as a result of inundation of flood waters during a 200-year design flood. We anticipated that the velocity of the flooding waters would be relatively low; however, some building damage should be expected as a result.

As the lower floor of the building is to be commercial space, we expect it will be occupied transiently/periodically, and as such, there is a risk to the occupants resulting from the design flood waters.

Given the above-noted risks, we recommend that major fixed equipment, including major electrical switchgear, furnaces, ventilation systems, and hot water tanks, that are integral to and necessary for the functioning of a building according to the BC Building Code be located above the FCL or suitably tanked.

Foundation Drainage

It is envisioned that conventional perimeter foundation drainage tied into the recommended free draining backfill material would be suitable to limit hydrostatic pressure on the foundation. This, however, does not preclude the possibility of dampness and/or minor seepage, which would be considered building envelope concerns.

The foundation drain arrangement (perforated pipe and uniform gravel/drain rock) should be covered with non-woven geotextile filter fabric (not landscape fabric), or a suitably graded granular medium, to prevent migration of finer materials from the backfill into voids within the drain arrangement. Where perimeter drains will be located on the inside of the building, weep holes should be provided in the foundation wall with clear drain rock providing hydraulic connectivity between the free draining exterior backfill and/or drainage mat, and the perforated drain. Where interior perimeter drains are required, minimum 100 mm diameter weep holes should be installed every 3 m. Plumbing and building envelope details will be by others. Any foundation elements, slab on grades, or pits that are not effectively drained to the perimeter drains will require their own drainage arrangement or will need to be waterproofed and designed to resist hydrostatic pressures.

Pavement Considerations

For the preparation of paved areas, we typically recommend the removal of all surficial organics and any deleterious fill material to expose undisturbed native subgrade. It may be possible to retain and re-work some of the existing non-select fills to mitigate the amount of earthworks required if the decreased performance of the paved areas is acceptable. However, this should be reviewed by a qualified geotechnical professional at the time of construction.

In areas of light traffic, 75 mm of asphalt over 250 mm of 20 mm minus crushed rock containing low fines should be sufficient. It may be possible to go to 50 mm of asphalt over 250 mm of crushed rock, as is typical for low volume roads, but such a structure will deteriorate quicker and may crack slightly more if 75 mm is not used. For heavier traffic areas (garbage truck access, etc.), we suggest 75 mm of asphalt over a minimum of 150 mm of 20 mm minus crushed rock above a further 150 mm of 75 mm minus crushed rock. Alternatively, 300 mm of 20 mm minus could be used, provided it is low in fines for good water drainage.

Optimum water content of the replacement fill soils described above is critical to achieve good compaction. We suggest performing spot check in-situ density tests to ensure soils are compacting to 100 % of the SPMDD below paved areas.

CLOSURE

The above summarizes the results of our investigation and recommendations pertaining to the proposed development. Following the review of our report, we anticipate discussions/feedback regarding the foundation design.

We trust the preceding is suitable for your purposes at present. Please do not hesitate to contact us if you have any questions or require further assistance.

Sincerely,

Ryzuk Geotechnical
Reviewed by: Christian Flanagan, P.Eng.
PN1002996

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. J. A. GYBELS
57900
2024-06-03

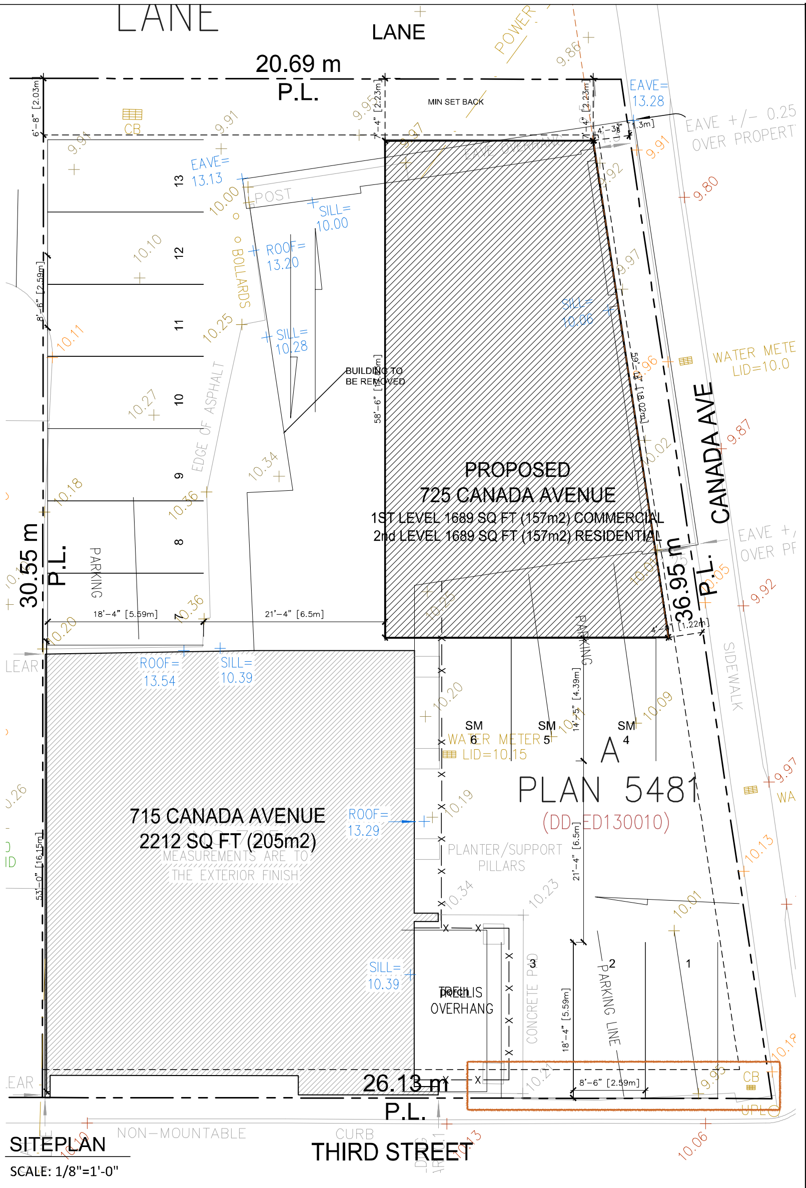
Jordan Gybels, P.Eng.
Intermediate Engineer

Attachments:
- Constance Nikiforova’s Site Plan
- Test Hole Location Plan
- Test Hole Log (TH23-01)
- Atterberg Limits
- MUSCS Geological Log Symbols and Abbreviations
- TH23-01 Liquefaction Assessment
- 2015 National Building Code Seismic Hazard Calculation

ADDRESS: 725 Canada Avenue,
Duncan

LEGAL DESCRIPTION: Lot A(DD ED130010), SECTION 18, RANGE 6,
QUAMICHAN DISTRICT, PLAN 5481

LOT AREA: 9,198 SQ FT (854m2)



SITEPLAN

SCALE: 1/8"=1'-0"

N

The contractor shall check and verify all dimensions and data noted on site and is responsible for reporting any discrepancies to Owner prior to commencement of work. All drawings are the property of Designer and shall not be reproduced without written consent of the Designer. Drawings shall not be scaled.

NO.	ISSUED / REVISED	DATE

Constance Nikiforova
ph: 604-600-5325
ni.constance@hotmail.com

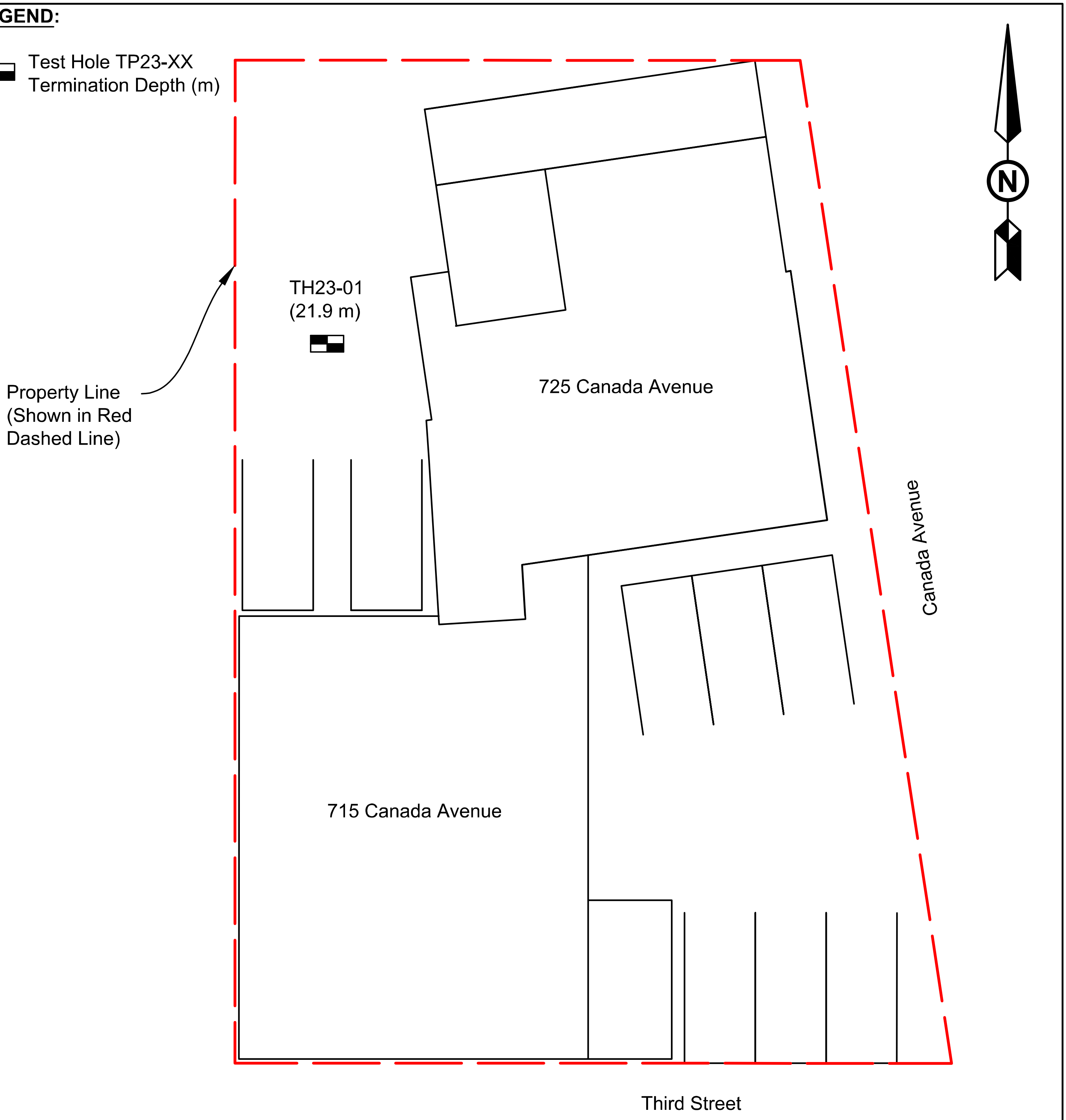
CLIENT:
725 Canada Avenue,
Duncan, BC

DRAWING TITLE:
SITE PLAN

DRAWN BY: CN
SCALE: 1/8"=1'-0"
DATE: April 4, 2023
DRAWING NUMBER:
A 1

LEGEND:

▚ Test Hole TP23-XX
Termination Depth (m)



NOTES

1. Base plan taken from Constance Nikiforova's Site Plan drawing, dated April 4, 2023.

RYZUK GEOTECHNICAL
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TEL: 250-475-3131
mail@ryzuk.com

SEAL

PTPN: 1002996

DRAWN BY: JJAG
EOR/LEAD: JJAG
REVIEW: CJF
SCALE: 1:200
DATE: 2023/08/25

CLIENT: NEEL TANNA
PROJECT TITLE: PROPOSED COMMERCIAL BUILDING
PROJECT ADDRESS: 715 & 725 CANADA AVENUE - DUNCAN, BC
DRAWING NAME: **TEST HOLE LOCATION PLAN**
PROJECT No.: 11762-1
SHEET No.: 1 of 1
REVISION: 00

R:\Ryzuk Data\8-11000 to 8-11999\11762-1 725 Canada Ave\5 Ryzuk Drawings\Working\2023.08.04_Location Plan.jjag.dwg

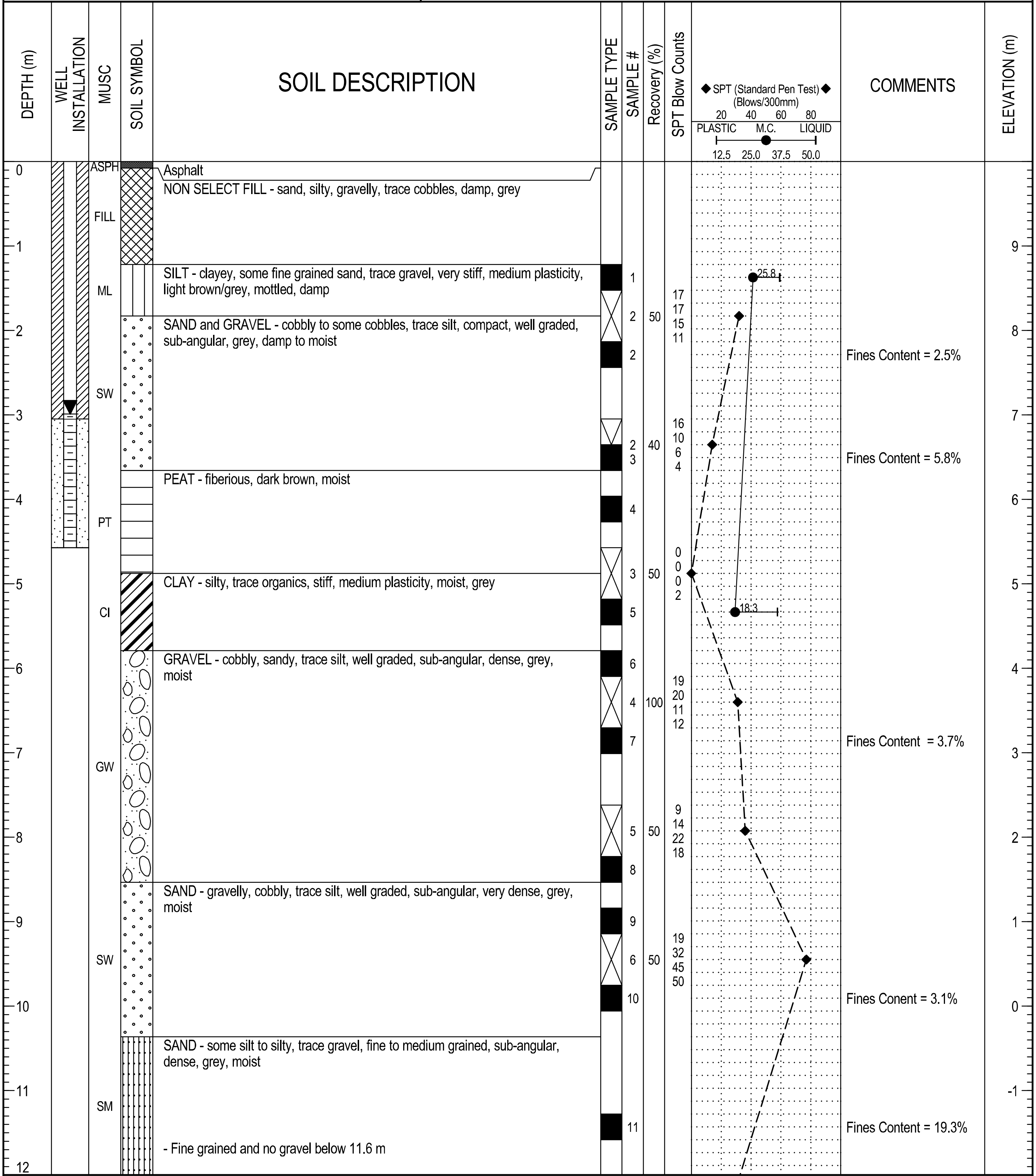
RYZUK GEOTECHNICAL
ENGINEERING & MATERIALS TESTING
6-40 Cadillac Avenue, Victoria, BC, V8Z 1T2
Tel: 250-475-3131 E-mail: mail@ryzuk.com
www.ryzuk.com

TEST HOLE LOG

TH23-01

PROJECT: Proposed Commercial Building
CLIENT: Neel Tenna
LOCATION: Test hole location plan
COORDINATES (m): N 5403560.9 E 447915.7
COMPLETION DATE: 2023-7-26

PROJECT NO.: 11762-1
METHOD: Sonic
ELEVATION (m): 10
CONTRACTOR: Drillwell
LOGGED/REVIEWED BY: JJAG/CJF



MUSC	SOIL DESCRIPTION
ASPH	Asphalt
FILL	NON SELECT FILL - sand, silty, gravelly, trace cobbles, damp, grey
ML	SILT - clayey, some fine grained sand, trace gravel, very stiff, medium plasticity, light brown/grey, mottled, damp
SW	SAND and GRAVEL - cobbly to some cobbles, trace silt, compact, well graded, sub-angular, grey, damp to moist
PT	PEAT - fiberious, dark brown, moist
CI	CLAY - silty, trace organics, stiff, medium plasticity, moist, grey
GW	GRAVEL - cobbly, sandy, trace silt, well graded, sub-angular, dense, grey, moist
SW	SAND - gravelly, cobbly, trace silt, well graded, sub-angular, very dense, grey, moist
SM	SAND - some silt to silty, trace gravel, fine to medium grained, sub-angular, dense, grey, moist - Fine grained and no gravel below 11.6 m

SAMPLE #	Recovery (%)	SPT Blow Counts	COMMENTS
1			
2	50	17 17 15 11	
2			Fines Content = 2.5%
2	40	16 10 6 4	
3			Fines Content = 5.8%
4			
3	50	0 0 0 2	
5			
6			
4	100	19 20 11 12	
7			Fines Content = 3.7%
5	50	9 14 22 18	
8			
9			
6	50	19 32 45 50	
10			Fines Conent = 3.1%
11			Fines Content = 19.3%

SAMPLE TYPE ☒ SPLIT SPOON ■ GRAB ▥ SHELBY TUBE ☰ BULK ◧ CORE ◺ NO RECOVERY

BACKFILL TYPE ■ CUTTINGS ⚀ GRAVEL ▥ SLOUGH ⚄ GROUT ▨ BENTONITE ⁘ SAND

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TEST HOLE LOG

TH23-01

PROJECT: Proposed Commercial Building
CLIENT: Neel Tenna
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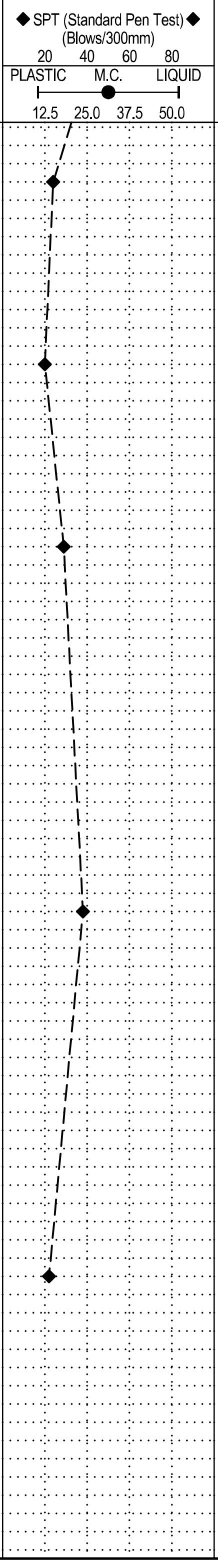
COORDINATES (m): N 5403560.9 E 447915.7
COMPLETION DATE: 2023-7-26

PROJECT NO.: 11762-1
METHOD: Sonic
ELEVATION (m): 10
CONTRACTOR: Drillwell
LOGGED/REVIEWED BY: JJAG/CJF

MUSC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Recovery (%)	SPT Blow Counts	COMMENTS
SM		☒	7	100	10 11 13 11	
		■	12			Fines Content = 16.2%
		☒	8	70	8 10 10 15	
		■	13			Fines Content = 31.8%
ML	SILT - sandy (fine grained), medium plasticity, very stiff, light brown, moist	■	14			
		☒	9	80	3 14 15 24	
SA	SAND - trace gravel, trace cobbles, trace silt, medium grained, sub-angular, compact to dense, grey, moist	■	15			Fines Content = 6.7%
	- Medium to coarse grained below 16.9 m					
		■	16			Fines Content = 6.4%
	- Fine to medium grained below 18.8 m	☒	10	100	11 15 23 29	
		■	17			Fines Content = 7.1%
		■	18			Fines Content = 5.9%
		☒	11	60	3 8 14 18	
	End of test hole at 21.9 m (desired depth) - Test hole backfilled to bottom of groundwater monitoring well with drill cuttings					

DEPTH (m)	ELEVATION (m)
12	
13	-3
14	-4
15	-5
16	-6
17	-7
18	-8
19	-9
20	-10
21	-11
22	-12
23	-13
24	



SAMPLE TYPE	☒ SPLIT SPOON	■ GRAB	▥ SHELBY TUBE	☰ BULK	◨ CORE	◪ NO RECOVERY
BACKFILL TYPE	■ CUTTINGS	▣ GRAVEL	▥ SLOUGH	▩ GROUT	▨ BENTONITE	⬚ SAND

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Victoria, BC, Canada V8Z 1S3
☎ 250-475-3131 📠 250-475-3611
✉mail@ryzuk.com

SOIL TESTS - ATTERBERG LIMITS - ASTM D4318

Project No:	8-11762-1	**Client:**	Neel Tenna
Project:	Proposed Commercial Building	**Contact:**	Neel Tenna
Project Address:	715 and 725 Canada Avenue- Duncan, B.C.	**Email/Fax:**	nileshtannarx@gmail.com

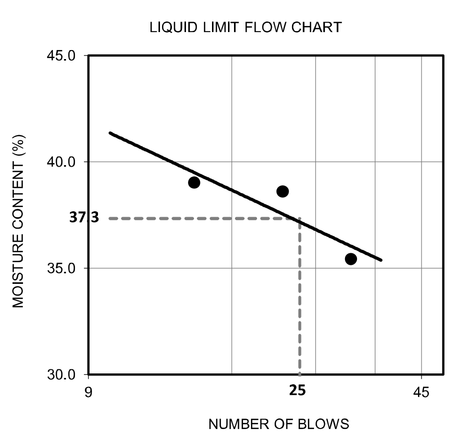
Date Sampled:	28-Jul	**Date Tested:**	19-Aug-23
Sampled By:	JJAG	**Tested By:**	CDB

PLASTIC LIMIT			
Test No.	1	2	3
Container No.	4	11	
Wt. Of Tare (g)	21.59	23.67	
Tare + Wet Soil (g)	28.60	30.38	
Tare + Dry Soil (g)	27.16	29.01	
Wt. of Water (g)	1.44	1.37	
Wt. of Dry Soil (g)	5.57	5.34	
Moisture Content (%)	25.9	25.7	
		AVERAGE	25.8

Sample Information:

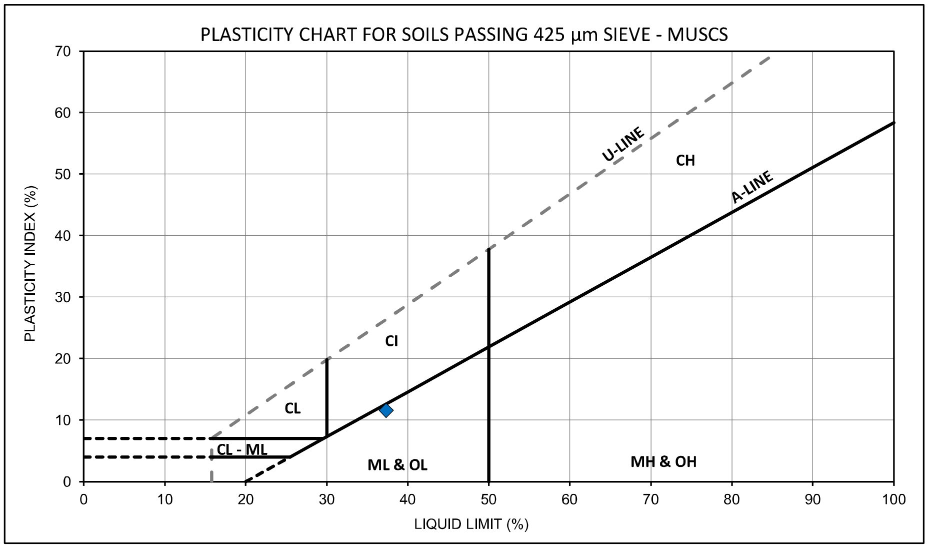
Test Method:	☑ Wet ☐ Dry
Test Hole ID:	01
Drill Type:	Sonic
Sample No.:	GS1
Depth:	1.7 m

LIQUID LIMIT				
Test No.	1	2	3	4
Number of Blows	32	23	15	
Container No.	60	82A	45	
Wt. of Tare (g)	30.22	36.44	30.94	
Tare + Wet Soil (g)	83.38	79.91	76.39	
Tare + Dry Soil (g)	69.47	67.80	63.63	
Wt. of Water (g)	13.91	12.11	12.76	
Wt. of Dry Soil (g)	39.25	31.36	32.69	
Moisture Content (%)	35.4	38.6	39.0	



Plasticity Index	12
Liquid Limit	37
Plastic Limit	26
Soil Classification	ML&OL
Field Moisture Content	28.3

Comments:



Reviewed By: ______________________

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✉mail@ryzuk.com

SOIL TESTS - ATTERBERG LIMITS - ASTM D4318

Project No:	8-11762-1	**Client:**	Neel Tenna
Project:	Proposed Commercial Building	**Contact:**	Neel Tenna
Project Address:	715 and 725 Canada Avenue- Duncan, B.C.	**Email/Fax:**	nileshtannarx@gmail.com

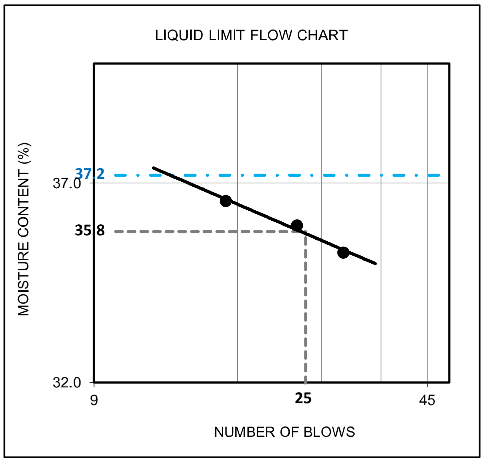
Date Sampled:	28-Jul	**Date Tested:**	19-Aug-23
Sampled By:	JJAG	**Tested By:**	CDB

PLASTIC LIMIT			
Test No.	1	2	3
Container No.	26	105	
Wt. Of Tare (g)	23.16	23.51	
Tare + Wet Soil (g)	30.28	29.90	
Tare + Dry Soil (g)	29.19	28.90	
Wt. of Water (g)	1.09	1.00	
Wt. of Dry Soil (g)	6.03	5.39	
Moisture Content (%)	18.1	18.6	
		AVERAGE	18.3

Sample Information:

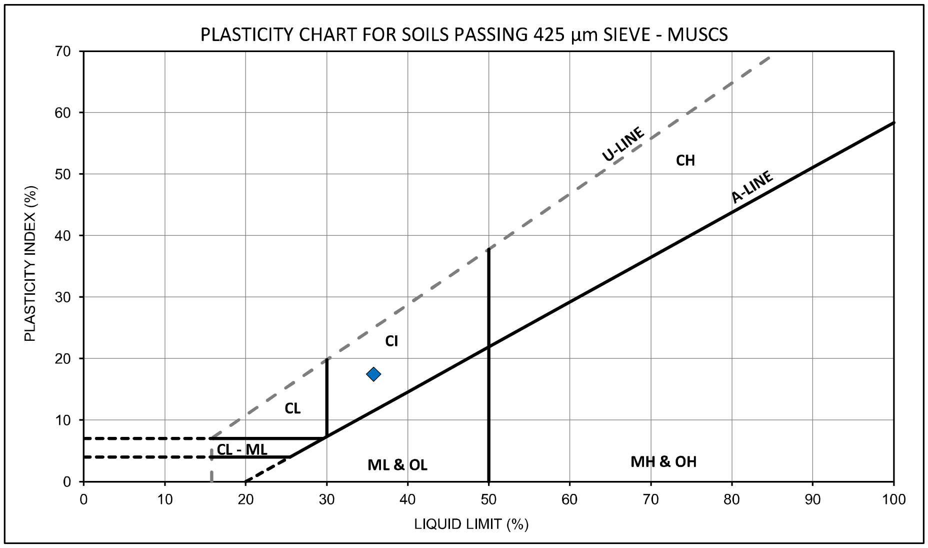
Test Method:	☑ Wet	☐ Dry
Test Hole ID:		01
Drill Type:		Sonic
Sample No.:		GS5
Depth:		5.3 m

LIQUID LIMIT				
Test No.	1	2	3	4
Number of Blows	30	24	17	
Container No.	93A	57	49A	
Wt. of Tare (g)	37.25	30.22	30.78	
Tare + Wet Soil (g)	96.75	77.16	60.03	
Tare + Dry Soil (g)	81.24	64.75	52.20	
Wt. of Water (g)	15.51	12.41	7.83	
Wt. of Dry Soil (g)	43.99	34.53	21.42	
Moisture Content (%)	35.3	35.9	36.6	



Plasticity Index	17
Liquid Limit	36
Plastic Limit	18
Soil Classification	CI
Field Moisture Content	37.2

Comments:



Reviewed By: ______________________

GEOLOGIC LOG SYMBOLS AND ABBREVIATIONS
MODIFIED UNIFIED SOIL CLASSIFICATION SYSTEM

UPDATED SEPT.2019

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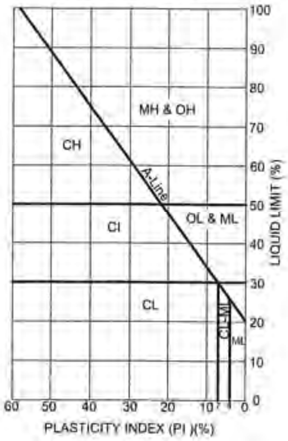
MAJOR DIVISIONS			Symbol	USC	TYPICAL DISCRIPTION	LAB CLASSIFCATION CRITERIA	
COARSE GRAINED SOILS	**GRAVELS** (MORE THAN HALF COARSE GRAINS LARGER THAN 4.75 mm)	CLEAN GRAVELS (LITTLE TO NO FINES)	•○•○	GW	WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4 \quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			⁘○	GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	DOES NOT MEET ABOVE REQUIREMENTS	
		GRAVELS WITH FINES	▥○	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE PI LESS THAN 4
			⧄	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE PI MORE THAN 7
	SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm)	CLEAN SANDS (LITTLE TO NO FINES)	⁙	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6 \quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			⋮⋮	SP	POORLY GRADED SANDS, LITTLE OR NO FINES	DOES NOT MEET ABOVE REQUIREMENTS	
		SANDS WITH FINES	▥⋮	SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE PI LESS THAN 4
			▨	SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE PI MORE THAN 7
FINE GRAINED SOILS	**SILTS** (BELOW 'A' LINE, NEGLIGIBLE ORGANIC CONTENT)	$W_L < 50$	▥	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED ON PLASTICITY CHART  	
		$W_L > 50$	▥	MH	INORGANIC SILTS, MICACEOUS OR DIAMACEOUS FINE SANDY OR SILTY SOILS		
	CLAYS (ABOVE 'A' LINE, NEGLIGIBLE ORGANIC CONTENT)	$W_L < 30$	▨	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY LEAN CLAYS		
		$30 < W_L < 50$	▨	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50$	▩	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS AND CLAYS	$W_L < 50$	▥	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		$W_L > 50$	▨	OH	ORGANIC CLAYS OF HIGH PLASTICITY		
FILL			▦	FL	SEE REPORT DESCRIPTION		
HIGHLY ORGANIC SOILS			▤	Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE	
BEDROCK			▦	BR	SEE REPORT DESCRIPTION		

SPT RESISTANCES (BLOWS/300 mm)		Undrained Shear Strength (S_u) (kPa)	
COHESIONLESS		COHESIVE	
0 - 4	VERY LOOSE	<12	VERY SOFT
4 - 10	LOOSE	12 - 25	SOFT
10 - 30	COMPACT	25 - 50	FIRM
30 - 50	DENSE	50 - 100	STIFF
50 +	VERY DENSE	100 - 200	VERY STIFF
		>200	HARD

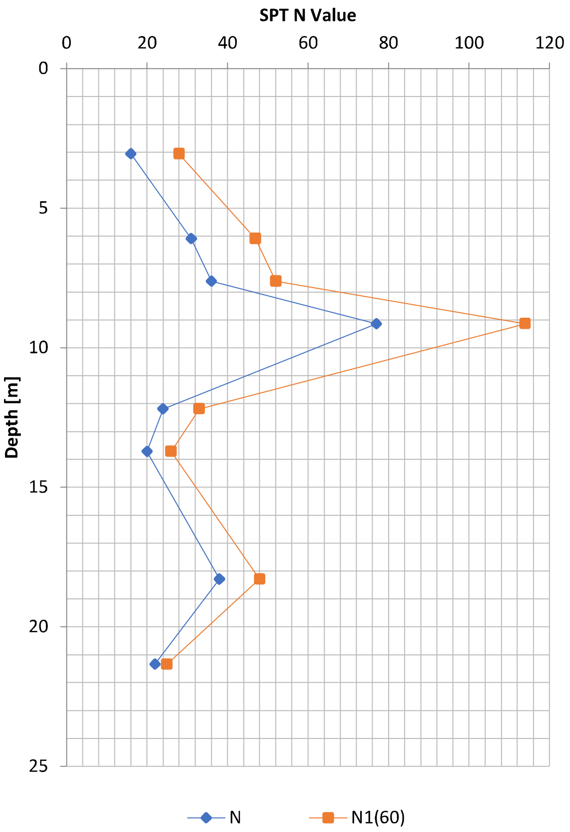
DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
PERCENT	IDENTIFIER
1 - 10	TRACE
10 - 20	SOME
20 - 35	_____Y
35 - 50	AND

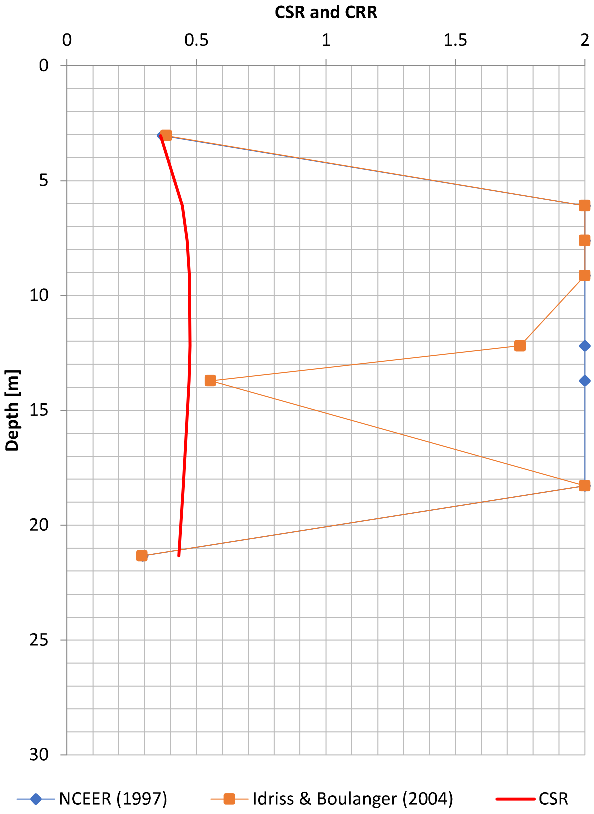
SOIL COMPONENTS (mm)			
BOULDERS		> 200	
COBBLES		75 - 200	
FRACTION		PASSING	RETAINED
GRAVEL	COARSE	75	19
	FINE	19	4.75
SAND	COARSE	4.75	2.00
	MEDIUM	2.00	0.425
	FINE	0.425	0.075
FINE GRAINED SOILS (SILT AND CLAY)		0.075	

Project: Proposed Commercial Building
Client: Neel Tenna
Address: 715 & 725 Canada Avenue
Job no.: 11762-1

Liquefaction Analysis Results

TH23-01





2015 National Building Code Seismic Hazard Calculation

INFORMATION: **Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836**
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 48.783N 123.709W

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Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.611	0.443	0.326	0.146
Sa (0.1)	0.940	0.683	0.500	0.222
Sa (0.2)	1.169	0.850	0.627	0.275
Sa (0.3)	1.203	0.872	0.640	0.275
Sa (0.5)	1.087	0.776	0.556	0.227
Sa (1.0)	0.634	0.427	0.291	0.108
Sa (2.0)	0.378	0.247	0.161	0.056
Sa (5.0)	0.118	0.067	0.036	0.011
Sa (10.0)	0.042	0.023	0.012	0.004
PGA (g)	0.511	0.371	0.272	0.118
PGV (m/s)	0.789	0.537	0.371	0.137

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information