Building Officials' Association of British Columbia
59th Annual Spring Education & AGM Conference

HOUSING FOUNDATIONS AND GEOTECHNICAL CHALLENGES

BEST PRACTICES FOR RESIDENTIAL BUILDERS IN BRITISH COLUMBIA

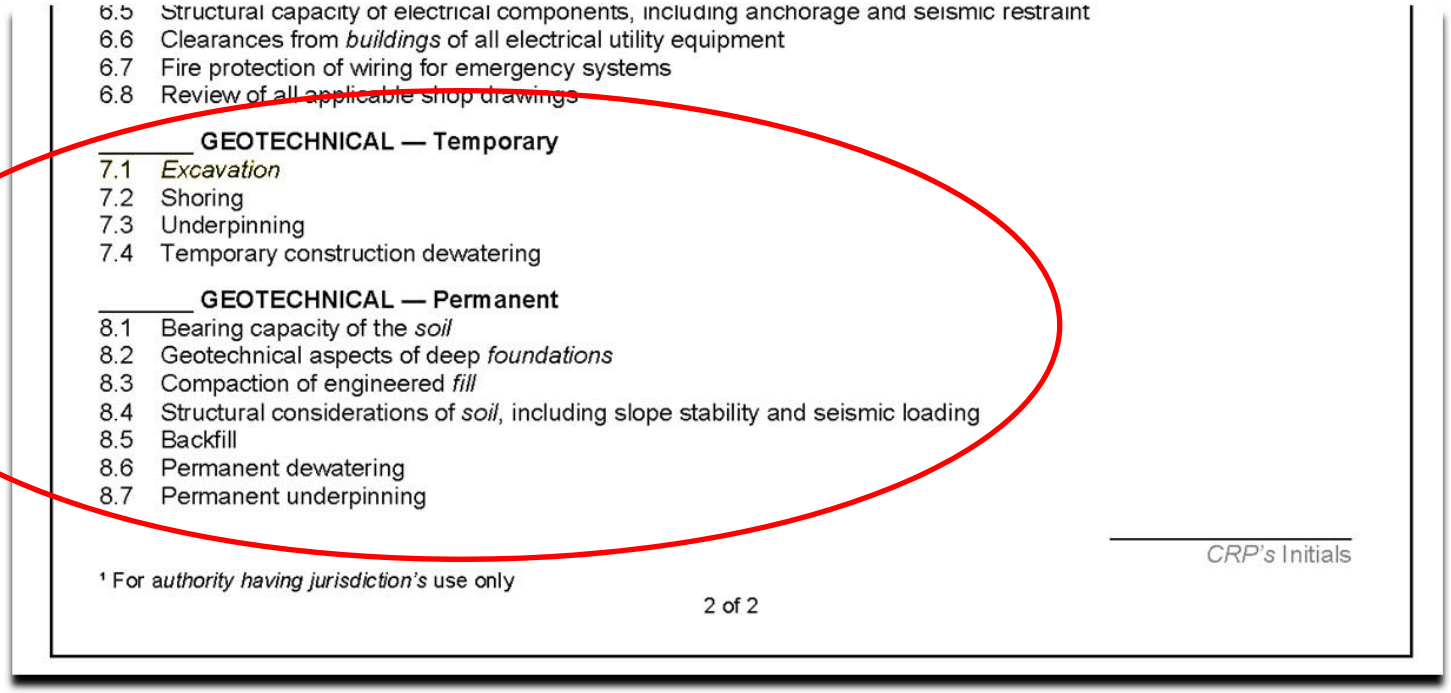
Karen Savage, P.Eng., FEC
Pamela Bayntun, P.Eng.
Horizon Engineering Inc.

May 27, 2014

Homeowner Protection Office
Branch of BC Housing

INTRODUCTION

- promotes best practices
- owner is responsible for implementing the provisions of the BCBC
- Building Code is minimum standards
- field reviews by professionals per BCBC Letters of Assurance



6.5 Structural capacity of electrical components, including anchorage and seismic restraint
6.6 Clearances from *buildings* of all electrical utility equipment
6.7 Fire protection of wiring for emergency systems
6.8 Review of all applicable shop drawings

_____ **GEOTECHNICAL — Temporary**
7.1 *Excavation*
7.2 Shoring
7.3 Underpinning
7.4 Temporary construction dewatering

_____ **GEOTECHNICAL — Permanent**
8.1 Bearing capacity of the *soil*
8.2 Geotechnical aspects of deep *foundations*
8.3 Compaction of engineered *fill*
8.4 Structural considerations of *soil*, including slope stability and seismic loading
8.5 Backfill
8.6 Permanent dewatering
8.7 Permanent underpinning

_____
CRP's Initials

[1] For *authority having jurisdiction's* use only

2 of 2

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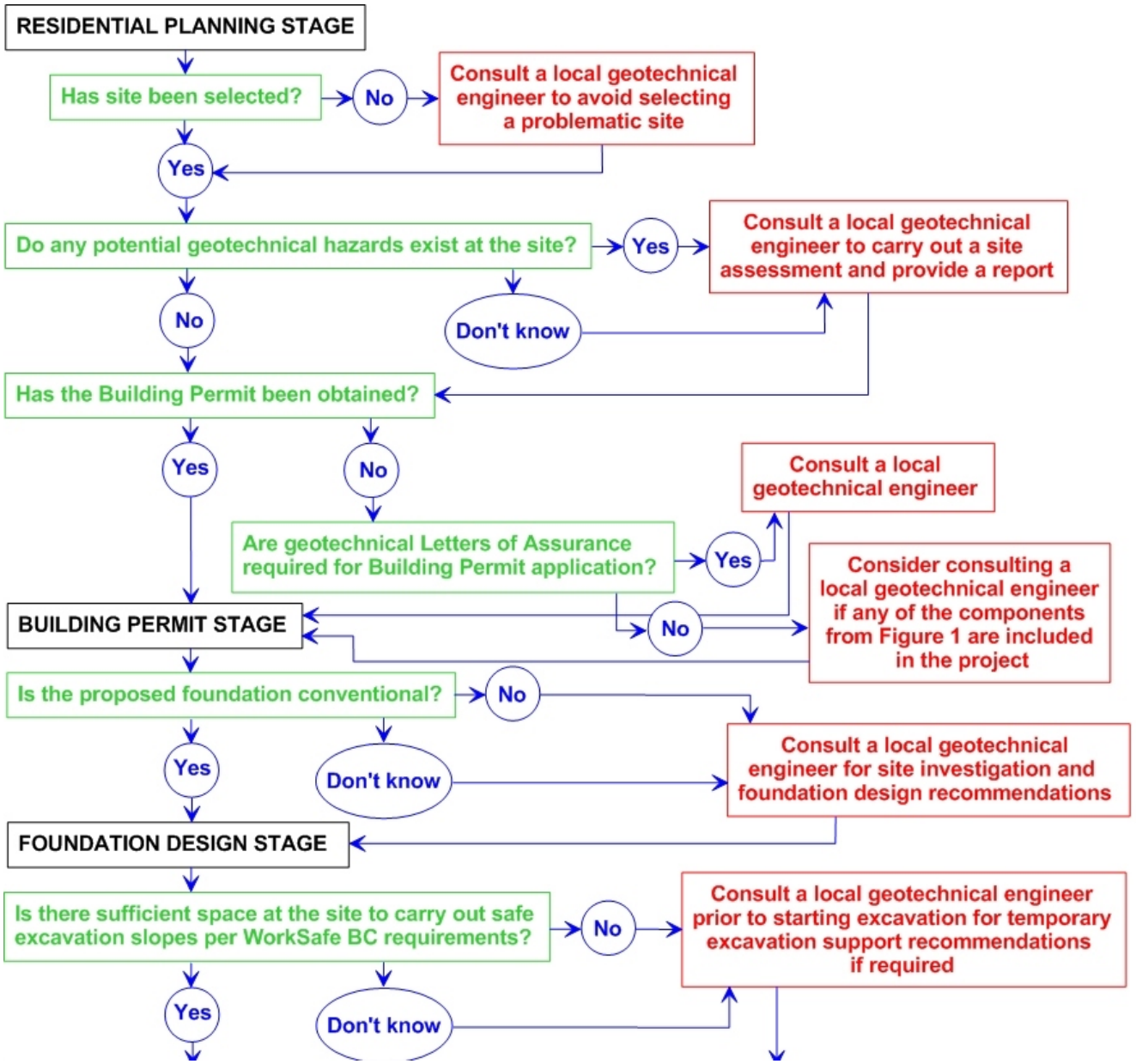

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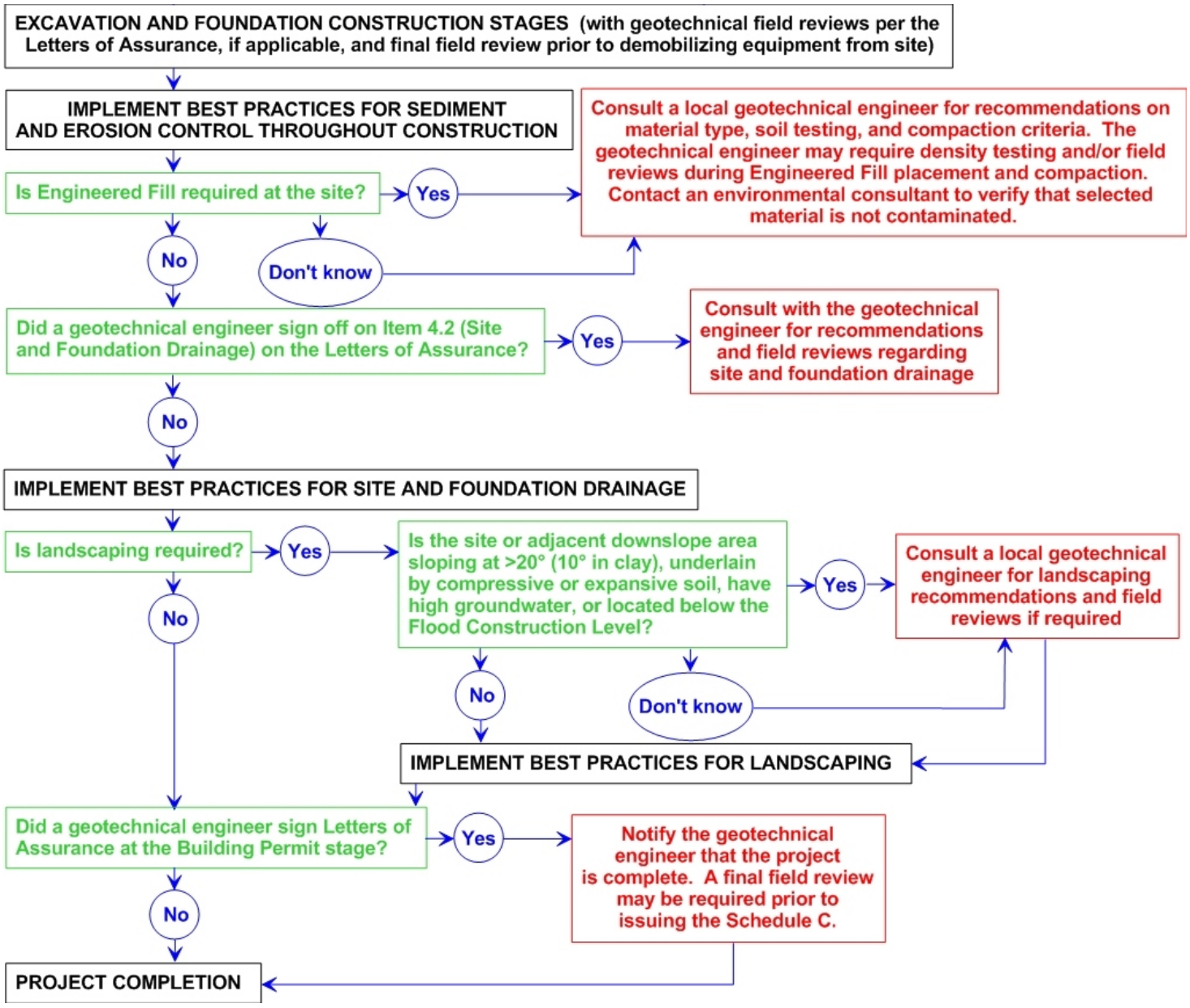

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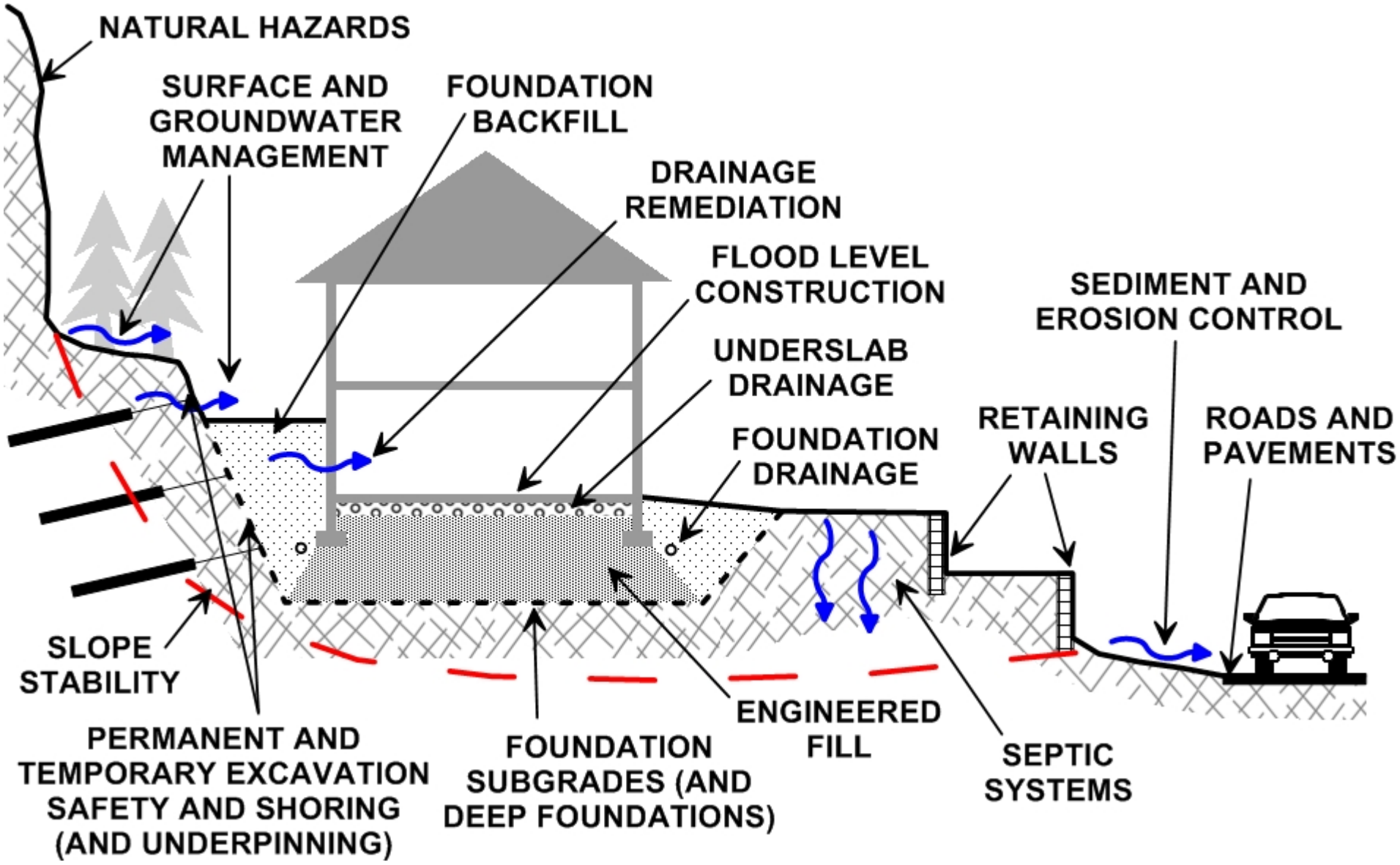

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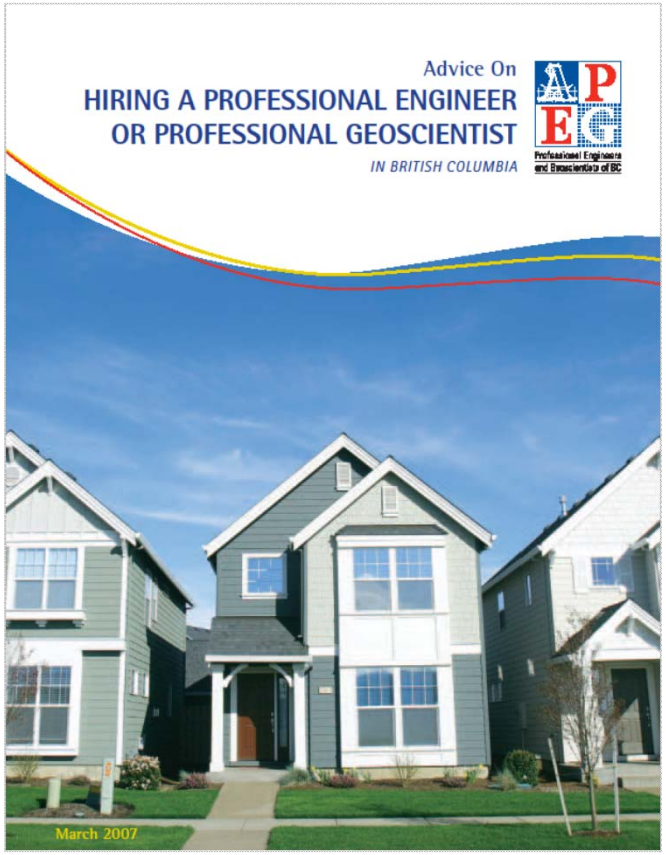
- builders can be found legally liable for problems later

CONSULTANT SELECTION

- APEGBC's "Advice on Hiring a Professional Engineer or Professional Geoscientist in British Columbia"



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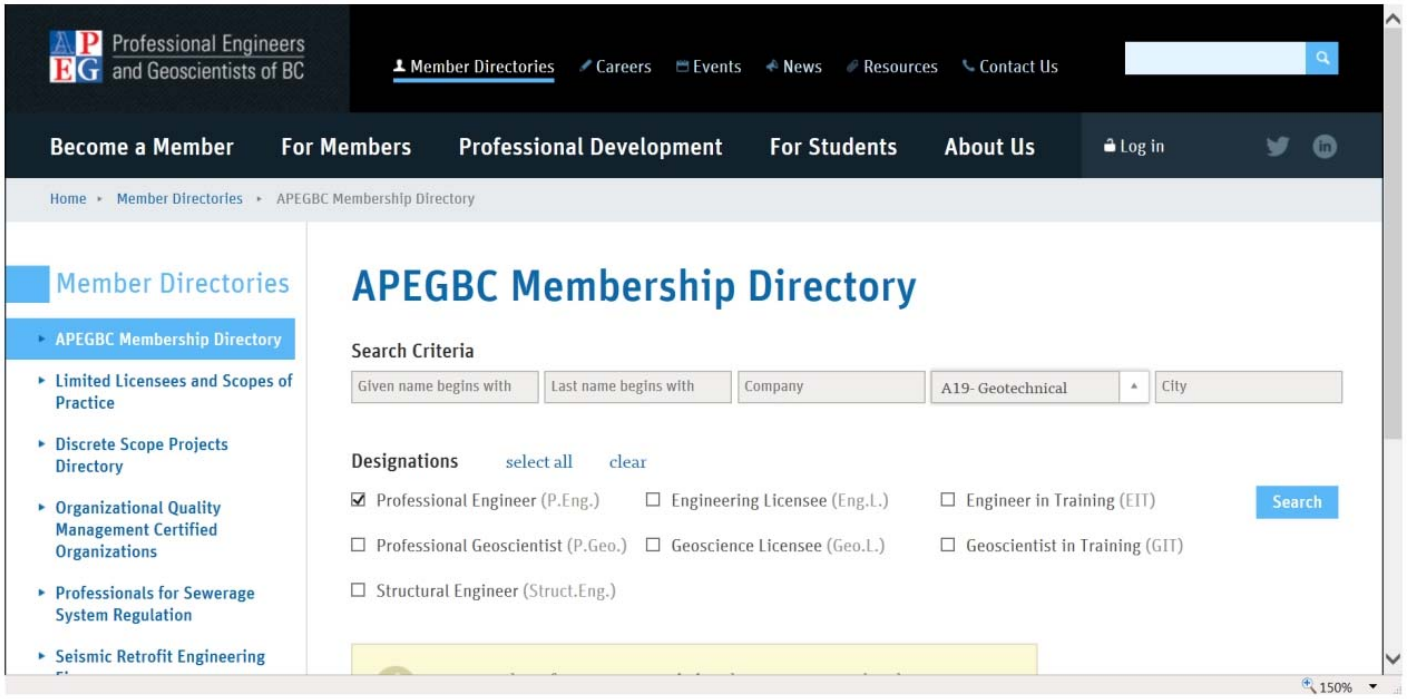

www.apeg.bc.ca/Member-Directories/APEGBC-Membership-Directory

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CONSULTANT SELECTION

- APEGBC's "Advice on Hiring a Professional Engineer or Professional Geoscientist in British Columbia"
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- Who do you refer owners to when they need a geotechnical engineer?

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PHYSIOGRAPHY, GEOLOGY, AND SOIL CONDITIONS OF BC

- potential geotechnical challenges depend on location, landforms, and geology

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PHYSIOGRAPHY, GEOLOGY, AND SOIL CONDITIONS OF BC

- potential geotechnical challenges depend on location, landforms, and geology
- geology = bedrock and soil (overburden)
- rock types: sedimentary, igneous, metamorphic

SEDIMENTARY ROCK

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IGNEOUS ROCK (VOLCANIC)

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IGNEOUS ROCK (PLUTONIC)

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METAMORPHIC ROCK

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- soil types: glacial, alluvial, aeolian, organic, colluvial, anthropogenic (fill)

GLACIAL SOIL

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ALLUVIAL SOIL

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AEOLIAN SOIL

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ORGANIC SOIL

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COLLUVIAL SOIL

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COLLUVIAL SOIL

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ANTHROPOGENIC SOIL (FILL)

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ANTHROPOGENIC SOIL (FILL)

Fill materials are typically problematic

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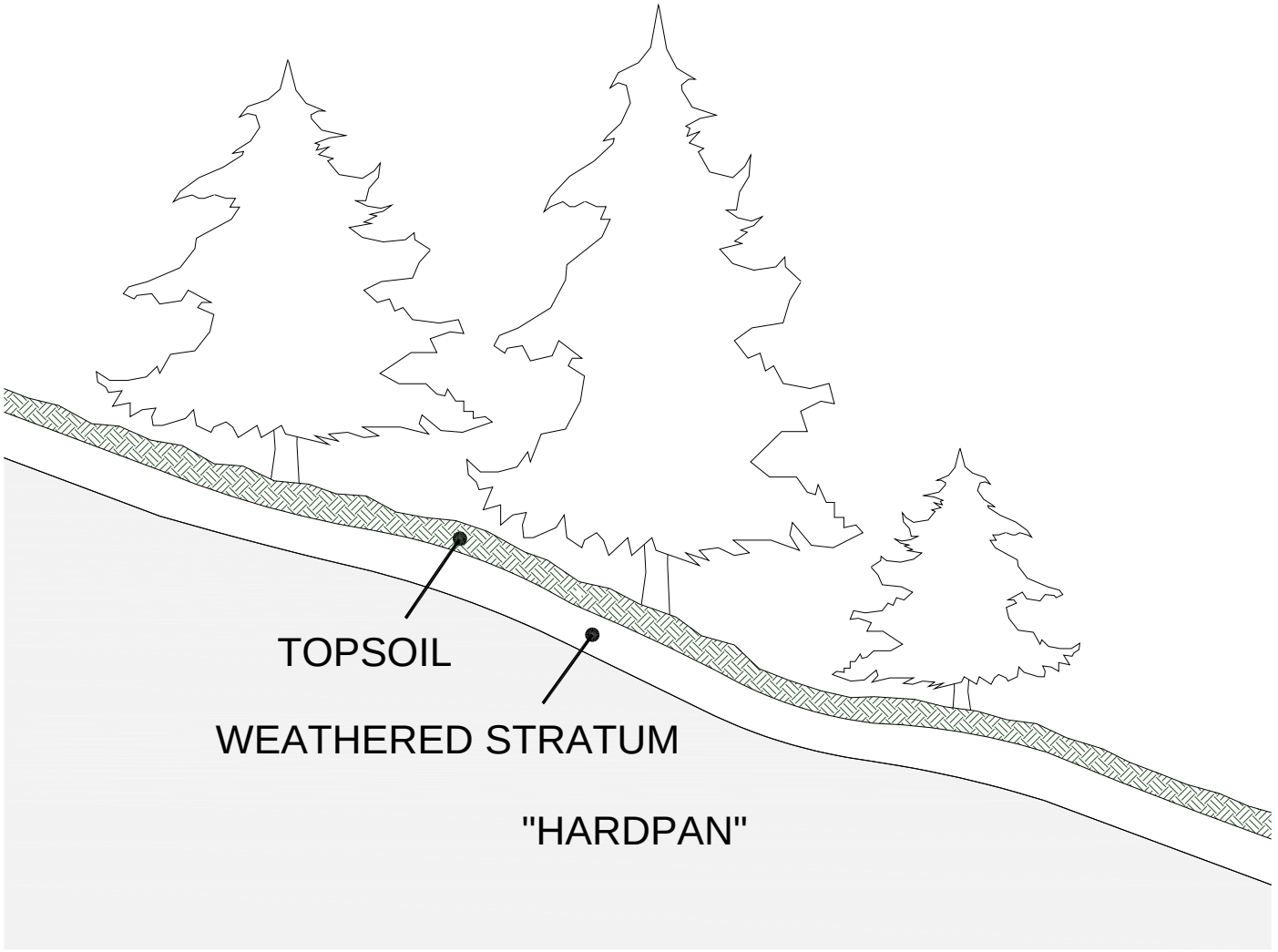

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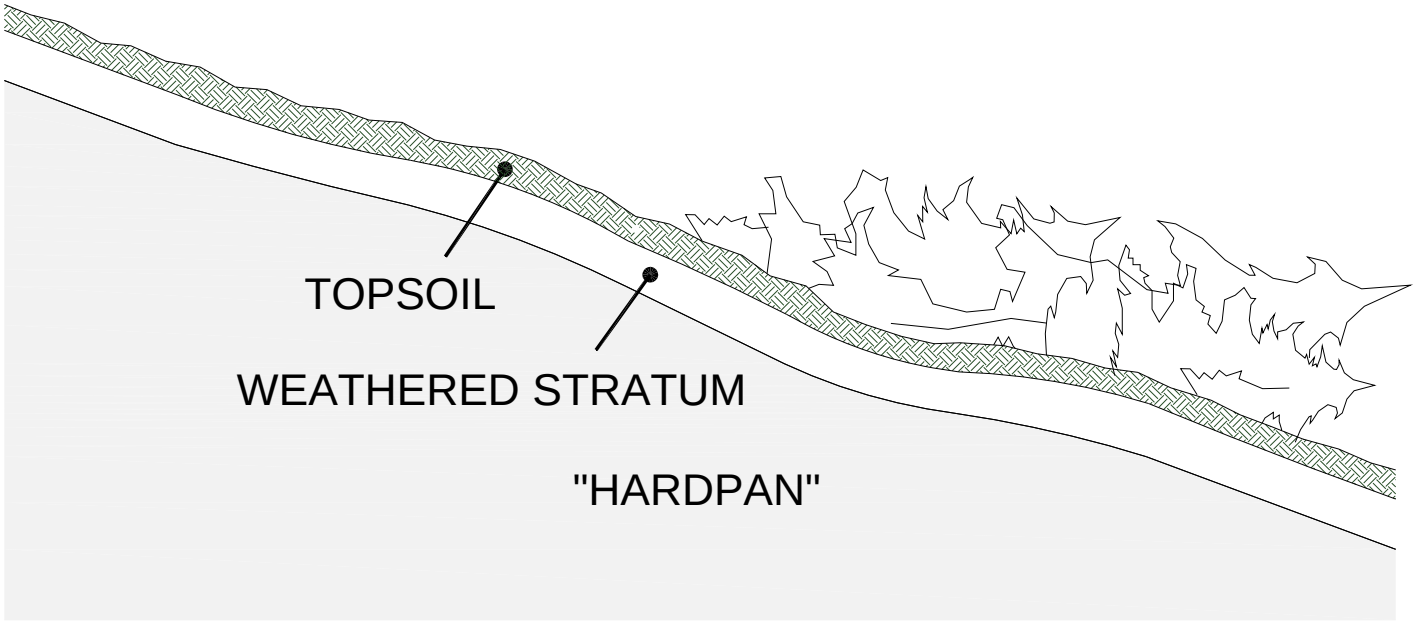

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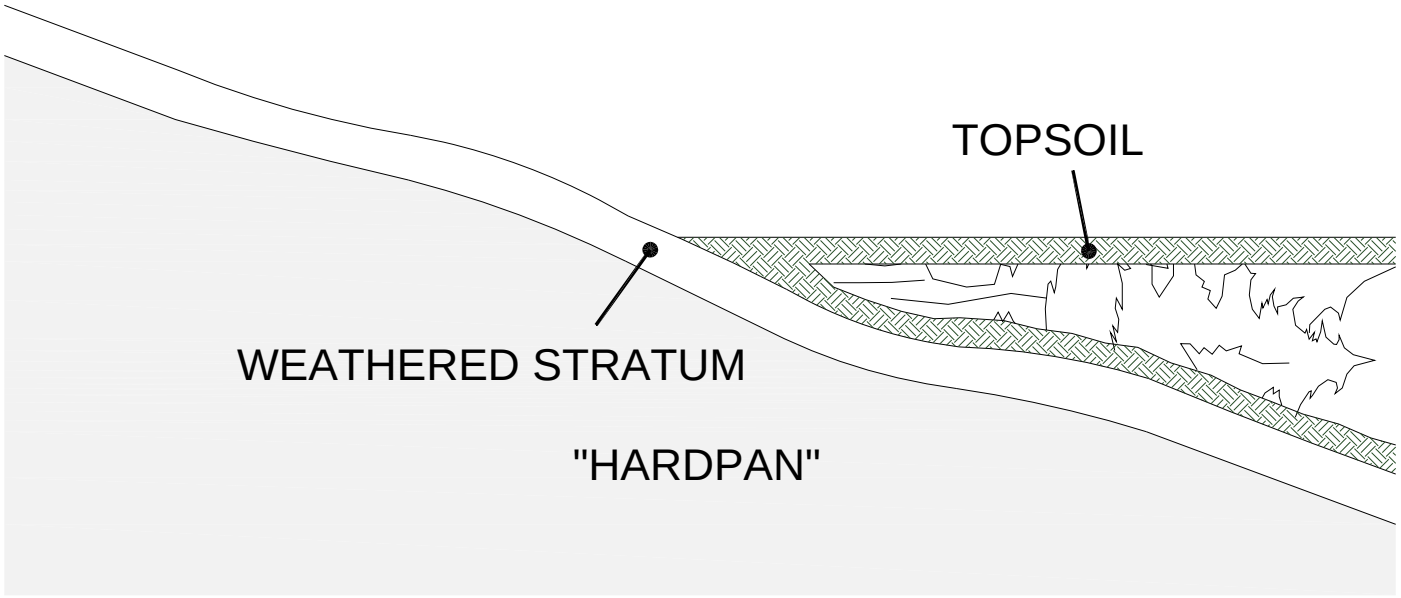
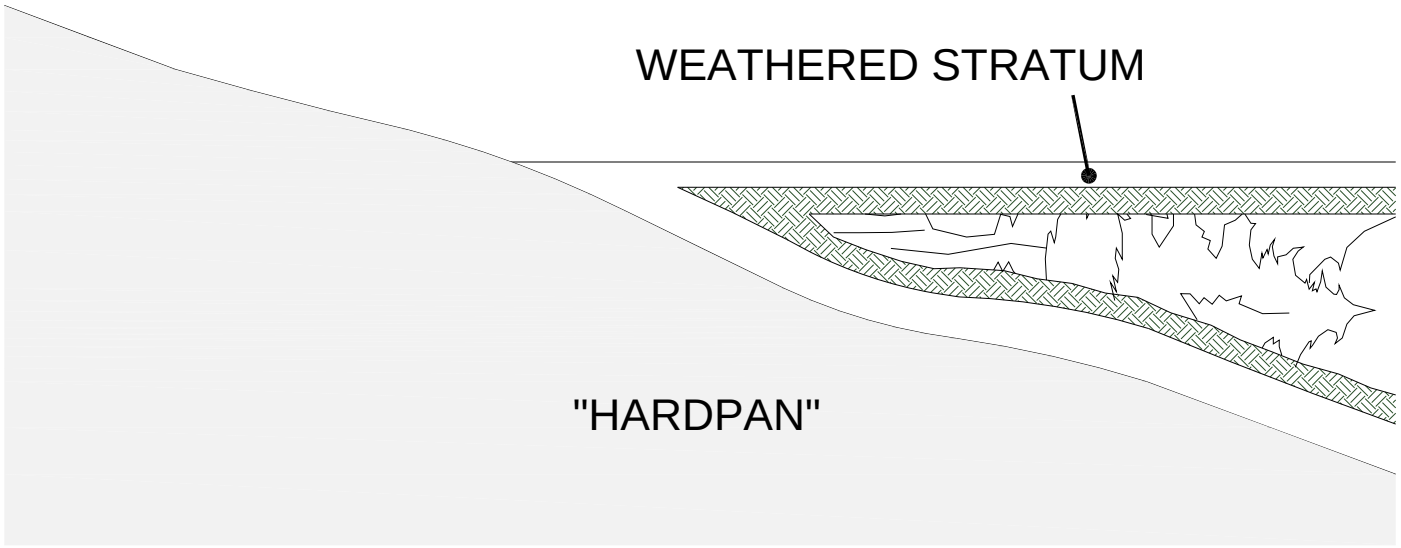

TOPSOIL
WEATHERED STRATUM
"HARDPAN"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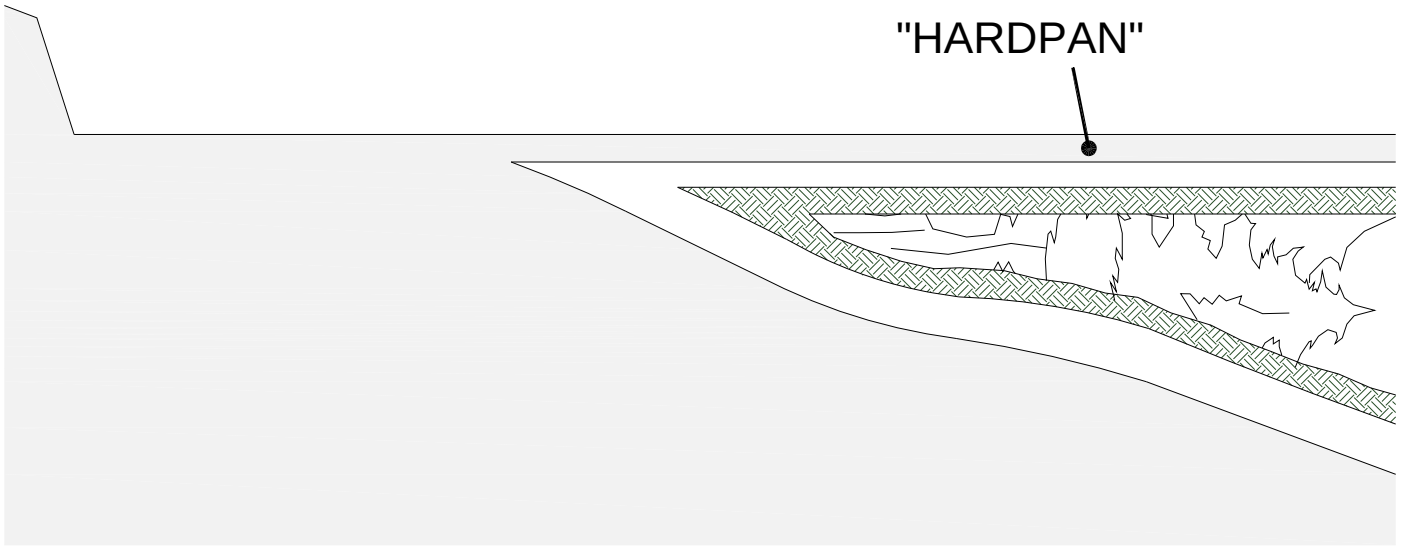

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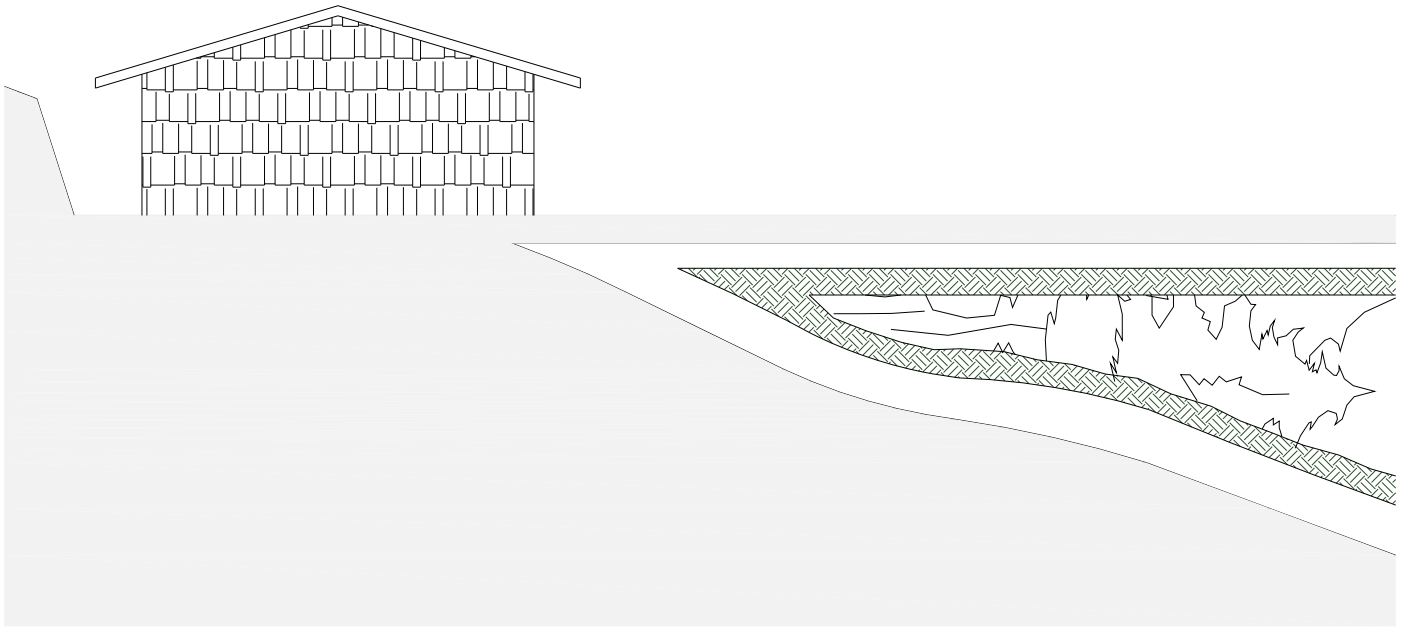

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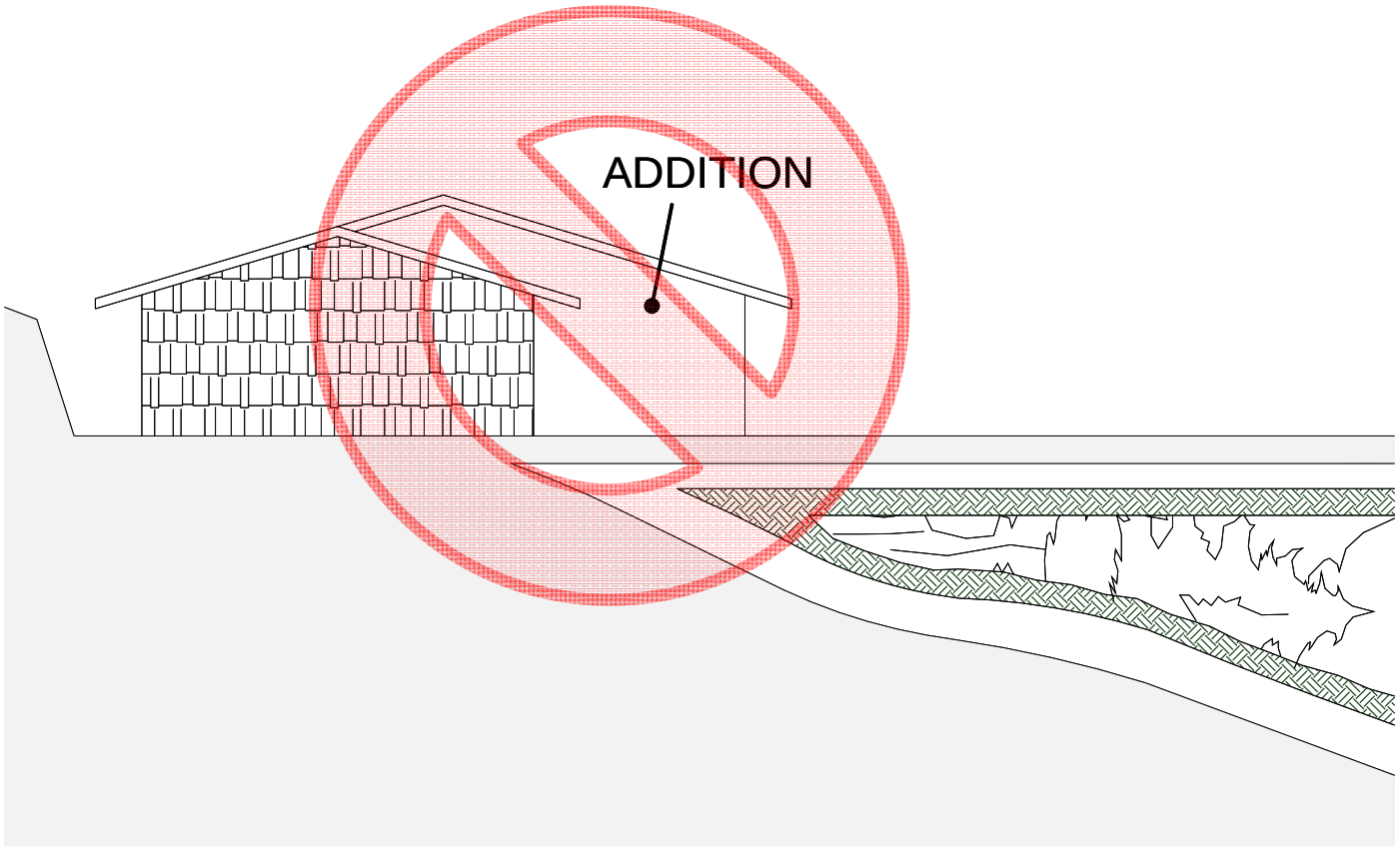

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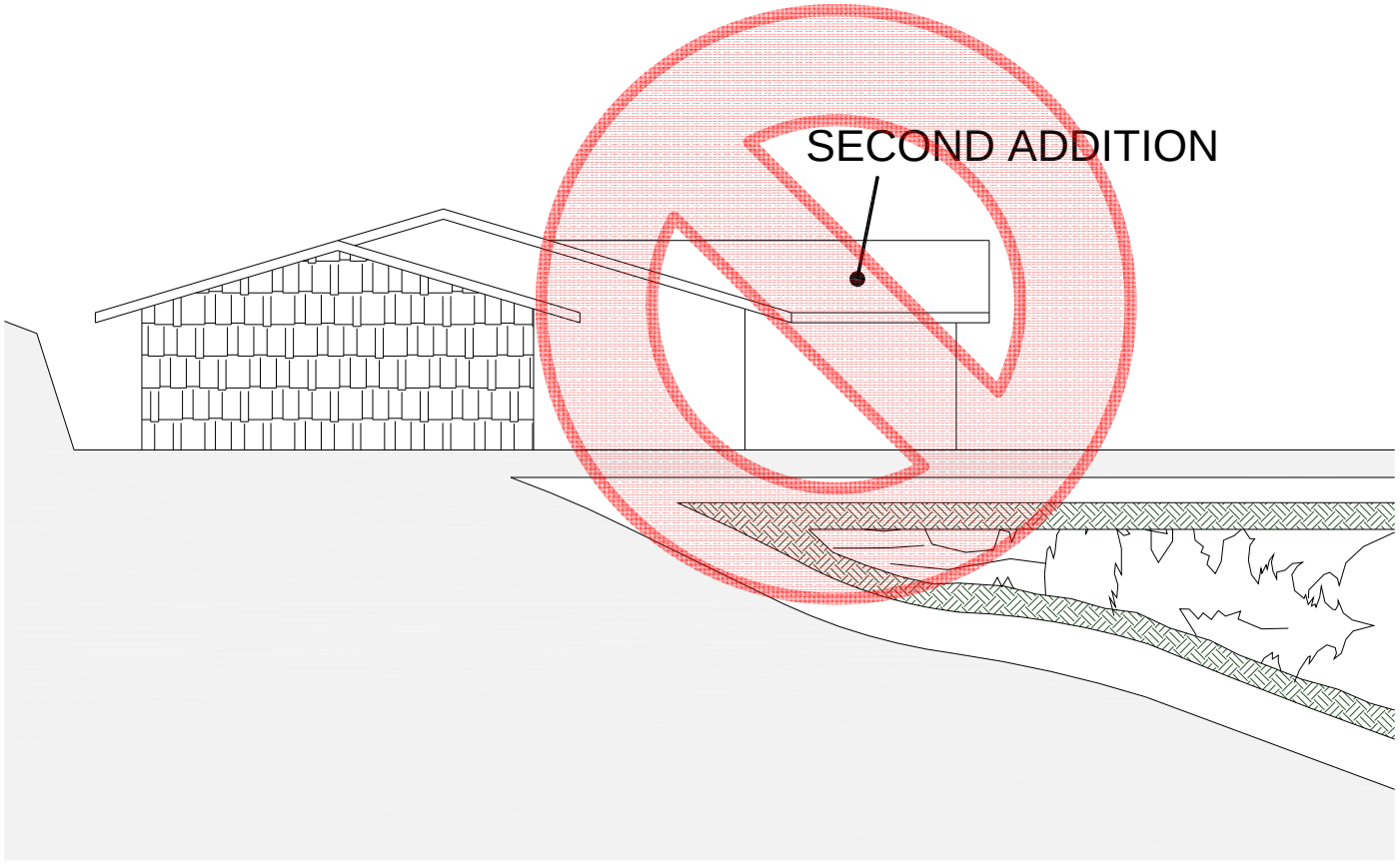

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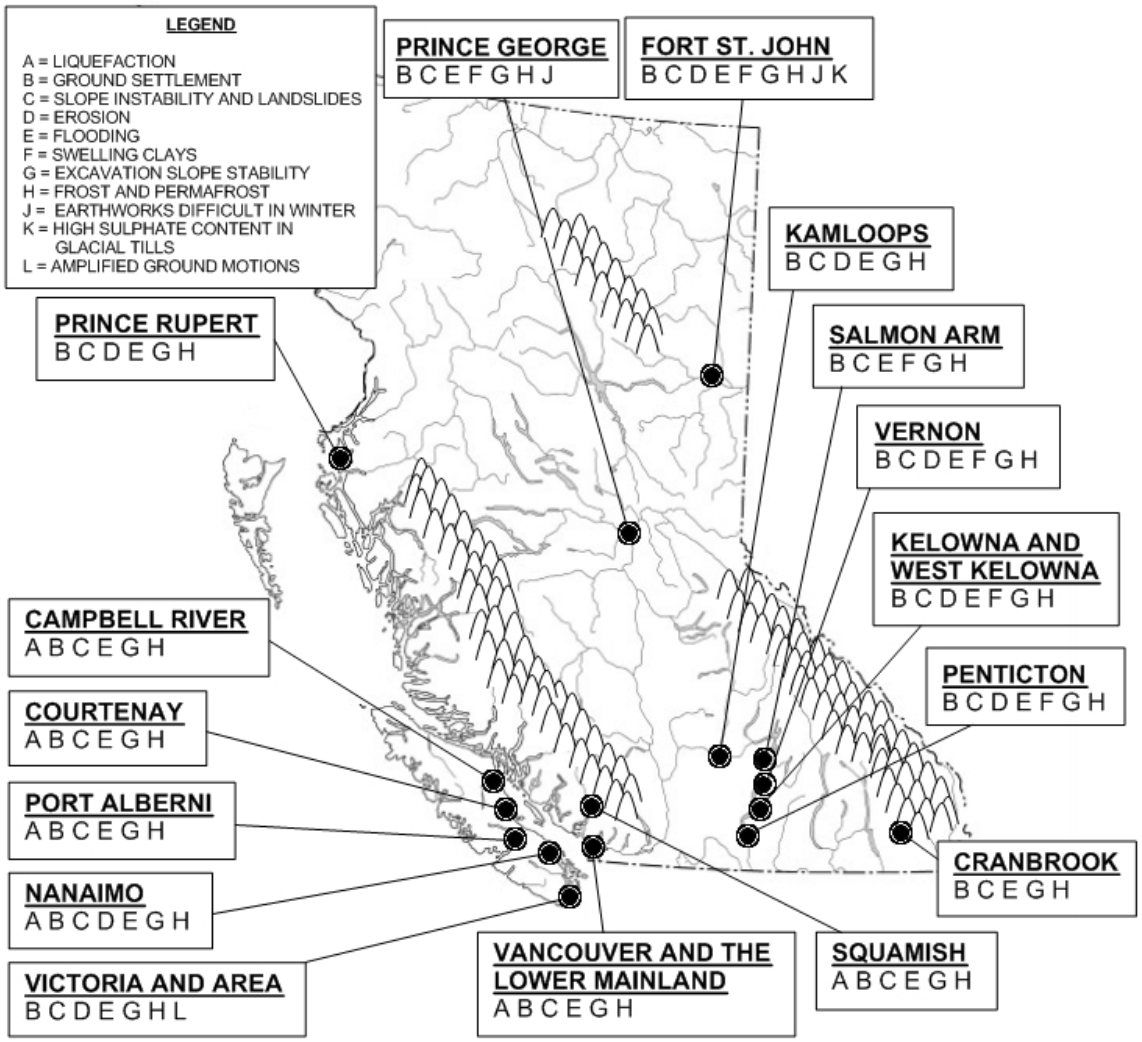
POTENTIAL GEOTECHNICAL CHALLENGES IN BC



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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

- liquefaction

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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

- liquefaction
- ground settlement

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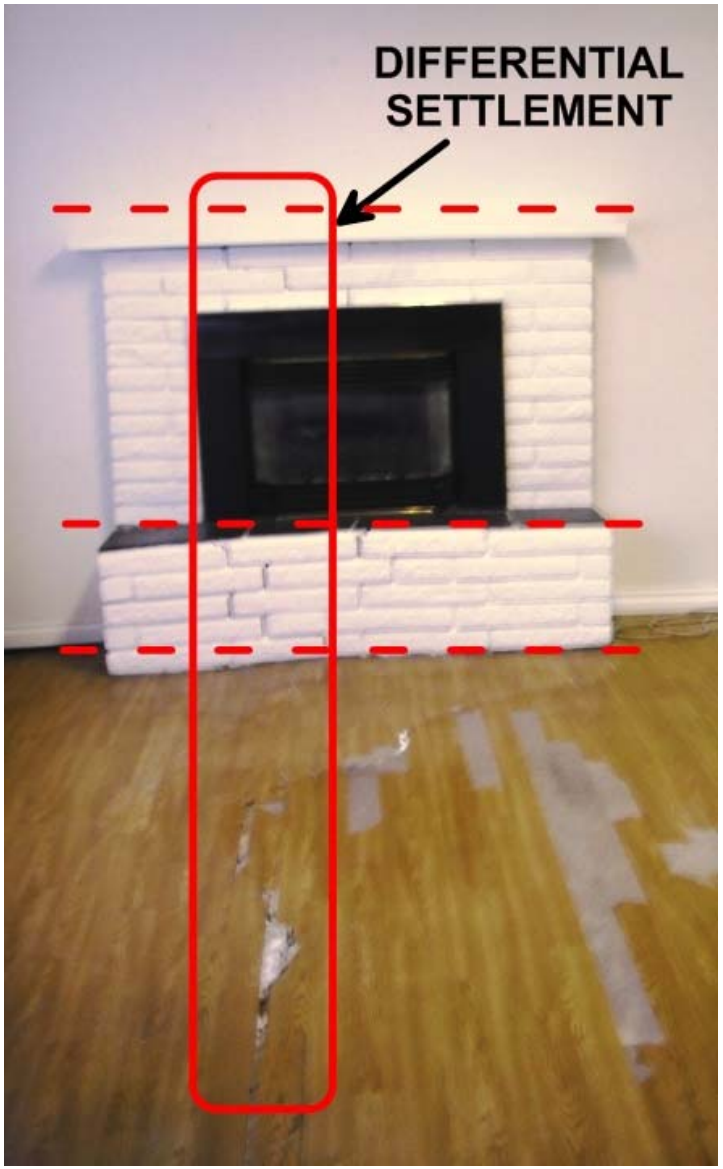

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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

- liquefaction
- ground settlement
- slope instability and landslides

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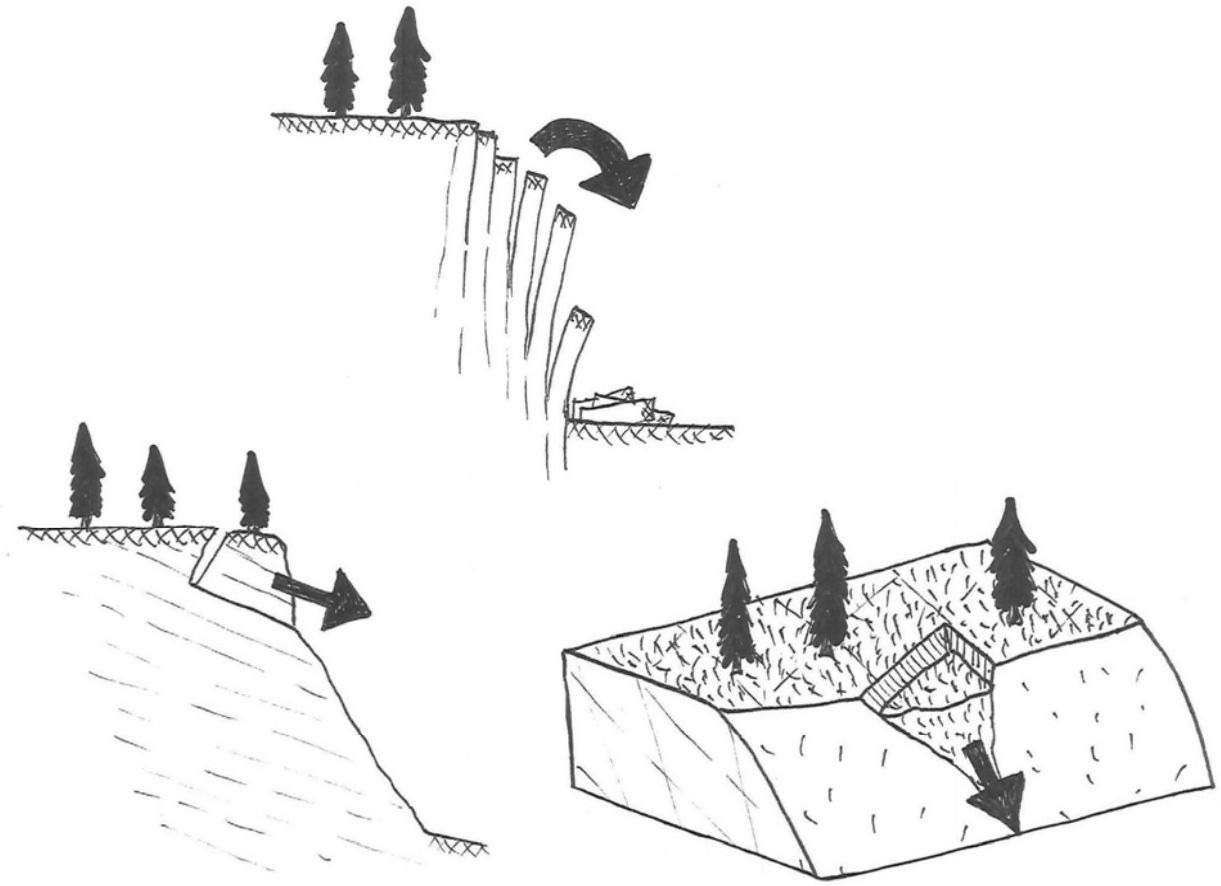

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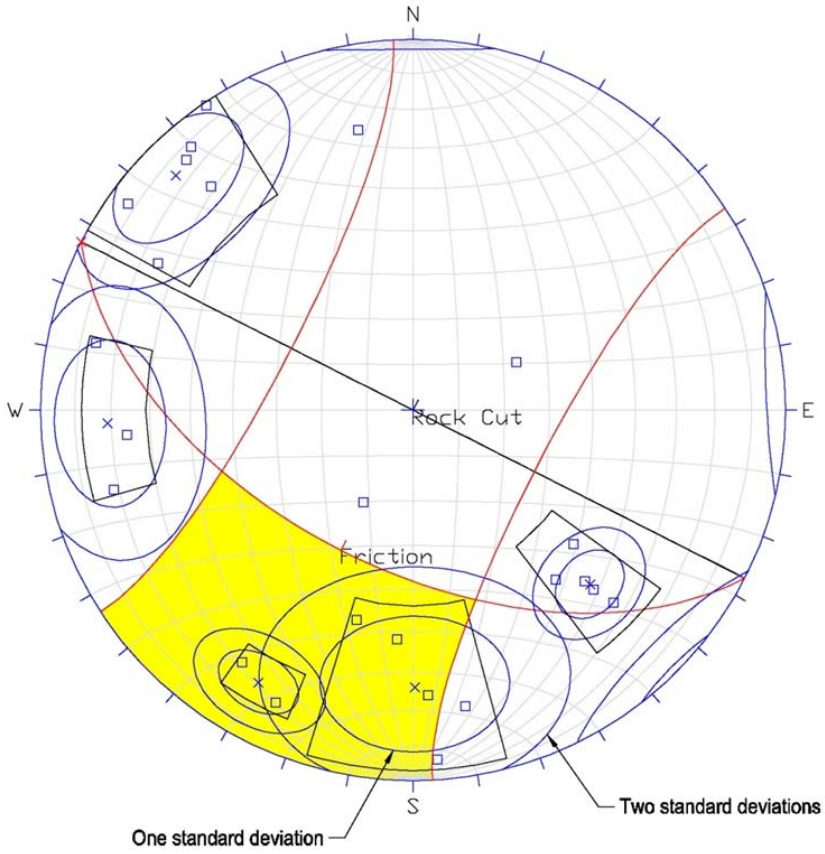

LEGEND:

- Poles
- Average pole for discontinuity set
- Rock cut
- Friction angle
- Average plan for discontinuity set
- Zone of potential failure

ORIENTATION = 117°/90° SW
FRICTION ANGLE = 35°

RESULT:
Potential toppling failure at set orientations:
- 270°/64°N
- 299°/73°NE

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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

- liquefaction
- ground settlement
- slope instability and landslides
- erosion
  - natural

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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

- liquefaction
- ground settlement
- slope instability and landslides
- erosion
  - natural
  - human-caused

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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

- liquefaction
- ground settlement
- slope instability and landslides
- erosion
- flooding

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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

- liquefaction
- ground settlement
- slope instability and landslides
- erosion
- flooding
  - sea level rise
  - tsunami hazard

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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

- liquefaction
- ground settlement
- slope instability and landslides
- erosion
- flooding
- swelling clays

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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

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- excavation slope stability

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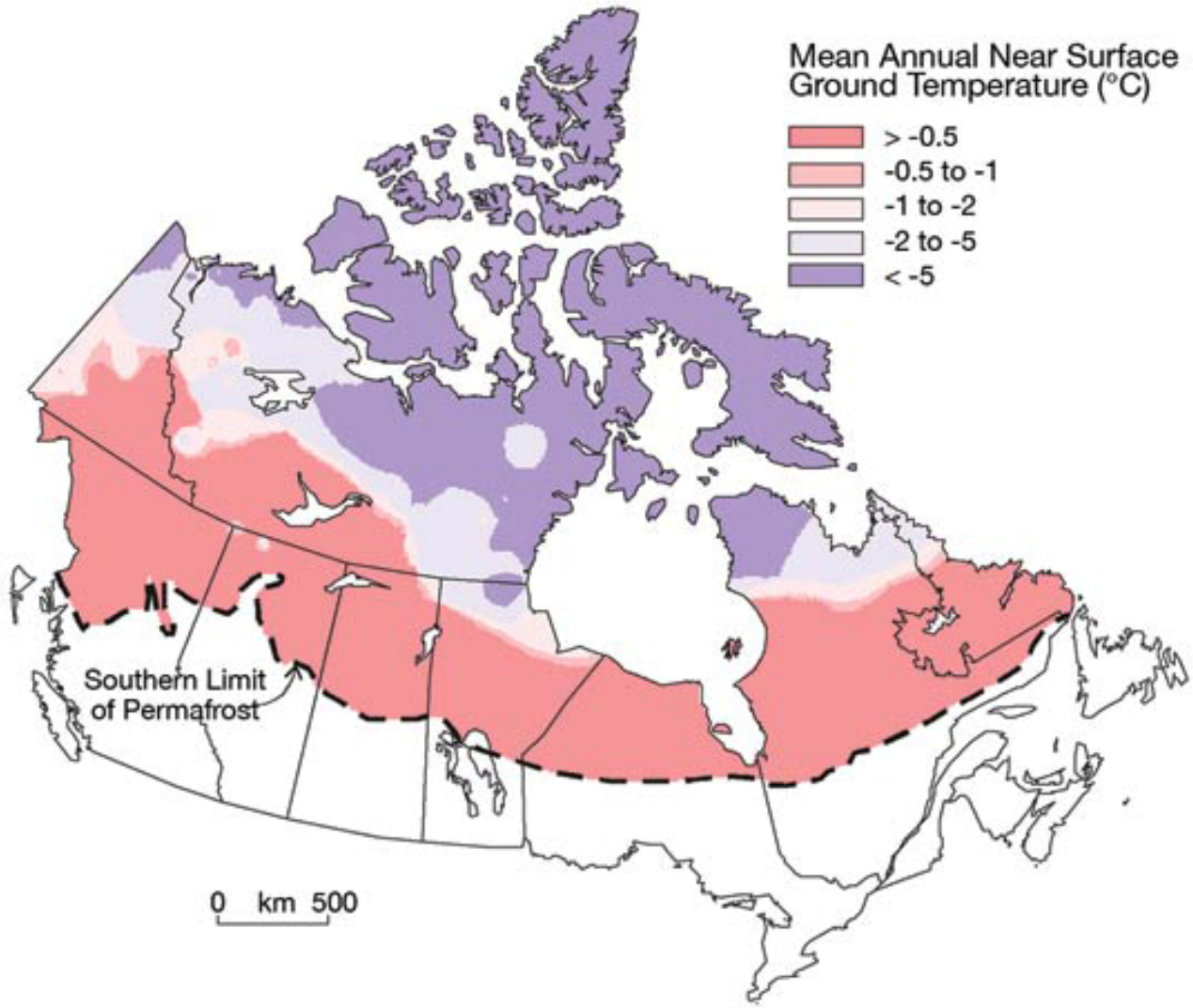
- frost and permafrost



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POTENTIAL GEOTECHNICAL CHALLENGES IN BC

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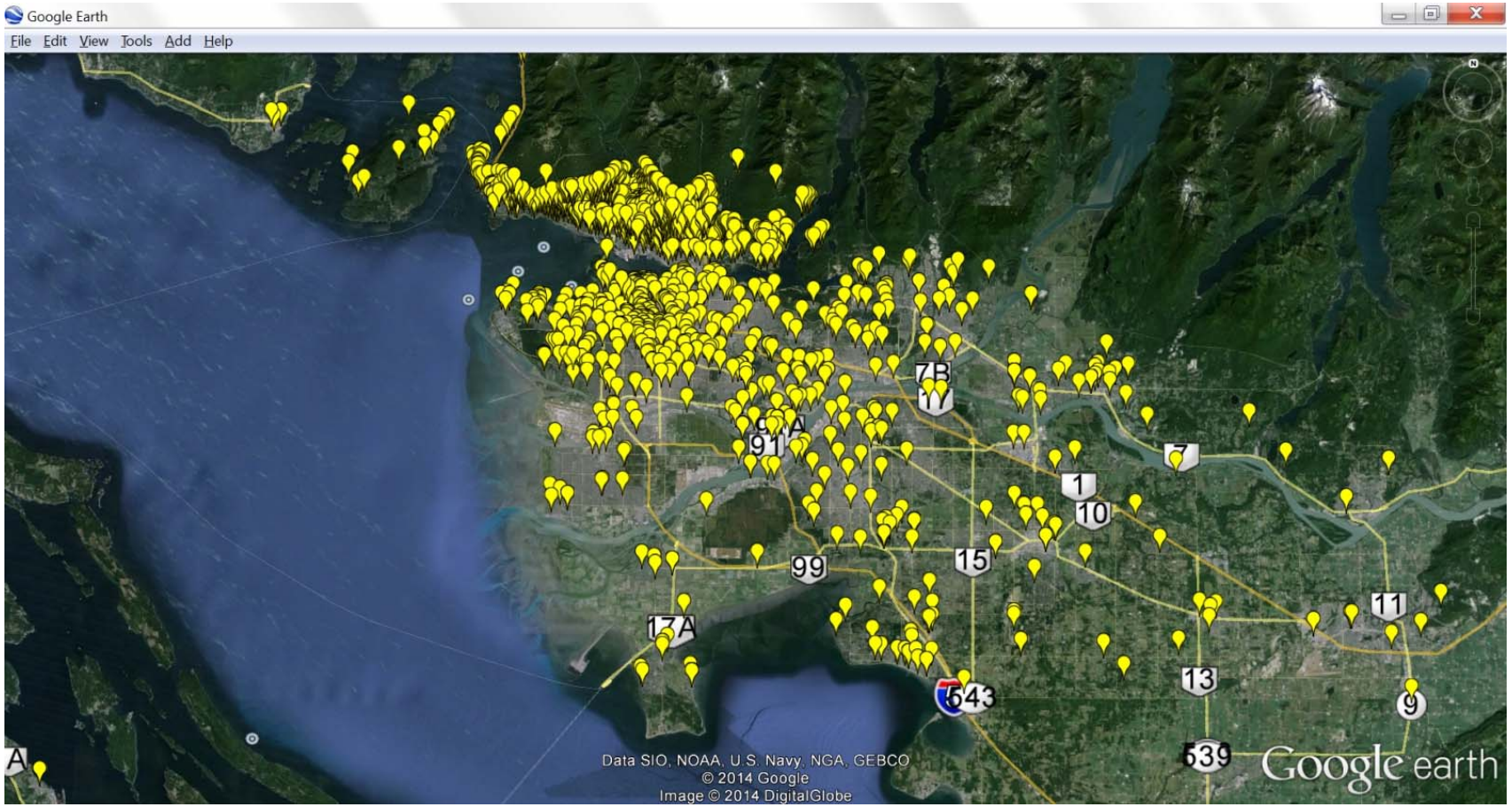
- erosion
- flooding
- swelling clays
- excavation slope stability
- frost and permafrost
- earthworks difficult in winter
- high sulphate content in glacial tills degrades concrete
- amplified seismic ground motions

SITE SELECTION

- engineers with local experience



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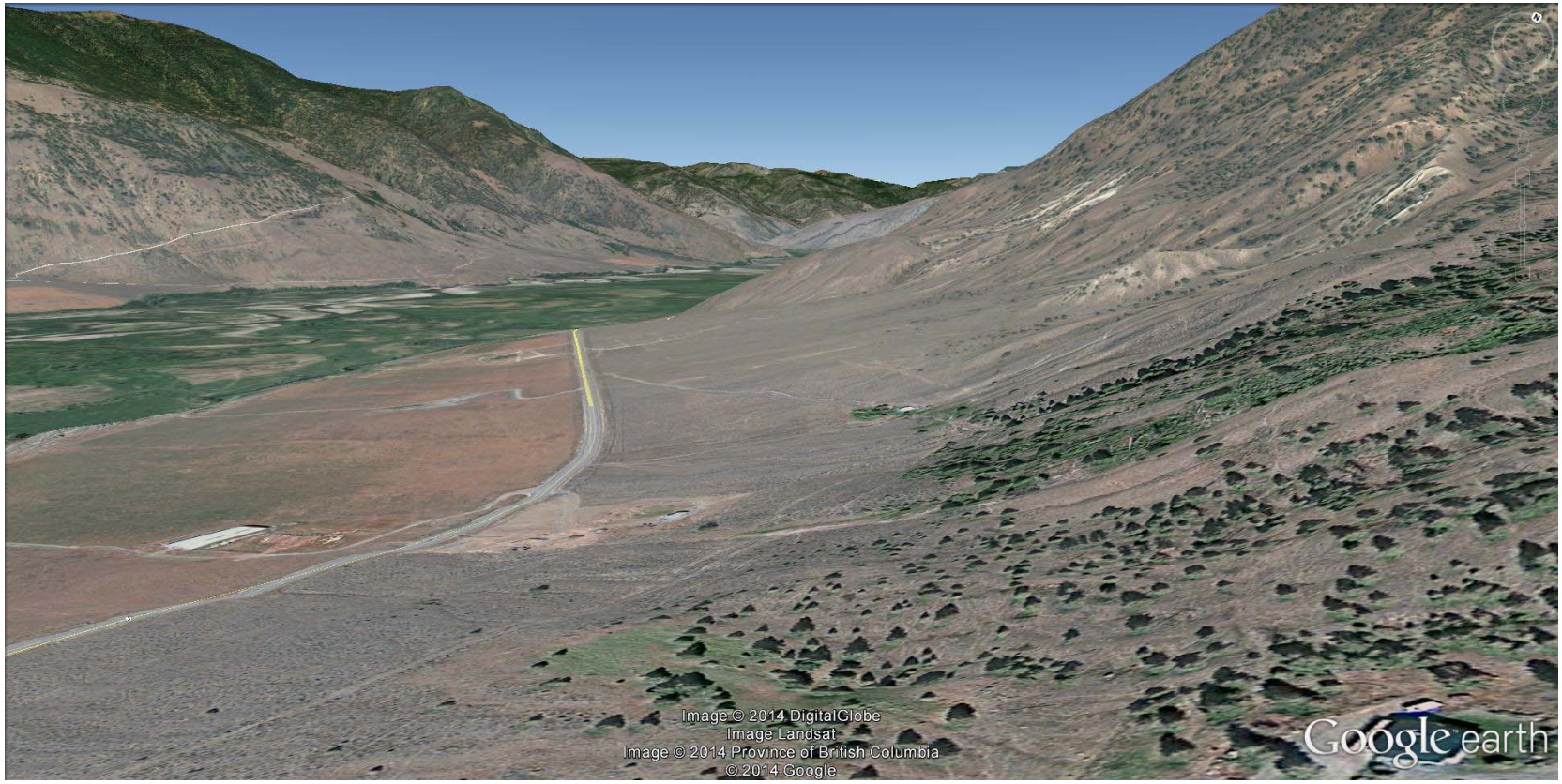

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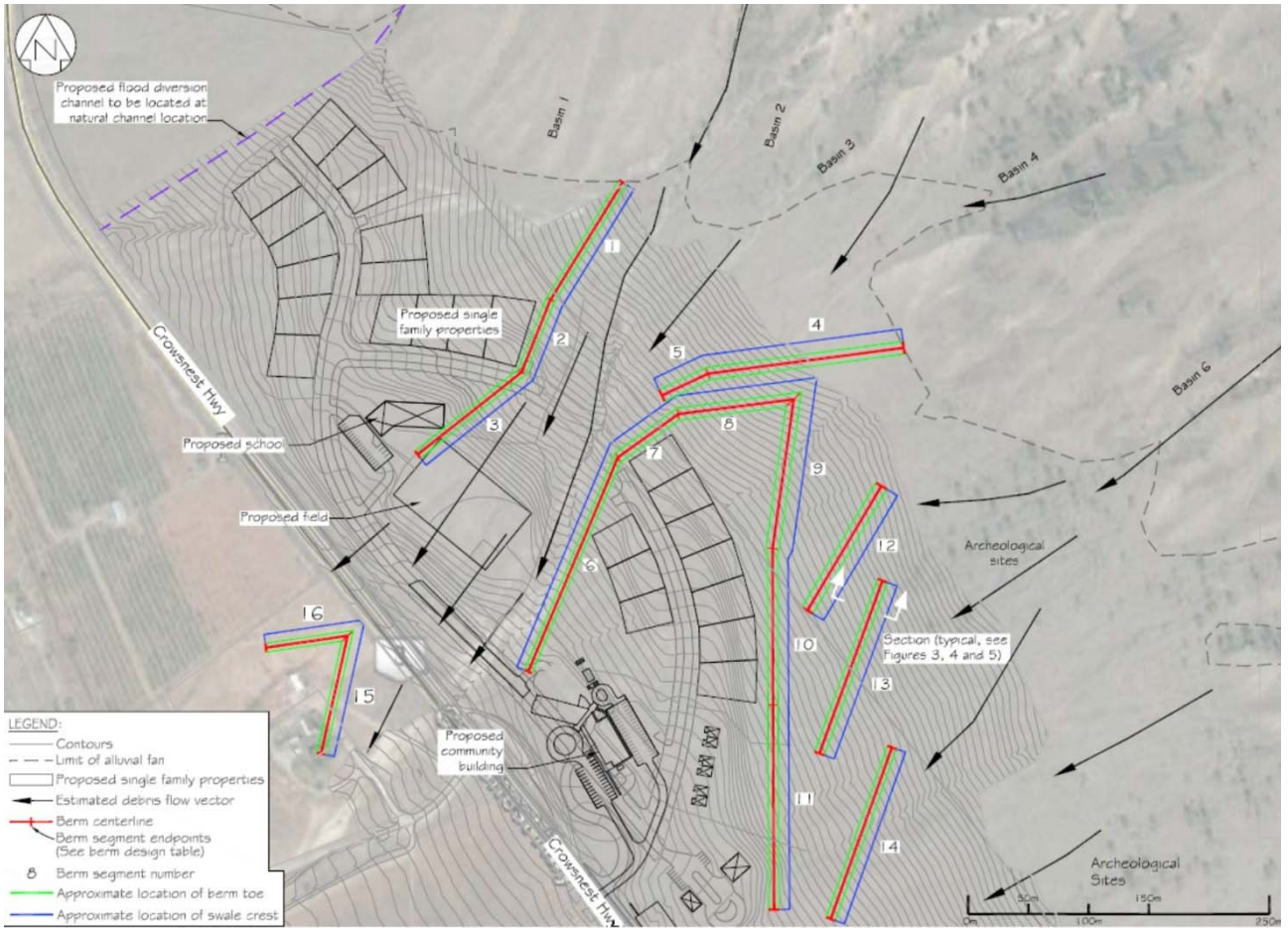

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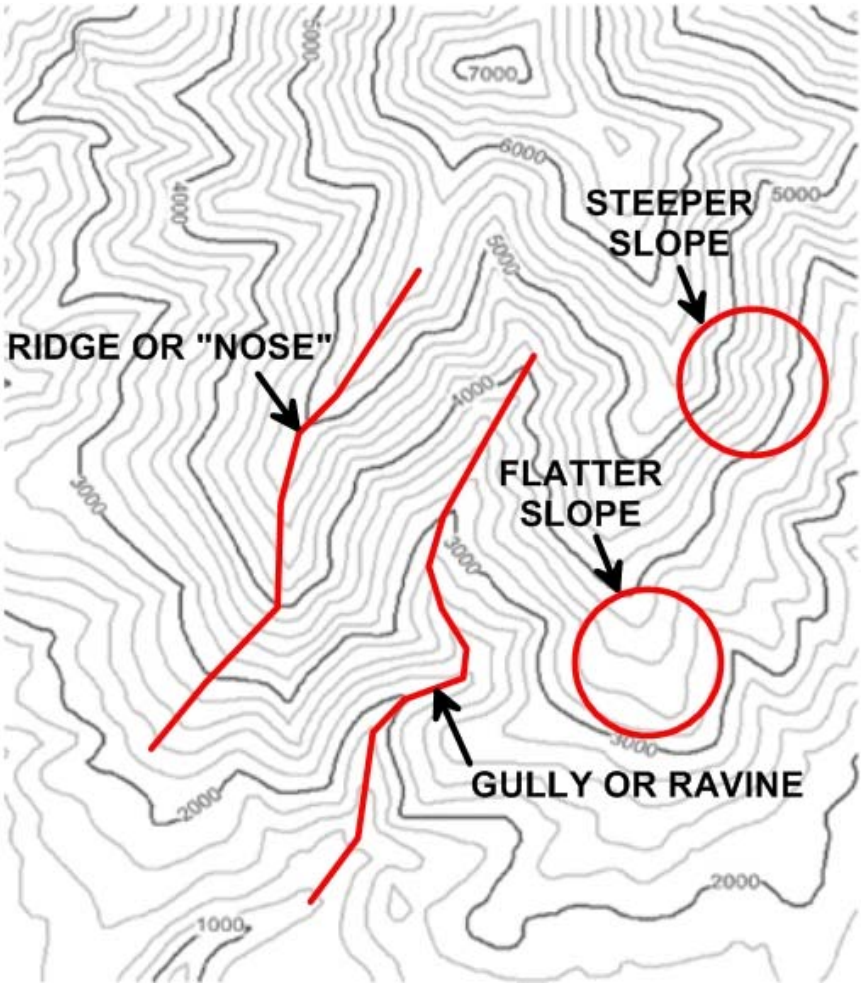
SITE SELECTION

- engineers with local experience
- historical aerial photos
- maps
  - topographic



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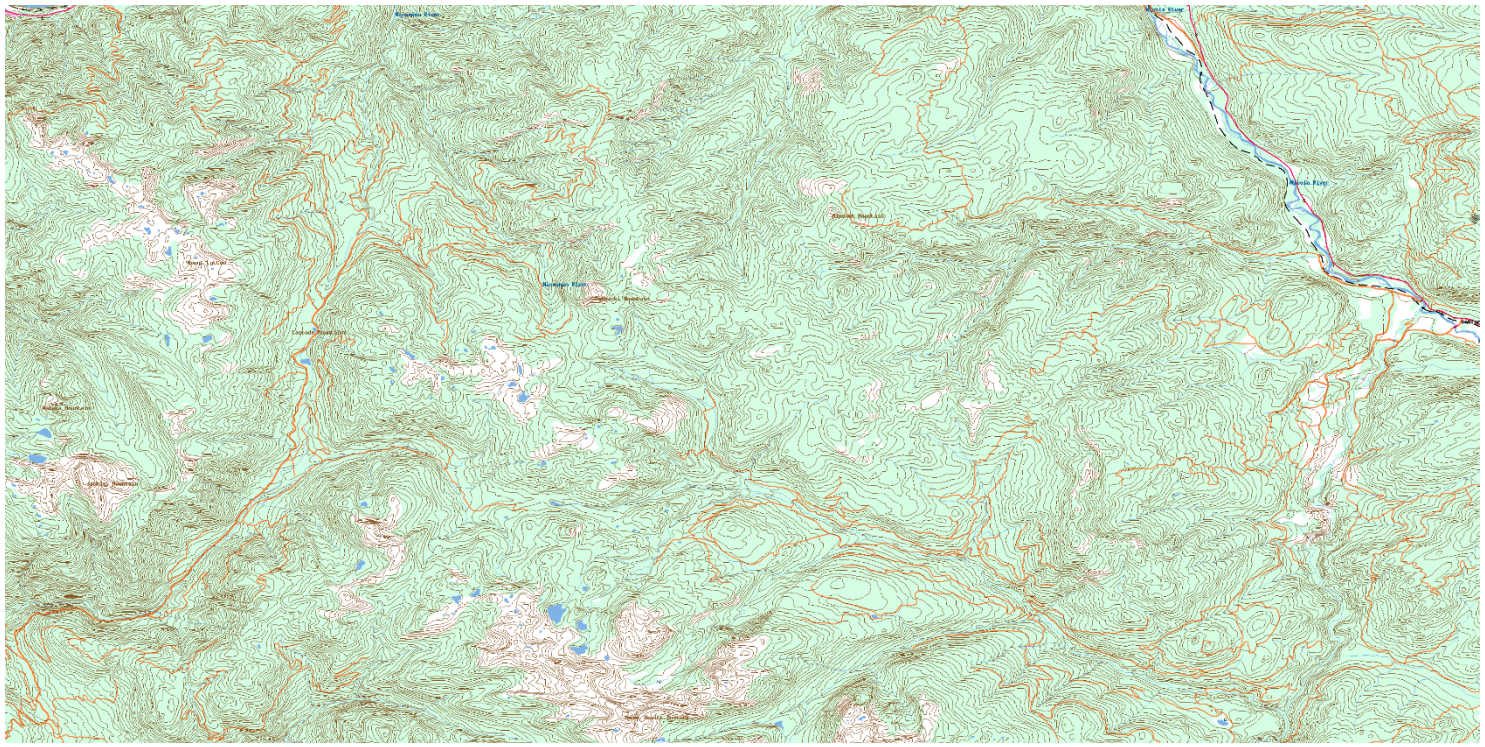

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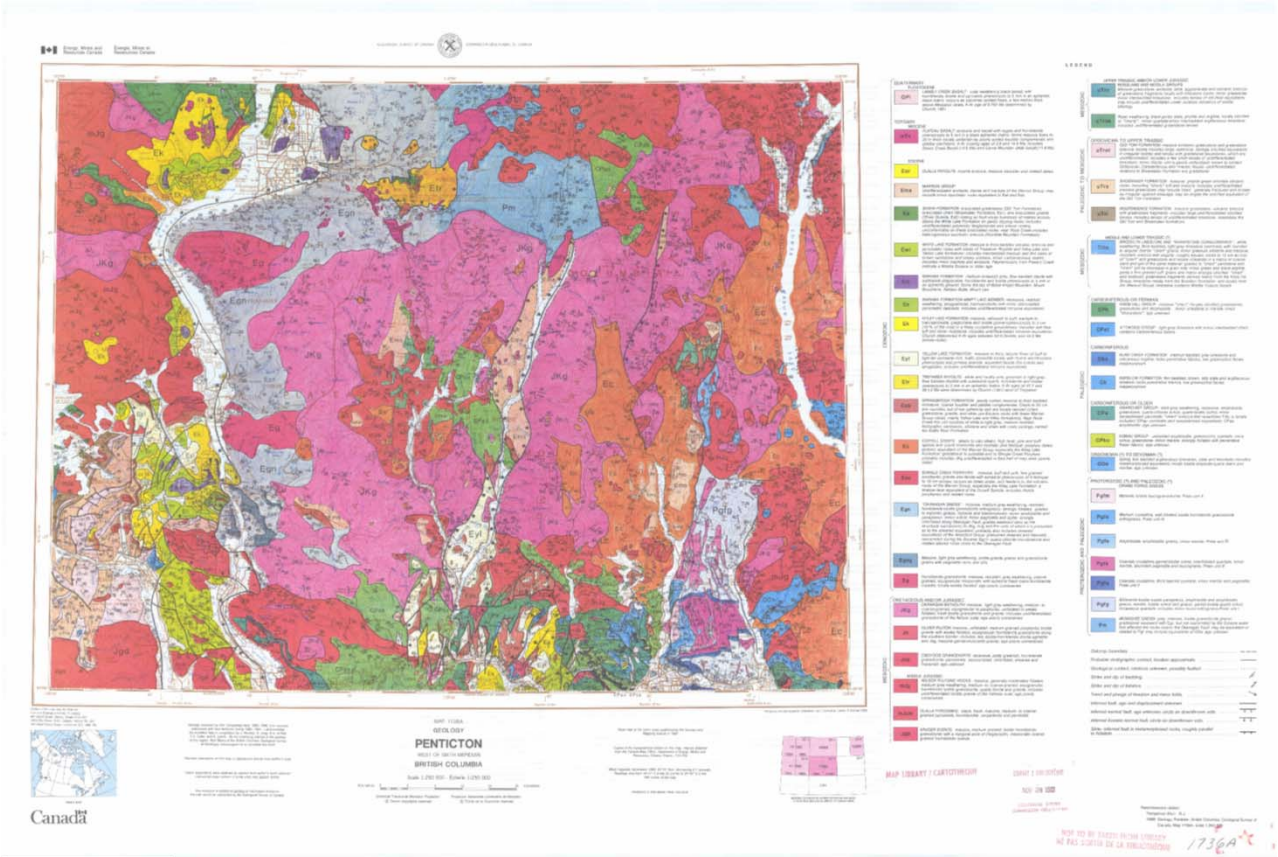

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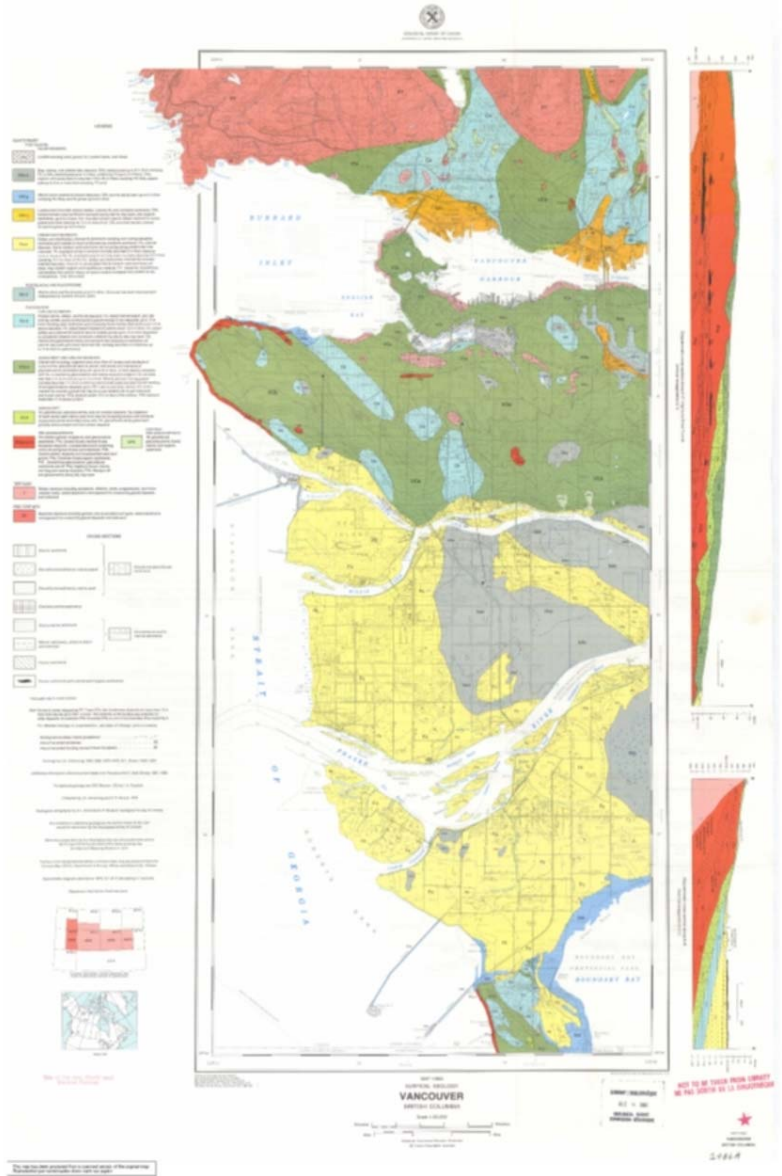

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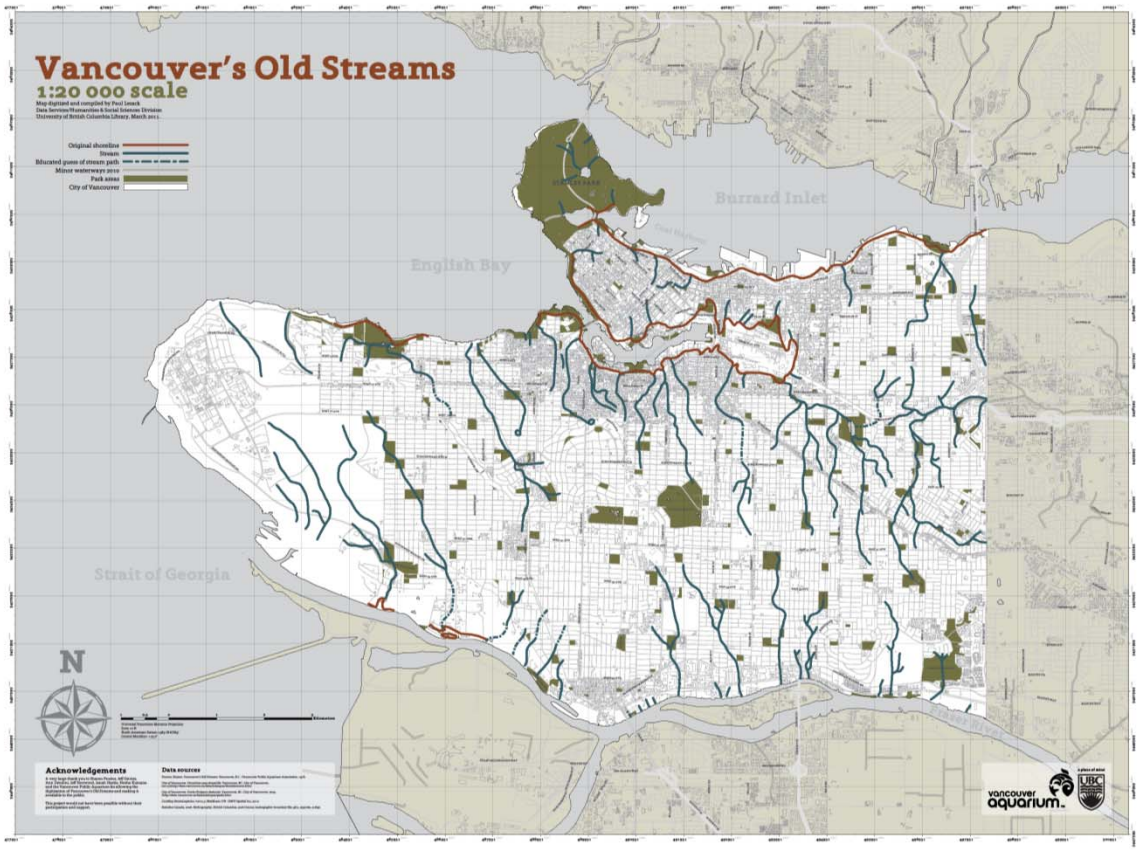
  - old streams



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- engineers with local experience
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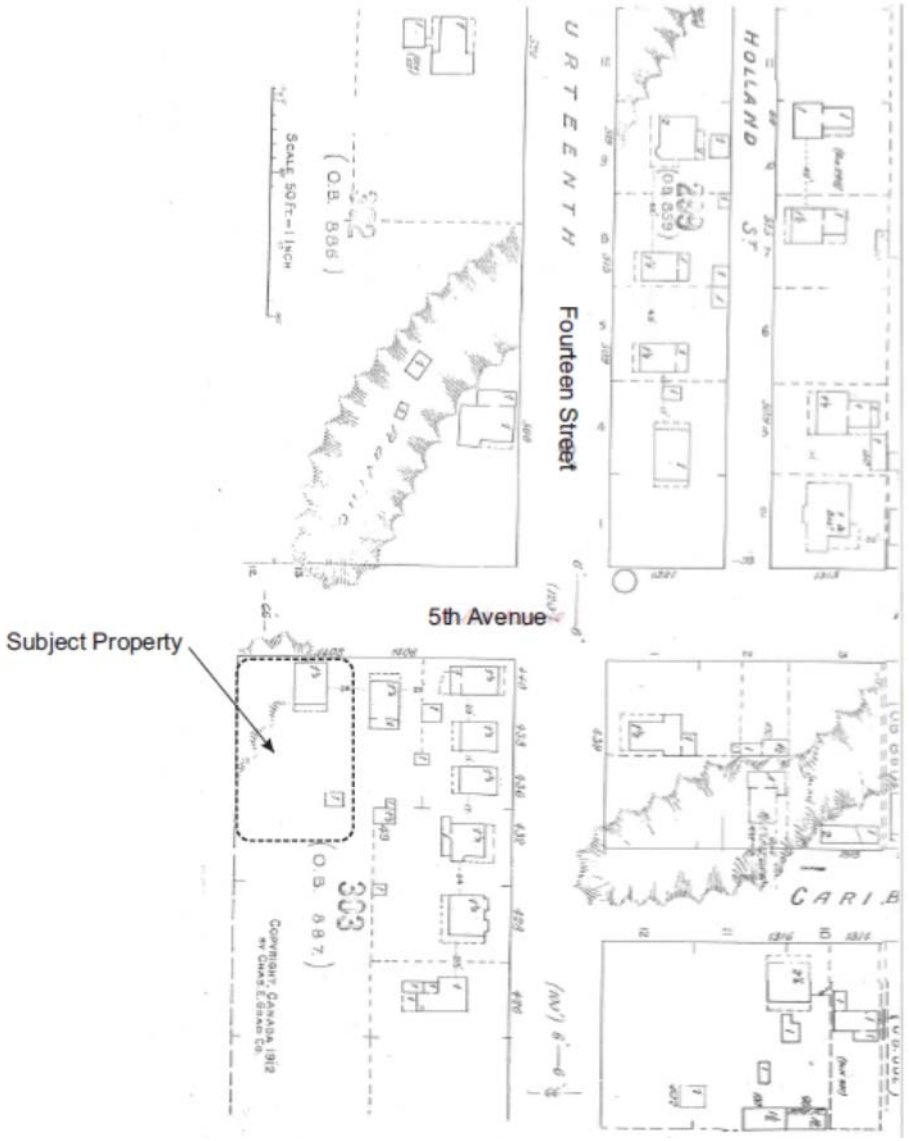
  - geological
  - old streets
  - fire insurance



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SITE SELECTION

- engineers with local experience
- historical aerial photos
- maps
  - topographic
  - geological
  - old streams
  - fire insurance
- archaeological sites
- local newspapers
- Land Titles Office
- canvass existing developments

SITE INVESTIGATION

- best practice is for geotechnical engineer to determine the type of subsurface investigation required
- test pits

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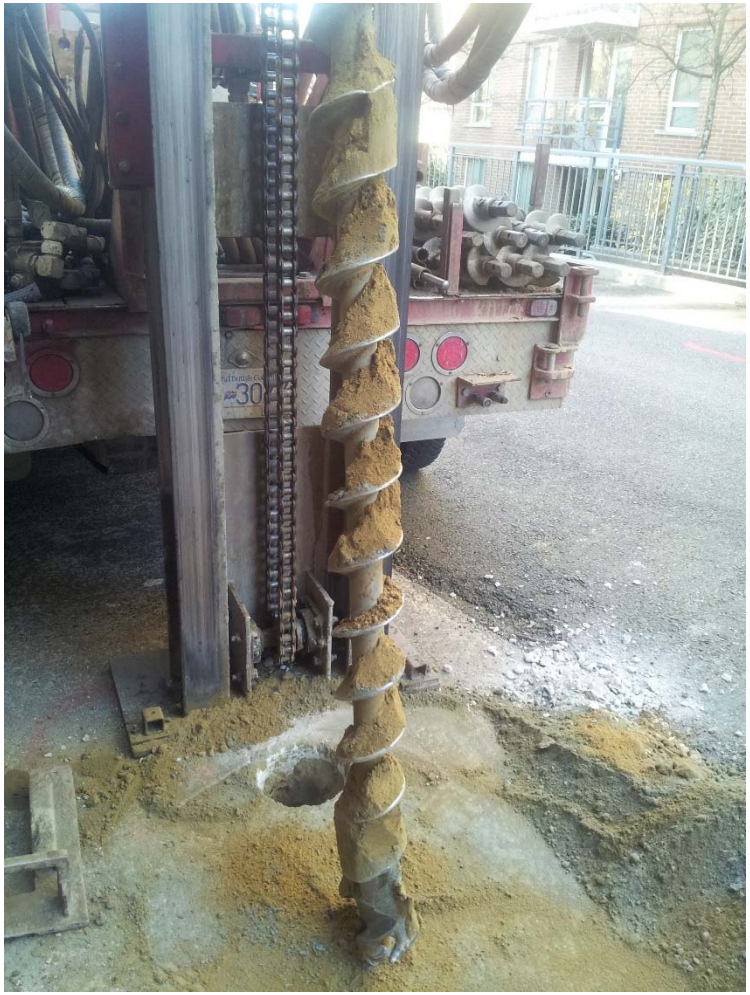

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- best practice is for geotechnical engineer to determine the type of subsurface investigation required
- test pits
- drilling (auger, sonic, Becker, mud/air rotary)

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- cone penetration testing (CPT, DCPT, WildCat)

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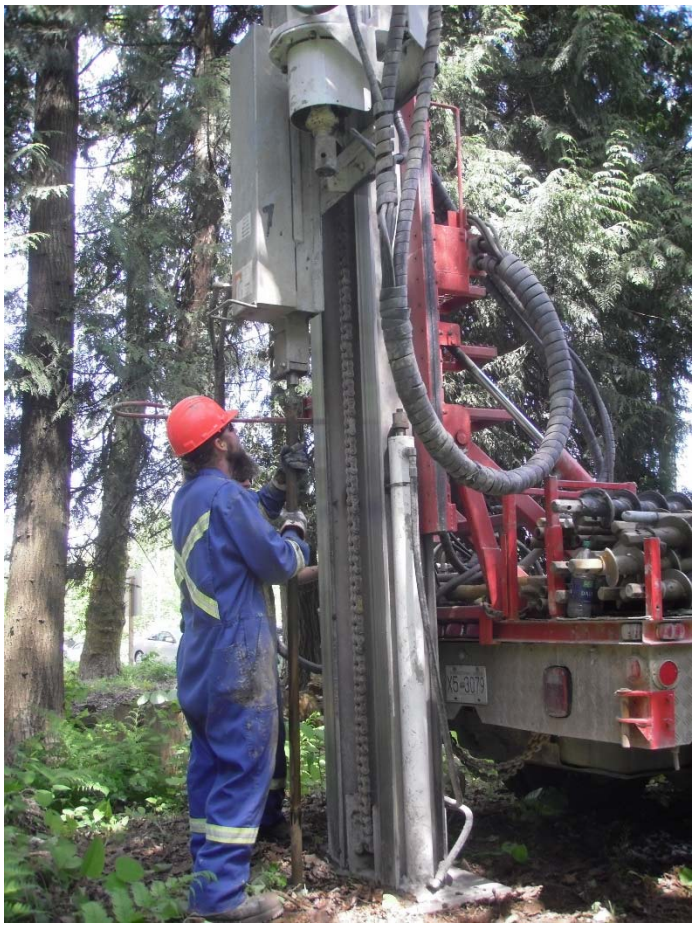

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- drilling (auger, sonic, Becker, mud/air rotary)
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- slope profiles

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FOUNDATIONS

- best practice to seek advice from geotechnical engineer at sites with potentially compressible, liquefiable, or swelling soils
- conventional foundations and foundation walls

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  - BCBC provides minimum requirements
  - frost protection

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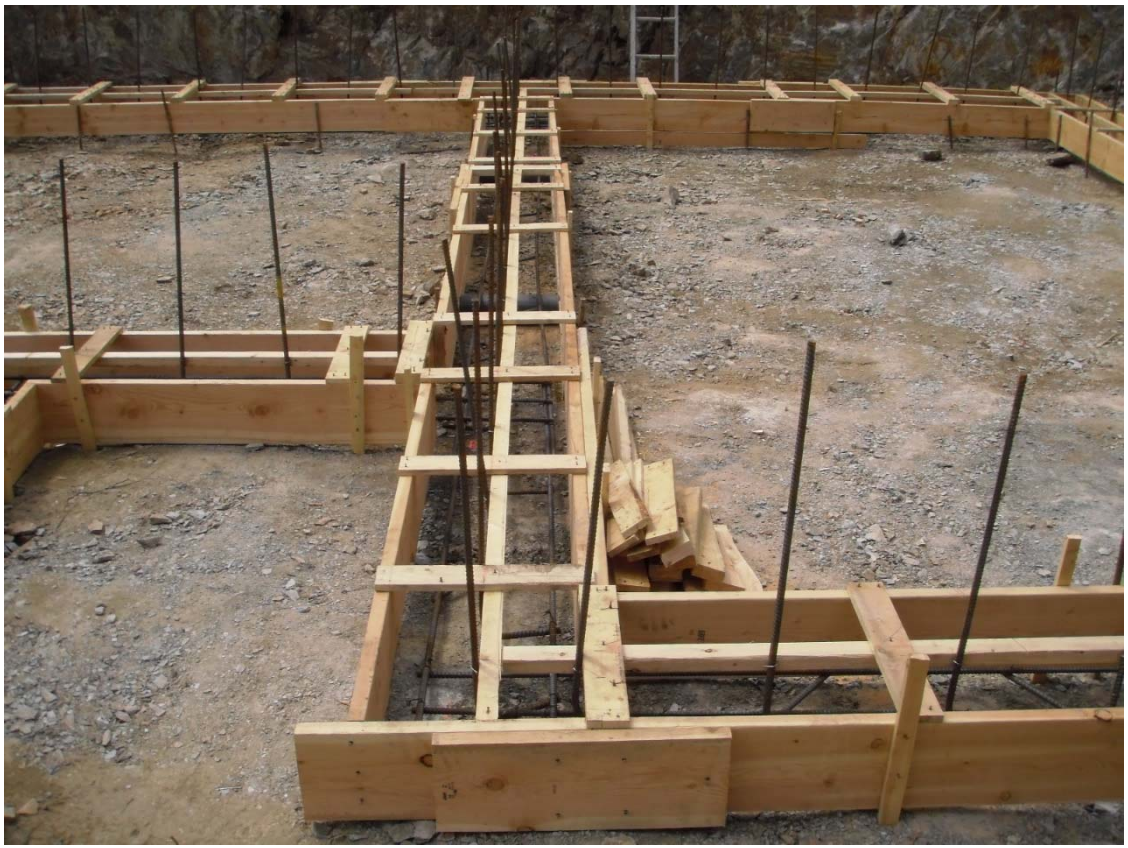
FOUNDATIONS

- best practice to seek advice from geotechnical engineer at sites with potentially compressible, liquefiable, or swelling soils
- conventional foundations and foundation walls
  - BCBC provides minimum requirements
  - frost protection
  - best practice to reinforce foundations



HORIZON ENGINEERING INC

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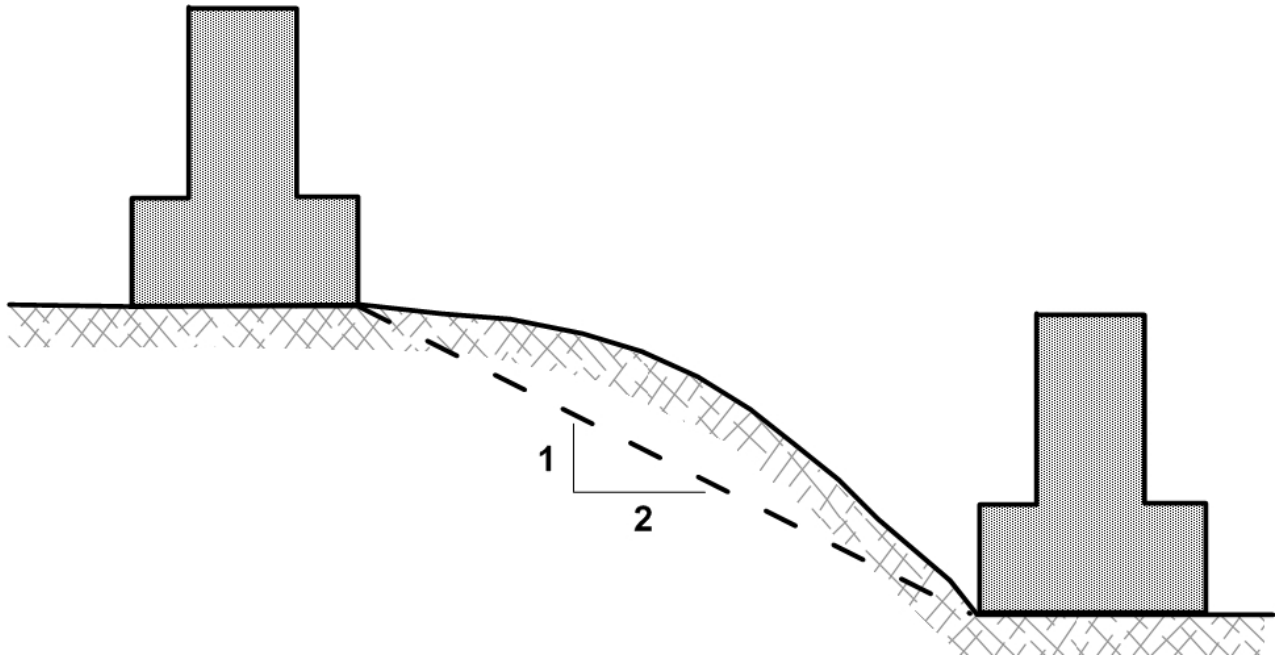
  - stepping of adjacent foundations



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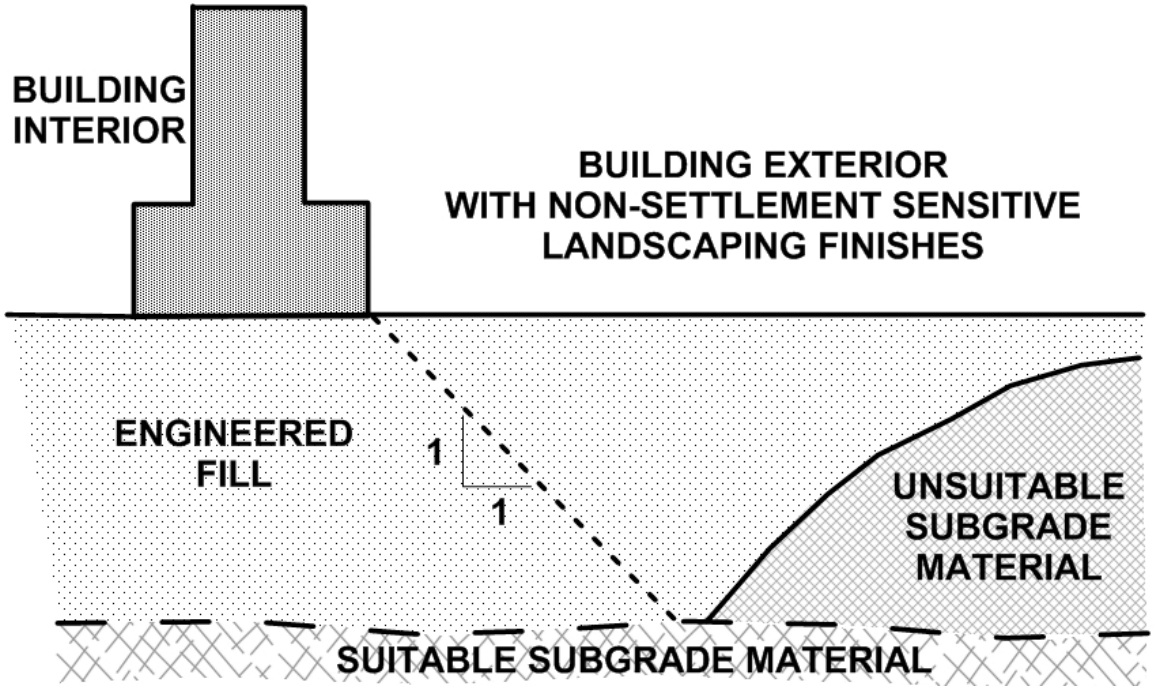
  - BCBC provides minimum requirements
  - frost protection
  - best practice to reinforce foundations
  - stepping of adjacent foundations
  - dowelling foundations into bedrock
  - Engineered Fill



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- conventional foundations and foundation walls
  - BCBC provides minimum requirements
  - frost protection
  - best practice to reinforce foundations
  - stepping of adjacent foundations
  - dowelling foundations into bedrock
  - Engineered Fill
  - foundation subgrade preparation

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POOR SUBGRADE PREPARATION

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POOR SUBGRADE PREPARATION

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POOR SUBGRADE PREPARATION

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UNDERCUTTING FOOTINGS

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UNDERCUTTING FOOTINGS

FOUNDATIONS

- best practice to seek advice from geotechnical engineer at sites with potentially compressible, liquefiable, or swelling soils
- conventional foundations and foundation walls
- other foundation types
  - preloading, raft foundation, weight compensation strategies
  - loading history important with compressible soils

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FOUNDATIONS

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- conventional foundations and foundation walls
- other foundation types
  - preloading, raft foundation, weight compensation strategies
  - loading history important with compressible soils
  - piles (timber, steel, helical, micropiles)

TIMBER PILES

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STEEL PILES

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STEEL PILES

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STEEL PILES

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MICROPILES

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HELICAL PILES

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HELICAL PILES

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FOUNDATIONS

- best practice to seek advice from geotechnical engineer at sites with potentially compressible, liquefiable, or swelling soils
- conventional foundations and foundation walls
- other foundation types
- seismic resistance of foundations

2010 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

Requested by: ,

March 27, 2013

Site Coordinates: 49.3264 North 123.1216 West

User File Reference: 2035 Fullerton Avenue, North Vancouver, BC

National Building Code ground motions:
2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.883	0.619	0.327	0.171	0.433

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2010 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. 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 calculated values.*** Warning: You are in a region which considers the hazard from a deterministic Cascadia subduction event for the National Building Code. Values determined for high probabilities (0.01 per annum) in this region do not consider the hazard from this type of earthquake.

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.2)	0.220	0.468	0.635
Sa(0.5)	0.150	0.322	0.438
Sa(1.0)	0.078	0.169	0.230
Sa(2.0)	0.039	0.086	0.119
PGA	0.112	0.232	0.312

References

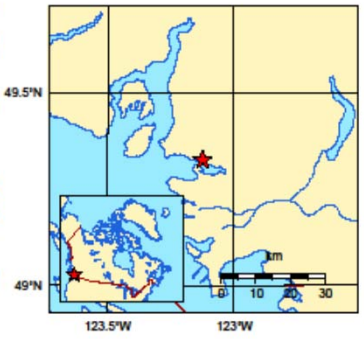
National Building Code of Canada 2010 NRCC no. 53301; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2010, Structural Commentaries NRCC no. 53543 (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Maps and grid values to be used with the 2010 National Building Code of Canada (in preparation)

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

Aussi disponible en français



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FOUNDATIONS

- best practice to seek advice from geotechnical engineer at sites with potentially compressible, liquefiable, or swelling soils
- conventional foundations and foundation walls
- other foundation types
- seismic resistance of foundations
  - deep subsurface investigation in potentially liquefiable soils

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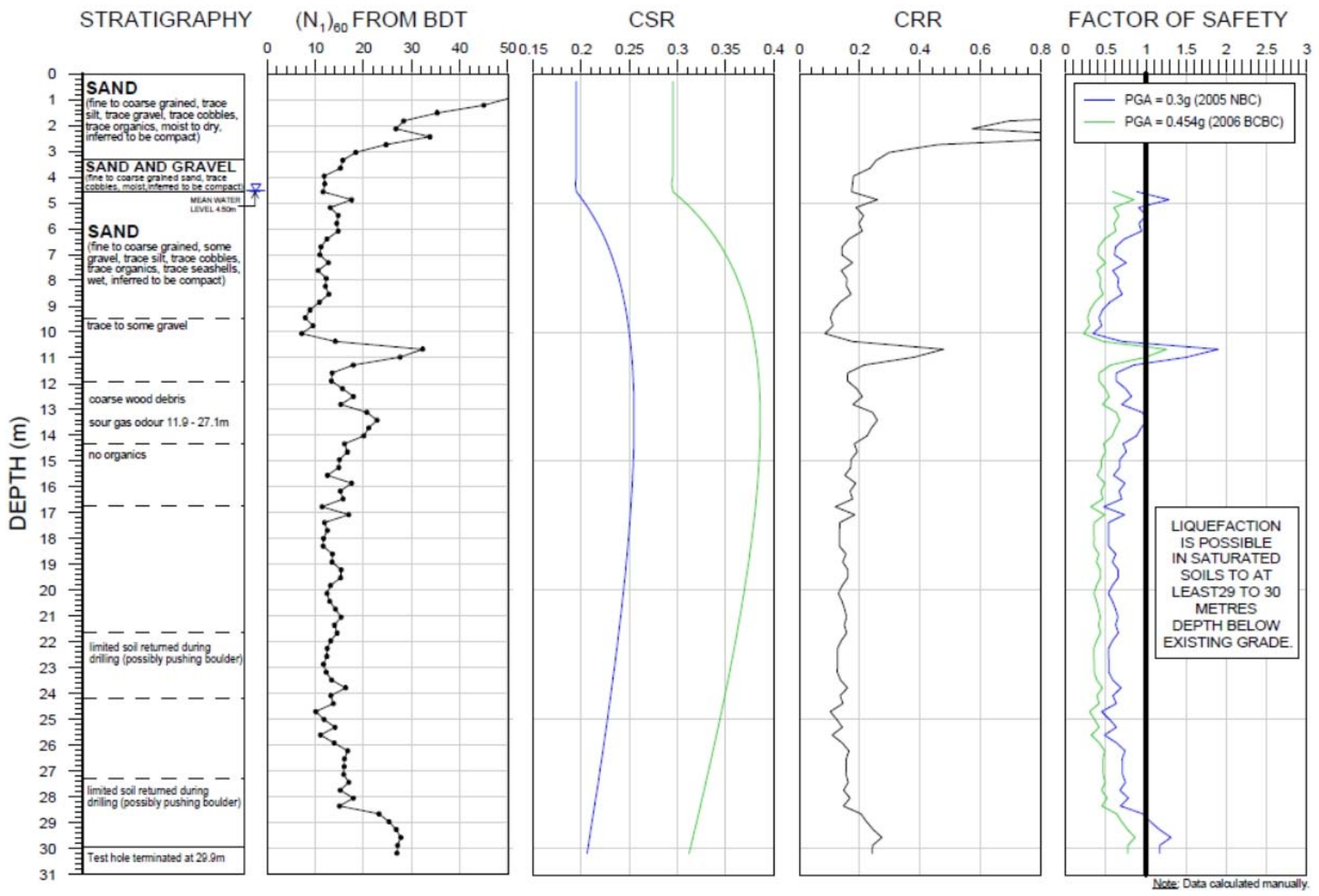

HORIZON ENGINEERING INC

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- conventional foundations and foundation walls
- other foundation types
- seismic resistance of foundations
  - deep subsurface investigation in potentially liquefiable soils
  - foundation repair should be expected following significant earthquakes
- variable subgrade conditions can lead to differential performance of foundations
- rock bolting of potential rock failures above or below site

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EXCAVATIONS

- WorkSafe BC requirements

EXCAVATIONS

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- advise geotechnical engineer before starting excavation

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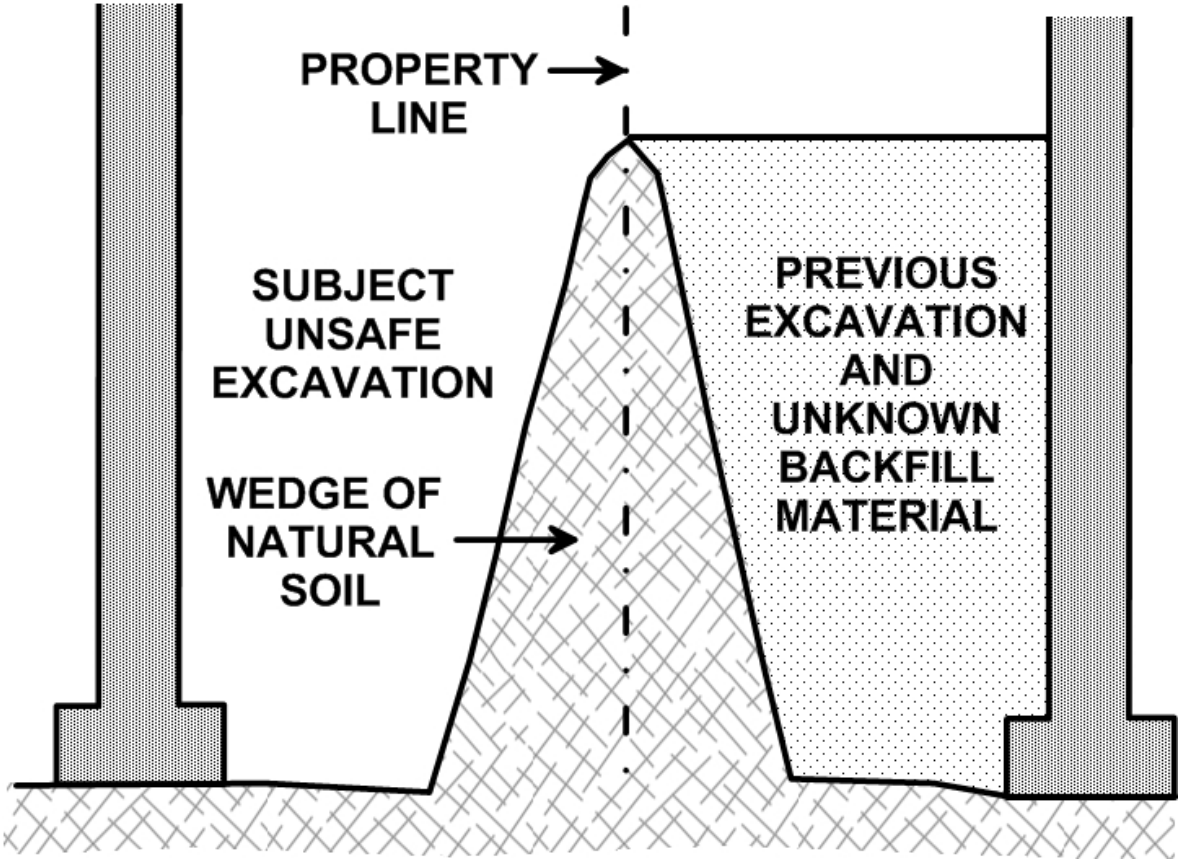
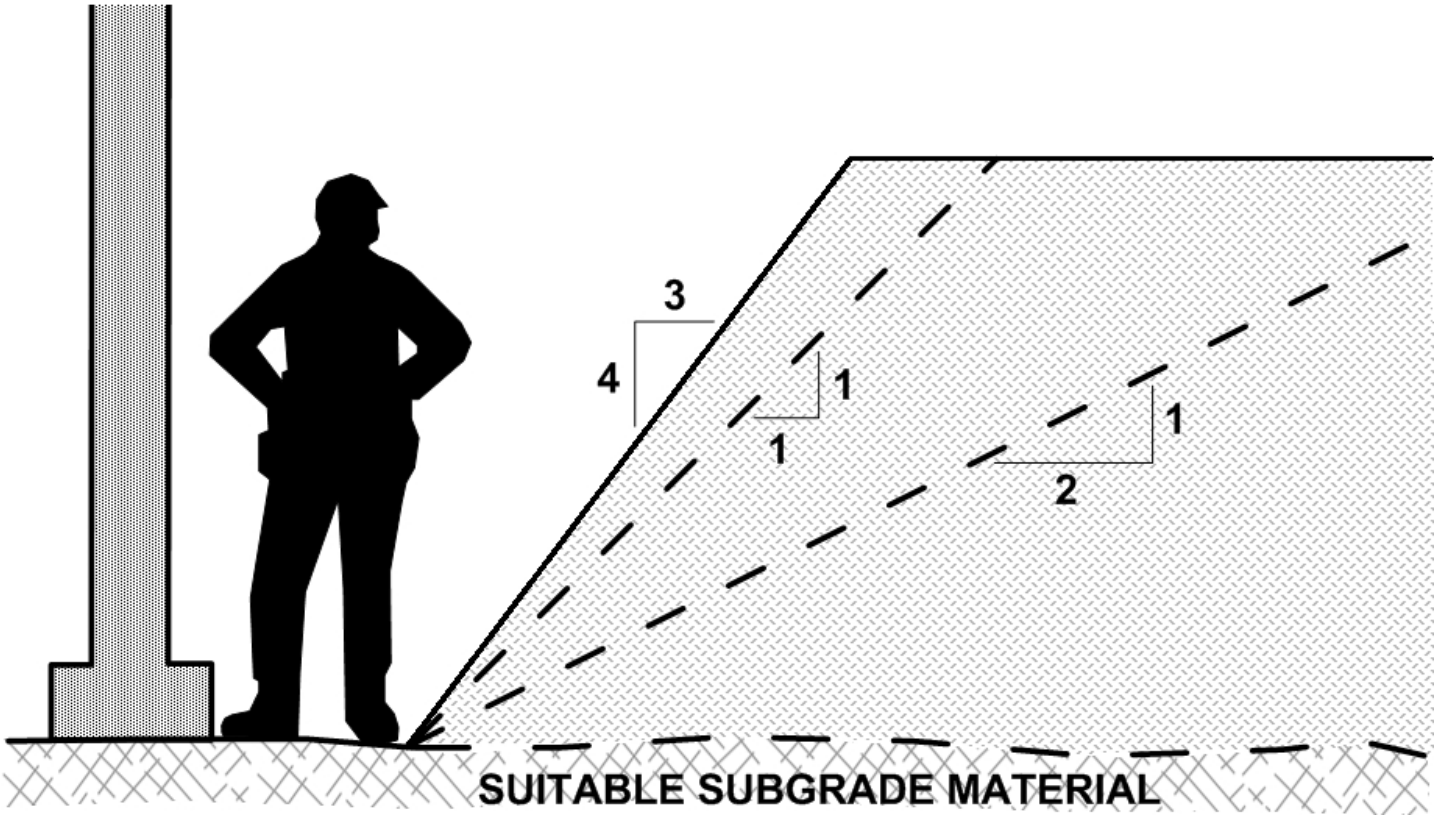


EXCAVATIONS

- WorkSafe BC requirements
- advise geotechnical engineer before starting excavation
- worker safety



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EXCAVATIONS

- WorkSafe BC requirements
- advise geotechnical engineer before starting excavation
- worker safety
- stability of adjacent structures and utilities
- temporary shoring when insufficient space for sloping
- encroachment onto neighbouring property advantageous

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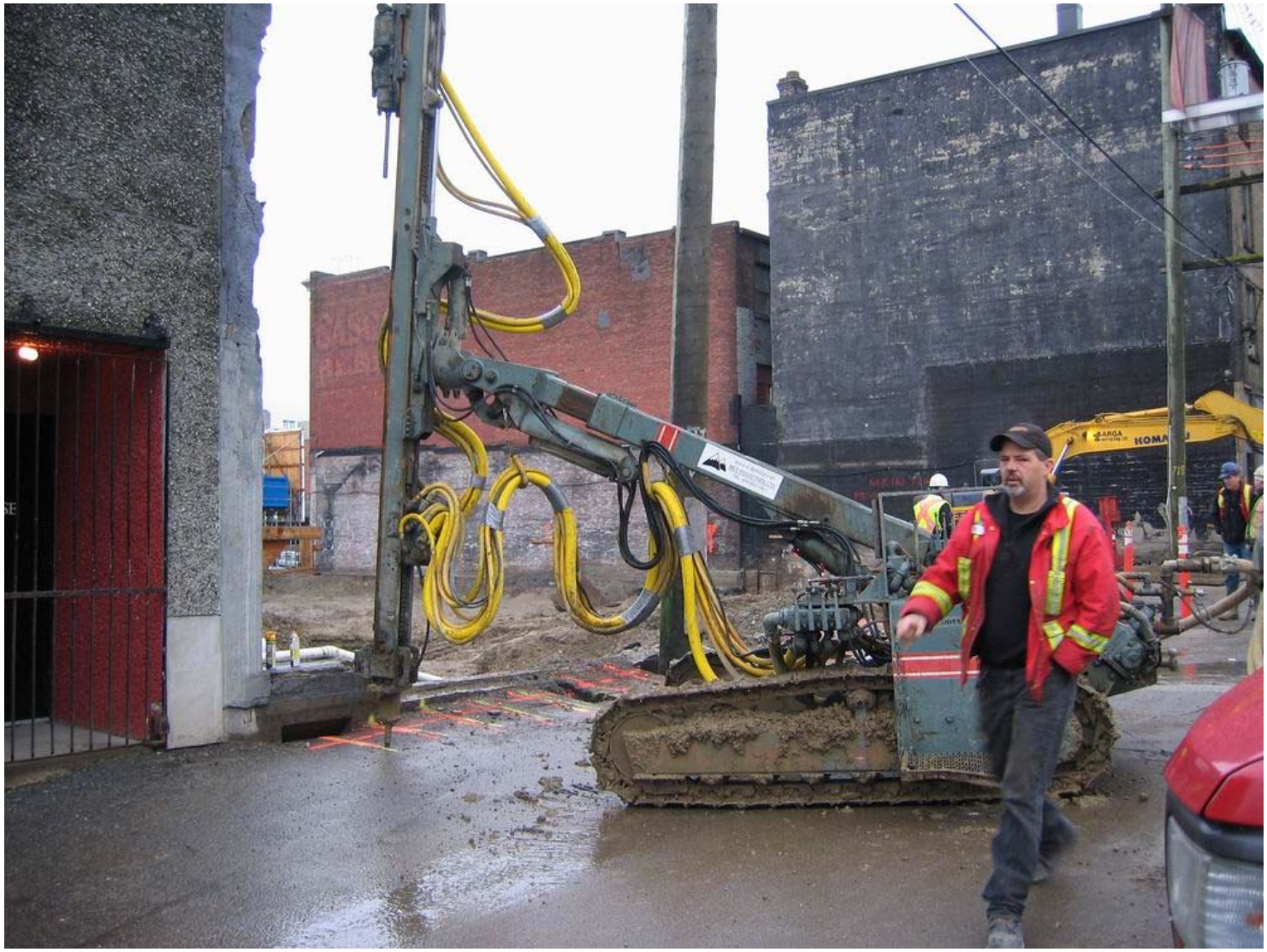

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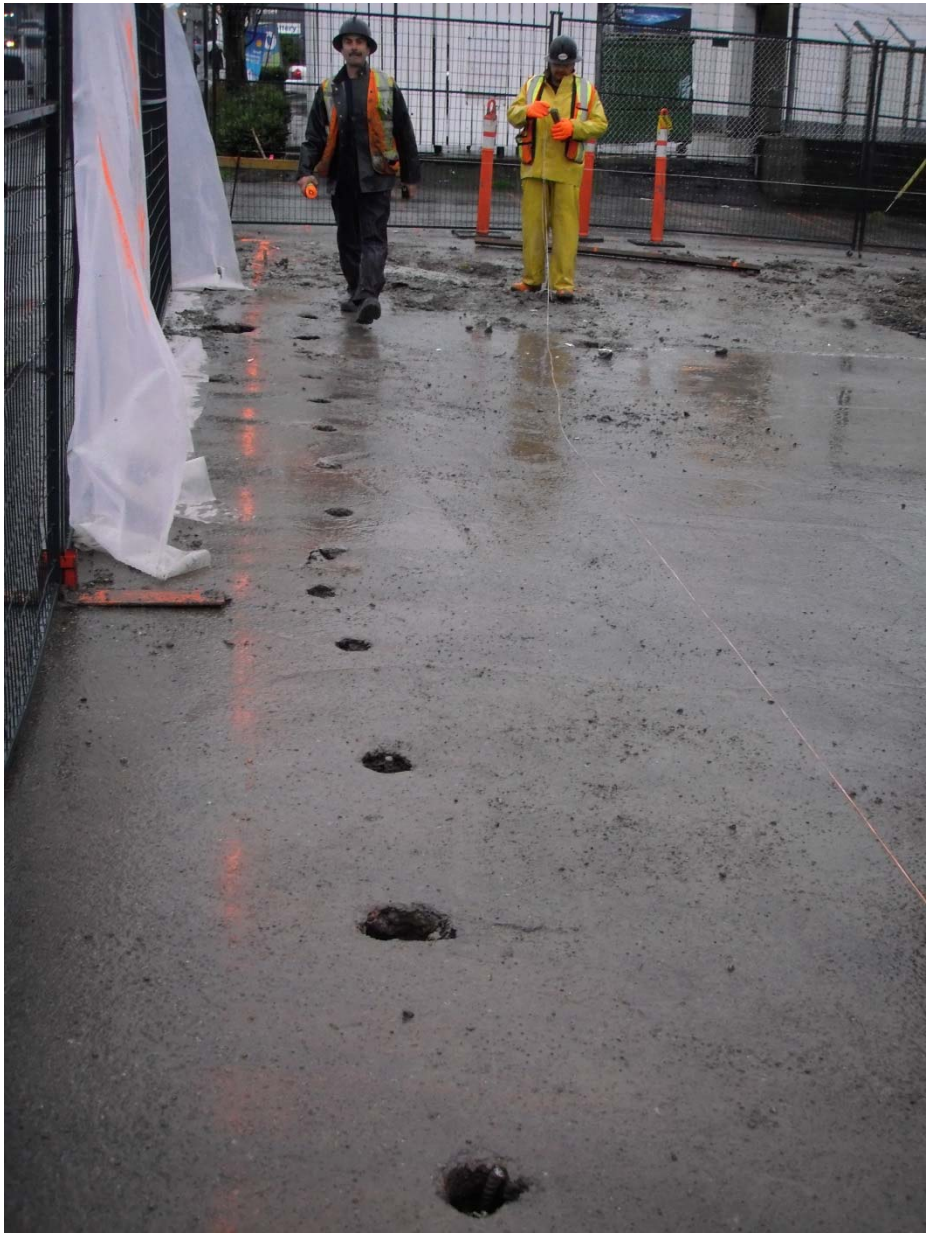

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EXCAVATIONS

- WorkSafe BC requirements
- advise geotechnical engineer before starting excavation
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- stability of adjacent structures and utilities
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- encroachment onto neighbouring property advantageous
- erosion protection

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- WorkSafe BC requirements
- advise geotechnical engineer before starting excavation
- worker safety
- stability of adjacent structures and utilities
- temporary shoring when insufficient space for sloping
- encroachment onto neighbouring property advantageous
- erosion protection
- field review prior to demobilizing equipment

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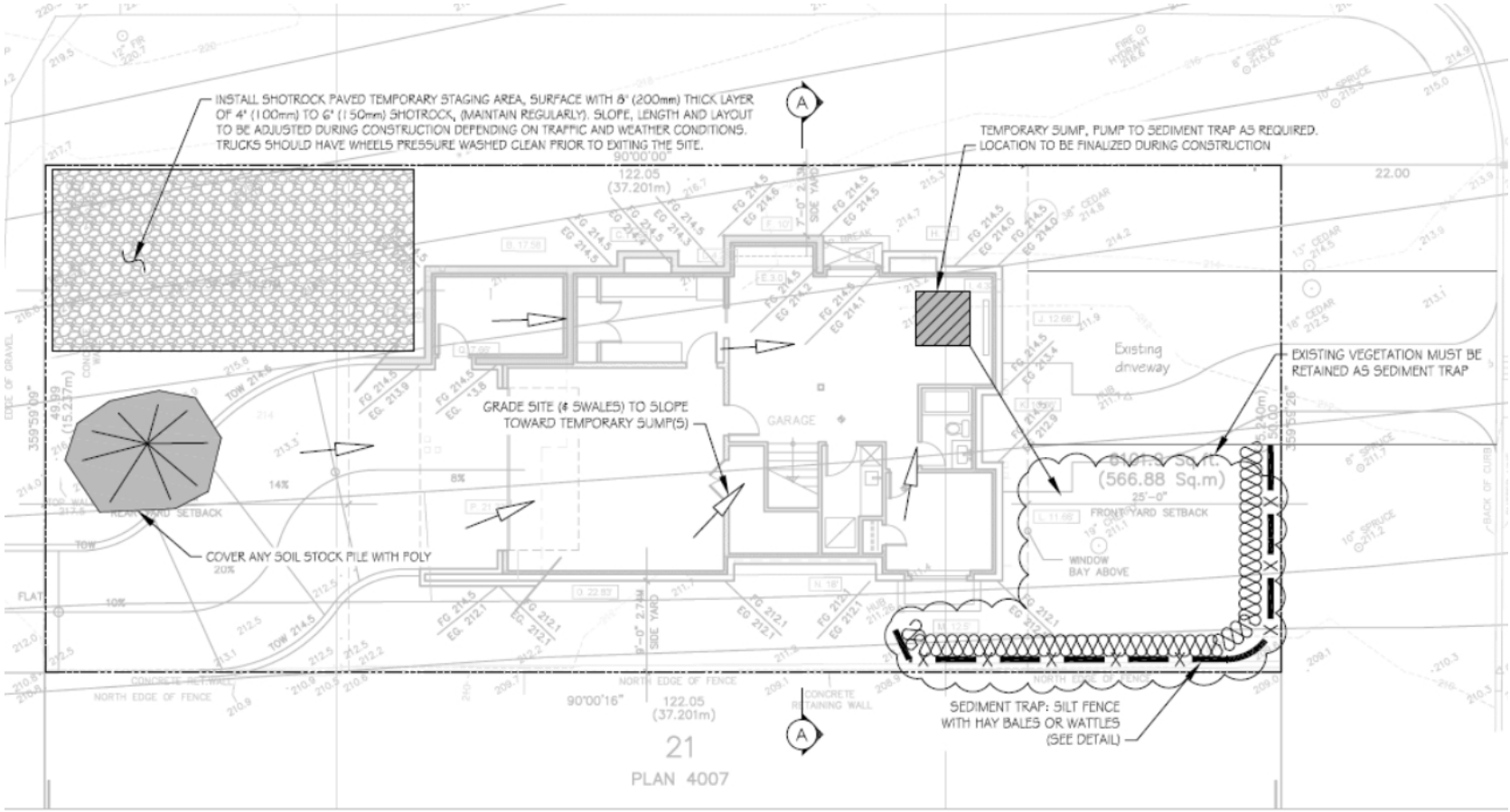
EROSION AND SEDIMENT CONTROL

- manage site surface water in a way that minimizes erosion

EROSION AND SEDIMENT CONTROL

- manage site surface water in a way that minimizes erosion
- Building Permit requirement in many urban areas, often with monitoring



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EROSION AND SEDIMENT CONTROL

- manage site surface water in a way that minimizes erosion
- Building Permit requirement in many urban areas, often with monitoring
- minimize impacting property, infrastructure, and natural drainage systems
- staging site clearing, mulching, and winnowing
- temporary sediment treatment infrastructure such as settling ponds, filters, and proprietary systems

SHOTROCK-PAVED SITE ACCESS

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TRUCK WHEEL WASH

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WITHOUT SHOTROCK-PAVED SITE ACCESS OR WHEEL WASH

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WITHOUT SHOTROCK-PAVED SITE ACCESS OR WHEEL WASH

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REGULARLY SWEEPING ADJACENT STREETS

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CATCH BASIN PROTECTION

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WITHOUT CATCH BASIN PROTECTION

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EROSION PROTECTION

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DUST CONTROL

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PERIMETER PROTECTION

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PERIMETER PROTECTION

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WASTEWATER TREATMENT SYSTEM

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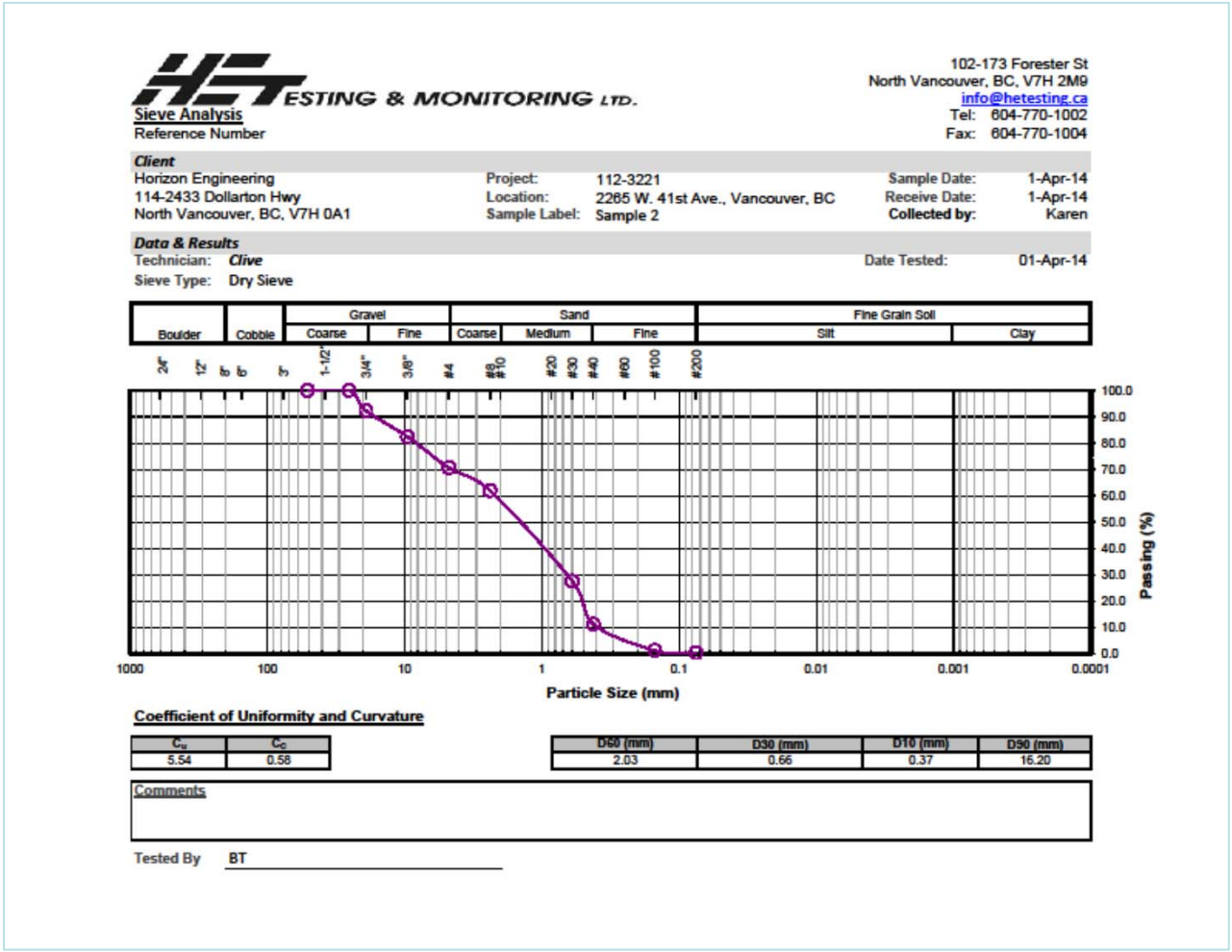
ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications



HETESTING & MONITORING LTD.

102-173 Forester St
North Vancouver, BC, V7H 2M9
info@hetesting.ca
Tel: 604-770-1002
Fax: 604-770-1004

Sieve Analysis
Reference Number

Client
Horizon Engineering
114-2433 Dollarton Hwy
North Vancouver, BC, V7H 0A1

Project: 112-3221
Location: 2265 W. 41st Ave., Vancouver, BC
Sample Label: Sample 2

Sample Date: 1-Apr-14
Receive Date: 1-Apr-14
Collected by: Karen

Data & Results
Technician: ***Clive***
Sieve Type: Dry Sieve

Date Tested: 01-Apr-14

Boulder	Cobble	Gravel		Sand			Fine Grain Soil	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

24" 12" 8" 6" 3" 1-1/2" 3/4" 3/8" #4 #8 #10 #20 #30 #40 #60 #100 #200

100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0
Passing (%)

1000 100 10 1 0.1 0.01 0.001 0.0001
Particle Size (mm)

Coefficient of Uniformity and Curvature

C_u	C_c
5.54	0.58

D60 (mm)	D30 (mm)	D10 (mm)	D90 (mm)
2.03	0.66	0.37	16.20

Comments

Tested By BT

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ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications

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ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications

HORIZON ENGINEERING INC

ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications

HORIZON ENGINEERING INC

ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications
- compaction criteria

HETESTING & MONITORING LTD.

102-173 Forester St
North Vancouver, BC, V7H 2M9
info@hetesting.ca

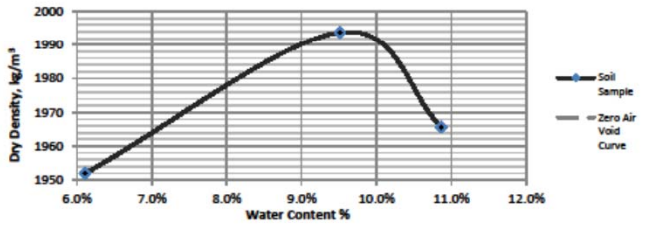
Labortory Compaction Characteristics of Soil

Reference Number: 112-3221

Client			
Horizon Engineering Inc.		Location:	2261 W. 41st Ave., Vancouver
114-2433 Dollarton Hwy		Project:	Mixed Use Development
North Vancouver, BC		Collected by:	CC
V7H 0A1		Sample Date:	April 24, 2014
		Receive Date:	April 24, 2014
Test Method		***Material I.D.***	
Proctor Type:	Standard, ASTM D698	Major Component:	Sandy Silt
Protor Number:	1	Size:	
Proctor Method:	A	Rock Type:	
	4" mold, 3 Layers	Sample Name:	
	25 Blows, Passing No. 4		
Preparation Method:	Moist	Description:	Site Spoil
Oversize Correction Method:	ASTM 4718		

Data & Results

Technician: CC
Date Tested: April 25, 2014



Data Point	Wet Density (kg/m³)	Dry Density (kg/m³)	Moisture Content (%)
1	2071	1952	6.1%
2	2184	1994	9.5%
3	2179	1966	10.9%
4			
5			

	Max Dry Density (kg/m³)	Optimum Moisture Content (%)
Regular	1998	8.7%
Oversize Corrected	2089	7.4%

Oversize Percentage:	17.7%

Note: Estimated Oversize Moisture Content of 1.5% and Specific Gravity of 2.65

Comments:

Tested By CC

Test results provided exclude any engineering interpretation or evaluation services

Page 1 of 1

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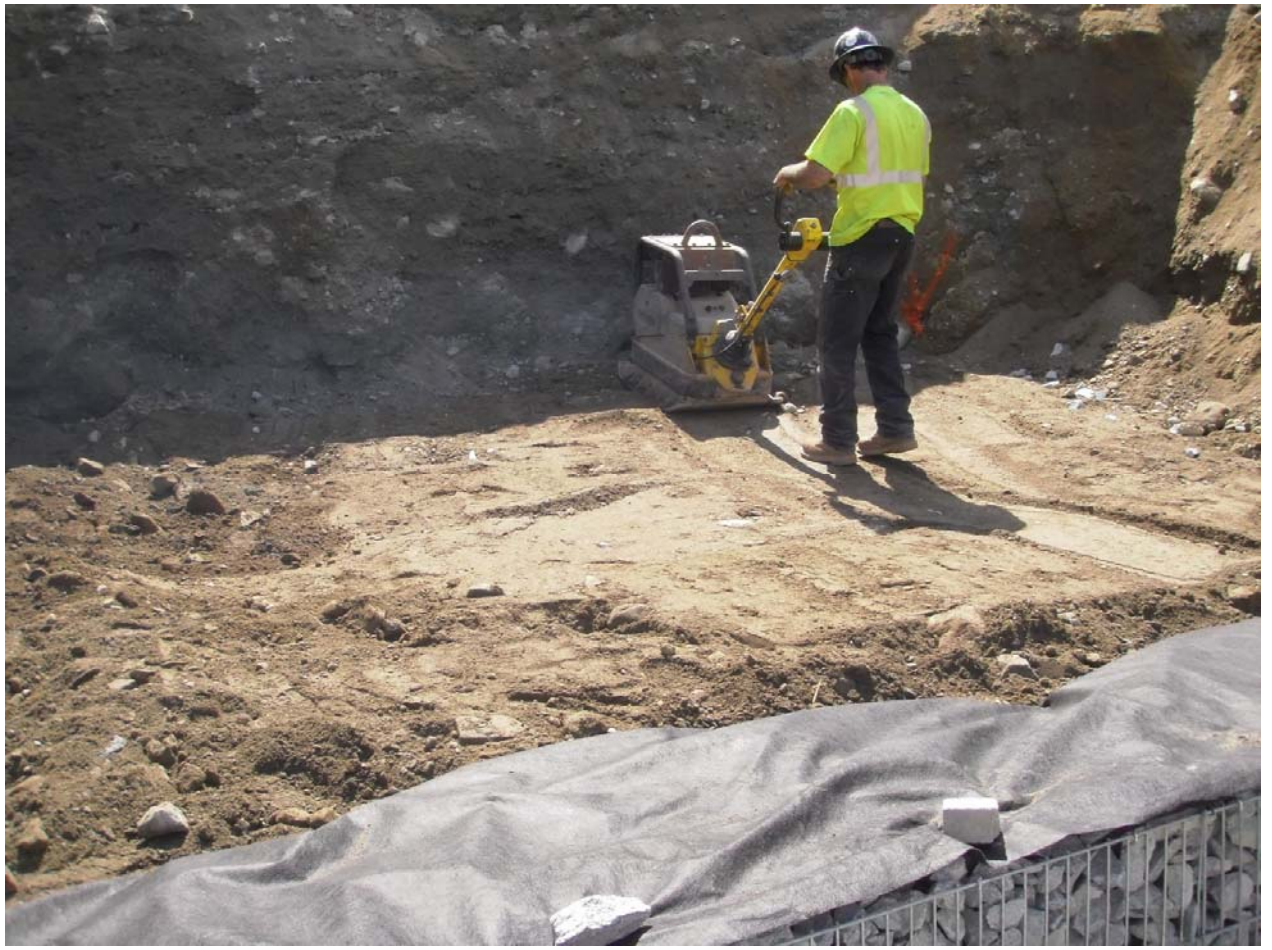
ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications
- compaction criteria



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ENGINEERED FILL AND BACKFILL MATERIALS

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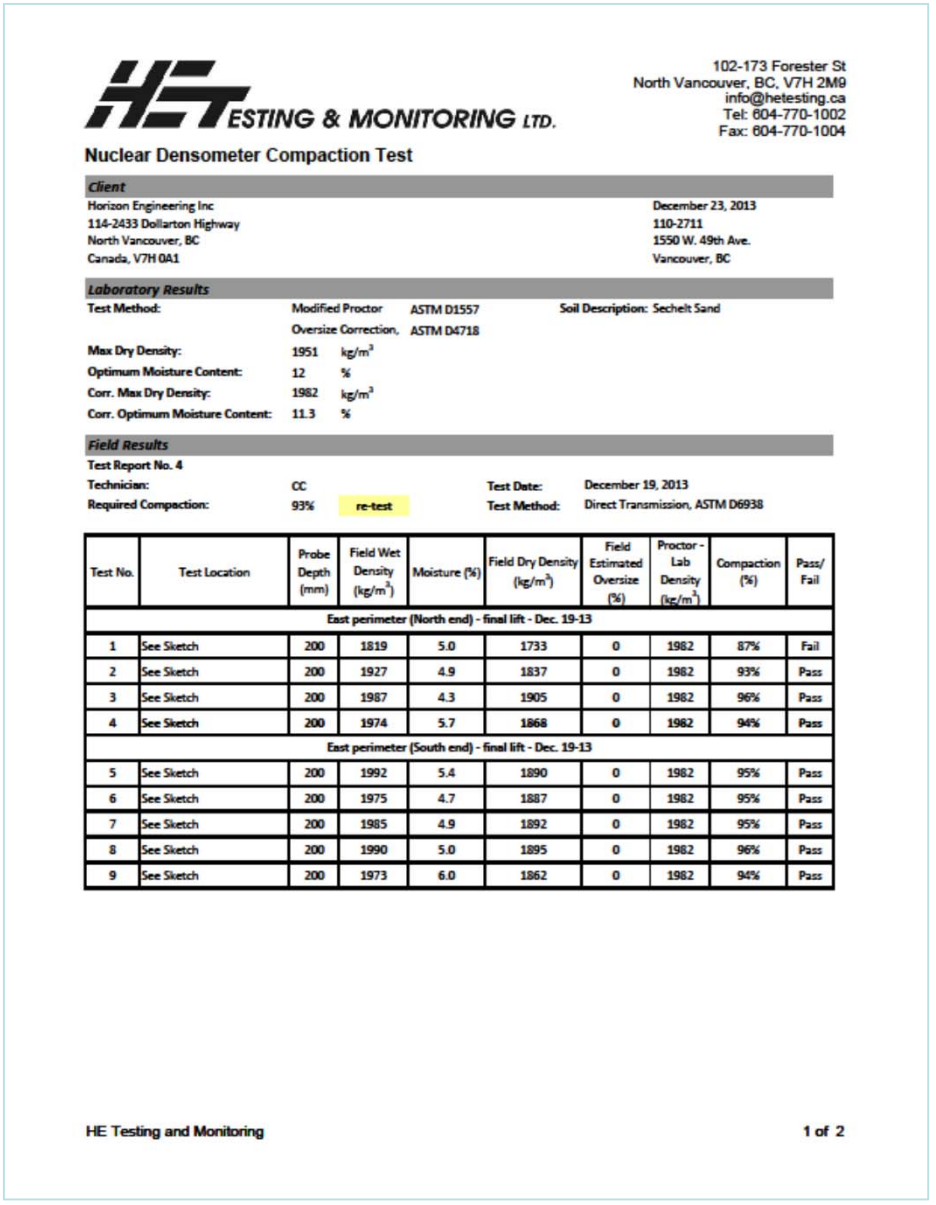

HE TESTING & MONITORING LTD.

102-173 Forester St
North Vancouver, BC, V7H 2M9
info@hetesting.ca
Tel: 604-770-1002
Fax: 604-770-1004

Nuclear Densometer Compaction Test

Client

Horizon Engineering Inc
114-2433 Dollarton Highway
North Vancouver, BC
Canada, V7H 0A1

December 23, 2013
110-2711
1550 W. 49th Ave.
Vancouver, BC

Laboratory Results

Test Method: Modified Proctor ASTM D1557; Oversize Correction, ASTM D4718
Soil Description: Sechelt Sand

Max Dry Density:	1951	kg/m³
Optimum Moisture Content:	12	%
Corr. Max Dry Density:	1982	kg/m³
Corr. Optimum Moisture Content:	11.3	%

Field Results

Test Report No. 4
Technician: CC
Required Compaction: 93% re-test
Test Date: December 19, 2013
Test Method: Direct Transmission, ASTM D6938

Test No.	Test Location	Probe Depth (mm)	Field Wet Density (kg/m³)	Moisture (%)	Field Dry Density (kg/m³)	Field Estimated Oversize (%)	Proctor - Lab Density (kg/m³)	Compaction (%)	Pass/ Fail
East perimeter (North end) - final lift - Dec. 19-13									
1	See Sketch	200	1819	5.0	1733	0	1982	87%	Fail
2	See Sketch	200	1927	4.9	1837	0	1982	93%	Pass
3	See Sketch	200	1987	4.3	1905	0	1982	96%	Pass
4	See Sketch	200	1974	5.7	1868	0	1982	94%	Pass
East perimeter (South end) - final lift - Dec. 19-13									
5	See Sketch	200	1992	5.4	1890	0	1982	95%	Pass
6	See Sketch	200	1975	4.7	1887	0	1982	95%	Pass
7	See Sketch	200	1985	4.9	1892	0	1982	95%	Pass
8	See Sketch	200	1990	5.0	1895	0	1982	96%	Pass
9	See Sketch	200	1973	6.0	1862	0	1982	94%	Pass

HE Testing and Monitoring 1 of 2

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ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications
- compaction criteria
- potential settlement

HORIZON ENGINEERING INC

ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications
- compaction criteria
- potential settlement
- filter cloth over clear gravels

HORIZON ENGINEERING INC

ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications
- compaction criteria
- potential settlement
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ENGINEERED FILL AND BACKFILL MATERIALS

- material specifications
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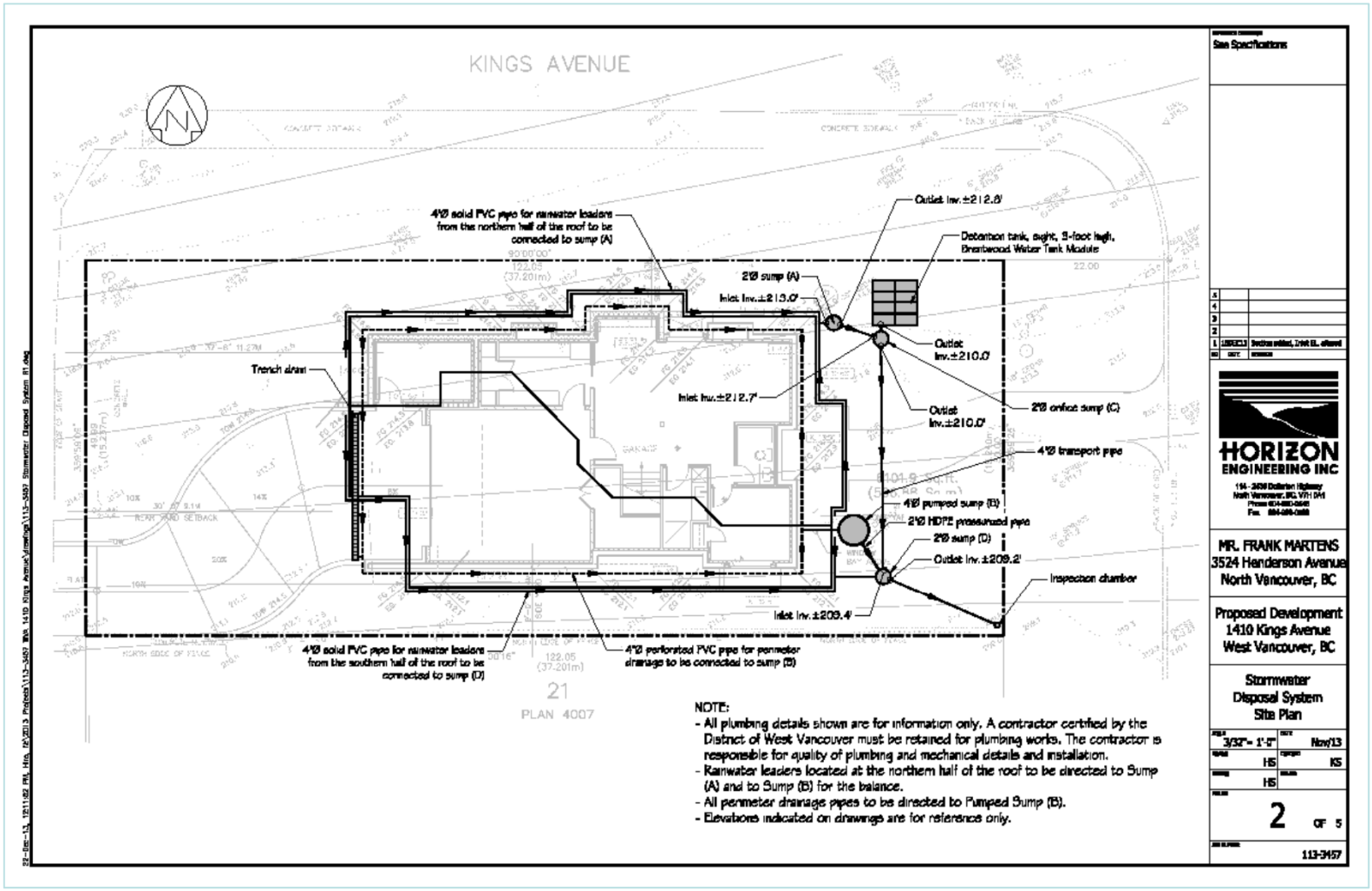
DRAINAGE

- stormwater management plans often required for building permit application



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DRAINAGE

- stormwater management plans often required for building permit application
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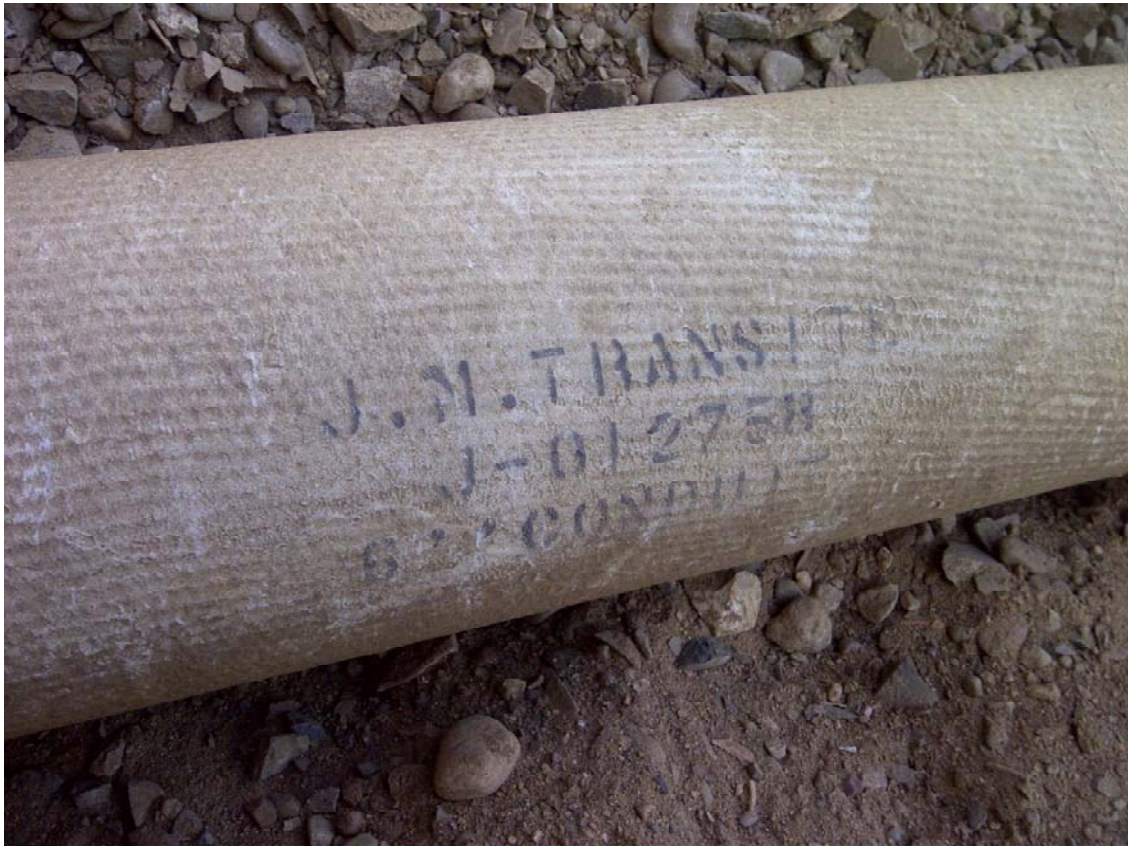

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HORIZON ENGINEERING INC

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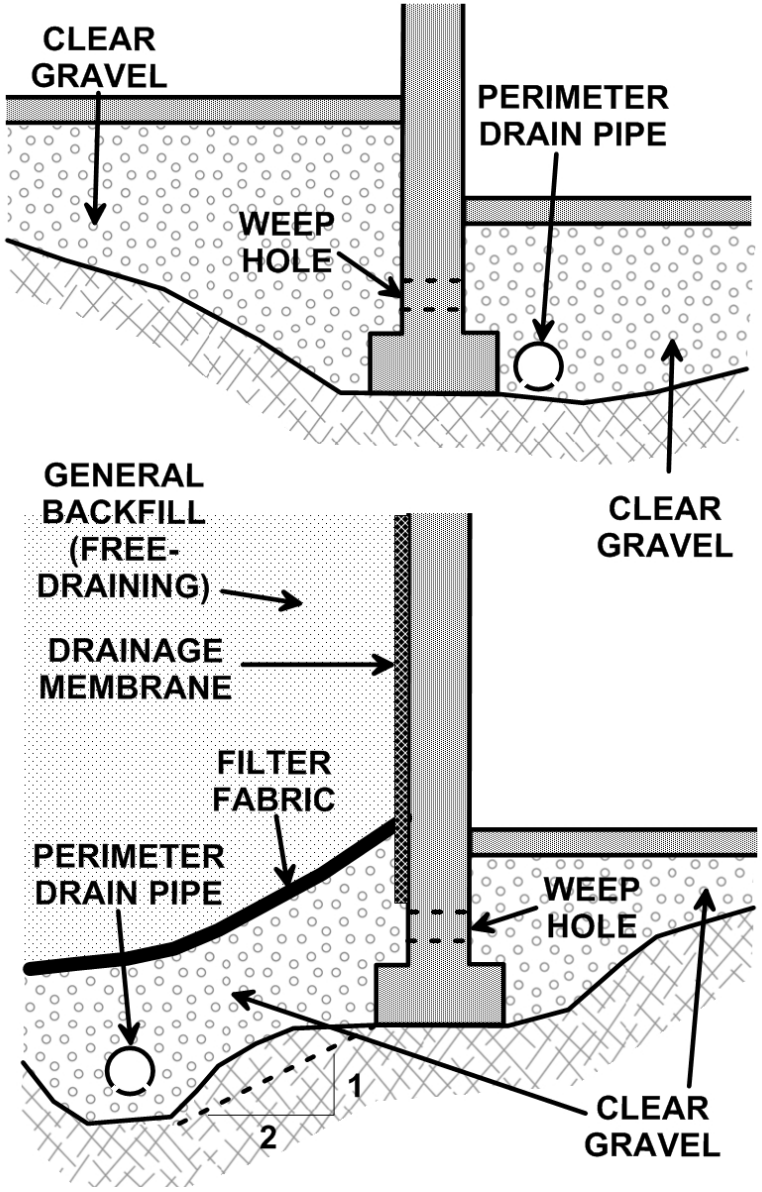

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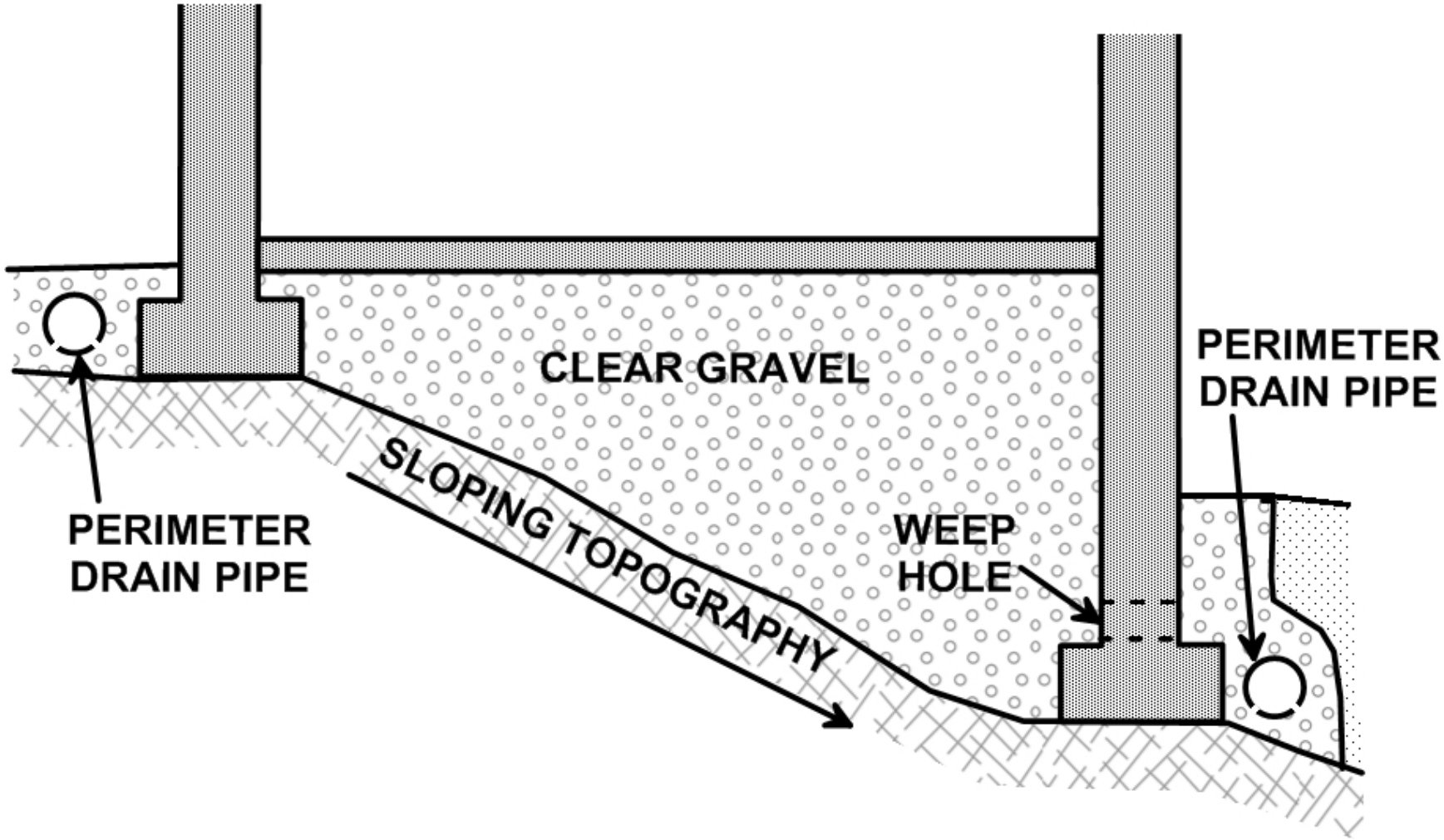

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  - filter fabric between clear gravel and other soil
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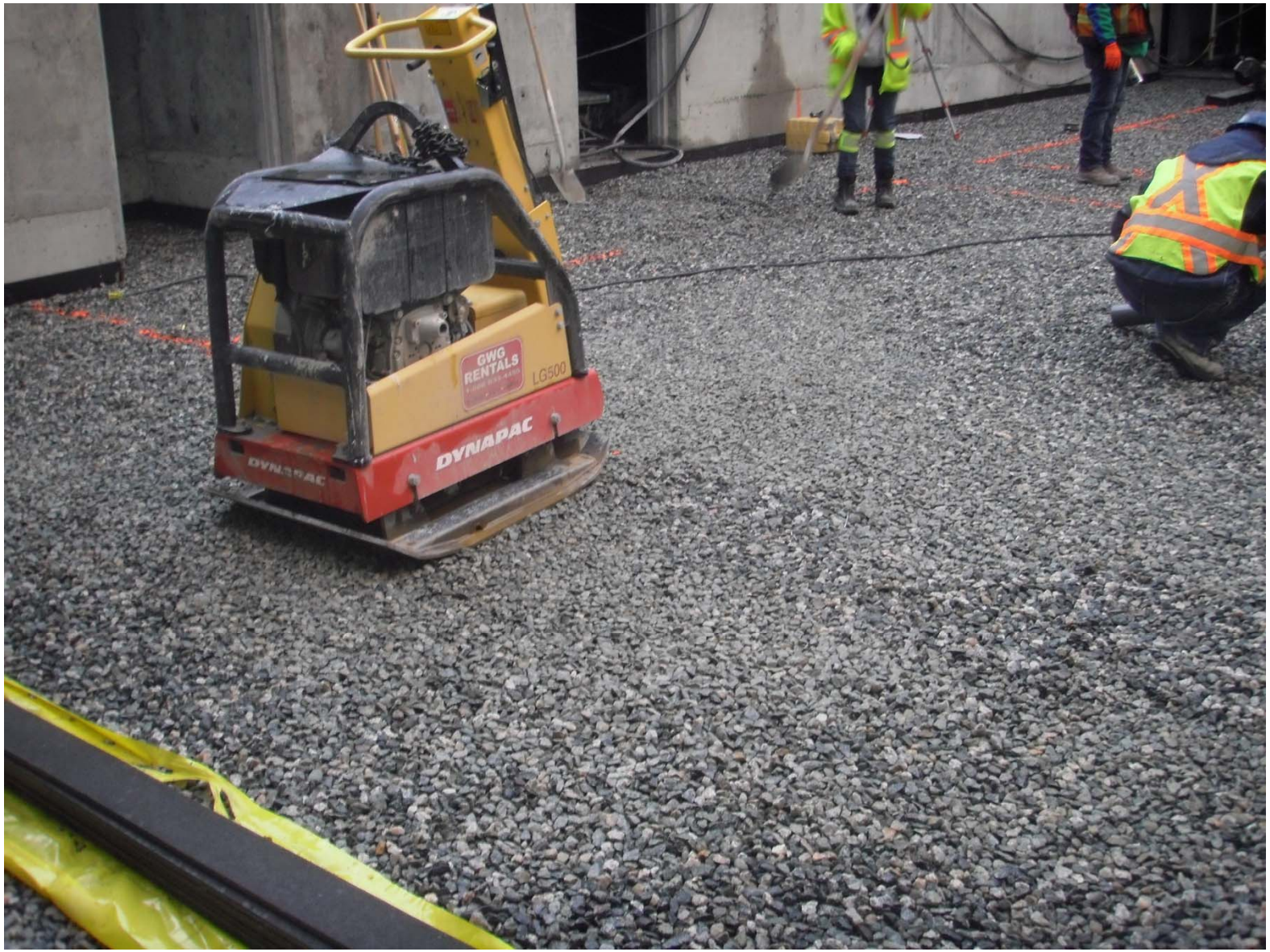

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  - filter fabric between clear gravel and other soil
  - clear gravel underslab drainage layer
  - weep holes through foundation walls
- drainage remediation expensive, iterative, and frustrating
- structural problems
- try easiest potential solution first

LANDSCAPING

- consult geotechnical engineer when site slopes more than 20° (10° in clay) or is below Flood Construction Level

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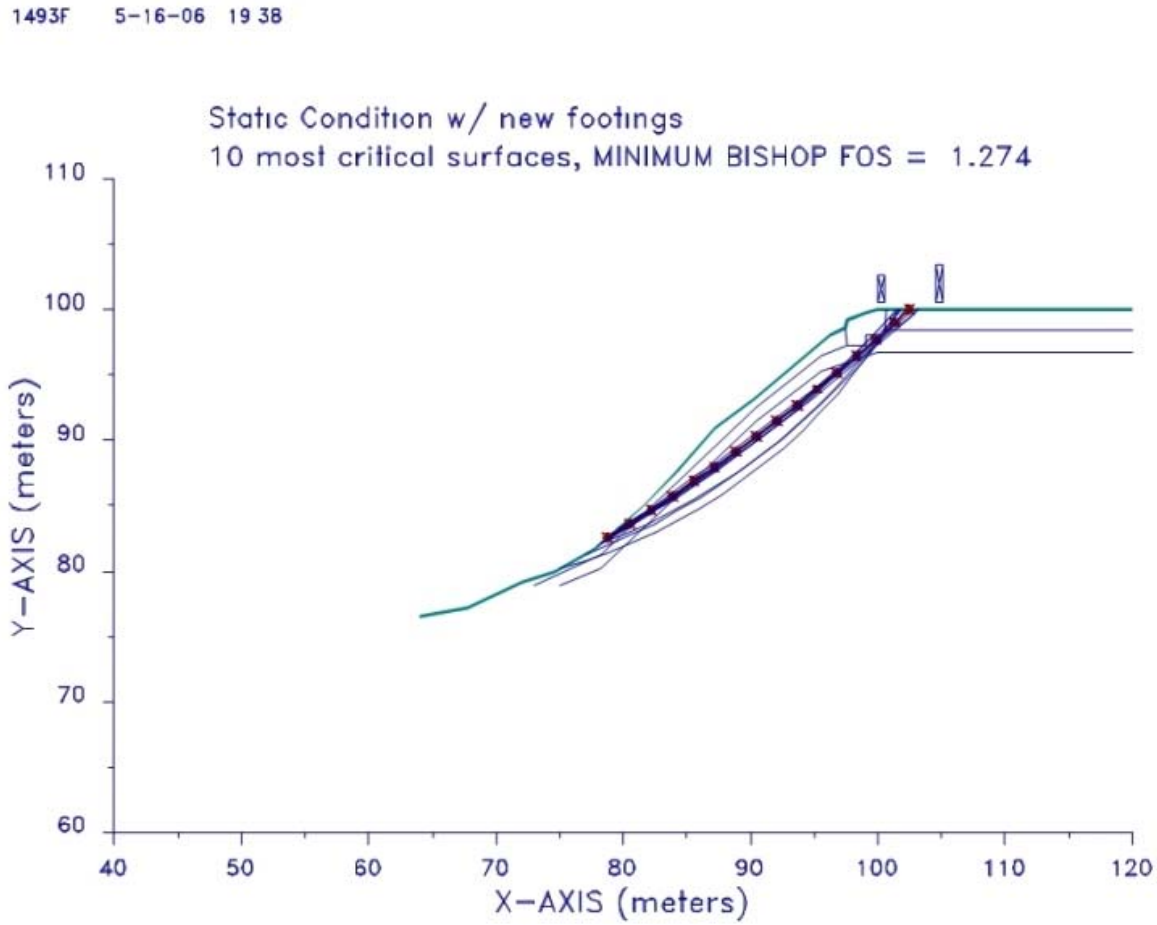

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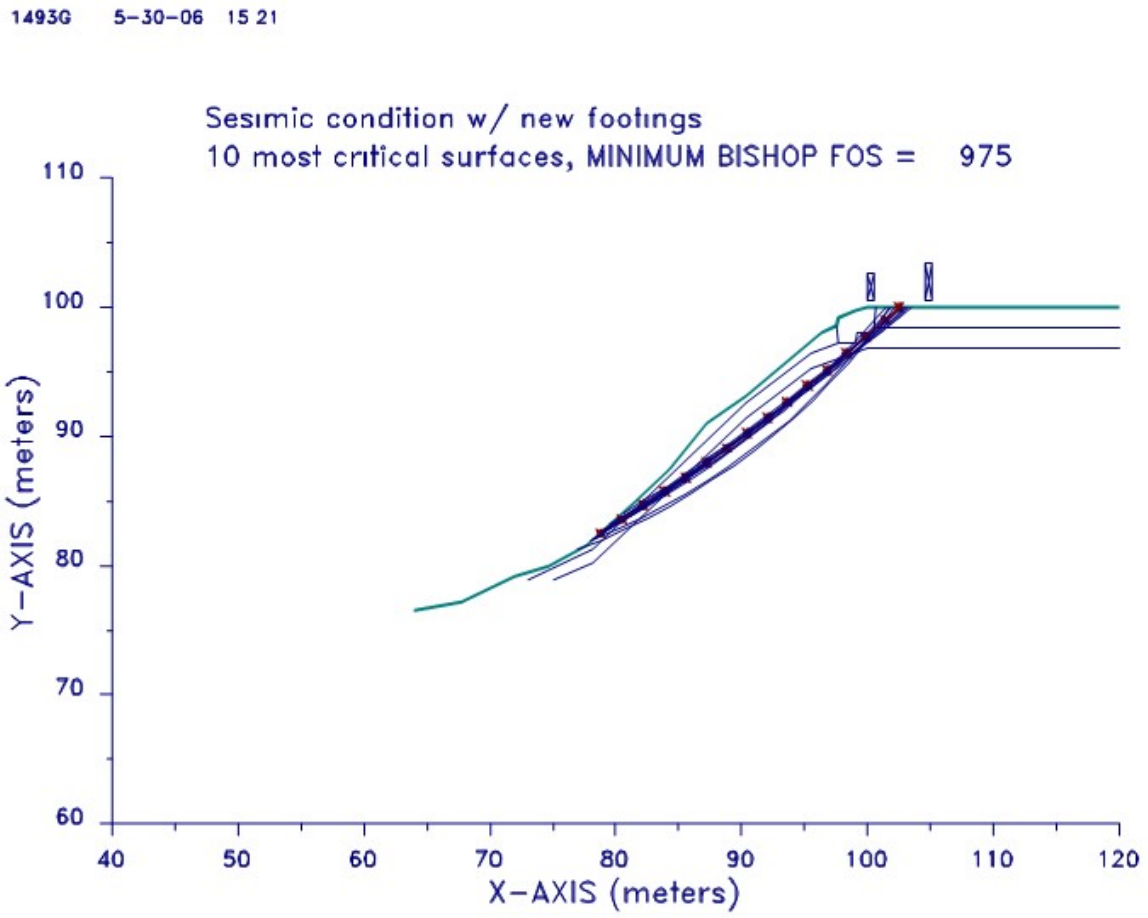

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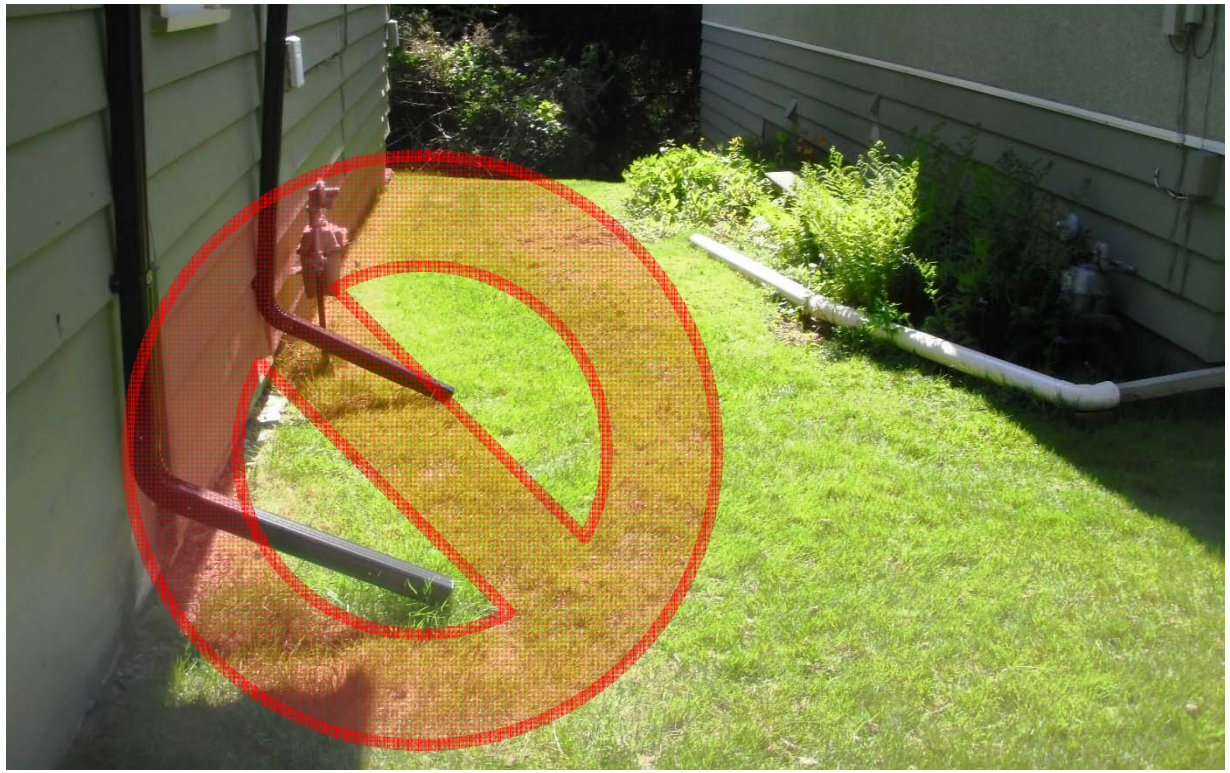

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SLOPE DESTABILIZATION

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- retaining walls
  - types: concrete cantilever, geogrid-reinforced proprietary block or modular systems (such as SierraScape, SierraSlope, Allan Block, Keystone, Pisa Stone, etc.), other gravity systems (such as Lock Block, Maccaferri gabions, or stacked boulders), or anchored systems

CANTILEVERED CONCRETE RETAINING WALLS

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SIERRASCAPE RETAINING WALLS

HORIZON ENGINEERING INC

ALLAN BLOCK RETAINING WALLS

HORIZON ENGINEERING INC

DELTALOCK RETAINING WALLS

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LOCK BLOCK RETAINING WALLS

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POORLY CONSTRUCTED LOCK BLOCK RETAINING WALL

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GABION RETAINING WALLS

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STACKED ROCK RETAINING WALLS

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POORLY CONSTRUCTED STACKED ROCK RETAINING WALL

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STABILIZED STACKED ROCK RETAINING WALL

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FAILING TIMBER RETAINING WALL

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TIED-BACK SHOTCRETE RETAINING WALL

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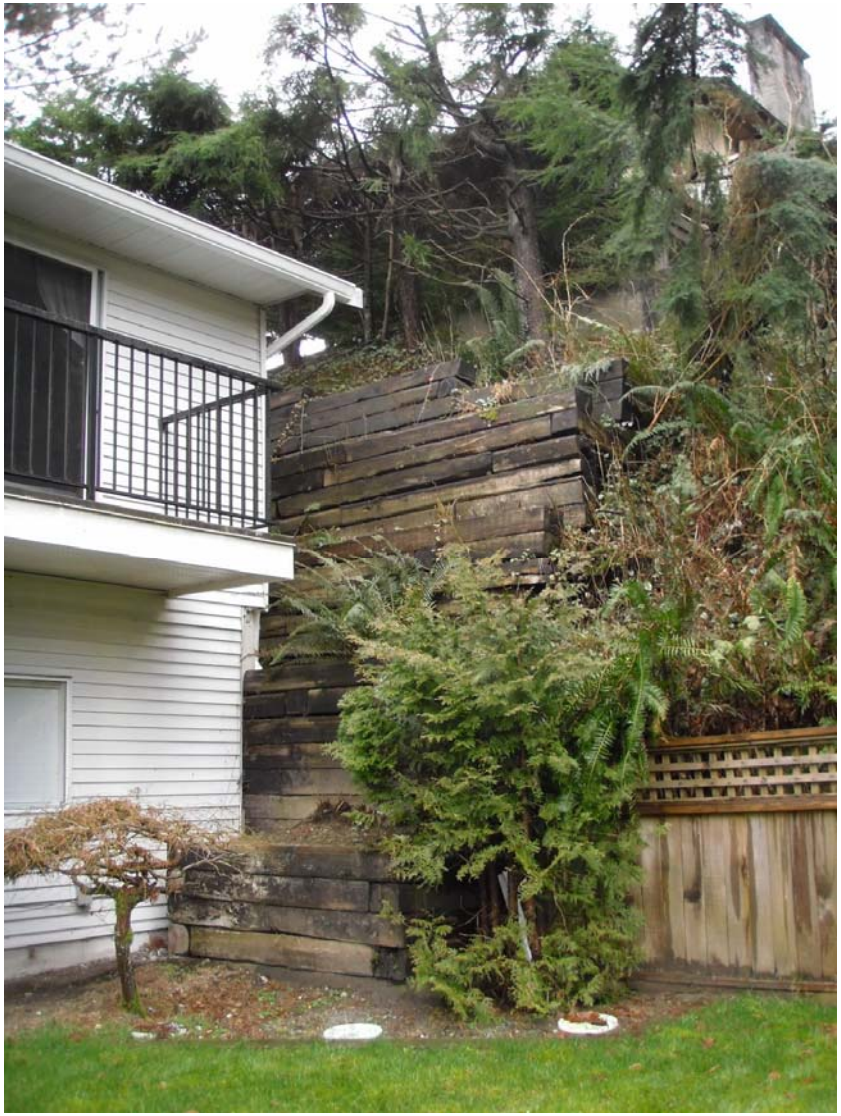
TIMBER RETAINING WALL



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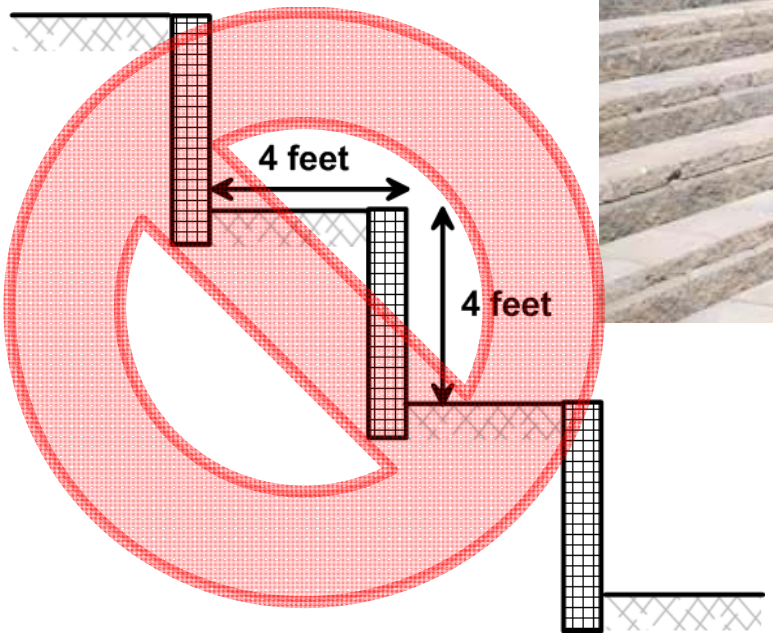
  - often require geotechnical design when higher than 1.2 metre (4 feet)
  - design retaining walls and combinations of retaining walls to resist overturning, sliding, bearing, and global failures due to retained earth and internal pressures
  - terraced retaining walls



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  - timber retaining walls not recommended
  - often require geotechnical design when higher than 1.2 metre (4 feet)
  - design retaining walls and combinations of retaining walls to resist overturning, sliding, bearing, and global failures due to retained earth and internal pressures
  - terraced retaining walls
  - seismic design of retaining walls

SURFACE WATER MANAGEMENT

- Flood Construction Level

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SURFACE WATER MANAGEMENT

- Flood Construction Level
- Q200 is not the surveyed ‘high water level’
- best practice to consult geotechnical engineer for design of flood-proofing measures
- grading to provide surface water management

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SURFACE WATER MANAGEMENT

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- french drains

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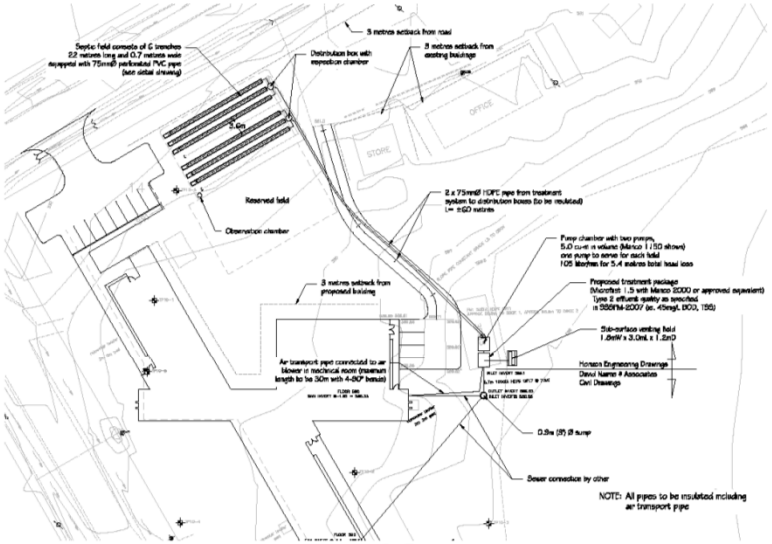
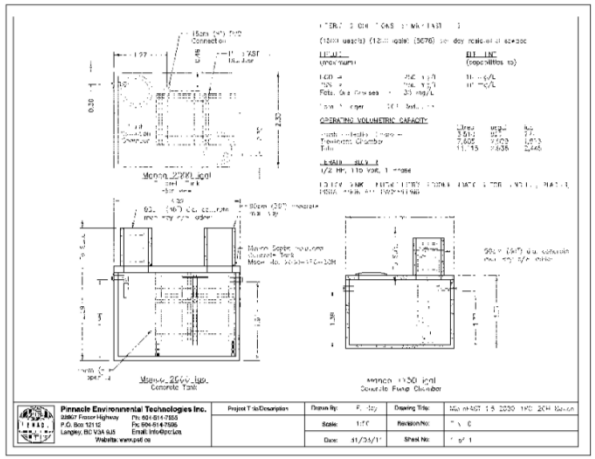
SEPTIC SYSTEMS

- septic systems are registered with local health department
- septic systems are designed and constructed by qualified engineers / practitioners, respectively
- general septic system design





NOTES AND SPECIFICATIONS

1.0 GENERAL

1.1 REFERENCED DRAWINGS
Prophet River Health & Administration Building Site Plan, dated January 10, 2005, prepared by David Nairne + Associates Ltd.
WaterMAST 1.5G 2000-1PC-SCH Monco, dated March 31, 2011, prepared by Pinnacle Environmental Technologies Inc.
Sub-Surface Air Vent Layout, dated March 31, 2011, prepared by Pinnacle Environmental Technologies, Inc.

1.2 The Engineer is Horizon Engineering Inc.
Phone (604) 980-0548
Fax: (604) 990-0583

1.3 SOIL CONDITIONS
Please refer to the geotechnical investigation report, dated August 2, 2010.

1.4 DESIGN CRITERIA
The proposed septic treatment system is designed to manage wastewater flow from the proposed Health & Administration Building with treated effluent volume of up to 5,000 liters per day. Estimate daily flow from the proposed development was provided by David Nairne Associates. The proposed system should be reviewed and revised accordingly in the event that the final expected number of people be working at the proposed development differs from the above estimated values. The septic field is designed based on effluent discharge from Type II treatment system as shown on the drawings.

2.0 UTILITIES
Contractor to verify utility information by independently collecting relevant reference drawings and field verification as required. All work indicated on these drawings must be carried out without disturbance to the existing utilities. Any discrepancies between the information provided in the contract drawings and site observations should be reported to Horizon Engineering prior to commencement of the work.

3.0 MATERIALS
Samples and technical specifications for proposed alternative materials may be submitted to the Engineer for technical review.

3.1 PVC PIPES
PVC pipes should be Schedule 40 or approved by the Engineer prior to installation.

3.2 ABS PIPES
ABS pipes should comply with CSA Standard (B181.1-96, B182.1-95) for Pipe and Pipe Fittings.

3.3 FILTER FABRIC
Filter fabric should be US150NW or equivalent.

3.4 FILL
Fill material should be composed of inert, clean, tough, durable, mineral particles capable of withstanding the effects of handling, spreading and compaction without excessive degradation or production of deleterious fines. The particles shall be reasonable uniform in quality and free from organic materials and deleterious matter.

3.4.1 CLEAR WASHED GRAVEL (Drain Rock)
Clean washed round (uncrushed) gravel gradation between 19 millimeters (3/4 inches) to 50 millimeters (2 inches).
3.4.2 FILTER MEDIUM (Sand)
Gradation of the filter medium should be in conformance with ASTM standard C-33.

4.0 TREATMENT PACKAGE
A treatment system for the proposed development should possess a 5,000 liter daily treatment capacity and should satisfy the requirement effluent quality of Type II quality (45mg/L BOD and TSS).–Mirafoss 1.5 or approved equivalent.

4.1 INSULATION/FROST PROTECTION
Treatment package, pump chamber and all connection pipes shall be insulated with minimum 50 millimeters of insulation such as sprayed on polyurethane insulation or styrofoam SM type.

5.0 SEPTIC FIELD
Septic field should be constructed at the locations shown on the plan. Final location should be confirmed by the Engineer on site. The following are different steps of installation of the field:

– Excavate footprint of the field as shown on drawings to a depth of approximately 1.5 metre below grade. At the bottom of the excavation, sub-excavation of additional 0.4 metres should be advanced for the proposed trench installation. The trench should be filled with clear washed gravel for the bottom 150millimetre.
– Install transportation pipes, distribution sumps as per design drawings.
– 75mm (3") diameter perforated lateral pipes to be installed and the trench be filled with clear washed gravel.
– Place additional 0.6 metre thick of clear washed gravel to cover the excavation footprint.
– Backfill with site selected material, covered by a layer of top soil (minimum thickness 0.15 metre) to the landscape design grades.

6.0 PUMP SPECIFICATION (For information only)
The pumps should be provided a discharge rate of 105 litres per minutes for total head of 5.4 metres. These values are estimated based on 5 minutes discharge duration with 5 times per day occurrence for each pump. A suitable dosing system, such as float switch or equivalent, must be incorporated into the ITI station to meet design requirement. All pumps should be submersible pumps (Zoeller Model 267 or approved equivalent). In case of selecting approved equivalent, pumps shall be selected in accordance with the following design criteria:

Number of Pumps:	2
Primary Design Flow:	105 liter/min per each
Primary Design Head:	5.4 metres
Motor Horsepower:	0.5 HP, 60 Hz
Motor Speed:	1725 RPM
Electrical:	115 Volts, 1 Ph, 10.4 Amp for each pump

6.1 Pump
The pump shall be capable of passing two (2) inch spherical solids. The pump shall be capable of handling liquids with temperatures to 110°F intermittent.

6.2 Fasteners
All exposed fasteners shall be of 300 series stainless steel.

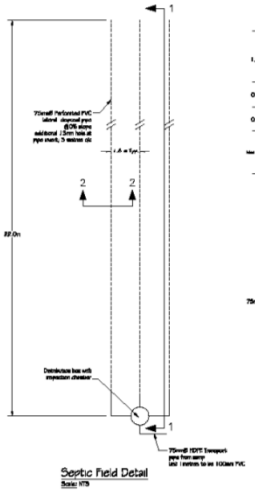
6.3 Air Blower
Air blower should comply with Fuji Electric VFC300.

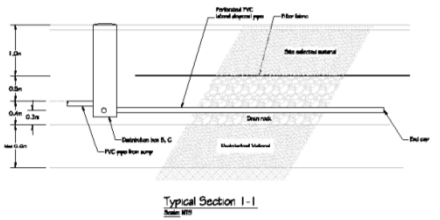
7.0 FIELD REVIEWS (Septic field)
The Engineer should review installation of the sewage disposal system at the following stages:

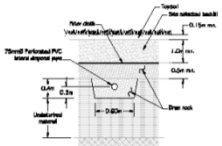
– subsequent to preparation of the base for the field and installation of the transport pipe, washed gravel, and filter cloth,
– installation of treatment and pump chambers, distribution boxes and lateral pipes as per the drawings,
– connection to inlet pipes and testing the system.

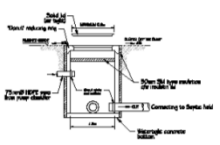
Engineer will issue certificate of completion based on field reviews and results of testing.

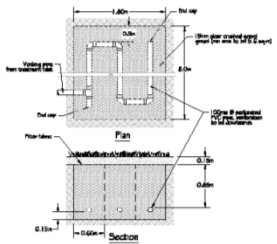
8.0 ANTI FLOTATION
All manholes, tanks, pump chamber, distribution box include anti-flotation rings, slabs or other approved alternate methods.

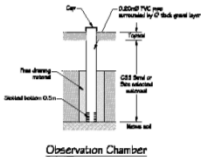


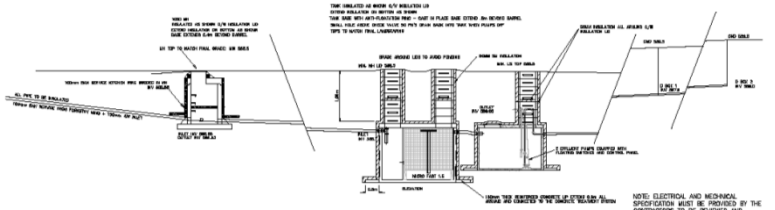












NOTE: ELECTRICAL AND MECHANICAL SPECIFICATION MUST BE PROVIDED BY THE CONTRACTORS TO BE REVIEWED AND APPROVED BY HORIZON ENGINEERING.

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1	KK	Issued for Tender	15 Apr/2011

HORIZON ENGINEERING INC
114 - 2439 Dollarton Highway
North Vancouver, BC, V7H 0A1
Phone 604-990-0548 Fax 604-990-0583

PROPHET RIVER IR #4
c/o David Nairne & Associates
West Esplanade, West Vanvcouver

Proposed Development
Prophet River IR #4
Fort Nelson, BC

SEPTIC TREATMENT SYSTEM

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OTHER GEOTECHNICAL CONSIDERATIONS

- soil gas management systems
- postpone schedule for building component replacement with an adequate maintenance regimen
- best practice for builder to provide homeowner with an operating and maintenance manual
- foundations are not expected to require replacement during design life

DISCLAIMER

- this presentation is intended to present some of what are judged to be current best practice guidelines according to industry professionals
- emphasize some basic Building Code requirements for geotechnical projects
- recommendations may not be suitable for every project or building site; every site must be considered on an individual basis
- best practice guidelines in geotechnical engineering are ever-evolving and may not be considered best practice in the future
- inclusion of a qualified professional geotechnical engineer on the project team who is current with regard to professional development and industry standards could be expected to lend to a project's success

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Members of Advisory Committee:

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- Scott Currie, P.Eng., of Ryzuk Geotecnical Engineering, Victoria, BC
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- Eric Constantinescu, M.Eng., P.Eng., of Golder Associates Ltd., Terrace, BC

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- Gary Sharp of the Canadian Homebuilders' Association, National Technical Research Committee
- Thomas Leung, P.Eng., Struct.Eng., FEC, MIStructE of Thomas Leung Structural Engineering Inc.

Questions?

HORIZON ENGINEERING INC

Karen Savage, P.Eng., FEC
Pamela Bayntun, P.Eng.

Horizon Engineering Inc.
114 – 2433 Dollarton Highway, North Vancouver
Tel. 604-990-0546 Fax 604-990-0583
www.horizoneng.ca

karen@horizoneng.ca
pamela@horizoneng.ca

HORIZON ENGINEERING INC