GEOTECHNICAL ASSESSMENT

Proposed Commercial Development
750 Tin Can Alley, Gabriola Island, BC

Legal Address:
Lot B, Section 19, Land District 32, Plan VIP60373, PID: 023-005-629

Prepared For:
Alley Enterprises Ltd.
(DBA Wild Rose Garden Centre)
750 Tin Can Alley
Gabriola Island, BC, V0R 1X3

Attention:
Mr. Kent Moen
wldrsgdn@telus.net

August 25, 2021

File No.: F9892.01
Revision No.: 00
Prepared by:
Tennes Hamre, GIT
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Lewkowich Engineering Associates Ltd.

DISCLAIMER

1. Lewkowich Engineering Associates Ltd. (LEA) acknowledges that this report, from this point forward referred to as "the Report," may be used by the Regional District of Nanaimo (RDN) as a precondition to the issuance of a development and/or building permit and that this Report and any conditions contained in the Report may be included in a restrictive covenant under Section 56 of the Community Charter and registered against the title of the property at the discretion of the RDN.
2. This Report has been prepared in accordance with standard geotechnical engineering practice solely for and at the expense of Alley Enterprises Ltd. (DBA Wild Rose Garden Centre). We have not acted for or as an agent of the RDN in the preparation of this Report.
3. The conclusions and recommendations submitted in this Report are based upon information from relevant publications, a visual site-assessment of the property, anticipated and encountered subsurface soil conditions, current construction techniques, and generally accepted engineering practices. No other warrantee, expressed or implied, is made. If unanticipated conditions become known during construction or other information pertinent to the structure(s) becomes available, the recommendations may be altered or modified in writing by the undersigned.
4. This Report was authored, to the best of our knowledge at the time of issuance, with considerations for local requirements specific to the Authority Having Jurisdiction (AHJ) and their standards for the preparation of such reports, the 2018 British Columbia Building Code (BCBC), and current engineering standards. Updates to municipal bylaws, policies, or requirements of the AHJ, or updates to the BCBC and/or professional practice guidelines may impact the validity of this Report.
5. This Report has been prepared by Mr. Tennes Hamre, GIT and Mr. Chris Hudec, M.A.Sc., P.Eng. Messrs. Hamre and Hudec are both adequately experienced and are also members in good standing with the Engineers and Geoscientists of British Columbia (EGBC).

EXECUTIVE SUMMARY

1. The following is a brief synopsis of the property, assessment methods, and findings presented in the Report. The reader must read the Report in its entirety; the reader shall not rely solely on the information provided in this summary.
2. The subject property, 750 Tin Can Alley, Gabriola Island, BC, from this point forward referred to as "the Property," is located on the east coast of Vancouver Island within the jurisdictional boundaries of the RDN. At the time of this Report, we understand that future development of the lot may consist of a commercial development in addition to the existing commercial buildings on the Property. The details of the proposed development are not yet known.
3. A site-specific assessment was conducted to identify potential geotechnical hazards for the subject Property and the proposed commercial development. Our assessment determined that there were no geotechnical hazards that may impact the proposed development.
4. The findings confirm that the development is considered safe as proposed.

List of Abbreviations Used in the Report

Abbreviation	Title
AHJ	Authority Having Jurisdiction
BCBC	British Columbia Building Code
EGBC	Engineers and Geoscientists of British Columbia
LEA	Lewkowich Engineering Associates Ltd.
RDN	Regional District of Nanaimo
SLS	Service Limit State
TP	Test-Pit
ULS	Ultimate Limit State

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1.0 INTRODUCTION

1.1 General

a. As requested, LEA has carried out a geotechnical assessment with respect to the above noted commercial development. This Report provides a summary of our findings and recommendations.

1.2 Background

a. At the time of our assessment the Property was developed and included two commercial retail shops and a plant nursery.

b. Based on the preliminary project information provided by the Client at the time of this Report, we understand that future development of the lot may consist of additional commercial building space and the relocation of the existing bulk soil and aggregate sale and storage area.

c. We expect that any new construction would be of conventional construction methods, and would include typical cast-in-place concrete foundations, with wood, and/or steel, and/or concrete superstructures.

1.3 Assessment Methodology

a. A subsurface geotechnical investigation was carried out on July 22, 2021 using a CAT 308C provided by the Client. A total of five TPs (TP 21-01 to TP 21-05) were advanced at locations within the Property. All TPs were backfilled upon completion of our investigation.

b. A site plan showing the location of the TPs (Drawing F9892-01) is attached, following the text of this Report.

c. The TP locations were sited to provide good general coverage of the Property given the available information regarding future building locations, anticipated construction depths, and general access relative to existing vegetation, structures, and underground servicing on the Property.

2.0 SITE CONDITIONS

2.1 Physical Setting

a. The Property is located in the southern region and jurisdictional limits of the RDN and is identified with the following civic and legal address:

   i. 750 Tin Can Alley, Gabriola Island; Lot B, Section 19, Land District 32, Plan VIP60373, PID: 023-005-629

b. The Property is situated on the east side of Tin Can Alley, located at the northeast corner of the Tin Can Alley/North Road intersection. A location plan of the Property is shown below in Figure 2.1.

Figure 2.1. – Location Plan of Subject Property[1]

c. Based on our desktop review, and a review of the RDN online GIS mapping[1], the subject Property is not located within a defined Development Permit Area.

2.2 Terrain and Features

a. The Property at the time of the assessment includes forested areas in the north and northeast boundary with gravel driveways and parking areas throughout.

b. The terrain of the subject Property includes minor vertical relief sloping downhill from the north to south with approximately 9.0m of relief over the Property as a whole. The 9.0m of vertical relief is over an approximate horizontal distance of 165m, which equates to a slope of approximately 3.1 degrees, or 5 percent. A detailed topographical survey was not available at the time of this Report.

c. The above measurements and distances are estimates based on measurements taken in the field during our investigation, and a review of satellite imagery and topographical information[1].

2.3 Regional Geology

a. Surficial geology for the area[2] is classified as part of the Saturna deposits, commonly comprised of channery sandy loam colluvial and glacial drift materials less than 100cm deep over sandstone bedrock. The soils are characterized as being well-draining.

b. Bedrock geology for the area[3] is classified as being part of the Nanaimo Group, typically consisting of boulder, cobble, and pebble conglomerate, coarse to fine sandstone, siltstone, shale, and/or coal.

2.4 Soil Conditions

a. Consistent soil strata were encountered during the TP investigation. Generally, these strata consisted of loose to compact, brown, dry, gravel and sand with trace percentages of cobbles, underlain by what was inferred to a be sedimentary bedrock.

b. The main strata are discussed in general below. Detailed descriptions of the subsurface conditions are provided on the attached TP logs (TP 21-01 to TP 21-05).

c. Loose to compact, brown gravel and sand, or gravelly sand, with trace percentages of cobbles were encountered in each of the TPs from 0.0m to 1.2m.

d. Sandstone bedrock or inferred sandstone bedrock was encountered in each of the TPs at depths from 0.7m to 1.2m with a mean depth of 0.86m.

e. Depths are referenced to the existing ground surface at the time of our field investigation. Soil classification terminology is based on the Modified Unified classification system. The relative proportions of the major and minor soil constituents are indicated by the use of appropriate Group Names as provided in ASTM D2488-93 and/or D2487 Figures 1a, 1b, and 2. Other descriptive terms generally follow conventions of the Canadian Foundation Engineering Manual.

2.5 Groundwater Conditions

a. Groundwater was not encountered during the course of our TP investigation. Note that our assessment was completed during an extended period of dry weather.

b. Given the encountered conditions, specifically the shallow bedrock subgrade, we expect that a shallow perched groundwater table may present seasonally. We expect that the groundwater flows associated with this perched condition would be related directly to the volume and frequency of storm events.

c. Groundwater levels can be expected to fluctuate seasonally with cycles of precipitation. Groundwater conditions at other times and locations can differ from those observed within the TPs at the time of our assessment.

d. If groundwater flows or conditions are different than those encountered during the TP investigation, additional measures may be required during construction. Contact our office immediately if unanticipated conditions are encountered at any point during construction.

2.6 Covenant Review

a. As part of our assessment, we have reviewed the Property title relative to any restrictive covenants that may be registered.

b. At the time of this Report, there were two restrictive covenants registered against the title of the Property. Both covenants, No's. EX009069 and EG124744 speak to land use requirements for the existing business

operations. The covenants registered against the Property are not geotechnical in nature and do not impact the comments, conclusions, or recommendations made in this Report.

3.0 DESIGN PHASE

3.1 Foundation Design and Construction

a. Prior to construction, the new building areas should be stripped to remove all unsuitable materials to provide an undisturbed natural subgrade for the footing support.

b. Foundation loads should be supported on natural undisturbed material approved for use as a bearing stratum by our office, or structural fill, and may be designed using the following values.

   i. For foundations constructed on structural fill over an approved naturally deposited subgrade, as outlined in Section 4.2 of this Report, an SLS bearing pressure of 150 kPa, and a ULS bearing pressure of 200 kPa may be used for design purposes. These values assume a minimum 0.45m depth of confinement or cover.

   ii. For foundations constructed on competent intact (unweathered/undisturbed) bedrock, an SLS bearing pressure of 400 kPa, and a ULS bearing pressure of 550 kPa may be used for design purposes. These values assume a minimum 0.45m depth of confinement or cover.

c. As the elevation of bedrock surfaces are expected to vary throughout the building areas, we recommend the Structural Engineer for the project use the design values for structural fill provided above. This will prevent conflict where the glacial till or bedrock is not present at a practical building elevation. The design values provided above for structural fill can be achieved through the conventional placement and compaction of engineered fill over an approved naturally deposited subgrade.

d. Exterior footings should be provided with a minimum 0.45m depth of ground cover for frost protection purposes.

e. The Geotechnical Engineer should evaluate the bearing soils at the time of construction to confirm that footings are based on appropriate and properly prepared founding material.

3.2 Modulus of Subgrade Reaction

a. The Modulus of Subgrade Reaction, k, while typically a constant, yields variable amounts of "reaction" based on the mass being supported and the thickness of the soil. For design purposes, a k_{v1} value of 70,000 kPa/m may be employed.

b. The k_{v1} value is based on a 1-foot x 1-foot square footing and must be adjusted for the actual footing size, following procedures such as those presented in Section 7.7.1 of the Canadian Foundation Engineering Manual (2006) for granular soils.

c. It is recommended that foundations are designed in consultation with the Geotechnical Engineer.

3.3 Seismic Criteria

a. As per the 2018 BCBC, Division B, Part 4, Table 4.1.8.4.A, "Site Classification for Seismic Site Response," average soil properties within the upper 30m as inferred based on regional geology and the encountered soils during the TP investigation would be "Site Class C" (very dense soil or soft rock).

3.4 Foundation Drainage

a. Conventional requirements of the 2018 BCBC pertaining to building drainage are considered suitable at this site.

4.0 CONSTRUCTION PHASE

4.1 General Excavation – Future Building Sites

a. Prior to construction, all unsuitable materials should be removed to provide a suitable base of support. Unsuitable materials include any non-mineral material such as vegetation, topsoil, peat, fill or other materials containing organic matter, as well as any soft, loose, or disturbed soils.

b. Unsuitable material, including existing fill soils, were encountered in each of the subsurface explorations from depths of 0.0m to approximately 1.2m, and to a mean depth of 0.86m. Note that bedrock was encountered in each TP, at depths from 0.7m to 1.2m, and to a mean depth of 0.86m. We expect that excavation depths will be dictated by design depths, and that bedrock removal will be required over some of the building footprint(s).

c. Ground water ingressing into any excavations should be controlled with a perimeter ditch located just outside of the building areas, connected to positive drainage.

d. Alluvially deposited fine-grained soils (silt and clay) are particularly moisture sensitive. Extended periods of saturated soil conditions can make these soils unsuitable for bearing purposes, where they could be suitable bearing surfaces when moist or damp. Exposure of these soils to water after excavation (rain or snow) can also make these soils unsuitable for bearing purposes. Therefore, weather conditions dictate whether these soils are suitable for bearing purposes at the time of construction.

e. Prior to placement of concrete footings, any bearing soils that have been softened, loosened, or otherwise disturbed during the course of construction should be removed, or else compacted following our recommendations for structural fill. Compaction will only be feasible if the soil has suitable moisture content and if there is access to heavy compaction equipment. If no structural fill is placed, a smooth-bladed clean up bucket should be used to finish the excavation.

f. The Geotechnical Engineer is to confirm the removal of unsuitable materials and approve the exposed competent inorganic subgrade, prior to the placement of any structural fill material.

4.2 Structural Fill

a. Where fill is required to raise areas that will support buildings, slabs, or pavements, structural fill should be used. The Geotechnical Engineer should first approve the exposed subgrade in fill areas, to confirm the removal of all unsuitable materials.

b. Structural fill should be inorganic sand and gravel. If structural fill placement is to be carried out in the wet season, material with a fines content limited to 5% passing the 75µm sieve should be used, as such a material will not be overly sensitive to moisture, allowing compaction during rainy periods of weather.

c. Structural fill should be compacted to a minimum of 95% of Modified Proctor maximum dry density (ASTM D1557) in foundation and floor slab areas, as well as in paved roadway and parking areas.

d. Structural fills under foundations, roadways, and pavements should include the zone defined by a plane extending down and outward a minimum 0.5m from the outer edge of the foundation at an angle of 45 degrees from horizontal to ensure adequate subjacent support. This support zone is shown below in Figure 4.2.

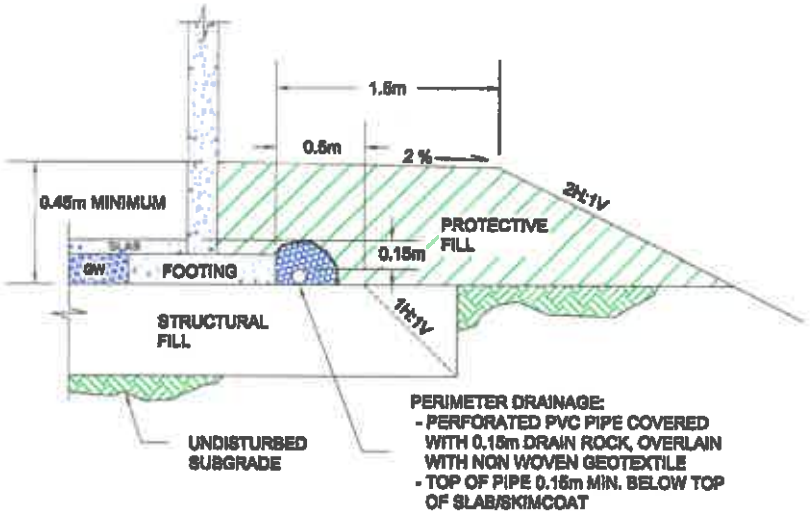

Figure 4.2 – Typical Section, Structural Fill

e. Compaction of fill should include moisture conditioning as needed to bring the soils to the optimum moisture content and compacted using vibratory compaction equipment in lift thicknesses appropriate for the size and type of compaction equipment used.

f. A general guideline for maximum lift thickness is no more than 100mm for light hand equipment such as a "jumping-jack," 200mm for a small roller and 300mm for a large roller or heavy (>500 kg) vibratory plate compactor or a backhoe mounted hoe-pac or a large excavator mounted hoe-pac, as measured loose.

g. It should be emphasized that the long-term performance of buildings, slabs, and pavements is highly dependent on the correct placement and compaction of underlying structural fills. Consequently, we recommend that structural fills be observed and approved by the Geotechnical Engineer. This would include approval of the proposed fill materials and performing a suitable program of compaction testing during construction.

4.3 Stormwater Management

a. As part of the geotechnical investigation, field observations of the subgrade soil conditions with respect to the on-site infiltration and disposal of stormwater were carried out.
b. Subgrade soil conditions consist of loose surficial soils overlying sedimentary bedrock at shallow depths.
c. Based on the subgrade conditions encountered during the TP investigation, it is the opinion of LEA that site conditions are not conducive to the installation of on-site stormwater infiltration measures.
d. Site conditions may be conducive to the installation of storm water detention measures. The location(s) of any proposed detention measures shall be reviewed by the Geotechnical Engineer to determine if the design method(s) and/or location(s) pose a hazard to the Property or any adjacent or adjoining properties.

4.4 Pavement Design – Private Works

a. Any organic or deleterious material should be removed from beneath the designated roadway, driveway, or parking areas prior to subgrade preparation. If fill is required to bring the subgrade up to the desired elevation, structural fill should be used.
b. The subgrade should be proof rolled after final compaction and any areas showing visible deflections should be inspected and repaired. The Geotechnical Engineer shall review the parking lot and roadway subgrade conditions during the course of excavation.
c. The parking lot subgrade and pavement should be sloped to provide adequate drainage as per the design and direction of the civil consultant.
d. An estimated soaked California Bearing Ratio of 30% and a 20-year design life have been used in the calculating pavement designs. See Tables 4.4.1 and 4.4.2 below.

Table 4.4.1 – Pavement Design Recommendations for Light Traffic/Low Volume Areas

Areas Subject to Cars and Small Trucks	
Estimated Equivalent Single-Axle Load: 2×10^4	
Asphaltic Concrete Pavement	50mm
19mm Well-Graded Granular Base Course	100mm
75mm Select Granular Subbase (SGSB)	250mm

Table 4.4.2 – Pavement Design Recommendations for Heavy Traffic/High Volume Areas

Areas Subject to Large Trucks	
Estimated Equivalent Single-Axle Load: 2×10^5	
Asphaltic Concrete Pavement	75mm
19mm Well-Graded Granular Base Course	150mm
75mm Select Granular Subbase (SGSB)	300mm

e. It is recommended that a reinforced concrete slab be utilized where garbage dumpsters are located. The slab should be large enough to contain the disposal unit and front tires of the garbage truck during disposal operations.

f. The above recommendations for general stripping, granular and pavement structure are in accordance with current best-practices. If the recommendations provided here prove cost-prohibitive or restrictive, alternative options may be considered through a balance of reduced preparation efforts, with a corresponding reduction in pavement design life.

5.0 CONCLUSIONS

5.1 Local Government Conformance Statement

a. From a geotechnical point of view, and provided the recommendations in this Report are followed, the land is considered safe for the use intended (defined for the purposes of this Report as a commercial development of conventional construction methods), with the probability of a geotechnical failure resulting in property damage of less than:

   i. 2% in 50 years for geotechnical hazards due to seismic events, including slope stability; and,

   ii. 10% in 50 years for all other geotechnical hazards.

5.2 Geotechnical and Quality Assurance Statement

a. The 2018 BCBC requires that a geotechnical engineer be retained to provide Geotechnical Assurance services for the construction of buildings that are outside of Part 9 of the BCBC. Geotechnical Assurance services include review of the geotechnical components of the plans and supporting documents, and responsibility for field reviews of these components during construction.

5.3 Acknowledgements

a. LEA acknowledges that this Report may be requested by the building inspector (or equivalent) of the RDN as a precondition to the issuance of a building or development permit. It is acknowledged that the Approving Officers and Building Officials may rely on this Report when making a decision on application for development of the land. We acknowledge that this Report has been prepared solely for, and at the expense of Alley Enterprises Ltd. (DBA Wild Rose Garden Centre).

b. We have not acted for or as an agent of the RDN in the preparation of this Report. We acknowledge the RDN and the Approving Officer(s) are authorized users of this Report. We acknowledge that this Report may be registered against the title of the Property as a restrictive covenant.

5.4 Limitations

a. The conclusions and recommendations submitted in this Report are based upon the data obtained from a limited number of widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction or further investigation. The recommendations given are based on the subsurface soil conditions encountered during the TP program, current construction techniques, and generally accepted engineering practices. No other warrantee, expressed or implied, is made. Subgrade conditions are known only at the TP locations and have been used to infer conditions throughout the site in preparation of this Report. If unanticipated conditions become known during construction or other information pertinent to the development become available, the recommendations may be altered or modified in writing by the undersigned.

6.0 CLOSURE

a. Lewkowich Engineering Associates Ltd. appreciates the opportunity to be of service on this project. If you have any comments, or additional requirements at this time, please contact us at your convenience.

Respectfully Submitted,
Lewkowich Engineering Associates Ltd.

2021-08-31

Tennes Hamre, GIT
Junior Geoscientist

Chris Hudec, M.A.Sc., P.Eng.
Senior Project Engineer

7.0 ATTACHMENTS

1. LEA, TP Site Plan, LEA Drawing No. F9892-01
2. LEA, TP Logs, LEA File No. TP 21-01 to TP 21-05

8.0 REFERENCES

1. Regional District of Nanaimo Online GIS Mapping System, Accessed August 2021.
2. Soils of the Gulf Islands Gabriola and Lesser Islands, British Columbia, Soil Survey Report No. 43, Volume 4.
3. Geoscience BC map titled "Map 2013-NVI-1-1, Geology, Northern Vancouver Island Project," Dated January 2013.

NOTE: LOT LINES ARE APPROXIMATE

REV No.	DATE	BY	P.Eng.	REVISION DESCRIPTION

DRAWING TITLE
TEST PIT LOCATION PLAN

PROJECT NAME
PROPOSED COMMERCIAL DEVELOPMENT
750 TIN CAN ALLEY, GABRIOLA ISLAND, BC

LEGAL DESCRIPTION
LOT B, SECTION 19,
LAND DISTRICT 32, PLAN VIP60373

ENGINEER'S SEAL

PLOT DATE	DRAWN BY
2021-08-23	NV
REVIEWED BY	SCALE
CH	1:1000
PROJECT No.	DRAWING No.
F9892	F9892-01

LEA
Lewkowich Engineering Associates Ltd.

Lewkowich Engineering Associates Ltd.

TEST PIT LOG

File Number: F9892 TP21-01
Client: Alley Enterprises Ltd. (DBA Wild Rose Garden Centre)
Project: 750 Tin Can Alley
Location: Gabriola Island, BC

Depth (m)	Soil Symbol	Description
0.0		Ground Surface
		0.0-0.7m Gravelly sand, some cobble, trace organics (roots, rootlets), loose, brown, dry
0.5		
		End of Test Pit at 0.7m (Refusal on Sandstone Bedrock)
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

Logged By: Tennes Hamre, GIT
Reviewed By: Chris M. Hudec P.Eng.
Digging Method: CAT 308C Excavator

Date: July 22, 2021
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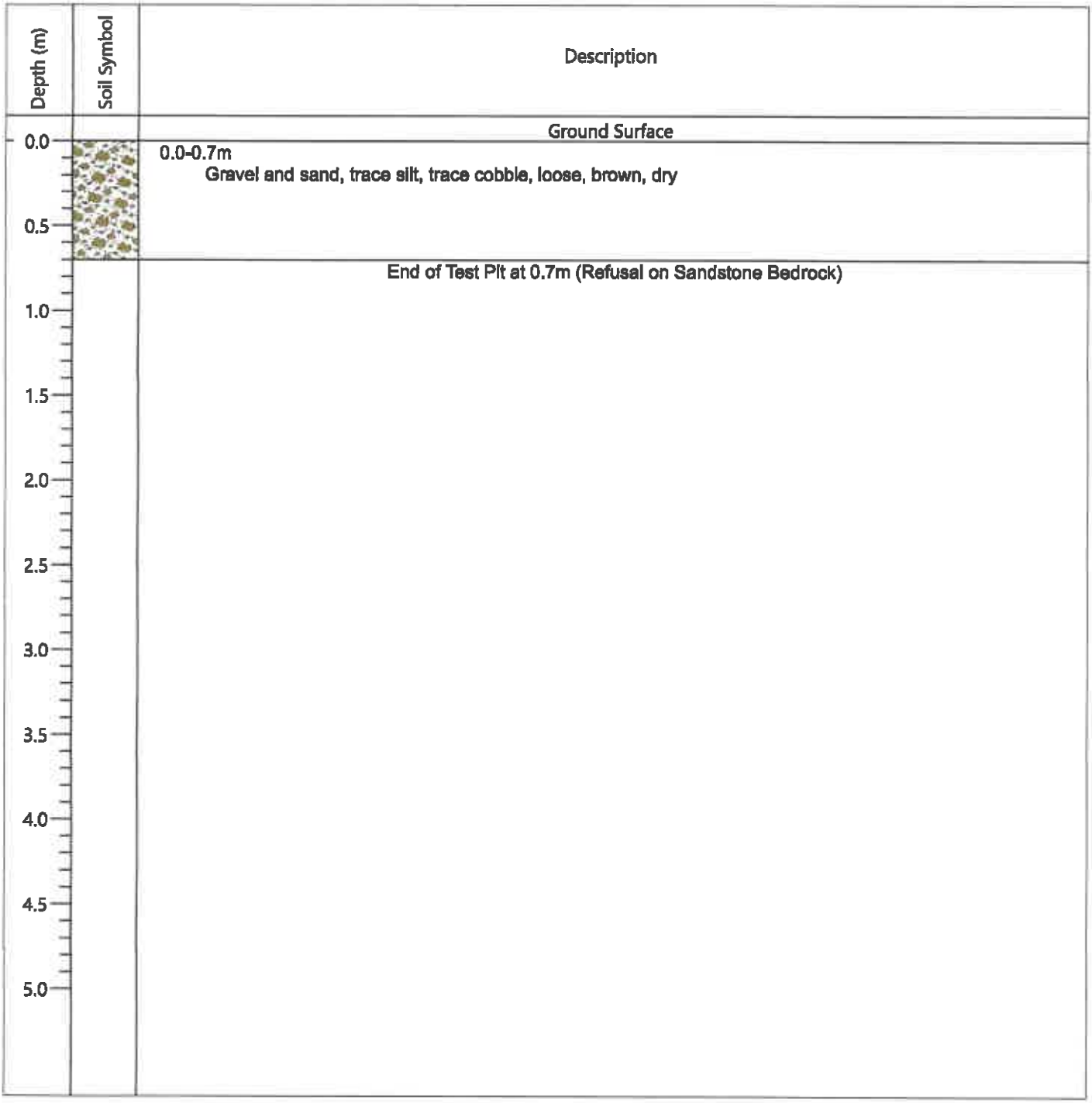
TEST PIT LOG

File Number: F9892 TP21-02
Client: Alley Enterprises Ltd. (DBA Wild Rose Garden Centre)
Project: 750 Tin Can Alley
Location: Gabriola Island, BC



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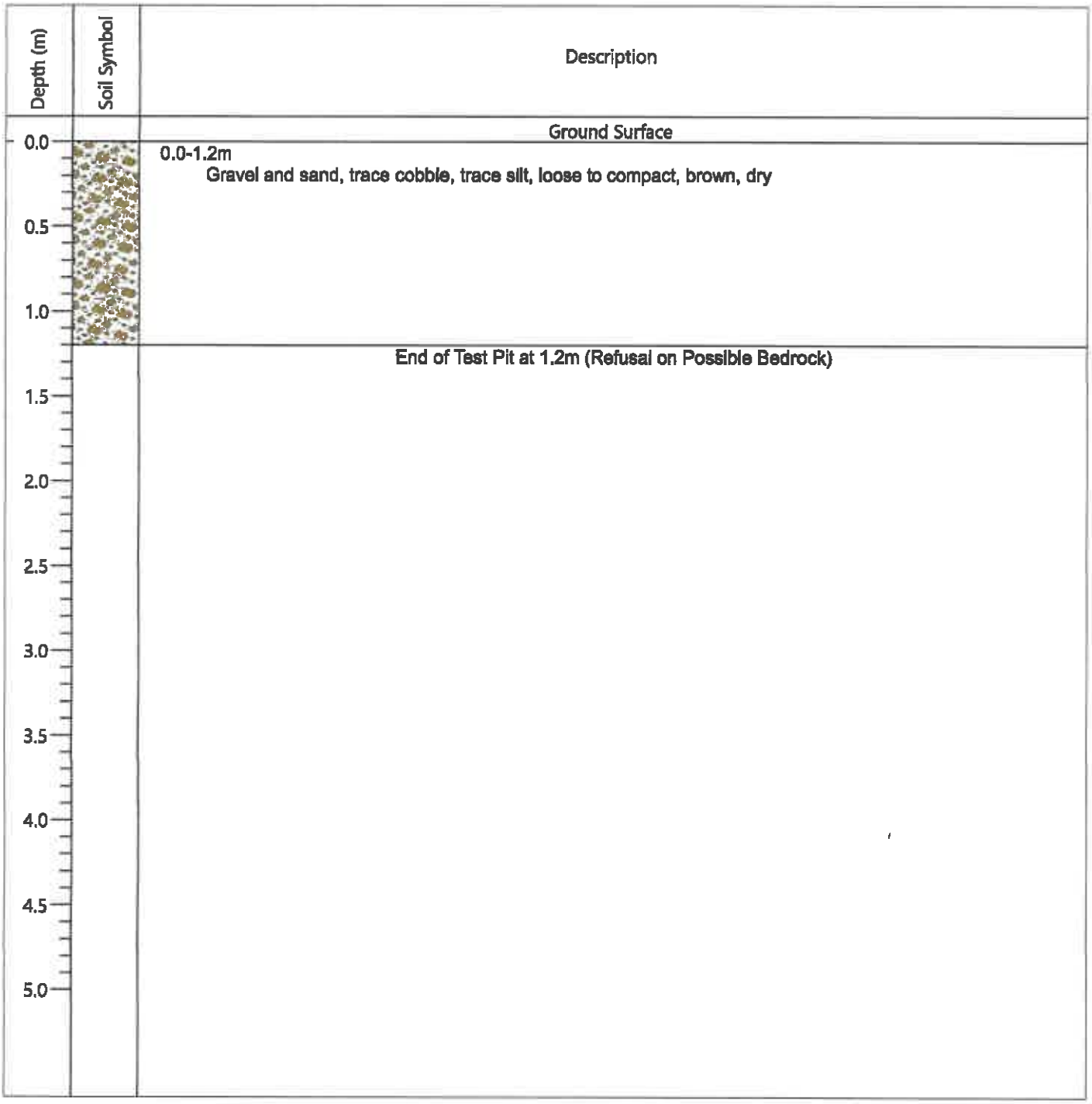
TEST PIT LOG

File Number: F9892 TP21-03
Client: Alley Enterprises Ltd. (DBA Wild Rose Garden Centre)
Project: 750 Tin Can Alley
Location: Gabriola Island, BC



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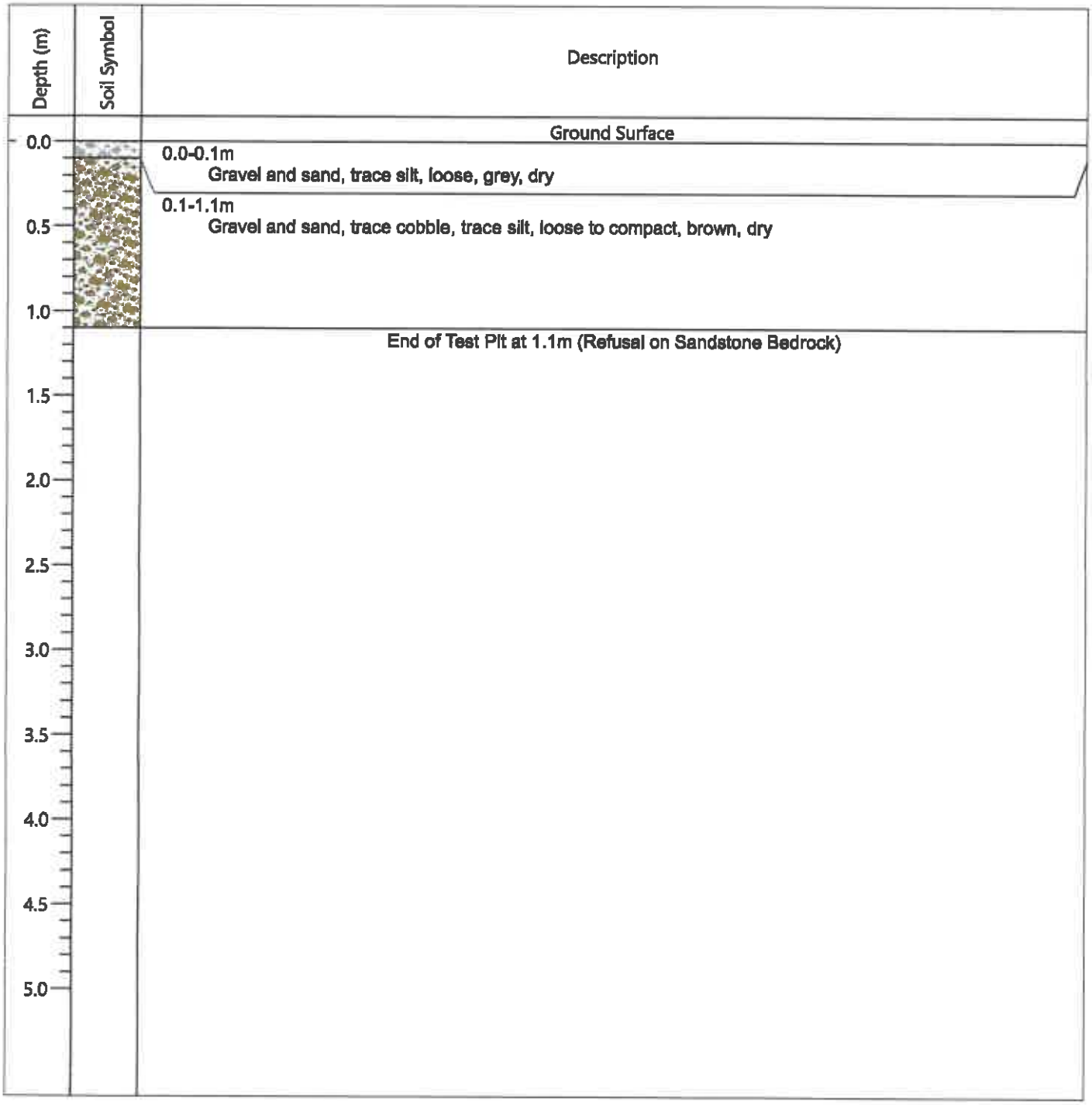
TEST PIT LOG

File Number: F9892 TP21-04
Client: Alley Enterprises Ltd. (DBA Wild Rose Garden Centre)
Project: 750 Tin Can Alley
Location: Gabriola Island, BC



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TEST PIT LOG

File Number: F9892 TP21-05
Client: Alley Enterprises Ltd. (DBA Wild Rose Garden Centre)
Project: 750 Tin Can Alley
Location: Gabriola Island, BC

Depth (m)	Soil Symbol	Description
0.0		Ground Surface
		0.0-0.6m Gravel and sand, trace cobble, trace silt, loose to compact, brown, dry
0.5		End of Test Pit at 0.6m (Refusal on Sandstone Bedrock)
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

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