1779 West 75 Avenue
Vancouver, BC
V6P 6P2
604-439-0922

R.F. Binnie & Associates Ltd
205 – 4946 Canada Way
Burnaby, BC
V5G 4H7

June 16, 2017
File: 15062

Attention: Mr. Matthew Harbut

Re: Geotechnical Investigation Report, Renfrew Park Improvements, Vancouver BC

1.0 INTRODUCTION

We understand that improvements are proposed for Renfrew Park including a new pedestrian bridge, viewing platform and access pathways within Renfrew Park and a proposed boardwalk and viewing platform within Renfrew Ravine.

As requested, GeoPacific attended the site on June 7, 2017, to complete a subsurface investigation within the proposed improvement areas. This letter summarizes the results of our investigation and makes geotechnical recommendations for the proposed improvements.

The report has been prepared exclusively for the client, for their use and the use of others within their design and construction team, however it remains the property of GeoPacific.

Based on our review of the 50% design drawings prepared by Binnie and dated March 22, 2017, we understand that four development areas are proposed. However, our scope of work was limited to Area A, Area B, and Area C as defined in the design drawings. For clarity, we have broken down the remainder of the report into the three proposed development areas.

2.0 DEVELOPMENT AREA A – Proposed Pedestrian Bridge

2.1 Site Description

The site is located within Renfrew Park and is bounded to the north by Nootka Elementary, to the south by 22nd Avenue, to the east by Nootka Street and to the west by Renfrew Street. We understand it is proposed to construct new access pathways down to Still Creek as well as a new pedestrian bridge. We further understand that the proposed bridge abutments are to consist of fully buried concrete lock blocks. The topography of the area is characterized by a moderate slope down towards Still Creek. The sidewalls of the creek consist of rock and mortar and are inclined at approximately 45 degrees.

2.2 Field Investigation

We were unable to gain access with a drill down to the proposed bridge location. Therefore, our investigation consisted of the excavation of two hand dug test pits on either side of the proposed bridge at abutment locations. The test pits were dug to depths of about 0.6 m.

2.3 Subsurface Conditions

In general, the soils encountered consisted of 60 to 100 mm of topsoil overlying dense grey sand with some cobbles. The location of the test pits are shown on the attached location plan, dwg. 15062-01. A description of the soils encountered is included on the attached test pit logs.

2.4 Design Recommendations

2.4.1 Site Preparation

Prior to the placement of the lock block bridge abutments, the site area should be stripped of all vegetation or topsoil to expose dense grey sand. The subgrade must be reviewed by a geotechnical engineer.

Any grade reinstatement beneath the abutments should be completed with "engineered fill". In the context of this report any "engineered fill" is defined as clean sand to sand and gravel fill, containing less than 8% fines, compacted in 300 mm loose lifts to a minimum standard of 100% of its Standard Proctor Maximum Dry Density (ASTM D698) while at a moisture content that is within 2% of its optimum for compaction. The engineered fill should extend horizontally outwards from the edge of foundations equal to the thickness of fill material placed.

A 150 mm thick levelling pad should be placed beneath the lock blocks. The levelling pad should consist of well compacted 19 mm minus crushed rock material.

2.4.2 Foundation Design

Bridge abutments bearing on the dense sand can be designed in consideration of Serviceability Limit State (SLS) and factored Ultimate Limit State (ULS) bearing pressures of 125 kPa and 250 kPa, respectively.

The bridge abutments should be located so that the base of the abutments are offset from the base of the creek at a minimum 2H:1V (horizontal: vertical) measured downward and outward from the proposed blocks to help maintain the stability of the foundation subgrade. Erosion protection recommendations for the creek banks should be completed by others.

3.0 DEVELOPMENT AREA B – Proposed Viewing Platform

3.1 Site Description

Development Area B is located a small section of park space located between St. Jude's church to the

south, residential buildings to the north and Renfrew Street to the west. The ground in the development area slopes moderately down from Renfrew Street to a near level area present at the top of Still Creek. The sidewalls of the creek consist of rock and mortar and are inclined at roughly 45 degrees and a box culvert is present aligned with Renfrew Street.

It is proposed to build a viewing platform of Still Creek, near the outlet of the existing box culvert. We understand that platform is to be supported on piers located to the north of the culvert and that some cast in place retaining walls may be required.

3.2 Field Investigation

Our investigation consisted of the advancement of one test hole near the location of the proposed platform utilizing a track mounted solid stem auger drill rig. The test hole was advanced to a depth of 8.5 m. Dynamic Cone Penetration Test (DCPT) soundings was completed to help us characterize the density of the subsurface soils. The location of the test hole is shown on the attached location plan, dwg. 15062-02.

3.3 Subsurface Conditions

The subsurface soils were observed to consist of 60 mm of topsoil overlying compact to dense sand or sand and gravel fill to a depth of 3.0 m. The fill was underlain by 2.2 m of firm grey silt which overlies dense glacial till. Weathered sandstone bedrock was encountered at 6.7 m depth.

A description of the soils encountered is included on the attached test hole log.

3.4 Design Recommendations

3.4.1 Site Preparation

The viewing platform area should be stripped of all topsoil, vegetation and loose fill material to expose a subgrade consisting of compact to dense granular fill. Based on our test hole we anticipate that compact to dense fill material will be encountered approximately 1.5 m below grade. It will be necessary that the fill is compacted in place once exposed. The subgrade should be reviewed by a geotechnical engineer.

Any grade reinstatement beneath foundations should be completed with “engineered fill”. In the context of this report any “engineered fill” is defined as clean sand to sand and gravel fill, containing less than 8% fines, compacted in 300 mm loose lifts to a minimum standard of 100% of its Standard Proctor Maximum Dry Density (ASTM D698) while at a moisture content that is within 2% of its optimum for compaction. The engineered fill should extend horizontally outwards from the edge of foundations a distance equal to the thickness of fill material placed.

3.4.2 Foundation Design

The proposed platform piers and retaining wall can be founded on conventional spread foundations following the recommend site preparation. We expect that the fill will provide adequate support for the foundations.

Footings bearing on the compacted granular fill can be design in consideration of a Serviceability Limit State (SLS) and factored Ultimate Limit State (ULS) bearing pressure of 125 kPa and 250 kPa, respectively.

All foundations should be located a minimum of 0.5 m below final grades for frost protection and be constructed on level subgrade.

Once a foundation layout is complete it should be confirmed by others that the proposed foundation loads will not adversely affect the adjacent box culvert.

3.4.3 Earth Pressures

The earth pressure on retaining walls depends on a number of factors including the backfill material, surcharge loads, backfill slope, drainage, rigidity of the retaining wall, and method of construction including sequence and degree of compaction. The following loads are provided based on the assumption of a free draining granular backfill with a unit weight of 19.5 kN/m^3, friction angle of 35 degrees, level backfill, and no surcharges. Heavier backfills or backfills with a lower angle of friction would be expected to induce higher loads.

For a fully restrained retaining wall designed for static pressures, a pressure distribution should be employed of 8H (kPa) triangular, where 'H' is the buried depth of the wall, in metres, below grade. For an unrestrained retaining wall a static pressure distribution of 5H (kPa) triangular may be employed.

We have assumed that a free draining granular backfill will be used behind the retaining walls and that a drainage system will also be employed to collect any water from behind the walls. Therefore, our wall loading scenario presented above assumes that no water pressure will be generated behind the walls. Our loading scenario also assume that only nominal compaction effort will be conducted within 0.6 metres of the retaining wall so that compaction pressures are not imposed on the retaining walls.

The provided earth pressures are based on unfactored soil parameters and so the earth pressures should be assumed to be unfactored as well.

4.0 DEVELOPMENT AREA C – Proposed Boardwalk and Viewing Platform

4.1 Site Description

The proposed boardwalk area is located within the northern extent of the Renfrew Ravine. The area is bounded to the north and east by the Boyd Diversion, to the south by a further extension of the ravine, and to the west by Renfrew Street. The topography of the site is characterized by 7 to 8 m high moderately steep slope down to the south from Boyd Diversion before flattening out alongside Still Creek. The area is well vegetated with mature trees.

We understand that it is proposed to construct a wooden boardwalk alongside the creek as well as a viewing platform. A steel staircase with concrete landing platforms is also proposed to lead down from Boyd Diversion to the proposed boardwalk.

4.2 Field Investigation

Due to the steep inclination and thick vegetation of the ravine, we were unable to gain access to the development area with an excavator or drill rig. We instead hand excavated three test pits along the proposed boardwalk and viewing platform location. The test pits were excavated to depths ranging from 0.5 to 0.8 m. The approximate locations of the test pits can be viewed on the attached location plan dwg, 15062-03.

4.3 Subsurface Conditions

The soil conditions observed in our test pits generally consisted of 0 to 100 mm of topsoil overlying compact medium grained sand with some gravel and cobbles or dense sand and gravel with some cobbles. The soil in all test pits was observed to be moist to dry.

4.4 Design Recommendations

4.4.1 Site Preparation

We understand that Krinner Ground Screws are proposed to support the boardwalk and viewing platform and therefore we do not anticipate that site stripping will be required. Site preparation required for the installation should be as per the supplier's installation guidelines.

We anticipate that the proposed stairway landings will be grade supported. Therefore, it will be necessary to remove all existing topsoil or fill material to expose suitable subgrade consisting of compact to dense sand and or sand and gravel material. Further, as the landings are to be constructed on the existing slope it will be necessary to create a level surface for the proposed foundations.

4.4.2 Foundation Design

As mentioned above, it is proposed to support the boardwalk and viewing platform on Krinner Ground Screws. A sealed shop drawing for the proposed design should be submitted by the contractor to GeoPacific for review.

The stairway landing platform can be founded on a conventional pad foundation following the recommend site preparation. Footings bearing on approved sand or sand and gravel subgrade can be design in consideration of a Serviceability Limit State (SLS) and factored Ultimate Limit State (ULS) bearing pressure of 125 kPa and 250 kPa, respectively.

It would also be feasible to support the boardwalk and viewing platform on conventional pad foundations instead of ground screws if desired. The design recommendations for the stairway landing platform would apply to boardwalk and viewing platform if this design option is chosen.

All foundations should be located a minimum of 0.5 m below final grades for frost protection.

5.0 FIELD REVIEWS

Field reviews may be required for Municipal "Letters of Assurance". GeoPacific Consultants Ltd. is required to carry out sufficient field reviews during construction to ensure that the geotechnical design recommendations have been adequately communicated to the design team and to the contractors implementing the design. These field reviews are not carried out for the benefit of the contractors and therefore do not in any way effect the contractor's obligations to perform under the terms of his/her contract.

It is the owner's or owner's representative's responsibility to advise GeoPacific Consultants Ltd. (a minimum of 24 hours in advance) that a field review is required. Geotechnical field reviews are required at the time of the following activities.

1. Stripping – Review of stripped subgrade prior to fill placement
2. Filling – Review of any engineered fill used to raise grades
3. Subgrade – Review of foundation or retaining wall subgrade

It is critical that these reviews are carried out to ensure that our intentions have been adequately communicated. It is also critical that contractors working on the site review this document in advance of any work being carried out so that they are familiar with the sensitive aspects of the works proposed. It is the responsibility of the developer to notify GeoPacific Consultants Ltd. when conditions or situations not outlined within this document are encountered.

6.0 CLOSURE

This report is prepared for R.F. Binnie & Associates Ltd for the project described above. It has been prepared to the general standards of similar work for similar projects in this area and no other warranty of any kind is expressed or implied. GeoPacific Consultants Ltd. accepts no responsibility for any other use of this report.

We are pleased to assist you with this project. Please contact the undersigned should require any clarification or additional details.

For:
GeoPacific Consultants Ltd.

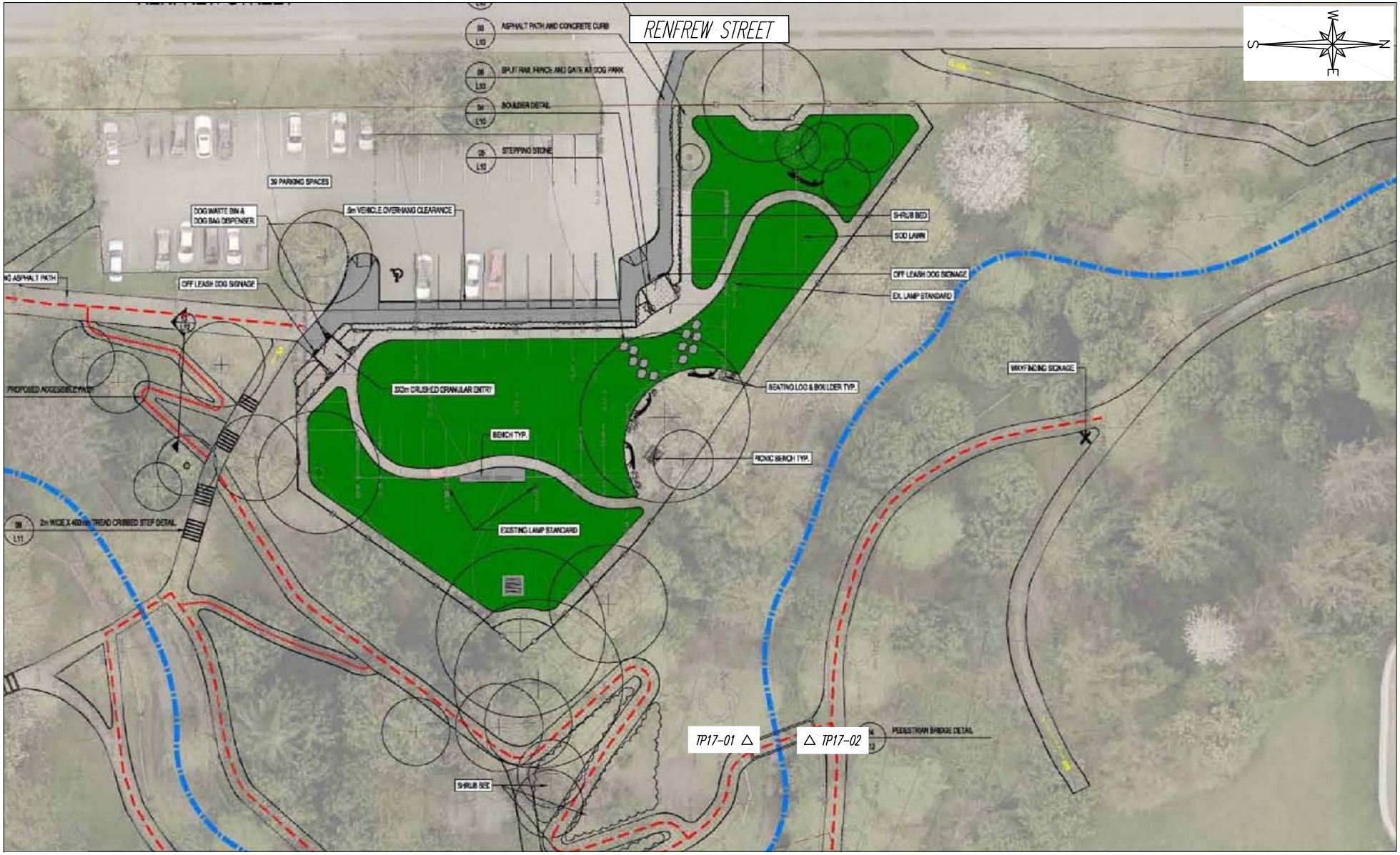
Jessica Gagne, EIT
Project Engineer

Reviewed by:

PROFESSIONAL PROVINCE OF S. M. FOFONOFF # 30836 BRITISH COLUMBIA ENGINEER

June 16, 2017

Steven Fofonoff, M.Eng., P.Eng.
Senior Geotechnical Engineer



L E G E N D :

△ TP#-# – TEST PIT (TP) LOCATION

SITE PLAN

*TEST LOCATIONS ARE APPROXIMATE

REFERENCE:

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY
1779 West 75th Ave.
Vancouver, B.C. V6P 6P2
P 604.439.0922
F 604.439.9189

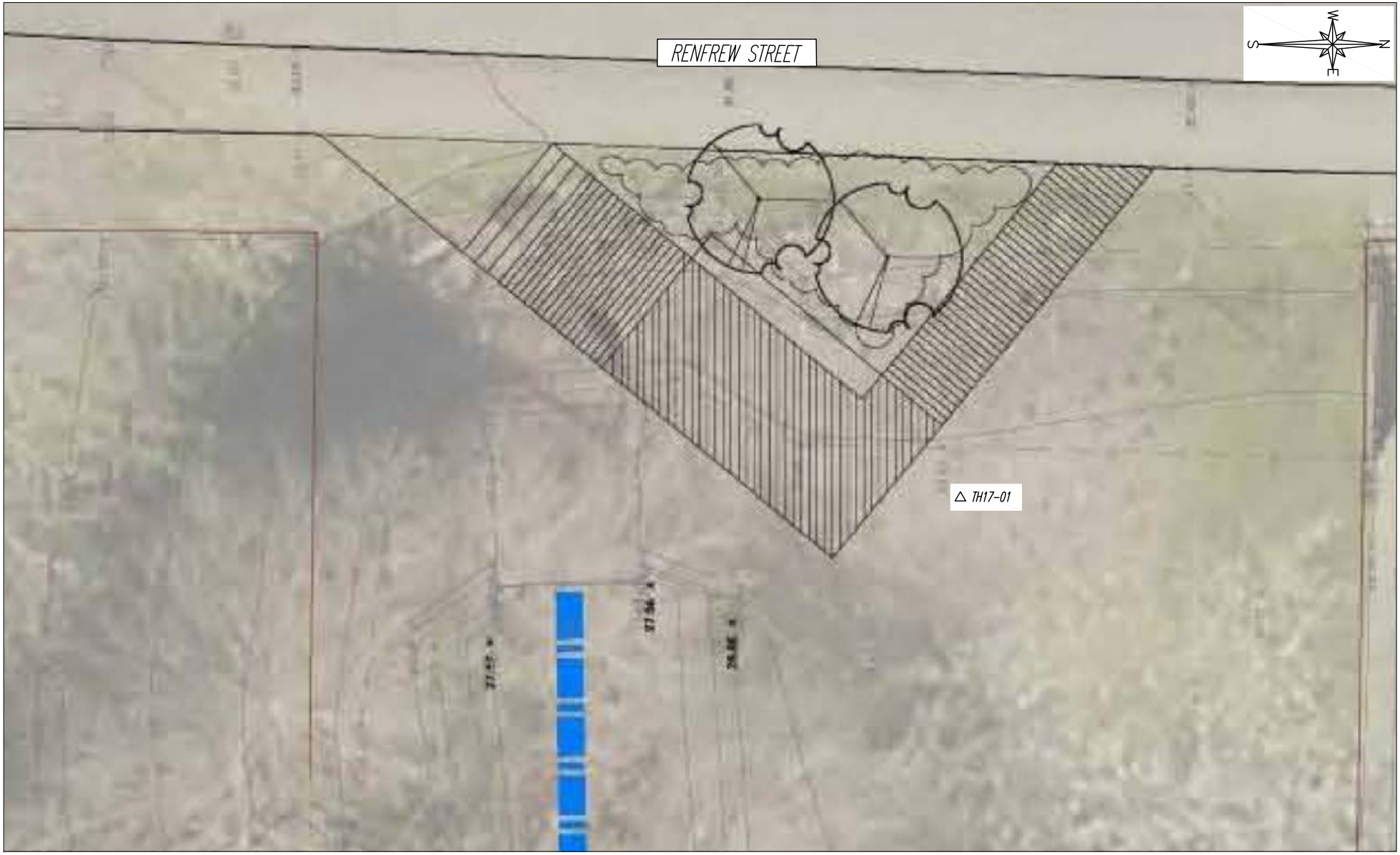
DATE:	08-June-2017	
DRAWN BY: ZH	APPROVED BY: SMF	REVIEWED BY: ZH
SCALE: NTS		

AREA A – PEDESTRIAN BRIDGE
RENFREW STREET, VANCOUVER, BC
TEST HOLE SITE PLAN

FILE NO.: 15062
DWG. NO.: 15062-01

REVISIONS:
A.
B.
C.

ORIGINAL PAPER SIZE 8.5"x11"



L E G E N D :

△ TH#-# – TEST HOLE (TH) LOCATION

SITE PLAN

*TEST LOCATIONS ARE APPROXIMATE

REFERENCE:

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY
1779 West 75th Ave.
Vancouver, B.C. V6P 6P2
P 604.439.0922
F 604.439.9189

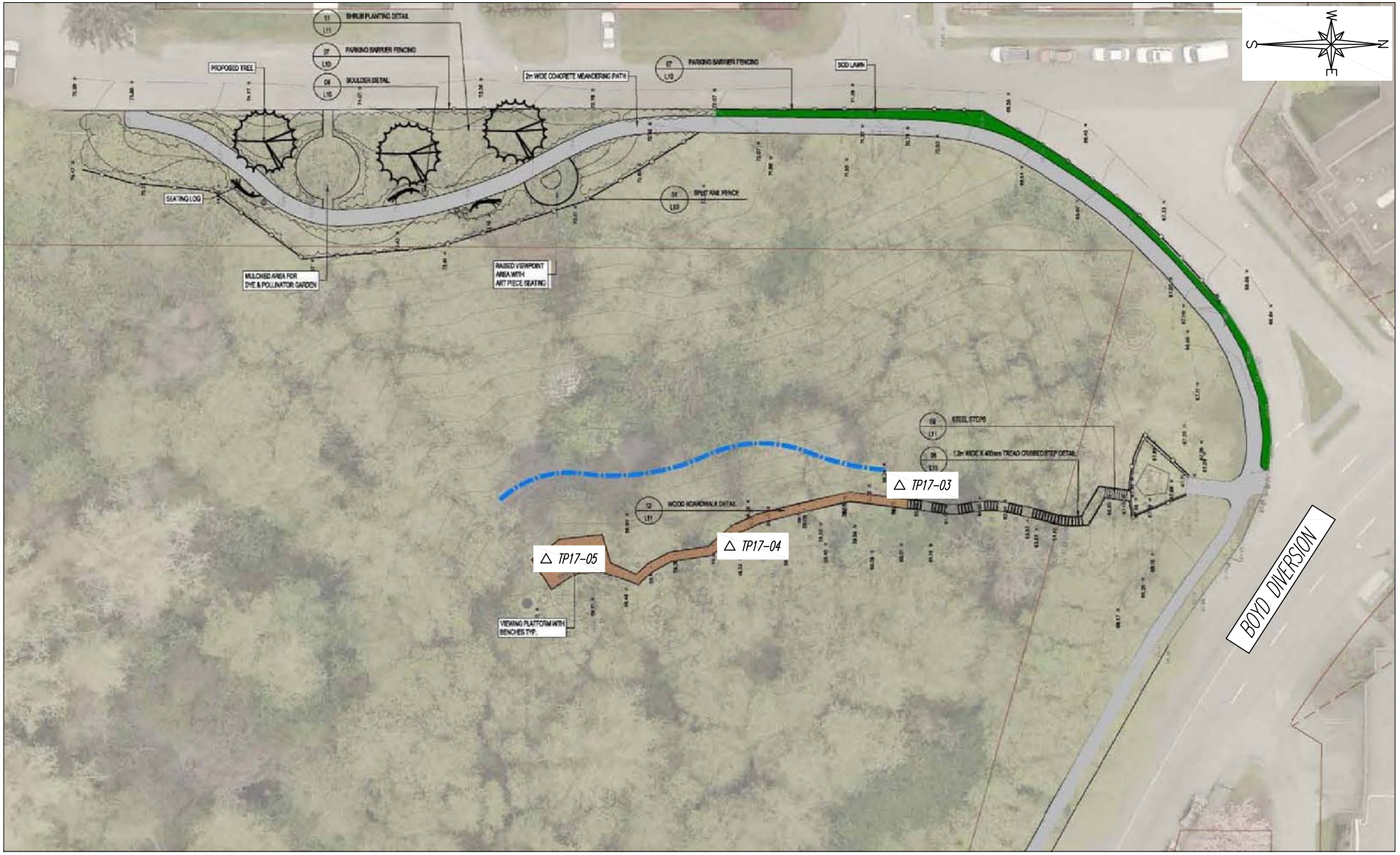
DATE: 08-June-2017		
DRAWN BY: ZH	APPROVED BY: SMF	REVIEWED BY: ZH
SCALE: NTS		

AREA B – VIEWING PLATFORM
RENFREW STREET, VANCOUVER, BC
TEST HOLE SITE PLAN

FILE NO.: 15062
DWG. NO.: 15062-02

REVISIONS:
A.
B.
C.

ORIGINAL PAPER SIZE 8.5"x11"



L E G E N D :

△ TP#-# – TEST PIT (TP) LOCATION

SITE PLAN

*TEST LOCATIONS ARE APPROXIMATE

REFERENCE:

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY
1779 West 75th Ave.
Vancouver, B.C. V6P 6P2
P 604.439.0922
F 604.439.9189

DATE: 08-June-2017		
DRAWN BY: ZH	APPROVED BY: SMF	REVIEWED BY: ZH
SCALE: NTS		

AREA C – BOARDWALK
RENFREW STREET, VANCOUVER, BC
TEST HOLE SITE PLAN

FILE NO.: 15062
DWG. NO.: 15062-03

REVISIONS:
A.
B.
C.

ORIGINAL PAPER SIZE 8.5"x11"

Test Hole Log: TP17-01

File: 15062
Project: RENFREW PARK IMPROVEMENTS
Client: R.F. BINNIE AND ASSOCIATES LTD
Site Location: RENFREW STREET, VANCOUVER, BC

GEOPACIFIC CONSULTANTS
1779 West 75th Avenue, Vancouver, BC, V6P 6P2
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE				Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)				
0		Ground Surface					
		Topsoil (60 mm) loose TOPSOIL with roots, black, dry	0.0				
		Sand dense SAND, medium grained, grey, some gravel, some roots brown-orange @ 0.3 m cobble @ 0.6 m					
		End of Borehole	0.6				No free water observed Could not advance test pit past 0.6 m

Logged: ZH
Method: Hand dug
Date: 06-June-2017

Datum: Ground elevation
Figure Number: A.01
Page: 1 of 1

Test Hole Log: TP17-02

File: 15062
Project: RENFREW PARK IMPROVEMENTS
Client: R.F. BINNIE AND ASSOCIATES LTD
Site Location: RENFREW STREET, VANCOUVER, BC

GEOPACIFIC CONSULTANTS
1779 West 75th Avenue, Vancouver, BC, V6P 6P2
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE				Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)				
0 / 0		Ground Surface					
		Topsoil (100 mm)	0.0				
		loose TOPSOIL with roots, black, some gravel, dry					
1		***Sand***					
		dense SAND, medium grained, brown-grey, trace gravel, some roots					
2		cobbley @ 0.7 m					
		End of Borehole	0.8				No free water observed Could not advance test pit past 0.8 m
3 / 1							
4							
5							
6 / 2							
7							
8							
9							
10 / 3							
11							
12							

Logged: ZH
Method: Hand dug
Date: 06-June-2017

Datum: Ground elevation
Figure Number: A.02
Page: 1 of 1

Test Hole Log: TP17-03

File: 15062
Project: RENFREW PARK IMPROVEMENTS
Client: R.F. BINNIE AND ASSOCIATES LTD
Site Location: RENFREW STREET, VANCOUVER, BC

GEOPACIFIC CONSULTANTS
1779 West 75th Avenue, Vancouver, BC, V6P 6P2
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE				Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)				
0		Ground Surface					
		Sand and gravel dense SAND and GRAVEL, some cobbles, rounded gravel, brown, slightly moist to moist	0.0				
2		End of Borehole	0.6				No free water observed Could not advance test pit past 0.6 m

Logged: ZH
Method: Hand dug
Date: 06-June-2017

Datum: Ground elevation
Figure Number: A.03
Page: 1 of 1

Test Hole Log: TP17-04

File: 15062
Project: RENFREW PARK IMPROVEMENTS
Client: R.F. BINNIE AND ASSOCIATES LTD
Site Location: RENFREW STREET, VANCOUVER, BC

GEOPACIFIC CONSULTANTS
1779 West 75th Avenue, Vancouver, BC, V6P 6P2
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE				Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)				
0		Ground Surface					
		Topsoil (50 mm)	0.0				
1		***Sand and gravel*** dense cobbley SAND and GRAVEL, rounded, brown, dry	0.2				No free water observed
		End of Borehole	0.5				Could not advance test pit past 0.5 m
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Logged: ZH
Method: Hand dug
Date: 06-June-2017

Datum: Ground elevation
Figure Number: A.04
Page: 1 of 1

Test Hole Log: TP17-05

File: 15062
Project: RENFREW PARK IMPROVEMENTS
Client: R.F. BINNIE AND ASSOCIATES LTD
Site Location: RENFREW STREET, VANCOUVER, BC

GEOPACIFIC CONSULTANTS
1779 West 75th Avenue, Vancouver, BC, V6P 6P2
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE				Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)				
0 / 0		Ground Surface					
		Topsoil (100 mm)	0.0				
1		***Sand*** compact SAND, medium grained, orange brown, trace silt, dry some rounded gravel and cobbles after 0.4m	0.2				No free water observed
2		End of Borehole	0.8				Could not advance test pit past 0.8 m
3 / 1							
4							
5							
6 / 2							
7							
8							
9							
10 / 3							
11							
12							

Logged: ZH
Method: Hand dug
Date: 06-June-2017

Datum: Ground elevation
Figure Number: A.05
Page: 1 of 1

Test Hole Log: TH17-01

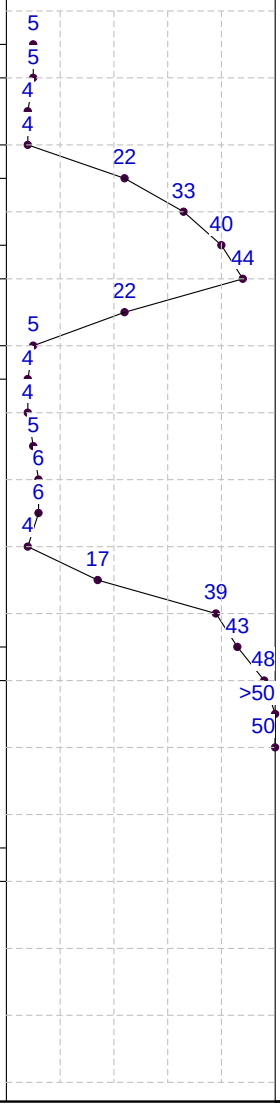
File: 15062
Project: RENFREW PARK IMPROVEMENTS
Client: R.F. BINNIE AND ASSOCIATES LTD
Site Location: RENFREW STREET, VANCOUVER, BC

GEOPACIFIC CONSULTANTS
1779 West 75th Avenue, Vancouver, BC, V6P 6P2
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)
		Ground Surface	
		Topsoil (60 mm)	0.0
		Sand [FILL] loose silty SAND fill, orange-brown, dry becomes dark brown @ 0.8 m some roots @ 1.0 m	
		Sand and gravel [FILL] compact to dense SAND and GRAVEL fill, orange-brown, slightly moist	1.5
		Sand [FILL] compact SAND fill, medium grained, grey-brown, moist	2.1
		Silt firm SILT, grey, moist to wet some rounded gravel @ 3.0 m to 4.6 m	3.0
		Sand [TILL LIKE] dense silty SAND till like, trace subangular gravel, grey, moist	5.2
		Sandstone dense to very dense weathered SANDSTONE bedrock, light grey, slightly moist to moist	6.7
		End of Borehole	8.5

Moisture Content (%): 11.1, 32.5, 19.8, 22.9, 19.0, 15.2



Groundwater / Well

Remarks: Perched water @ 2.4 m; DCPT refusal @ 6.7 m

Logged: ZH
Method: Solid stem auger
Date: 07-June-2017

Datum: Ground elevation
Figure Number: A.06
Page: 1 of 1