

Annex 3

**Geotechnical Planning Review Report  
for Section 16 Application for**

**Proposed Development  
at  
No. 105 Robinson Road  
Mid-Level West, Hong Kong I.L. 942**

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This report is for our client and is not intended  
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## 1) **INTRODUCTION**

According to “GEO Advice Note for Planning Applications”, a geotechnical planning review report will be required if any of the following criteria apply: -

(i) where the maximum gradient across a site from boundary to boundary, or for a large site across any 50m long strip, is greater than 15°,

(ii) where a slope steeper than 30°, or retaining wall, or combination of the two with a height greater than 6m exists on the site or within 6m of the site, or

(iii) where there is ground outside the site but in the same catchment that is at an angular elevation of more than 20° from the site and there is ground sloping at more than 5° within 50m upslope of the site.

This geotechnical planning review report is in support of a Section 16 application under the Town Planning Ordinance for a site located at No. 105 Robinson Road. The application is submitted on behalf of the applicant, who currently owns and occupies the site.

This report provides a review of how the geotechnical features in the vicinity, such as retaining walls and/or slopes, shown on the plan may affect, or be affected by, the proposed development and presents an assessment of the geotechnical feasibility of the proposed development as reflected in the Master Layout Plans submitted together with this report (copies of the submitted Master Layout Plans are attached in Appendix A).

The proposed development scheme contains 1 no. of blocks with a maximum building height to be +215mPD.

## 2) **DESCRIPTION OF SITE**

The Application Site, covering a total site area of about 2,557m<sup>2</sup>, is located at west of Robinson Road and to the east of Conduit Road, and within the Mid-levels Area (Scheduled Area No.1) as shown in **Figure 1**. The site is irregular in shape. It is surrounded by natural vegetated slopes and positioned at the crest of slope. The Section 16 application comprises a proposed residential development. The application site is zoned "Residential (Group C)5" ("R(C)5") on the Approved Mid-Levels West Outline Zoning Plan No. S/H11/15. In accordance with the Notes of the "R(C)5" zone. This application is for the submission of a layout plan for the proposed residential development in addition to the submission of a layout plan, a minor relaxation of the building height restriction ("BHR") from 161mPD to 215mPD is also requested under this S16 application.

### 2.1 **Site Topography**

The Site is located in between Robinson Road and Conduit Road where generally consists of one platform, which supported by several existing registered retaining structures, at +120.0mPD as shown on **Figure 9**.



## 2.2 Existing Registered Feature

There are 10 numbers of registered man-made features in the vicinity of the proposed development. The locations of those features are shown in **Figure 3**. Records of those registered features are retrieved from the Slope Information System (SIS) and Slope Maintenance Responsibility Information System (SMRIS) and attached in **Appendix A**.

### Maintenance Responsibility of Features

Feature No.	Sub-division No.	Maintenance Responsibility	Location	Facilities at Crest	Facilities at Toe	C-T-L
11SW-A/CR386	(1)	I.L. 942	TO THE WEST OF ROBINSON ROAD	Indoor car park	Road/footpath with low traffic density	1
	(2)	LandsD				
11SW-A/C61	-	HyD	ADJOINING ROBINSON ROAD	Residential	Road/footpath with moderate traffic density	1
11SW-A/R382	-	I.L. 942	Within Lot Boundary	Residential	Road/footpath with heavy traffic density	1
11SW-A/R384	-	HyD	ROBINSON ROAD, TO THE NORTH OF JADE GARDEN	Residential	Road/footpath with heavy traffic density	2
11SW-A/R385	-	HyD	ROBINSON ROAD, TO THE NORTH OF PANORAMA GARDEN	Residential	Road/footpath with moderate traffic density	2
11SW-A/CR62	(1)	I.L. 2611	Within Lot Boundary & ON GOVERNMENT LAND ADJACENT TO ROBINSON ROAD	Residential	Road/footpath with heavy traffic density	1
	(2)	HyD				
11SW-A/R380	(1)	I.L. 942	PARTLY WITHIN IL942 AND PARTLY WITHIN IL949	Residential	Residential	1
	(2)	I.L. 949 RP				
11SW-A/CR60	-	I.L. 942	Within Lot Boundary	Residential	Residential	1
11SW-A/R842	(1)	I.L. 942	PARTLY WITHIN IL942 AND PARTLY WITHIN NHX457	Remote area or abandoned facilities	Lightly-used open area/facilities	3
	(2)	NHX457				
11SW-A/FR200	(1)	LandsD	PARTLY WITHIN IL942 AND PARTLY ON GOVERNMENT LAND	Undeveloped green belt	Road/footpath with low traffic density	3
	(2)	I.L. 942				



**Features Location Plan**

The descriptions of the registered features are demonstrated as follows:

**Feature No. 11SW-A/CR386 (Partially within lot boundary)**

Feature No. 11SW-A/CR386 is man-made slope that located at the west of the site. The 11SW-A/CR386 (1) is the platform which is bounded by indoor car park and the 11SW-A/CR386 (2) is bounded by road/footpath with low traffic density. The cut slope is about 1.8m in height and 35m in length with slope gradient of about 20°. The surface of the slope is mainly covered with shotcrete. It consists of 70mm diameter weepholes at 0.8m spacing and a sewer is located on the slope. Part (1) of the retaining wall is 2m in height and 35m in length with face angle of about 80° and the part (2) is 4.3m in height and 20m in in length with face angle of about 80°. The wall is made up of masonry (Part (1)) and concrete (Part (2)) with 90mm diameter of weepholes at 1.7m spacing. The maintenance responsibilities of feature belong to IL942 and LandsD. Stage 2 Study was carried out in 1991, the study report concluded that the feature is up to standard.

**Feature No. 11SW-A/C61 (Outside lot boundary)**

Feature No. 11SW-A/C61 is a man-made slope that located at the north of the site. The crest of the feature is residential area and 11SW-A/R382 and the toe is bounded by road/footpath with moderate traffic density. The cut slope is about 4.5m in height and 21m in length with slope gradient of about 60°. The surface of the slope is mainly covered with shotcrete. It consists of 50mm diameter weepholes at 0.9m spacing and a sewer is located on the slope. The maintenance responsibilities of this government feature belong to HyD. Stage 3 Study was carried out in 1989, upgrading works were carried out by LPM/EM and the feature is up to standard.

**Feature No. 11SW-A/R382 (Within lot boundary)**

Feature No. 11SW-A/R382 is a retaining wall that located at the north of the site. The crest of the feature is residential area and the toe is bounded by 11SW-A/C61 and road/footpath with heavy traffic density. The retaining wall is about 7.1m in height and 85m in length with face angle of about 88°. The wall is made up of masonry with 80mm diameter of weepholes at 2.2m spacing. The maintenance responsibilities of this private feature belong to IL942. Two Stage 2 Study was carried out in 1994 and 2010 respectively, the study report concluded that the DH Order shall be served to the owners. The DH order (DH0051/HK/15/C) is issued in 2015 by the Buildings Department (BD). As of today, the DH order of the feature is not discharged.

**Feature No. 11SW-A/R384 (Outside lot boundary)**

Feature No. 11SW-A/R384 is a retaining wall located at the north of the site. The crest of the feature is residential area and 11SW-A/R382 and the toe is bounded by road/footpath with heavy traffic density. Part of the wall is 10m in height and 40m in length with face angle of about 80° and another part of the wall is 8m in height and 49m in length with face angle of about 80°. The wall is made up of concrete with 30mm diameter of weepholes at 1.3m spacing. The maintenance responsibilities of this government feature belong to HyD. Stage 2 Study was carried out in 1989 and the feature is upgraded by LPM/EM.

**Feature No. 11SW-A/R385 (Outside lot boundary)**

Feature No. 11SW-A/R385 is a retaining wall located at the east of the site. The crest of the feature is residential area and the toe is bounded by road/footpath with moderate traffic density. The wall is 6m in height and 20m in length with face angle of about 80°. The wall is made up of concrete with 50mm diameter of weepholes at 1.3m spacing. The maintenance responsibilities of this government feature belong to HyD. Stage 2 Study was carried out in 1989 and the feature is upgraded by LPM/EM.

**Feature No. 11SW-A/CR62 (Outside lot boundary)**

Feature No. 11SW-A/CR62 is man-made slope that located at the east of the site. The crest of the feature is bounded by residential area and the toe is bounded by road/footpath with heavy traffic density. The cut slope is maximum 16.3m in height and 27m in length with average slope angle of 50°. The surface of the slope is mainly bare. It consists of 70mm diameter weepholes at 1.2m spacing and a sewer is located on the slope. The wall is 1.2m in height and 11.7m in length with face angle of about 90°. The wall is made up of concrete with 30mm diameter of weepholes at 1.5m spacing. The maintenance responsibilities of feature belong to IL2611 and HyD. Stage 2 Study was carried out and finalized in 2013 and a type 3 advisory letter was issued to the owners in 2013 with respect to Sub-division No.1 of the feature.

**Feature No. 11SW-A/R380 (Partially within lot boundary)**

Feature No. 11SW-A/R380 is a retaining wall located at the south of the site. The crest and toe of the feature is bounded by residential area and Feature 11SW-A/CR60 respectively. The wall is 6.8m in height and 57m in length with face angle of about 85°. The wall is made up of other material with 65mm diameter of weepholes at 1.2m spacing. Drainage is located at the toe. The maintenance responsibilities of this feature belong to IL942 and IL949RP. Stage 2 Study was carried out in 1991 and an advisory letter was issued to the owners in 1991. The DH order (DH58/HK/96/C) is issued in 1996 by BD

for 11SW-A/R380 (sub-division 1) and (sub-division 2). The feature was strengthened by soil nails and up to current standard. BD has acknowledged on the completion of the remedial works in 2001.

**Feature No. 11SW-A/CR60 (Within lot boundary)**

Feature No. 11SW-A/CR60 is man-made slope that located along southern site boundary. The crest of the feature is 11SW-A/R380 and toe of the feature is bounded by residential area. The cut slope is maximum 9m in height and 70m in length with slope gradient of about 65°. The surface of the slope is mainly covered with shotcrete. It consists of 65mm diameter weepholes at 1.2m spacing. The wall is 4m in height and 25m in length with face angle of about 90°. The wall is made up of masonry with 65mm diameter of weepholes at 1.2m spacing. The maintenance responsibilities of this private feature belong to IL942. Stage 2 Study was carried out in 1991 and the study report concluded that the feature has adequate factors of safety and it is considered to be in good condition, no further action is recommended. The DH order (DH58/HK/96/C) is issued in 1996 by BD. The feature was strengthened by soil nails and up to current standard. BD has acknowledged on the completion of the remedial works in 1999.

**Feature No. 11SW-A/R842 (Partially within lot boundary)**

Feature No. 11SW-A/R842 is a retaining wall located at southwest of the site. The crest of the feature is bounded by remote area or abandoned facilities and the toe is bounded by lightly-used open area/facilities. The wall is 3m in height and 17m in length with face angle of about 90°. The maintenance responsibilities of this private feature belong to IL942 and NHX457. Stage 3 Study was carried out. The DH order (DH011/HK/91P) is issued in 1991 by BD and upgrading works was carried out for 11SW-A/R842 (sub-division 1) by LPM/EM.

**Feature No. 11SW-A/FR200 (Partially within lot boundary)**

Feature No. 11SW-A/FR200 is man-made slope that located at the west of the site. The crest of the feature is bounded by undeveloped green belt and the toe is bounded by road/footpath with low traffic density. The fill slope is 1m in height and 30m in length with slope gradient of about 20°. The surface of the slope is partially vegetated and chunam. It consists of 85mm diameter weepholes at 1m spacing. 20m of the wall is 3m in height and 30m of the wall is 1.5m in height. Its face angle is about 90°. The wall is made up of masonry with 70mm diameter of weepholes at 2m spacing. The maintenance responsibilities of this feature belong to LandsD and IL942.

### 2.3 Surrounding Buildings

As shown in **Figure 2**, the Site is mainly surrounded by the Robinson Road, and several existing residential buildings. The foundation record plans of those surrounding buildings are retrieved from the BD and are summarized as follows:-

Name of Building	Location	Type of Foundation	Approximate Founding Level
Panorama Gardens – No. 103 Robinson Road	Southeast of the site	Caisson Foundation	+70.0 mPD
Woodland Gardens – No. 107 Robinson Road	South of the site	Footing Foundation	+132.32 mPD

The foundation records for the abovementioned buildings are enclosed in **Appendix B**.

### 2.4 Surrounding Utilities

Based on the existing utilities record retrieved from utilities companies and relevant government departments, the following utilities are found in the vicinity of the site:-

- A 375mm dia stormwater drainage pipe run along Robinson Road
- A 150mm dia sewer pipe run along Robinson Road
- A 250mm dia and a 200mm dia freshwater main run along Robinson Road
- A 300mm dia and a 200mm dia saltwater main run along Robinson Road
- A Towngas pipeline run along Robinson Road

The correspondences with utilities company and utilities record plans are attached in **Appendix B1**.

### 3) **SITE GEOLOGY**

With reference to the 1:20,000 geological map published by the Geotechnical Control Office, Hong Kong Geological Survey Sheet 11, it is indicated that the area of site is underlain by Jurassic to Cretaceous medium grained GRANITE covered by Quaternary DEBRIS FLOW DEPOSITS. This is also confirmed by findings of the previous ground investigation results in the vicinity of the site. A part plan extracted from the 1:20,000 geological map is shown in **Figures 4a-4d**.

With reference to the GEO Technical Guidance Notes No. 50, the site is partially located at Zone II of Schedule Area No. 1, an extracted plan is attached below.



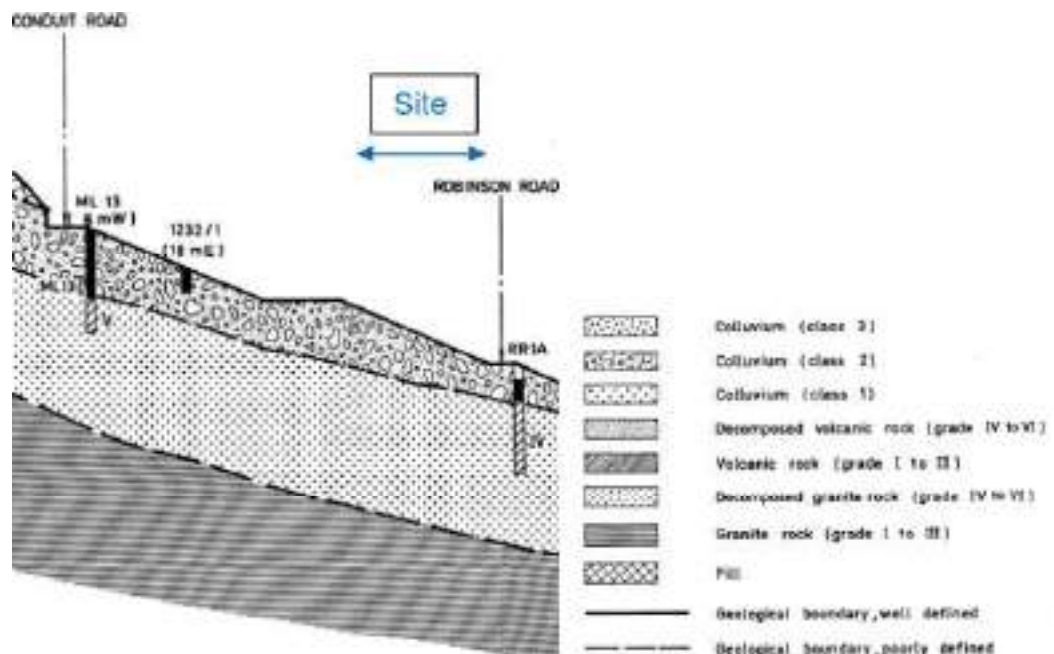
**Site Location Plan overlaid with Schedule Area No.1 Zoning Extent**

Under Zone II of Schedule Area No. 1, bulk excavation up to a maximum of 7.5m below the pre-development topography may be carried out where this improves the local slope stability.

With reference to the Mid-Level Study Drawing No. G14, G20 and G23, it is found that the surface of in-situ material lied within the site varies from +100mPD to +120 mPD, with a 5m to 10m thick of colluvium overlaying on it.



Part Plan Extract from Drawing No. G23 "Surface of in-situ Material"



Part Section Extract from Drawing No. G14 "Geological Section 36K"

### 3.1 Existing Site Investigation

Previous Ground investigation records at the nearby area are retrieved from the Geotechnical Information Unit of GEO and are summarized as follows-

GIU Report No.	Location	GI Contractor	Investigation Period	Site Investigation works
11368	SLOPES No.11SW-A/R384 & R385 AT 105A-B ROBINSON ROAD	Bachy Soletanche Group	1988	4 vertical boreholes 1 chunam strip 6 trial pit Groundwater monitoring
37767	105 ROBINSON ROAD	HK M.D. & E. LTD	1975	7 vertical boreholes

The previous GI records as shown in GIU report No. 11368 and 37767 were carried out at the location next to the Site, while the boreholes covered the platforms varying from +104.75mPD to +120.13mPD as well as the platforms of the Site. Those previous GI records are therefore considered appropriate for using to infer the geology and groundwater condition of the Site,

The previous GI records as shown in GIU report No. 11368 was carried out at the location of the Site. This previous GI records is therefore considered appropriate for using to infer the geology and groundwater condition of the Site.

The extract of ground investigation records retrieved from GIU and a summary of records are attached in **Appendix C**.

### 3.2 Site-specific Ground Investigation Works

Site specific Ground investigation work that attached in **Appendix C** was carried out by Inter Pacific Limited. In the period for Ground Investigation work from 4 May 2021 to 20 July 2021.

The GI included: -

- 17 nos. of vertical drillholes
- 6 nos. of horizontal/ inclined drillholes
- 4 nos. trial pits
- Groundwater monitoring; and
- Laboratory testing

The following sampling / tests / instrumentation was also carried out:

- Sampling in boreholes (small disturbed samples, SPT liner samples, mazier samples and rock samples of T2-101);
- Installation of 6 nos. of standpipes and 6 nos. of piezometers;
- In-situ testing (standard penetration tests);
- Laboratory testing

FGI	Ground Level	Thickness of Material (m)
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No.	(mPD)	Fill	Colluvium	CDG
DH1	119.89	2.00	14.00	54.60
DH2	120.00	5.00	15.00	51.35
DH3	120.09	7.80	14.30	48.70
DH4	120.04	8.90	10.60	47.85
DH5	120.02	4.00	22.00	39.63
DH6	120.16	0.50	17.20	47.93
DH7	120.22	2.00	9.00	52.50
DH8	120.16	7.00	6.60	48.47
DH9	120.12	2.00	8.00	47.08
DH10	120.07	9.50	-	44.34
DH11	120.14	4.00	8.60	47.98
DH12	120.14	2.00	6.00	53.42
DH13	120.13	2.00	1.40	57.80
DH14	120.17	2.00	3.10	66.25
DH15	120.12	2.00	4.00	48.50
DH16	120.06	3.00	12.00	53.52
DH17	120.01	2.00	13.50	51.60
Max.		9.50	22.00	66.25
Min.		0.50	1.40	39.63

### 3.3 Soil and Rock

In view of in close proximity of existing previous GI, it supposed that the inferred geological profile based on previous GI is consistence with the Site. The general description of each geological stratum based on previous GI record is outlined as below:

- Fill – with thickness varying between 1m and 2m. Brown speckled white, brown and yellowish brown silty fine to coarse SAND with gravels and cobbles.
- Colluvium – with thickness varying between 8m to 35.5m. Brown speckled white, grey mottled pinkish, brown and yellowish brown clayey silty fine to coarse SAND with grade III/IV gravels & cobble of tuff.
- Completely decomposed granite – pink, pinkish brown, mottled white & dark yellowish brown and speckled reddish brown and pink clayey silty fine to coarse SAND.

### 3.4 Geotechnical Parameters

Typical generalized soil parameters of Fill, Colluvium, and CDG are proposed for design based on the typical ranges of geotechnical parameters of Hong Kong soils as recommended in Geoguide 1 and the shear strength parameters discussed in Soil Properties Report of Mid-Levels Study. The soil parameters are summarized as follows:-

Soil Type	Adopted Soil Parameters for Design Purposes			
	Bulk	Effective	Effective	Stiffness (E)

	Density (kN/m <sup>3</sup> )	cohesion c' (kPa)	Friction Angle $\phi'$ (°)	(kPa)
Fill	19	0	35	12000
Colluvium (Above +120mPD Near Woodland Gradens)	19	5	33	12000 (linearly increase 1857kPa per m depth from +127mPD to +120mPD)
Colluvium (Below +120mPD)	19	5	33	11000 (linearly increase 1227kPa per m depth from +112mPD)
Completely Decomposed Granite (CDG)	19	5	36	37500 (linearly increase 4350kPa per m depth from +95mPD)

### 3.5 Groundwater

Groundwater measurement is carried by Bachy Soletanche Group for the site in 1988. The monitoring records are extracted from the GIU report and are summarized in the following table:

GIU Report No.	Borehole Mark	Ground Level (mPD)	Measured Highest Groundwater Level	
			Depth (m)	Level (mPD)
11368	RH-3	+106.36	15.32	+91.04
	RH-4	+120.13	19.75	+100.38
	RH-5	+114.96	20.20	+94.76
	RH-6	+116.49	21.97	+94.52

The groundwater monitoring records extracted from GIU report No. 11368 is attached in **Appendix E**.

Groundwater measurement is carried by Inter Pacific Limited. for the site in 2021. The monitoring records are extracted from the GIU report and are summarized in the following table:

Borehole Mark	Ground Level (mPD)	Measured Highest Groundwater Level				Measured Lowest Groundwater Level			
		Standpipe		Piezometer		Standpipe		Piezometer	
		Depth (m)	Level (mPD)	Depth (m)	Level (mPD)	Depth (m)	Level (mPD)	Depth (m)	Level (mPD)
DH1	+119.89	11.46	+108.43	22.65	+97.24	13.08	+106.81	22.67	+97.22
DH3	+120.09	8.57	+111.52	21.36	+98.73	11.27	+108.82	26.57	+93.52
DH8	+120.16	14.13	+106.03	22.30	+97.86	14.95	+105.21	22.60	+97.56
DH10	+120.07	25.20	+94.87	26.40	+93.67	26.45	+93.62	28.27	+91.8
DH11	+120.14	12.58	+107.56	15.82	+104.32	12.75	+107.39	15.94	+104.2

DH14	+120.17	14.89	+105.28	25.22	+94.95	17.86	+102.31	25.44	+94.73
Measured highest GEL		8.57	+111.52	15.82	+104.32	-	-	-	-
Measured lowest GEL		-	-	-	-	26.45	+93.62	28.27	+91.8

The groundwater monitoring records extracted from GIU report No. 11368 is attached in **Appendix D**.

Based on the above existing groundwater monitoring record, it noted that the measured highest groundwater level in the vicinity of the Site is found to be well below the existing ground level.

Refer to the previous GI record, the ground water monitoring works conducted on January 1988 to March 1988, June 1991 to July 1991, August 2017 to September 2017 and July 2021 to August 2021.

Refer to the GI record for DH1, DH3, DH8, DH10, DH11 & DH14, heavy rainfall occurred on 19/07/2021, amber rainstorm signal with rainfall intensity 117.20mm. The measured groundwater level rised about 2m in average. The highest measured water level of each piezometer in wet season are selected to plot the water contour line.

#### **3.5.1 Seasonal Rise of Water Table**

For seasonal rise of water table, since the water contour is plotted from highest measured water level at wet season, seasonal rise for water table is considered in the water contour map, no additional seasonal rise is added to the design ground water level.

#### **3.5.2 Storm Water Rise of Water Table**

For storm water rise, although plotted water contour had covered measured ground water level during amber rainstorm signal on 2021, additional 1m storm water rise is considered for heavy rainfall for design purpose.

#### **3.5.3 Perched Water Rise of Water Table**

For perched water rise, perched water rise only occurred at colluvium zone. Refer to the GI record and measured ground water record, the measured ground water level lies at colluvium zone. Hence, perched water rise has covered at the measured ground water record. No additional perched water rise is added to the design ground water level.

#### **3.5.4 Water Rise of Water Table due to Damming Effect (Site Formation)**

Damming effect due to pipe pile and soldier pile is considered in this design (site formation work). Refer to **Appendix F**, the rise of ground water level is 0.13 m.

#### **3.5.5 Water Rise of Water Table due to Damming Effect (Foundation)**

For damming effect due to foundation works, 2m centre to centre pile spacing covering a 32.5m influence zone is adopted for the calculation, the water

damming due to foundation is 1.5m which is the same of the foundation submssion. The calculation is attached in Appendix F

Therefore, addition groundwater table for 1m storm rise and 1.7 m for damming effect above the plotted water contour shall be considered in the site formation works. However, the additional groundwater level to the highest water contour at upslope, i.e. +111.5 mPD + 2.7 = **114.2 mPD**, is still lower the 1/3 x retaining height. The adopted design ground water level is summarized as follow:-

Design Checking	Adopted Design Groundwater Level
Regional Stability	Highest measured groundwater level +2.7m
Access the Effect due to Excavation	Highest measured groundwater level +2.7m
Local Stability Checking (Pipe pile/ Soldier Pile)	1/3 x retaining height
Structural Checking	1/3 x retaining height

#### 4) **PROPOSED DEVELOPMENT**

The proposed development is described in the Building Plans submitted by the Architect (A copy of the General Building Plans are enclosed in **Appendix F**).

The proposed development comprises the construction of one 28-p residential towers. It is proposed to rest on the existing platform. A vehicular access connecting between the development and Robinson Road is located at the west of the site.

The construction work involves demolition of the existing building within the Site, construction of foundation and pile cap, excavation and lateral support works and superstructure construction. To suit the proposed development, Feature Nos. 11SW-A/FR200(2), 11SW-A/R842(1), 11SW-C/R60, 11SW-A/R382, 11SW-A/CR386(1) would be removed, other existing features would be remained. Precautionary measures will be proposed if required.

#### 5) **GEOTECHNICAL CONSIDERATIONS**

The following section gives an assessment on the geotechnical aspects of the proposed redevelopment:-

## **5.1 Demolition**

The existing building structure forms an intricate frame with retaining walls that retain up to about 10m of level difference between the interior of the site and Robinson Road. The building to be demolished consists of 3 nos of 10-storey high building at No 105 Robinson Road, Mid- Levels West (Lot NO. I.L 942 Block A-B, Block C-D and Block E-F.) The building demolition plan was approved by BD on 4 May 2021.

## **5.2 Proposed Foundation**

The proposed development comprises the construction of one 28-storey residential towers. In order to resist the loading from the building, it is proposed to transfer the loading to the deeper sound rock strata using pile foundation.

### *Bored Pile foundation / Socketed H-pile foundation*

In view of the large loading of the multi-storey residential towers, it is proposed to transfer the loading to the deeper soil strata. As such, bored piles or pre-bored H-piles socketed into bedrock are also considered to be feasible for supporting the proposed residential tower and local podium structure respectively. The bottom level of proposed pile caps will be above the TBEL. All bored piles/socketed pre-bored H-piles would be embedded into the Grade III or better rock with total core recovery greater than 85%. In accordance with the Code of Practice for Foundations (BD, 2004), the allowable vertical bearing capacity and bond friction of the founding rock and socket rock are taken as below:

Category of rock	Description of Rock	Presumed Allowable Bearing Pressure (kPa)		Presumed Allowable Bond Friction between Rock and Concrete (kPa)			
		w/o wind	with wind	Under compression and transient tension		Under permanent tension	
				w/o wind	with wind	w/o wind	with wind
1(b)	Fresh to slightly decomposed strong rock of material weathering grade II or better, with a total core recovery of more than 95% of the grade and minimum uniaxial compressive strength of rock material (UCS) not less than 50MPa (equivalent point load index strength $PLI_{50}$ not less than 2MPa)	7500	9375	700	875	350	437.5
1(c)	Slightly to moderately decomposed moderately strong rock of material weathering grade III or better, with a total core recovery of more than 85% of the grade and minimum uniaxial compressive strength of rock material (UCS) not less than 25MPa (equivalent point load index strength $PLI_{50}$ not less than 1MPa)	5000	6250	700	875	350	437.5

The effect of the proposed foundation on adjacent buildings, structures and features shall be investigated during detailed design stage. In order to prevent the transmission of lateral loads onto the adjacent slopes/retaining walls from proposed pile foundation, pile caps and basement walls, mitigation measures such as pile sleeving and installation of joint fillers will be adopted, if necessary.

### 5.3.1 Excavation and Lateral Support

In view of the final excavation levels for construction of pile cap & basement structure, the maximum excavation involved is about 13m, pile walls would be adopted to retain the level difference. Where underground obstruction is encountered, preboring technique by ring bit method will be adopted as necessary. In addition, open cut excavation would also be carried out.

In the design of ELS works, surcharge from the existing adjoining buildings and traffic load would be taken into account. ELS design shall be in accordance with GCO Publication No. 1/90.

The ELS works should be designed in a manner that the effect of the proposed works should be minimal and does not cause adverse effects on adjacent grounds, features and structures. The ground movement due to the deflection of the pile wall should be determined. The differential settlements of adjoining structures and surrounding utilities caused by the proposed ELS works should also be considered in detailed design.

In addition, the anticipated excavation for the pile cap construction is limited to a maximum of about 13m. Therefore, bulk excavation works will not be extensive. Based on the Tentative Bulk Excavation Limits (TBEL) as shown in **Figure 5**, it is anticipated that no excavation for the construction of pile cap or other structural elements will be carried out below the TBEL.

After issuance of Determined Bulk Excavation Limit (DBEL) for the site, the excavation and lateral support works shall be reviewed based on the DBEL to ensure that no excavation is proposed to be below DBEL.

Schematic sections showing the excavation and lateral support works are given in **Appendix H**. The level difference will be retained by cantilever pile wall or by pile wall with shoring system. The alternative schematic layout plan for pile wall with system are also shown in **Appendix H**.

### 5.3.2 Site Formation Work

For the proposed development works, some registered features would be removed or modified to facilitate the building and site formation works. To cater for the level difference between the existing slope profile and the final formation levels, a portion of the pile wall installed for ELS will also act as permanent retaining wall. The stability of the registered feature and effect from the proposed work will be assessed in the detailed design stage.

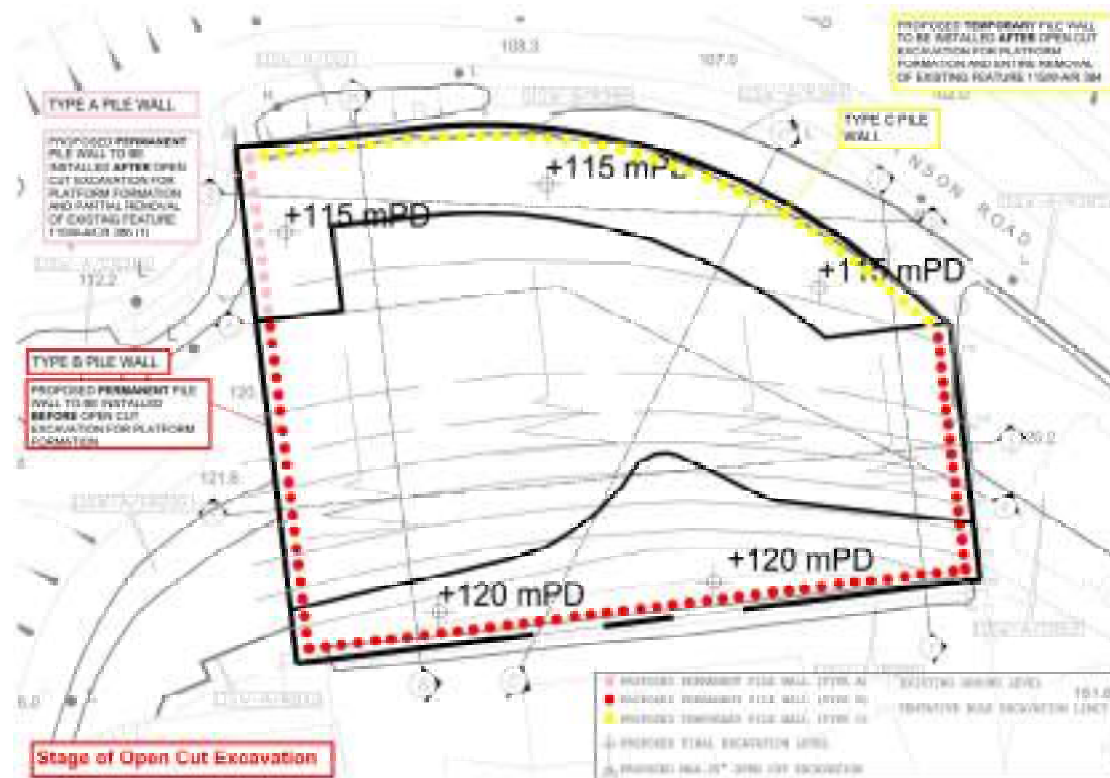
A schematic plan showing proposed permanent wall is given in **Figure 8**.

## 5.4 Master Construction Sequence

The proposed master construction sequence is summarized as follows:-

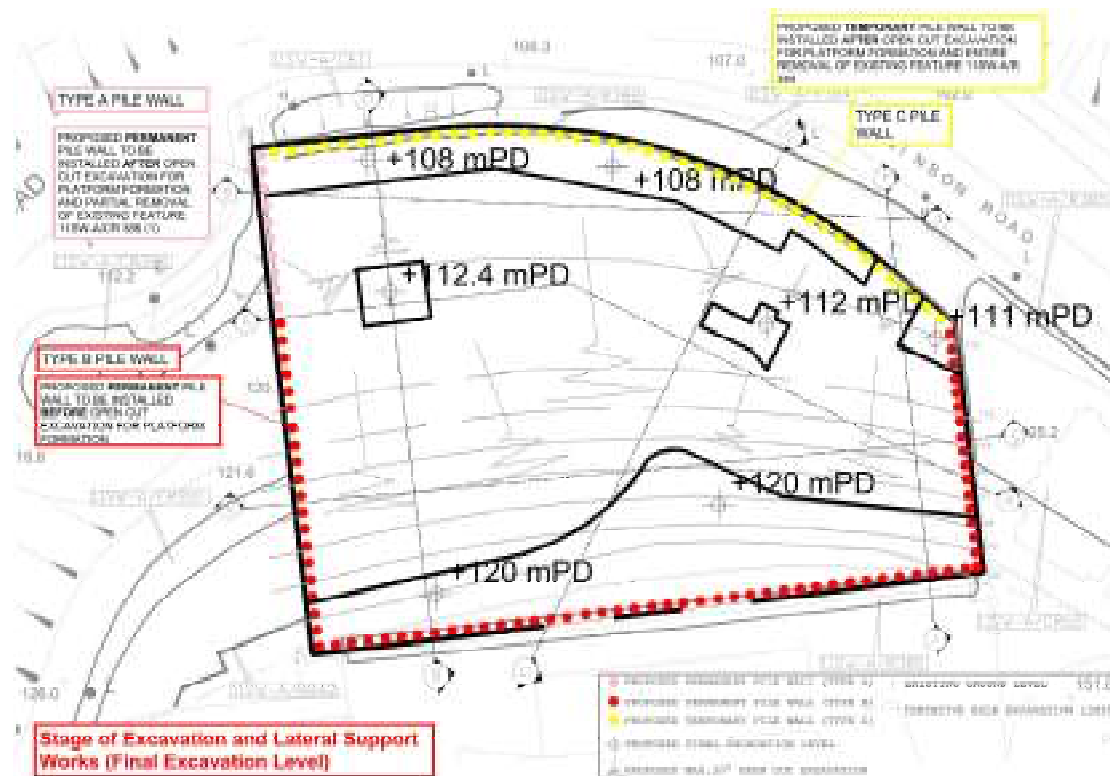
1. Install proposed permanent pile wall (Type B)
2. Carry out open-cut excavation for formation of platform
3. Entirely remove registered feature 11SW-A/R 382, 11SW-A/ CR 386(1).and 11SW-A/CR 60
4. Carry out foundation work
5. Install proposed permanent pile wall (Type A) and temporary pile wall (Type C)
6. Remove registered features 11SW-A/R 842(1) and 11SW-A/FR 200(2).
7. Carry out bulk excavation to proposed final excavation level
8. Construct proposed pile cap, basement structure and superstructure.

\*Item 3 and Item 4 could be carried out independently or concurrently.



### Pile Wall Layout Plan for ELS and Site Formation Works (Open Cut Excavation)





Pile Wall Layout Plan for ELS and Site Formation Works (Final Excavation)

## 5.5 Regional Stability

The removal of existing buildings and soil during demolition and excavation stage will reduce the toe weight, and hence the regional stability of the concerned area would be affected. In this regard, the effect on regional stability due to the proposed construction works in the Site will be analysed based on all available information in detailed design stage and the proposed works shall be designed in a manner that the effect on regional stability shall be minimized. A preliminary regional stability analysis enclosed in Appendix I.

## 5.6 Existing Feature

As discussed in the previous section, 10 numbers of register features are located within, partially within or outside the Site. For those portions of features located within the Site, the features would be removed to suit the proposed development.

### Feature No. 11SW-A/CR386 (Partially within lot boundary)

This feature is a concrete retaining wall which located at the east of the Site facing the Robinson Road. Stage 2 Study was carried out in 1991, the study report concluded that the feature is up to standard. The portion of features (sub-division 1) within the Site would be entirely removed to suit the proposed development. For the portion of feature outside the Site (sub-division 2), the stability of the modified feature would be checked in complying with the current standard or guidance in detailed design stage. The effect on the feature due to proposed temporary and permanent works would be assessed in detailed design stage. Location of proposed pile wall would be further studied in detailed design stage in order to avoid collision between existing

soil nails of the feature and proposed pile wall. Precautionary measures will be proposed if required.

**Feature No. 11SW-A/C61 (Outside lot boundary)**

This feature is a man-made slope that located at the north of the site. Stage 3 Study was carried out in 1989, upgrading works were carried out by LPM/EM and the feature is up to standard. The feature will be retained by temporary pile wall and basement wall during construction stage and permanent stage respectively. In order to prevent the transmission of lateral loads onto the adjacent slopes/retaining walls from proposed pile foundation pile caps and basement walls, mitigation measures such as pile sleeving and installation of joint fillers will be adopted, if necessary. The stability of the modified feature would be checked in complying with the current standard or guidance in detailed design stage to ensure that both proposed temporary and permanent works will not result in adverse effect to the feature. Precautionary measures will be proposed if required.

To minimize the effect to the feature due to proposed pile installation for ELS work, precautionary measures such as limiting the number of operating piling rig and limiting compressed air pressure during pre-boring operation would be considered in detailed design stage. Concentric drilling system would also be adopted for the piling operation to minimize the risk of overbreaking.

**Feature No. 11SW-A/R382 (Within lot boundary)**

This feature is a retaining wall that located at the north of the site. Two Stage 2 Study was carried out in 1994 and 2010 respectively, the study report concluded that the DH Order shall be served to the owners. The DH order (DH0051/HK/15/C) is issued in 2015 by the Buildings Department (BD). As of today, the DH order of the feature is not discharged. It would be entirely removed to suit the proposed development. As the final formation level would be lower than the ground level outside site boundary, the level difference would be first retained by temporary pile wall and subsequently retained by permanent basement wall.

**Feature No. 11SW-A/R384 (Outside lot boundary)**

This feature is a retaining wall located at the north of the site. Stage 2 Study was carried out in 1989 and the feature is upgraded by LPM/EM. The stability of the feature would be checked in complying with the current standard or guidance in detailed design stage in order to ensure that both proposed temporary and permanent works will not result in adverse effect to the feature. Location of proposed pile wall would be further studied in detailed design stage in order to avoid collision between existing soil nails of the feature and proposed pile wall. Precautionary measures will be proposed if required.

In order to prevent the transmission of lateral loads onto the adjacent slopes/retaining walls from proposed pile foundation, pile caps and basement walls, mitigation measures such as pile sleeving and installation of joint fillers will be adopted, if necessary.

To minimize the effect to the feature due to proposed pile installation for ELS work, precautionary measures such as limiting the number of operating piling rig and limiting compressed air pressure during pre-boring operation would be considered in detailed design stage. Concentric drilling system would also be adopted for the piling operation to minimize the risk of overbreaking.

**Feature No. 11SW-A/R385 (Outside lot boundary)**

This feature is a retaining wall located at the east of the site. Stage 2 Study was carried out in 1989 and the feature is upgraded by LPM/EM. The stability of the modified feature would be checked in complying with the current standard or guidance in detailed design stage in order to ensure that both proposed temporary and permanent works will not result in adverse effect to the feature. Precautionary measures will be proposed if required.

**Feature No. 11SW-A/CR62 (Outside lot boundary)**

This feature is man-made slope that located at the east of the site. Stage 2 Study was carried out and finalized in 2013 and a type 3 advisory letter was issued to the owners in 2013 with respect to Sub-division No.1 of the feature. The stability of the modified feature would be checked in complying with the current standard or guidance in detailed design stage in order to ensure that both proposed temporary and permanent works will not result in adverse effect to the feature. Precautionary measures will be proposed if required.

**Feature No. 11SW-A/R380 (Partially within lot boundary)**

This feature is a retaining wall located at the south of the site. Stage 2 Study was carried out in 1991 and an advisory letter was issued to the owners in 1991. The DH order (DH58/HK/96/C) is issued in 1996 by BD and BD has acknowledged on the completion of the remedial works in 2001. The feature is up to standard to current standard. Permanent pile wall will be proposed in front of the feature to retain the level difference between the final formation level inside and outside the site boundary stabilizing the feature and ensuring the feature have no adverse effect to the Site. The stability of the modified feature would be checked in complying with the current standard or guidance in detailed design stage in order to ensure that both proposed temporary and permanent works will not result in adverse effect to the feature. Location of proposed pile wall would be further studied in detailed design stage in order to avoid collision between existing soil nails of the feature and proposed pile wall. Precautionary measures will be proposed if required.

**Feature No. 11SW-A/CR60 (Within lot boundary)**

This feature is man-made slope that located along southern site boundary. Stage 2 Study was carried out in 1991 and the study report concluded that the feature has adequate factors of safety and it is considered to be in good condition, no further action is recommended. The DH order (DH58/HK/96/C) is issued in 1996 by BD. It would be entirely removed to suit the proposed development.

**Feature No. 11SW-A/R842 (Partially within lot boundary)**

This feature is a retaining wall located at southwest of the site. Stage 3 Study was carried out. The DH order (DH011/HK/91P) is issued in 1996 by BD and upgrading works was carried out by LPM/EM. The portion of features (sub-division 1) within the Site would be entirely removed to suit the proposed development. For the portion of feature outside the Site (sub-division 2), the stability of the modified feature would be checked in complying with the current standard or guidance in detailed design stage to ensure that both proposed temporary and permanent works will not result in adverse effect to the feature. Precautionary measures will be proposed if required.

Feature No. 11SW-A/FR200 (Partially within lot boundary)

This feature is man-made slope that located at the west of the site. The stability of the modified feature would be checked in complying with the current standard or guidance in detailed design stage. The portion of features (sub-division 2) within the Site would be entirely removed to suit the proposed development. For the portion of feature outside the Site, the stability of the modified feature would be checked in complying with the current standard or guidance in detailed design stage. Precautionary measures will be proposed if required.

## **5.7 Surrounding Building / Structure**

According to the foundation record plans retrieved from the BD, The nearby existing buildings, Panorama Gardens and Woodland Gardens in the vicinity of the Site are supported by caisson pile and footing foundation respectively.

For Panorama Gardens, as the founding level of existing caisson pile foundation is approximately +70 mPD which is significantly below the proposed lowest final excavation level of +108.0 mPD. The effect on the building due to proposed works is considered to be minimal.

For Woodland Gardens, the founding level of existing footing is approximately +132.32 mPD which is higher than the proposed final excavation level. Therefore, additional loading from the existing footings to the Site will be considered in detailed design stage. The effect on Woodland Gardens due to proposed temporary and permanent construction works would also be assessed in detailed design stage to ensure the effect on the building is tolerable.

Furthermore, monitoring measures will also be proposed to be installed on the buildings to safeguard their stability.

## **5.8 Effect on Groundwater Table**

The groundwater level at the site is relatively well below the existing ground level. As the proposed final excavation level is above the groundwater level, dewatering work will not be required for ELS works. Hence the proposed excavation works and foundation works are considered to have insignificant effects on the groundwater table.

If groundwater table is observed close to the design groundwater table during the course of construction period, design review on the respective affected existing retaining wall shall be carried out to review the validity of the design assumption, if found necessary, precautionary raking drain shall be installed to the affected proposed retaining wall to avoid building up high groundwater pressure behind the retaining wall.

## **5.9 Damming Effect of Groundwater Table**

The proposed pile foundations (bored pile / socketed H-Pile) and temporary pile wall for ELS work and permanent retaining wall for site formation work

will penetrate through the subsoil into the groundwater table. As such, they will reduce the effective area through which the groundwater flows, and the groundwater table may be dammed up as a result. Such damming effect should be studied carefully and taken into account during the detailed foundation and ELS design. The groundwater levels should be monitored throughout the construction period and reviewed in the Performance Review Report.

## **6) INTERPRETATION OF BULK EXCAVATION LIMIT**

As mentioned before in Section 2, the site partially is located in Zone II of Schedule Area No. 1, bulk excavation up to a maximum of 7.5m below the pre-development topography may be carried out where this improves the local slope stability.

The proposed development would be carried out with lowering the existing platform and subsequent removal of entire 11SW-A/R 382 at the crest of 11SW-A/R384, a local stability analysis is carried out and the result shows that the proposed development will further enhance the local stability of nearby. Result is attached in Appendix I.

It is proposed to interpret the bulk excavation limit in the following method:

### **To determine the Pre-development topography of the site**

Referring to Section 5.1.1 and 5.1.2 of TGN 50, and together with the proposed site specific GI, existing GI nearby and the interpreted geological sections from Mid-Level Study (as references), the pre-development topography of the site can be determined. The BEL can then determine up to 7.5m below the pre-development topography. Local slope stability of the development can be also improved after excavation for the proposed development.

Based on the aforementioned desk study, it is estimated that the bulk excavation limit would be in a similar order to the tentative bulk excavation limit. And it will be further reviewed once the site specific ground investigation is completed and the topography survey data as per the technical requirements given in Section 5.2 of TGN 50 was obtained.

### **By interpolating between DBEL from nearby developments**

Also, determined bulk excavation limit from nearby developments are also retrieved and we interpreted the site specific bulk limit by interpolation between the nearby developments. Excavation for the proposed development would not exceed the bulk excavation limit we interpreted.

Upon detail design stage with site specific GI data obtained and the site topographic survey data as per the technical requirements given in Section 5.2 of TGN 50 was obtained, the determined bulk excavation limit would be further reviewed.

## **7) MONITORING SCHEME**

A comprehensive monitoring programme shall be implemented on site in order to safeguard the adjacent utilities, structures and/or slopes & retaining walls. The locations and details of the monitoring works shall be addressed in the detailed design stage.

The initial readings of all the monitoring checkpoints and piezometers/standpipes shall be taken prior to the commencement of construction works on site and these devices shall be monitored regularly throughout the construction period.

In order to minimize the effects of the foundation works and excavation works on the adjacent ground, building structures and retaining walls, the following precautionary / monitoring works will be proposed in the detailed design:-

1. Prior to the commencement of foundation / excavation works, settlement, tilting and vibration checkpoints and piezometers / standpipes shall be installed at the adjacent ground, building structures and retaining walls in accordance with the monitoring plan;
2. The vibration, settlement and tilting on the adjacent ground, building structures and retaining wall and groundwater fluctuation shall be monitored throughout the construction period;
3. During the course of the works, the monitoring readings shall be reviewed by the TCP T5 under RGE's Stream at regular interval and the review result shall be included in the T5 supervision report;
4. If the ppv exceeds the limit, or undue movement and settlement, or undue groundwater fluctuation are found, all construction works shall be ceased immediately and the Engineer shall be informed. The construction works shall not be recommenced until remedial works are submitted to Building Authority and found satisfactory.

## **8) CONCLUSION**

This report has provided a review of how the geotechnical features in the vicinity, such as retaining walls and/or slopes shown on the plan may affect, or be affected by the proposed development and has discussed all the relevant issues regarding the geotechnical assessment of the proposed development.

This report has discussed all the relevant issues regarding the geotechnical assessment of the proposed residential development at No.105 Robinson Road, Mid-level west, Hong Kong I.L. 942.

The proposed final excavation profile will not exceed the Determined Bulk Excavation Limit of Schedule Area No.1, and all slopes and retaining walls affecting or being affected by the proposed works will be assessed, if necessary, upgrading works will be proposed in detailed design stage.

With reference to the preceding discussions, it is considered that the proposed development is **geotechnically feasible**.