

Agreement No. CE 46/2020 (CE)
Term Consultancy for Site Formation and
Infrastructure Works for Proposed Housing
Developments in Zone 1 (2021-2024)
- Feasibility Study
(Task Order 4 – Shap Pat Heung Road)

Final Preliminary Drainage Impact Assessment for
Shap Pat Heung Road (Rev.2)

(5210095-OR001-03)

March 2023

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1. Introduction

1.1 General

1.1.1 The Civil Engineering and Development Department (hereinafter called “CEDD”) of the Government of the Hong Kong Special Administrative Region appointed Atkins China Limited (hereinafter called “Atkins”), under Agreement No. CE 46/2020 (CE), to provide professional services in respect of the Term Consultancy for Site Formation and Infrastructure Works for Proposed Housing Developments in Zone 1 (2021 - 2024) - Feasibility Study (hereinafter called “the Assignment”).

1.1.2 Task Order 4 – Shap Pat Heung Road was issued to Atkins on 27th October 2021.

1.2 Background

1.2.1 The Government is committed to facilitating steady and continued land supply, not only for providing people with a place to live and work, but also for the developments of Hong Kong's commerce, industry, innovation and technology and various emerging sectors. In the short to medium term, the Government will continue to optimise the use of built-up land and its surrounding areas to meet the demand of the public for land for housing and other purposes.

1.2.2 The demarcation of Zone 1 includes Yuen Long district, Tuen Mun district, Tsuen Wan district and Kwai Tsing district, while the study area of Task Order 4 – Shap Pat Heung Road surrounded by nearby residential buildings, including Atrium House, LA Grove and Park Signature.

1.2.3 For the proposed housing site at Shap Pat Heung Road under Task Order 4, the site has been zoned as R(A) for high density housing development.

1.2.4 The engineering feasibility study is carried out to determine the scope of the infrastructure works and provide necessary engineering information to support the Section 16 Application for increasing the domestic plot ratio of the site at Shap Pat Heung Road near Lung Tin Tsuen, Yuen Long for the proposed public housing development.

1.3 Project Scope

1.3.1 Carry out necessary study(ies) and/or assessment(s) for the instructed Site under Task Order issued by the CEDD in order to ascertain the feasibility of the intensification of the Development(s) to a maximum domestic Plot Ratio of 6.5 and define the scope of the Project (Infrastructure) for the relevant parties to put forward the respective detailed designs.

1.3.2 This scope of study(ies) and technical assessment(s) of the instructed Site include, but not limited to, the following principal works elements:

- (a) Recommendation of optimum development schemes for the Development(s) and the required supporting facilities for the Development(s);

- (b) Slope cutting and earth filling works as well as geotechnical works/structures (including slope/retaining wall upgrading works if necessary);
- (c) Decontamination works, if any;
- (d) Transport infrastructure works (including new road connecting to the Site, diversion/ upgrading of existing roads, flyovers, traffic improvement works, PTL/public transport laybys, pedestrian footpath, cycle track, footbridges/ subways and any other pedestrian and transport facilities etc. if necessary);
- (e) Sewerage infrastructure works (including pumping station(s), treatment plants and reclaimed water (treated sewage effluent, grey water and harvested rainwater as applicable) treatment facilities if necessary);
- (f) Drainage infrastructure works and necessary diversion works;
- (g) Water supply infrastructure works and necessary diversion works;
- (h) Environmental mitigation measures for the Development(s); and
- (i) Other infrastructure works, such as utility works, electricity substation, etc., if any deemed to be necessary to support the Development(s).

1.4 Purpose of the Report

1.4.1 In accordance with Clause 6.6 of the Brief, the Preliminary Drainage Impact Assessment (hereinafter called “the Report”) shall be conducted to:

- a) Review the relevant drainage master plan and drainage works completed, and other completed, on-going or planned studies as appropriate and take note of the completed, on-going or any scheduled developments and improvement works in the vicinity of the Development(s);
- b) Prepare and submit the project profile for the preliminary DIA with details as outlined in Appendix A of ETWB TC(W) No. 2/2006;
- c) Agree with the DSD and the DR on the approach, assumptions, methodologies and hydraulic model for the preliminary DIA;
- d) Develop calibrated and verified GIS and InfoWorks models based on latest available information to assess, through the process of hydraulic analysis, the impact due to the Development(s) and the associated Infrastructure Works on the existing drainage system, particularly due to any discharge of stormwater to the existing drainage system;
- e) Recommend all necessary measures to mitigate adverse drainage impacts arising from the Development(s) and the associated Infrastructure Works as identified in the preliminary DIA;
- f) Formulate drainage proposals, including any drainage system to be provided with a green and eco-hydraulic approach for integration with the landscape design and/or revitalising the existing watercourse if feasible and

applicable, or otherwise necessary diversion, channelization, and decking over of existing streams and pipes, drainage reserves (i.e an extent of 3m on each side of the existing pipe measured from its outer edge), site for drainage pumping stations, and any necessary improvement or upgrading works to existing and planned drainage system arising from the Development(s);

- g) Develop the recommended drainage scheme adopting environmental-friendly design;
- h) Carry out schematic design of the proposed improvement schemes and measures on plans and sections in enough details to illustrate their feasibility with respect to the topography and surrounding developments/structures etc. and for proceeding with statutory procedures of Section 16 application;
- i) Prepare preliminary drainage layout plan to illustrate the hydraulic feasibility of the proposed connection points;
- j) Recommend measures necessary to prevent every anticipated and unacceptable drainage impacts arising during construction and operation of the infrastructures;
- k) Review whether any existing water courses within the Site would be maintained or diverted;
- l) Design the new drainage system that should be sustainable with blue-green concept and with a view to reducing the quantity as well as improving the quality of site runoff according to the SDM; and
- m) Consult and obtain an in-principle agreement from DSD on the maintenance requirements of the proposed drainage works.

1.5 Structure of the Report

1.5.1 After this Introduction, the Report is further divided into the following sections:

- Section 2 describes the development parameters;
- Section 3 describes the methodology and design criteria adopted for assessing the drainage impact;
- Section 4 discusses the existing drainage conditions and current flooding susceptibility of the study site;
- Section 5 describes the drainage catchment after the development and the proposed drainage connections;
- Section 6 assesses the likely impacts of the proposed development on the drainage conditions;
- Section 7 describes the temporary drainage during the construction; and
- Section 8 summarizes the assessment results.

1.6 Abbreviations

1.6.1 The following abbreviations are used in this Report:

CEDD	Civil Engineering and Development Department
CLP	China Light and Power Ltd
DEVB	Development Bureau
DGV	Dangerous Goods Vehicle
DIA	Drainage Impact Assessment
DPM	Deputy Project Manager
DSD	Drainage Services Department
E&M	Electrical and Mechanical
EDB	Education Bureau
EIA	Environmental Impact Assessment
EIAO	Environmental Impact Assessment Ordinance
EMSD	Electrical and Mechanical Services Department
EPD	Environmental Protection Department
ETWB	Environmental Transport and Works Bureau
FEHD	Food and Environmental Hygiene Department
FSD	Fire Services Department
GEO	Geotechnical Engineering Office
GI	Ground Investigation
HAD	Home Affairs Department
HD	Housing Department
HyD	Highways Department
LandsD	Lands Department
LCSD	Leisure and Cultural Services Department
LVIA	Landscape and Visual Impact Assessment
PER	Preliminary Environmental Review
PlanD	Planning Department
PTI	Public Transport Interchange
SDM	Stormwater Design Manual
SI	Site Investigation
SIA	Sewerage Impact Assessment
TD	Transport Department
TIA	Traffic Impact Assessment

UIA	Utilities Impact Assessment
WIA	Waterworks Impact Assessment
WSD	Water Supplies Department

2. Proposed Public Housing Development

2.1 Development Parameters

2.1.1 The development parameters of the proposed public housing site at Shap Pat Heung Road is given in **Table 2.1**:

Table 2.1 Development Parameters of Proposed Public Housing Site at Shap Pat Heung Road

Area of Proposed Housing Site	0.71ha approx.
Max. Domestic Plot Ratio	6.5
Total Nos. of Flats	910 nos.
Population	2,457 (Factor for 2028/2029 is 2.7P)
Intake Year	2028/2029
Proposed Welfare Facilities ⁽¹⁾⁽²⁾	Home Care Services (HCS) Residential Child Care Centre (RCCC)

Remark:

- (1) About 5% of domestic GFA had been set aside for the provision of social welfare facilities under the proposed housing development.
- (2) The final list of social welfare facilities shall be subject to confirmation by user departments at later stage.

3. Methodology and Design Criteria

3.1 Model Setting-up

3.1.3 Hydraulic model was developed by using InfoWorks ICM (Integrated Catchment Modeling) software (Version 10) to facilitate design and evaluate hydraulic performance of the proposed drainage works at Yuen long District under this assignment. With full integration of 1D and 2D hydrodynamic simulation techniques, InfoWorks ICM is an integrated modeling platform to incorporate both urban and rural river catchments, and to enables the hydraulics and hydrology of natural and manmade environments to be incorporated into a single model.

3.1.4 The hydraulic modelling was carried out in accordance with the standards set out in the DSD's Stormwater Drainage Manual (SDM) in terms of model set-up, design criteria, modelling assumptions and parameters, etc.

3.2 Hydrological Parameters

Runoff Coefficient

3.2.1 Fixed Percentage Runoff values, adopted for urban catchment, are conservatively estimated to be 1.0 for paved and 0.3 for unpaved areas.

- 3.2.2 Curve Number values, adopted for rural catchment, are adopted to follow **Table 3.1** below in accordance with the baseline model and the DMP Review. The lowest CN value has been preliminarily set to 65 according to established modelling experience in Hong Kong.

Table 3.1 Curve Number for Different Land Uses

Land Use	Curve Number
<i>Agriculture and Upland</i>	
Green belt	65*
Coastal protection area	65*
Country park	65*
Agriculture	65*
<i>Drainage</i>	
River Channel	100
<i>Highway, Road, and Rail</i>	
Major Road and Junction	100
<i>Urban</i>	
Commercial / Residential	85
Comprehensive Development Area	90
Residential	95
Government, Institution and Community	90
<i>Village</i>	
Village	90
<i>Storage and Industrial</i>	
Industrial	95
Open Space	90

3.3 Hydraulic Parameters

Roughness

- 3.3.1 For the hydraulic assessment of urban pipeline systems, the Colebrook-White equation is adopted in performing the hydraulic assessment. In general, uniform roughness value of $K_s=3\text{mm}$ is applied for pipes and culverts for conservative purpose.
- 3.3.2 For the hydraulic assessment of open channel, river and natural stream systems, the Manning's roughness coefficient n is applied in the hydraulic model. The Manning values, used in the Sobek models of the DMP study based on findings

of model calibration and verification, are adopted for this study and listed in **Table 3.2** below:

Table 3.2 Manning Roughness Coefficients Adopted for Different Landscaping Features

Channel Description	Manning's n
Wide channel subject to tidal inundation	0.02-0.03
Engineered channels with concrete lining	0.016-0.02
Engineered channels with concrete or masonry sides	0.02-0.025
Engineered channels with grasscrete lining (some vegetation)	0.025-0.035
Engineered channels with grasscrete lining (a lot of vegetation)	0.035-0.05
Natural channels	0.04- 0.05
Natural channels with a lot of vegetation	0.05-0.15

Siltation

- 3.3.3 The proposed drainage network has been assessed considering siltation as stated in Section 9.3 of SDM 2018. Siltation has been applied on drainage pipes and culverts. Impact of siltation is assumed included in the adopted roughness coefficient for open channel sections. According to SDM guidance, 10% siltation has been considered for drainages with less than 1 in 25 slope, 5% has been considered in the other cases.

Head Loss

- 3.3.4 Head losses are generally considered in line with the approaches defined in DSD-SDM and InfoWorks ICM Manual.
- 3.3.5 The 'Normal' head loss condition is applied with a default value of 1.0 for the head loss coefficient at the upstream and downstream ends of a conventional drain, e.g. pipe or box culvert.
- 3.3.6 Energy loss due to a change of flow cross section at the interfacing location between river reach and conduit is considered in a form of sudden contraction and subsequent enlargement of flow area and incorporated into the hydraulic model as "Fixed" head loss with coefficient configurations. The head loss coefficient $K = 0.5$ and $K = 1.0$ is applied for flow contraction and expansion respectively in the models.
- 3.3.7 Following the InfoWorks ICM Manual, head loss coefficients of the pipe drains due to flow bending are considered and presented in **Table 3.3** below.

Table 3.3 Head loss Coefficients for Bending

Bend (degree)	Head Loss Coefficient
30	3.3
60	6.0
90	6.6
>90	8.0

3.4 Design Criteria

Design Flood Protection Level

3.4.1 Stormwater Drainage Manual (fifth edition,2018) suggest protection standards as shown in **Table 3.4** below:

Table 3.4 Design Return Periods Based on Flood Levels adopted

Urban Drainage Trunk Systems	200-year ¹
Urban Drainage Branch Systems	50-year ¹
Main Rural Channel	50-year

Notes:

1. For definitions of Urban Drainage Branch and Urban Drainage Trunk Systems, refer to Section 6.6.2 of DSD-SDM (2018).

Design Storm Combination

3.4.2 The flood level return period combinations as recommended in the DSD-SDM (2018) Table 2.3 have been adopted in the hydraulic modelling analysis. The combinations of rainstorm and tide events used in the analysis are summarised in **Table 3.5** below.

Table 3.5 Design Combination of Rainstorm and Tide Events

Flood Level Return Period (Years)	Scenarios	Rainfall Return Period (Years)	Sea Level Return Period (Years)
200	Case A	200	10
	Case B	10	200
50	Case A	50	10
	Case B	10	50

Design Considerations Rainfall and Sea Level due to Climate Change

- 3.4.3 By taking account of the effect of climate change in the drainage design, the projection of rainfall increases percentage and sea level rise given in SDM (2018) Table 28 should be added to the respective design rainfall intensities / synthetic rainstorm profiles and design extreme sea levels. The climate change effects of mid-21st century and end-21st century have been assessed and are shown in **Table 3.6** below.

Table 3.6 Rainfall Increase and Sea Level Rise due to Climate Change

	Rainfall Increase	Sea Level Rise (m)
Mid 21 st Century (2041-2060)	10.4%	0.23
End 21 st Century (2081 – 2100)	13.8%	0.49

- 3.4.4 The climate change impacts are assessed in this DIA. Both rainfall intensity increase and sea level rise stated in SDM (2018) are used.

Design Rainstorm

- 3.4.5 Synthetic rain falls profiles have been adopted. The considered rain has a symmetrical distributed profile in accordance with SDM (2018). Rainfall parameters defined in SDM Table 3a have been adopted. For symmetrical rain fall profiles, rainfall duration has to be greater than the concentration time of the assessed catchment. A 4-hour rainfall has been considered. With a conservative approach, no areal reduction factor has been applied.

Design Tide

- 3.4.6 Being consistent with the DMP study, the design sea levels are the extreme sea levels at the Tsim Bei Tsui gauge, which is the nearest recorder site to Deep Bay.

Freeboard

- 3.4.7 In accordance with the SDM(2018), the minimum 300 mm freeboard should be provided to the pipeline system as a safety margin for the following considerations where applicable:
- to avoid surface flooding within the drainage catchment;
 - to ensure free surface flow if practicable; and
 - to take account of inaccuracies in flood level estimations.
- 3.4.8 A 200mm allowance is also considered adequate in the situations of super-elevations at bends and wave run-ups if both apply.

4. Existing Drainage Condition and Flooding Susceptibility

4.1 General

4.1.1 The proposed housing site is located at Shap Pat Heung Road, Yuen Long. The layout plan of the proposed housing site is shown in **Figure no. 5210095-ATK-GA-1001**.

4.2 Existing Drainage Catchment

4.2.1 The proposed housing site falls within the catchment boundary of Yuen Long Basin.

4.2.2 A large portion of the site is paved area and is being used as an open car park. Land use at the proposed development site is considered as “open space” in the baseline scenarios assessed in Drainage Master Plan (DMP).

4.2.3 Currently, runoff from the open car park located at the proposed housing site is discharged to the 525mm u-channel near the north side of boundary of the proposed housing site and it is conveyed to existing manhole SMH1047869 and SMH1047868 which are located at the Shap Pat Heung Road, via two 600mm diameter pipes respectively. In addition, the runoff from the access road to Park Signature is also discharged to this 525mm u-channel at the east end.

4.2.4 The existing topography of study area is +5.4mPD approximately, which is relatively lower than Shap Pat Heung Road and nearby developments which are at around +6.5mPD.

4.3 Existing Drainage Condition

4.3.1 Based on the drainage record plan, runoff at the location of the proposed housing site will be discharged to the drainage system at Sheung Pat Heung Road. The surface runoff is further conveyed via the twin 2500mm (Wide) x 1800mm (Height) box culvert at Yuen Long Tai Yuk Road to the Yuen Long Main Nullah. The existing drainage system is shown in **Figure no. 5210095-ATK-DIA-1001**.

4.4 Flood Susceptibility

4.4.1 The drainage network at Shap Pat Heung Road performs within the freeboard requirements for a 50-year storm event including mid-21st or end-21st Century Climate Change allowance.

4.4.2 Localized flooding occurs at the location of the proposed housing site due to the relatively low-lying nature under baseline condition with a 1-in-50-year return period as demonstrated in Figure 1.

5. Drainage Condition After Development

5.1 Drainage Catchment after Development

5.1.1 The proposed housing site at Shap Pat Heung Road will occupy the area of existing open space car park, with the area of 0.71ha approximately. The catchment plans before and after the development are shown in **Figures 5210095-ATK-DIA-1011** and **1031** respectively.

5.1.2 Based on the latest topographic level, the ground level for the catchment YL_1543.2 in the hydraulic model has been updated to +7.0mPD to match with the as-built topographic level of Park Signature and nearby developments. Surface runoff from such catchment shall directly be discharged to the channel near Lam Hi Road, south side of Park Signature, which has reduced surface runoff discharging to the storm drain along Shap Pat Heung Road.

5.2 Proposed Drainage for the Development

5.2.1 The Existing 525mm u-channel which is located at the north side of the proposed housing site is proposed to be demolished to cater the housing development. 2 nos. of terminal manholes (STMH1 and STMH2) with 6.5mPD cover level are proposed for the housing development.

5.2.2 Two terminal manholes STMH1 and STMH2 are proposed to convey surface runoff collected from the proposed housing development to the trunk drain at Shap Pat Heung Road.

5.2.3 The existing catchpit SCH1028421 and 600mm diameter pipe connecting the catchpit and manhole SMH 1047869 shall be abandoned.

5.2.4 The proposed terminal manhole STMH1 shall connect the existing manhole SMH1047869 by a new 600mm dia. storm drain.

5.2.5 Existing catchpit SCH1026461 will be demolished. Proposed terminal manhole STMH2 will be located at the existing location of catchpit SCH1026461 and connect to the existing 600mm diameter pipe.

5.2.6 Surface runoff directed to the trunk drain at Shap Pat Heung road shall be further conveyed towards the box culvert at the junction of Shap Pat Heung Road and Yuen Long Tai Yuk Road and finally discharged to the Yuen Long Main Nullah.

5.2.7 The proposed drainage network is shown in **Figure 5210095-ATK-DIA-1021**.

6. Drainage Impact Assessment and Mitigation Measures

6.1 Impact Assessment

- 6.1.1 Proposed drainage works comply with the stated freeboard requirements.
- 6.1.2 Drainage network at the upstream and downstream of the proposed development is unchanged. No adverse impact has been identified.
- 6.1.3 Only minor change in the paved/unpaved ratio at the location of the proposed housing site (i.e. the unpaved area at the north side of the site is assumed to be paved after development) from around 90% to 100% assumed in the model. Thus, there is only minimal impact on existing drainage network at downstream.
- 6.1.4 A minimum +6.5mPD platform is recommended to be adopted for the housing development. It helps to minimise surface runoff from flowing into the site from nearby high land.
- 6.1.5 There is no flooding with flood depth larger than 0.1m within the housing development area under the 1-in-50 years return period. Flood extent map after the proposed development is presented under **Appendix A1**.
- 6.1.6 Critical nodes of the drainage networks including existing box culvert have been checked with no adverse impacts identified. Summary of node from SMH1045840 to SGJ1028420 is demonstrated under **Appendix A2**.

6.2 Options for Further Mitigation

- 6.2.1 To enhance site drainage performance, runoff can be reduced from the proposed housing site with consideration of blue-green infrastructure subject to site situation and detailed design.
- 6.2.2 Blue-green infrastructure considers a series of solutions which limit flow downstream by impounding and dispersing water locally. These solutions can be applied within the development site to reduce peak runoff without constraining land use.
- 6.2.3 For example, runoff can be stored within the site in geocellular units underneath pedestrian walkways or the re-provided playground. Another storage solution can be a lowered square, or sport facility, that stores water only during intense storm events (so while it is not in use) and releasing the volume at a given flow rate, thus reducing peak flow. Both these storages can be built within the development site, adjusting already proposed facilities and infrastructures without conflicting with their main stakeholder or proposed land use.
- 6.2.4 In a similar way, water dispersion infrastructure such as soakaways, swales and infiltration trenches reduce both peak runoff flow as well as runoff volume. These elements have been preliminary not considered but, in detail design stage, may further limit flow to the drainage network and reduce storage required volume.

The feasibility of those structures is related to site permeability and water table level.

6.3 Flooding Situation upon Completion of the Project

- 6.3.1 No flooding has been identified within the proposed site for the design return period.
- 6.3.2 No significant flood risk modification has been identified at the adjacent areas due to the proposed housing site.

7. Temporary Site Drainage, Monitoring and Audit

7.1 Temporary Site Drainage

7.1.1 To provide sufficient drainage capacity, without over-sizing the temporary drainage, the temporary drainage shall be designed in accordance with DSD PN No.1/2017 Design Rainfall Depth and Profile for Temporary Works within the Dry Season.

7.1.2 The runoff coefficient of the construction site will be approximately the same as the planned condition. Improvement / upgrading works should be conducted in advance of the change in site conditions to avoid adverse hydraulic impact to the drainage system during construction.

7.2 Site Monitoring and Audit

7.2.1 The purpose of site monitoring and auditing is to monitor the performance of the drainage system to ensure that the drainage system will not be affected or blocked by the construction activities.

7.2.2 During construction stage, Temporary Drainage Management Plan (TDMP) should be submitted by the Contractor for DSD's comments before carrying out any diversion and upgrading works. Sufficient information to clearly show the nature of works proposed shall be described in TDMP. TDMP shall also explain how the drainage works will be implemented with works programme, and assess the impact on the drainage system with proposed mitigation measures. Monitoring and mitigation procedures with contingency plans shall be provided.

7.2.3 Appropriate mitigation measures shall be proposed to ensure that the proposed works will not cause any unacceptable increase in the risk of flooding throughout the construction period, and fulfil all relevant requirements of DSD. The provision of site drainage should be adequate during construction. Any temporary dewatering required for underground works will be pumped to a suitable storm drain. During wet weather, ponding of water in localized low spots within works sites may develop in respect of temporary works and temporary storage. This will need to be collected by the temporary site drains and gravity discharge / pumped to the nearest storm drain or culvert. This flow discharge is required to be desilted and closely monitored for the compliance with the EPD statutory requirements.

7.2.4 Prior to the onset of wet season and upon announcement of rainstorm warnings by Hong Kong Observatory, the Contractor will carry out drainage inspection to ensure free flow passage of the drainage system. Cleansing works will be carried out before and after each heavy rainstorm. Routine inspection to the drainage system should be carried out by the Contractor during construction and the frequency of inspection should be agreed by the Engineer or DSD when necessary.

7.2.5 Surface run-off from the construction site should be directed into the existing public storm water drainage system via adequately designed sand / silt removal facilities such as sand traps, silt traps and sediment basins. Channels, earth

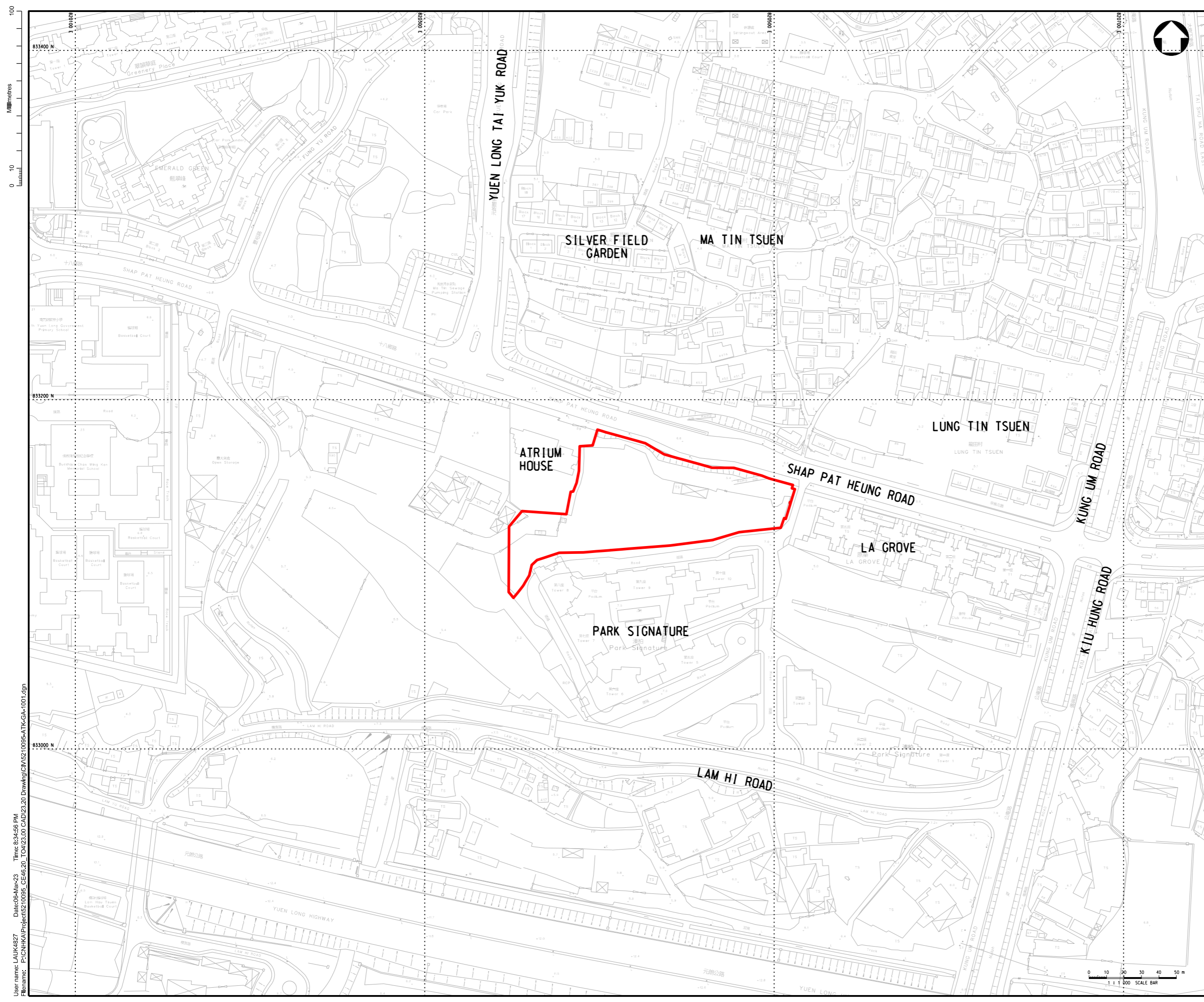
bunds or sand bag barriers will be provided on site to properly direct storm water to such silt removal facilities.

- 7.2.6 Silt removal facilities, channels and manholes should be maintained, and the deposited silt and grit will be removed regularly, and particularly after each rainstorm, to ensure that these facilities are functioning properly at all times.
- 7.2.7 During excavation in the wet season, temporarily exposed soil surfaces should be covered wherever practicable and temporary access roads should be protected by crushed stone or gravel as excavation proceeds. Intercepting channels will be provided, for example along the crest / edge of the excavation, to prevent storm runoff from washing across exposed soil surfaces. Arrangements will be in place to ensure that adequate surface protection measures can be satisfactorily carried out well before the arrival of a rainstorm; and
- 7.2.8 Earthworks final surfaces will be well compacted, and the subsequent permanent work or surface protection will be carried out as soon as practical after the final surface are formed to prevent erosion caused by rainstorms. Appropriate intercepting channels will be provided, where necessary. Rainwater pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities.

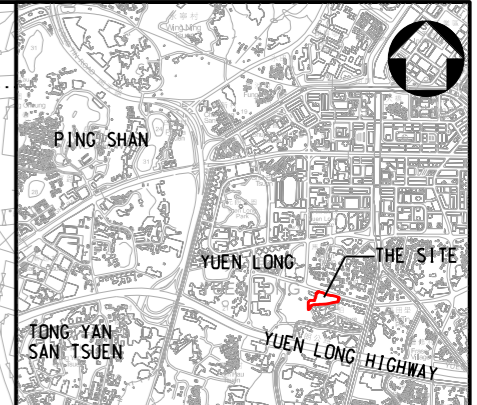
8. Conclusion and Recommendations

- 8.1.1 An integrated hydrological and 1D/2D hydraulic model was developed in InfoWorks ICM to conduct the drainage impact assessment for the proposed housing development.
- 8.1.1 This DIA has assessed the potential drainage impacts arising from the proposed Development under this Development by adopting the design criteria and parameter provided in SDM (2018).
- 8.1.2 There is a minor change in the paved/unpaved ratio in the site. Thus, the existing pipeline system at the downstream of the connection point shall bear a minimal drainage impact.
- 8.1.3 The downstream existing pipeline system from SMH1047868 to SGJ1028420 and the box culvert have sufficient capacity to convey the surface runoff from the Site after the development and the existing catchments.
- 8.1.4 Proposed drainage works comply with stated freeboard requirements.
- 8.1.5 With the provision of the proposed drainage works, this hydraulic assessment indicates that the Development would not induce adverse drainage impact to that catchment.
- 8.1.6 It is concluded that there is no adverse drainage impact due to the proposed housing development and hence no mitigation measures or upgrading works would be necessary.

Figures



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KEY PLAN
N.T.S.

LEGEND:
 PROPOSED HOUSING DEVELOPMENT BOUNDARY
 (SUBJECT TO DETAILED SURVEY AND DESIGN)

Rev.	Date	Description	By	Crkd	App'd	Suitability
A	NOV 2021	FIRST ISSUED	WL	KL	DL	
Drawing Status: FEASIBILITY STUDY						



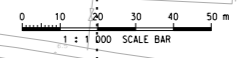
Client
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 Civil Engineering and Development Department
 土木工程處
 房屋工程3部
 Civil Engineering Office
 Housing Projects 3 Division

Project Title
 AGREEMENT NO. 46/2020 (CE)
 TERM CONSULTANCY FOR SITE FORMATION
 AND INFRASTRUCTURE WORKS FOR
 PROPOSED HOUSING DEVELOPMENT IN
 ZONE 1 (2021-2024) - FEASIBILITY STUDY
 (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

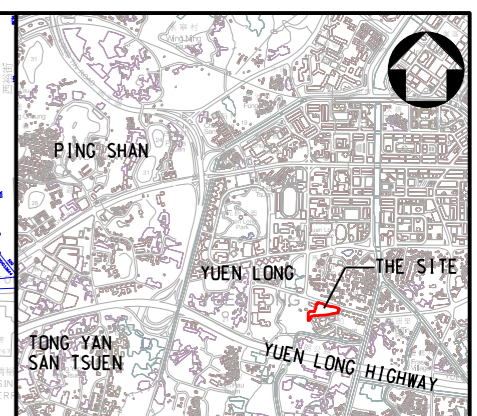
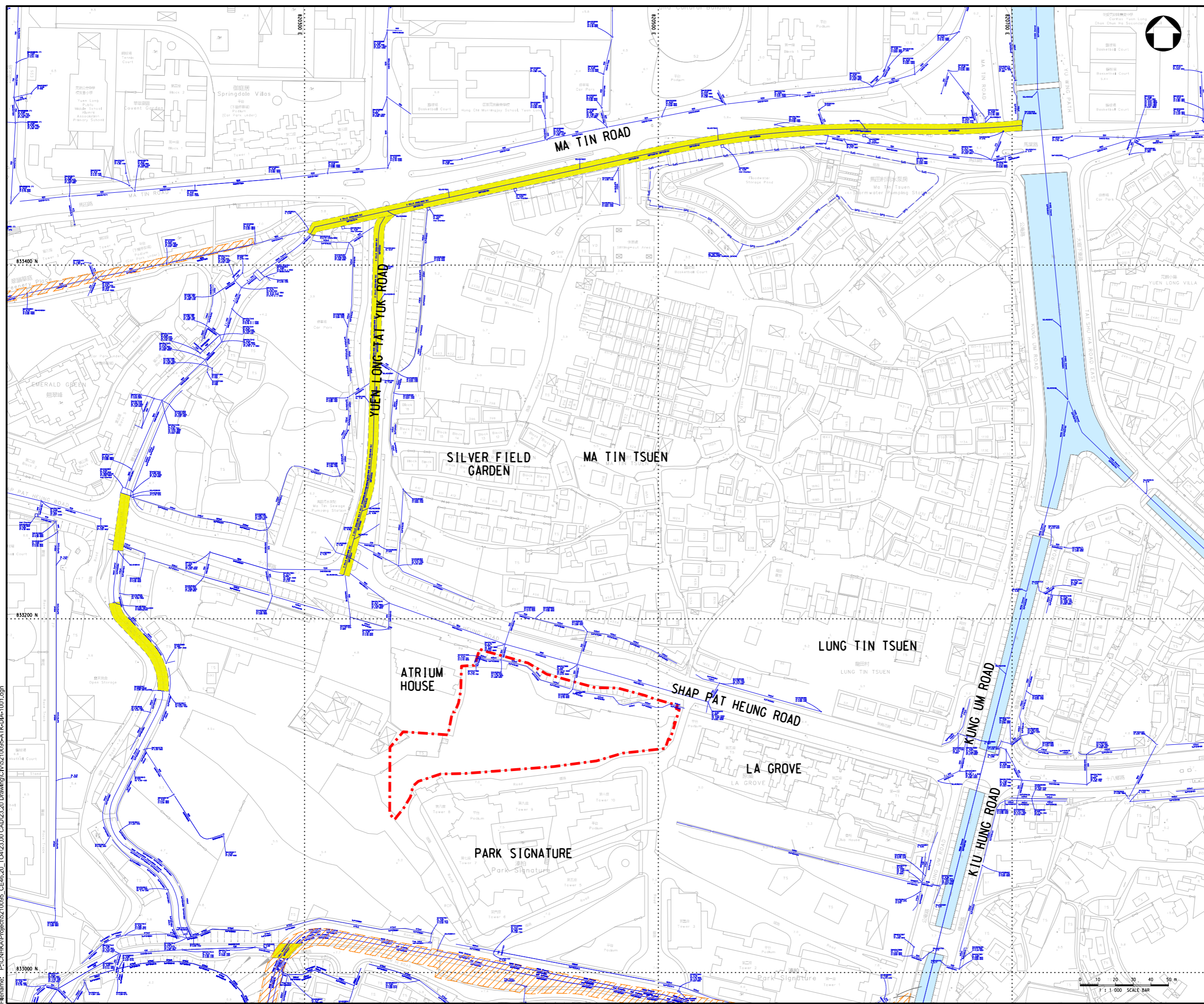
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 OF TASK ORDER 4**

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Original Size	Date	Date	Date	Date
A1	NOV 2021	NOV 2021	NOV 2021	NOV 2021

Drawing Number: **5210095-ATK-GA-1001** Revision: **A**



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KEY PLAN
N.T.S.

- LEGEND:**
- PROPOSED HOUSING DEVELOPMENT BOUNDARY (SUBJECT TO DETAILED SURVEY AND DESIGN)
 - EXISTING CHANNEL / STREAM
 - EXISTING BOX CULVERT
 - EXISTING STORM DRAINAGE SYSTEM
 - DRAINAGE RESERVE

Rev.	Date	Description	By	Crk'd	App'd
C	OCT 2022	FOURTH ISSUE (FINAL REV.2)	CC	KL	DL
B	MAR 2022	SECOND ISSUE (FINAL)	CC	KL	DL
A	DEC 2021	FIRST ISSUE (DRAFT)	CC	KL	DL

Drawing Status: **FEASIBILITY STUDY** Suitability: -

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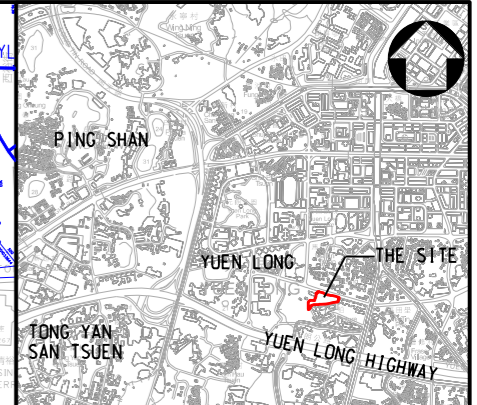
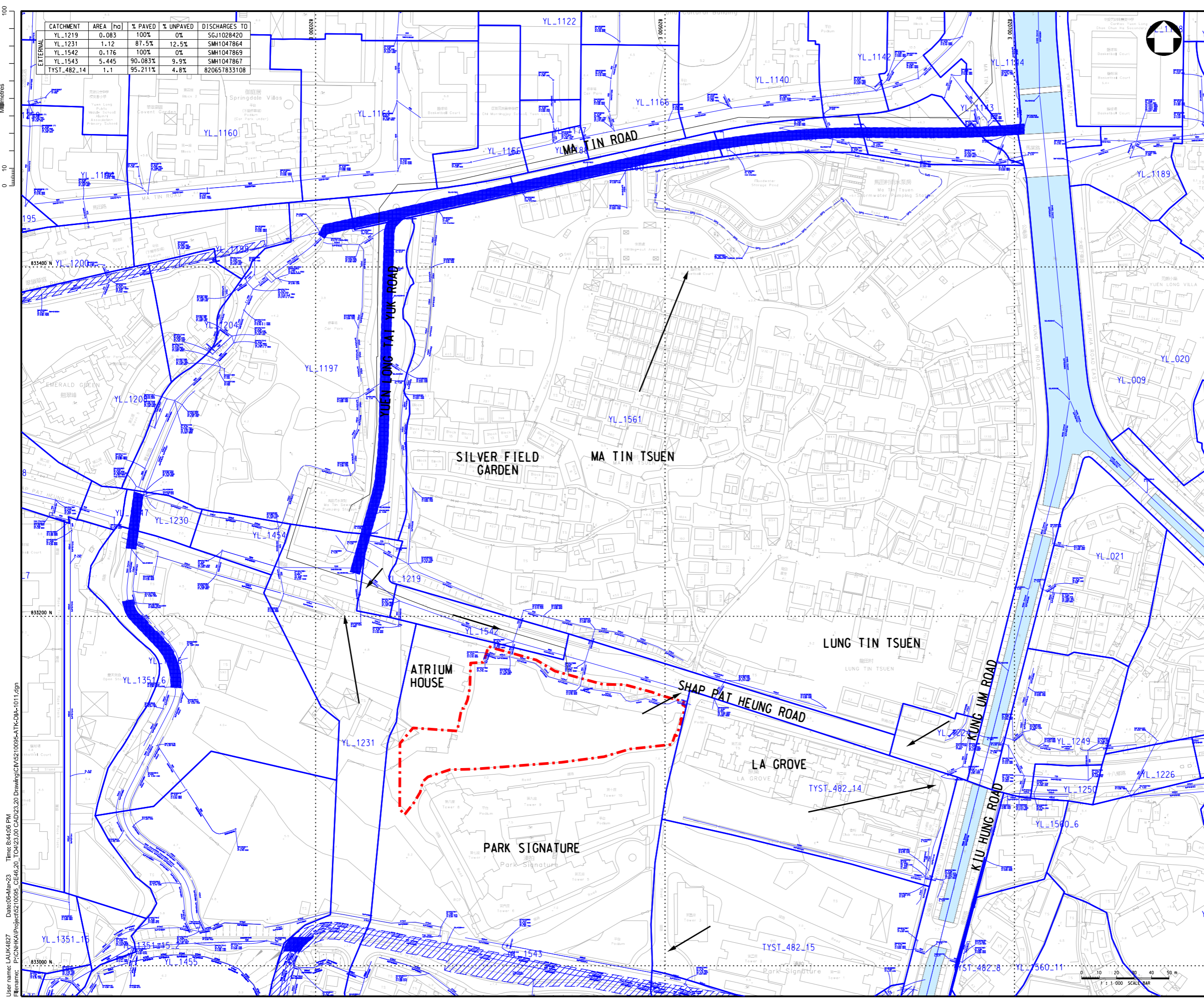
土木工程處
房屋工程3部
Civil Engineering Office
Housing Projects 3 Division

Project Title: AGREEMENT NO. 46/2020 (CE)
TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE DEVELOPMENT WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **EXISTING STORMWATER DRAINAGE SYSTEM**

Scale	Designed	Drawn	Checked	Authorised
1:1000	CC	CAD	KL	DL
Original Size	Date	Date	Date	Date
A1	DEC 2021	DEC 2021	DEC 2021	DEC 2021

Drawing Number: 5210095-ATK-DIA-1001 Revision: C



KEY PLAN
N.T.S.

- LEGEND:**
- PROPOSED HOUSING DEVELOPMENT BOUNDARY (SUBJECT TO DETAILED SURVEY AND DESIGN)
 - EXISTING CHANNEL / STREAM
 - CATCHMENTS BOUNDARY
 - CATCHMENTS SURFACE FLOW DIRECTION
 - EXISTING STORM DRAINAGE SYSTEM

Rev.	Date	Description	By	Crkd	App'd
B	MAR 2022	SECOND ISSUE (FINAL)	CC	KL	DL
A	DEC 2021	FIRST ISSUE (DRAFT)	CC	KL	DL

Drawing Status: **FEASIBILITY STUDY** Suitability: -



Client: **CEDD** 土木工程拓展署
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Civil Engineering Office
Housing Projects 3 Division

Project Title: AGREEMENT NO. 46/2020 (CE)
TERM CONSULTANCY FOR SITE FORMATION
AND INFRASTRUCTURE WORKS FOR
PROPOSED HOUSING DEVELOPMENT IN
ZONE 1 (2021-2024) - FEASIBILITY STUDY
(TASK ORDER 4 - SHAP PAT HEUNG ROAD)

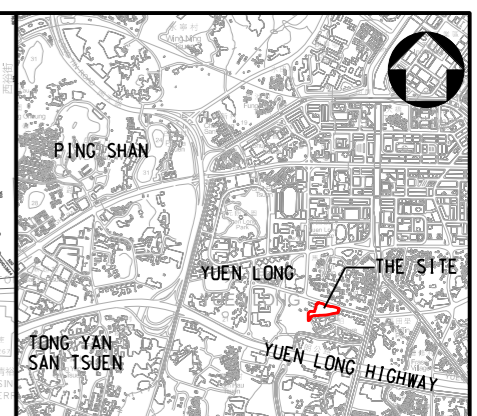
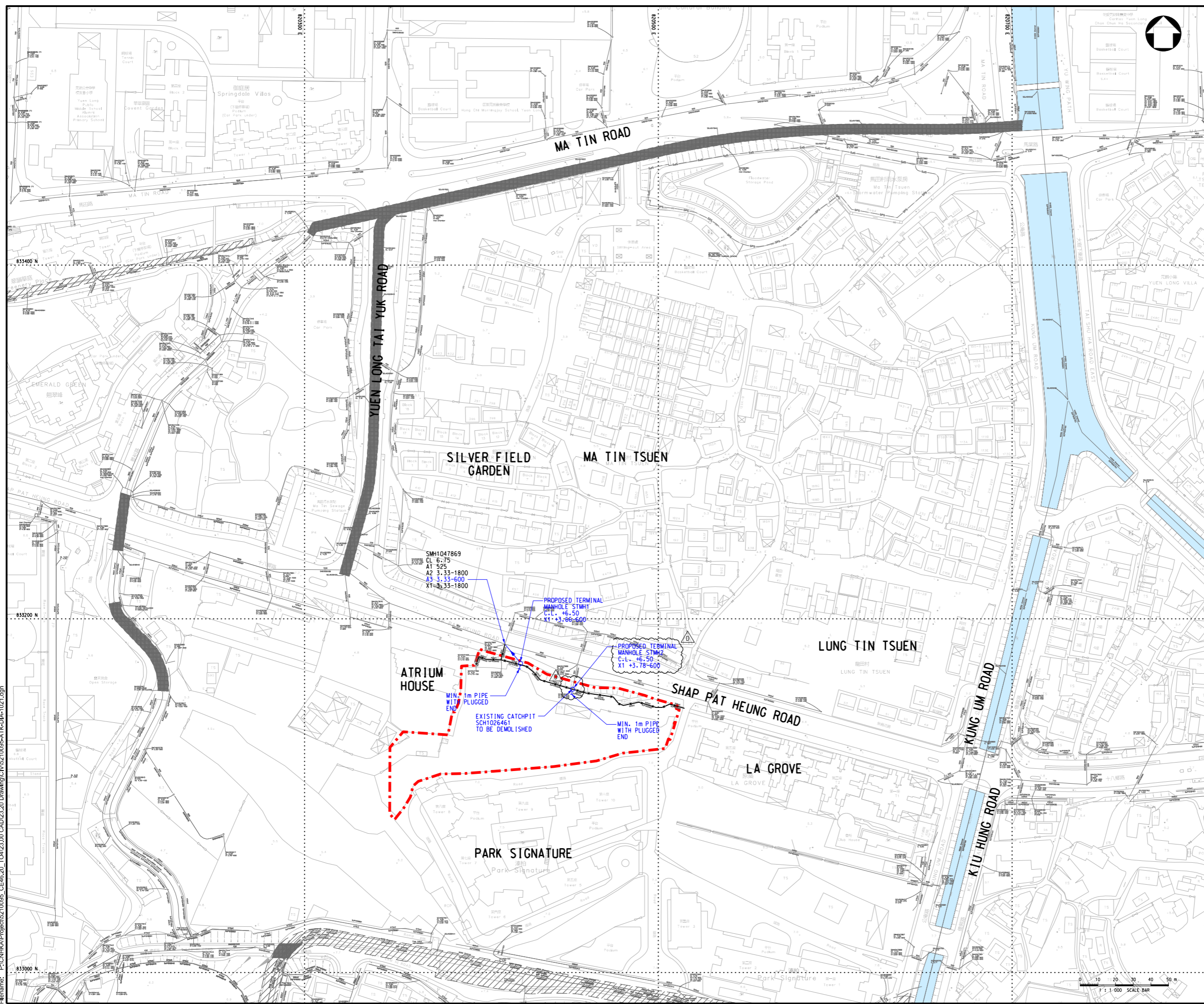
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AT SHAP PAT HEUNG ROAD -
BEFORE DEVELOPMENT**

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Original Size	Date	Date	Date	Date
A1	DEC 2021	DEC 2021	DEC 2021	DEC 2021

Drawing Number: **5210095-ATK-DIA-1011** Revision: **B**

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KEY PLAN
N.T.S.

- LEGEND:**
- PROPOSED HOUSING DEVELOPMENT BOUNDARY (SUBJECT TO DETAILED SURVEY AND DESIGN)
 - EXISTING CHANNEL / STREAM
 - EXISTING BOX CULVERT
 - EXISTING STORM DRAINAGE SYSTEM
 - DRAINAGE RESERVE
 - PROPOSED STORM DRAINAGE SYSTEM
 - EXISTING DRAINAGE SYSTEM TO BE DEMOLISHED

Rev.	Date	Description	By	CHKD	App'd
D	OCT 2022	FOURTH ISSUE (FINAL REV.2)	CC	KL	DL
C	JUN 2022	THIRD ISSUE (FINAL REV.1)	CC	KL	DL
B	MAR 2022	SECOND ISSUE (FINAL)	CC	KL	DL
A	DEC 2021	FIRST ISSUE (DRAFT)	CC	KL	DL

Drawing Status: **FEASIBILITY STUDY** Suitability: **-**

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Civil Engineering and Development Department

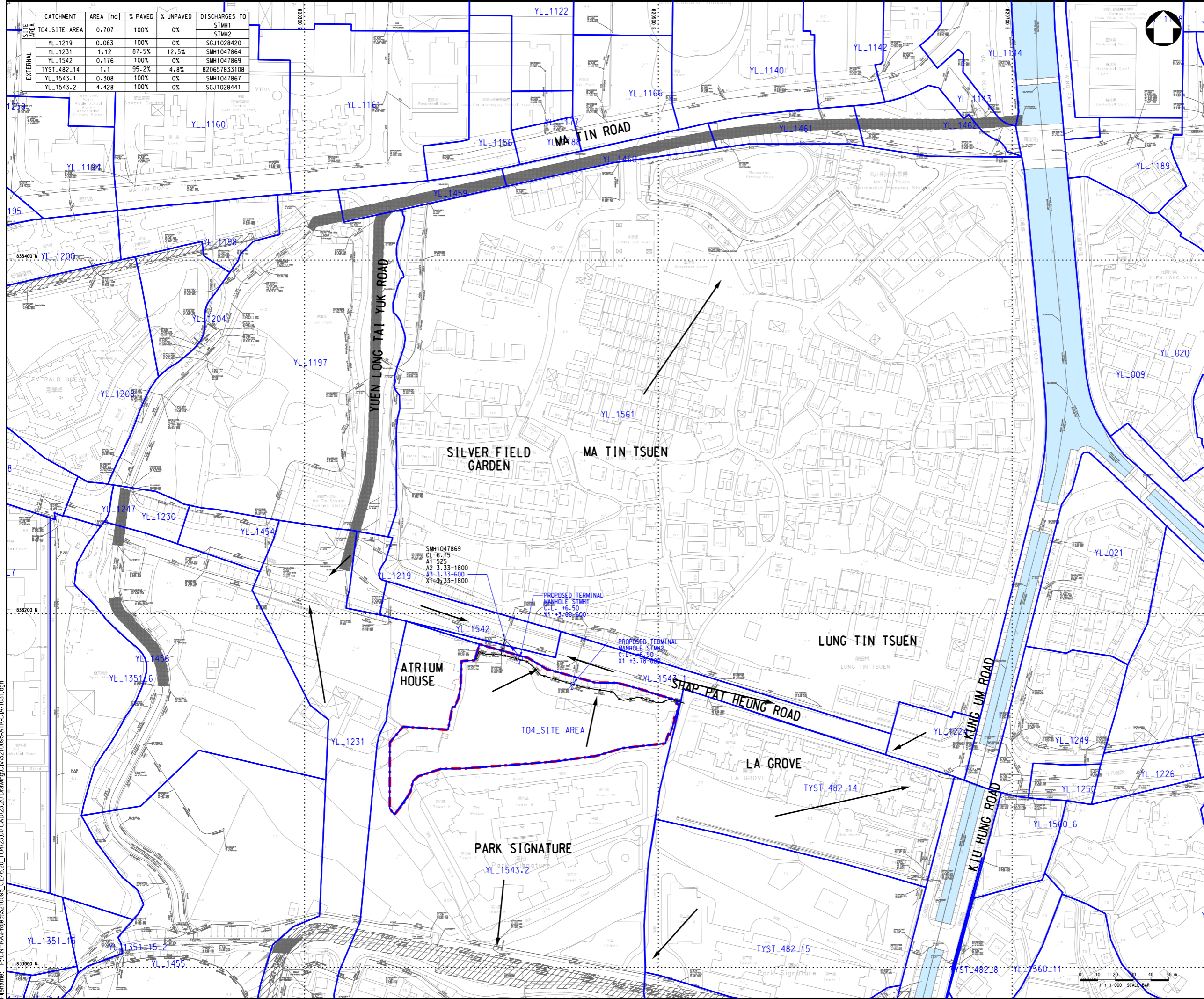
土木工程處
房屋工程3部
Civil Engineering Office
Housing Projects 3 Division

Project Title: **AGREEMENT NO. 46/2020 (CE) TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)**

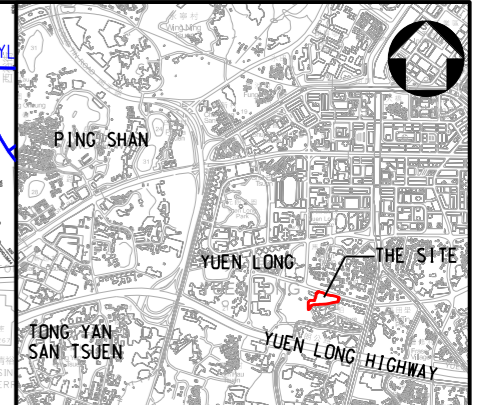
Drawing Title: **PROPOSED STORMWATER DRAINAGE SYSTEM**

Scale	Designed	Drawn	Checked	Authorised
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A1	DEC 2021	DEC 2021	DEC 2021	DEC 2021
Drawing Number				Revision
5210095-ATK-DIA-1021				D

Millimetres
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CATCHMENT	AREA [ha]	% PAVED	% UNPAVED	DISCHARGES TO
TO4_SITE AREA	0.707	100%	0%	STMH1
YL_1219	0.083	100%	0%	SGJ1028420
YL_1231	1.12	87.5%	12.5%	SMH1047864
YL_1542	0.176	100%	0%	SMH1047869
TYST_482_14	1.1	95.2%	4.8%	B20657833108
YL_1543.1	0.308	100%	0%	SMH1047867
YL_1543.2	4.428	100%	0%	SGJ1028441



KEY PLAN
N.T.S.

- LEGEND:**
- PROPOSED HOUSING DEVELOPMENT BOUNDARY (SUBJECT TO DETAILED SURVEY AND DESIGN)
 - EXISTING CHANNEL / STREAM
 - CATCHMENTS BOUNDARY
 - CATCHMENTS SURFACE FLOW DIRECTION
 - EXISTING STORM DRAINAGE SYSTEM
 - PROPOSED STORM DRAINAGE SYSTEM
 - EXISTING DRAINAGE SYSTEM TO BE DEMOLISHED

Rev.	Date	Description	By	CHK'd	App'd
C	OCT 2022	FOURTH ISSUE (FINAL REV.2)	CC	KL	DL
B	JUN 2022	THIRD ISSUE (FINAL REV.1)	CC	KL	DL
C	MAR 2022	SECOND ISSUE (FINAL)	CC	KL	DL
A	DEC 2021	FIRST ISSUE (DRAFT)	CC	KL	DL

Drawing Status: **FEASIBILITY STUDY** Suitability: -



Client: **CEDD** 土木工程拓展署
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Project Title: AGREEMENT NO. 46/2020 (CE)
TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **CATCHMENT PLAN AT SHAP PAT HEUNG ROAD - AFTER DEVELOPMENT**

Scale	Designed	Drawn	Checked	Authorised
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Drawing Number: 5210095-ATK-DIA-1031 Revision: D

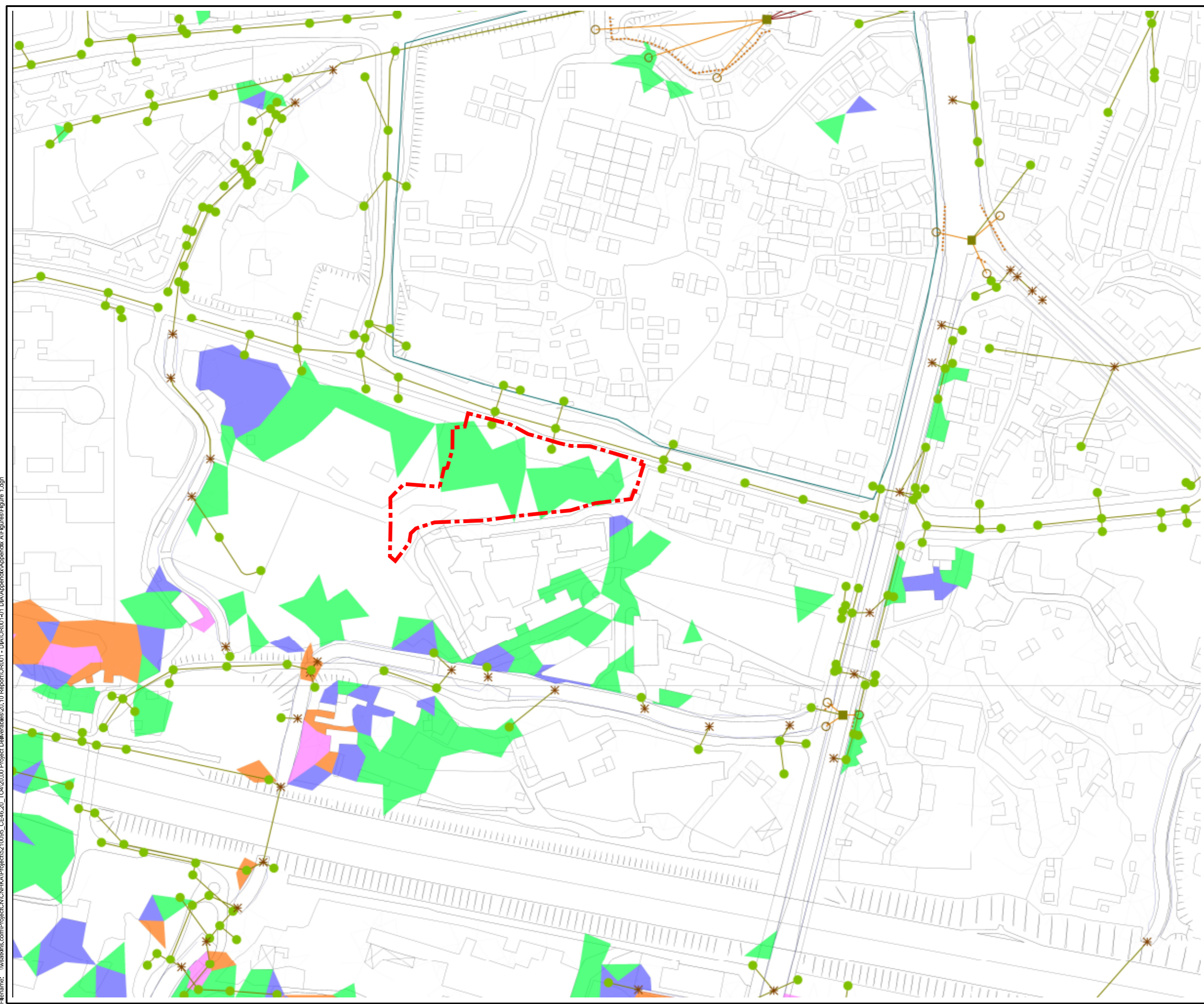
Appendix A

Hydraulic Modelling Results

Appendix A1

Flood Extent Maps

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Depth Interval [m]	
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0.1 < Depth < 0.3	▲
0.3 < Depth < 0.6	▲
0.6 < Depth < 1.0	▲
Depth > 1.0	▲

Proposed Housing Site Boundary (Subject to Detailed Survey and Design)

— — — — —

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -

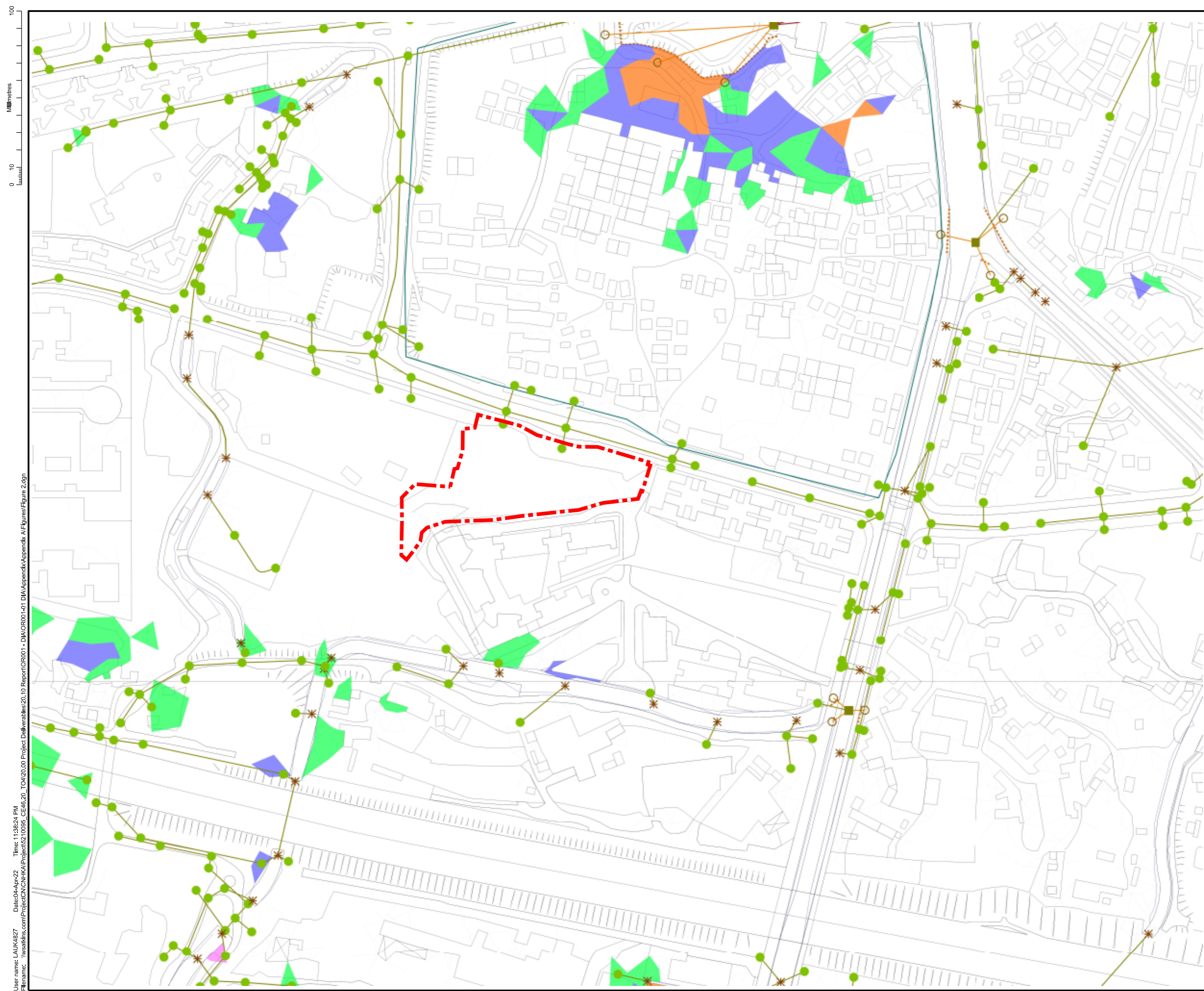


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 Housing Projects 3 Division

Project Title: AGREEMENT NO. 46/2020 (CE) TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **FLOOD EXTENT MAP OF BASELINE CONDITION UNDER 1 IN 50 YEARS RETURN PERIOD CASE A (MID 21 CENTURY)**

Scale	Designed	Drawn	Checked	Authorised
N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
A3	DEC 2021	DEC 2021	DEC 2021	DEC 2021
Drawing Number	FIGURE 1			Revision
				-



Depth Interval [m]	
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Proposed Housing Site Boundary
(Subject to Detailed Survey and Design)

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -



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Civil Engineering Office
Housing Projects 3 Division

Project Title: AGREEMENT NO. 46/2020 (CE)
TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

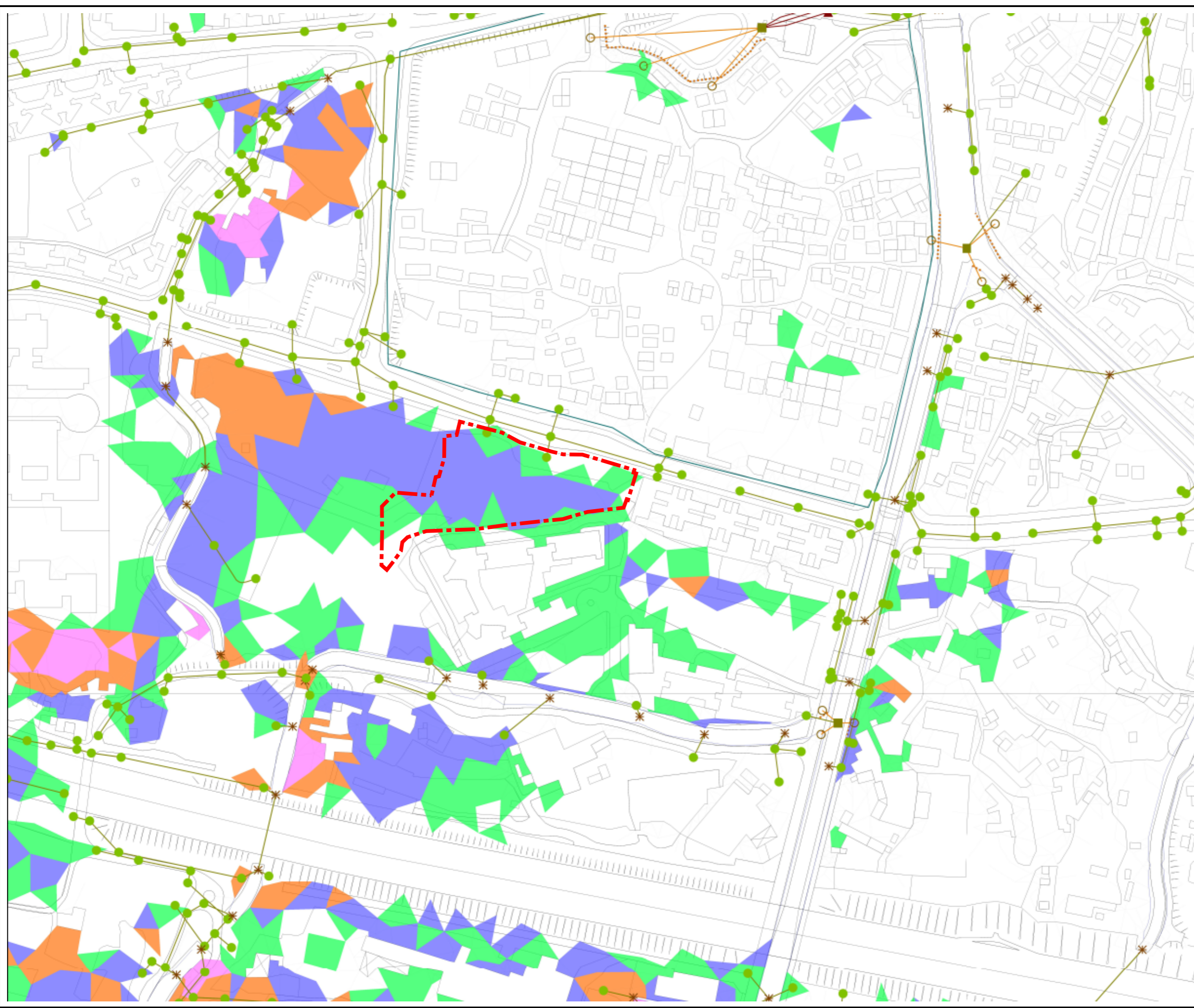
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Drawing Number: **FIGURE 2** Revision: -

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Depth Interval [m]	
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0.6 < Depth < 1.0	▲
Depth > 1.0	▲

Proposed Housing Site Boundary (Subject to Detailed Survey and Design)

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -

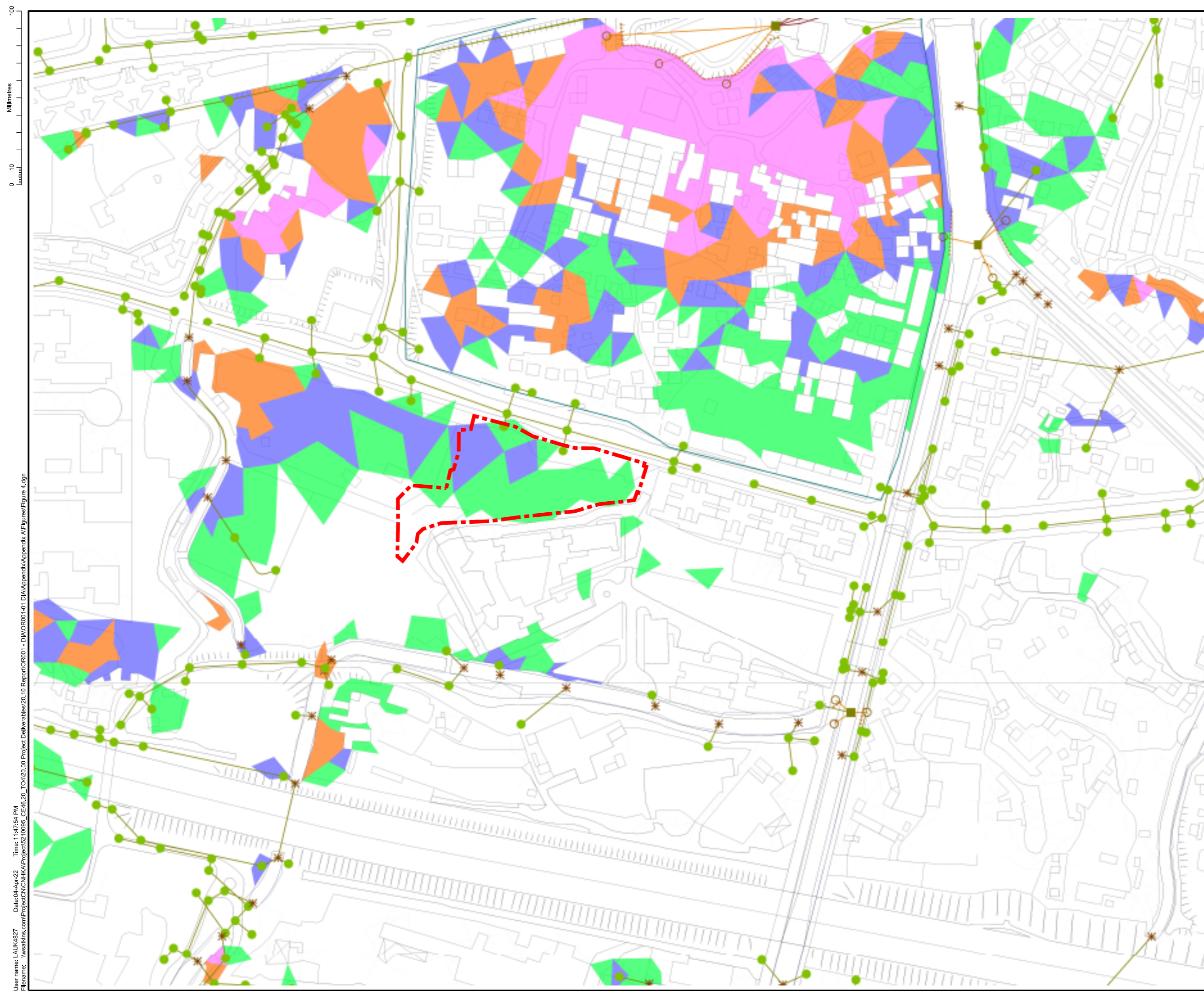


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 Civil Engineering and Development Department
 土木工程處
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 Housing Projects 3 Division

Project Title: AGREEMENT NO. 46/2020 (CE) TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **FLOOD EXTENT MAP OF BASELINE CONDITION UNDER 1 IN 200 YEARS RETURN PERIOD CASE A (MID 21 CENTURY)**

Scale	Designed	Drawn	Checked	Authorised
N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
A3	DEC 2021	DEC 2021	DEC 2021	DEC 2021
Drawing Number	FIGURE 3			Revision
				-



Depth Interval [m]	
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0.1 < Depth < 0.3	▲
0.3 < Depth < 0.6	▲
0.6 < Depth < 1.0	▲
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Proposed Housing Site Boundary (Subject to Detailed Survey and Design)

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -



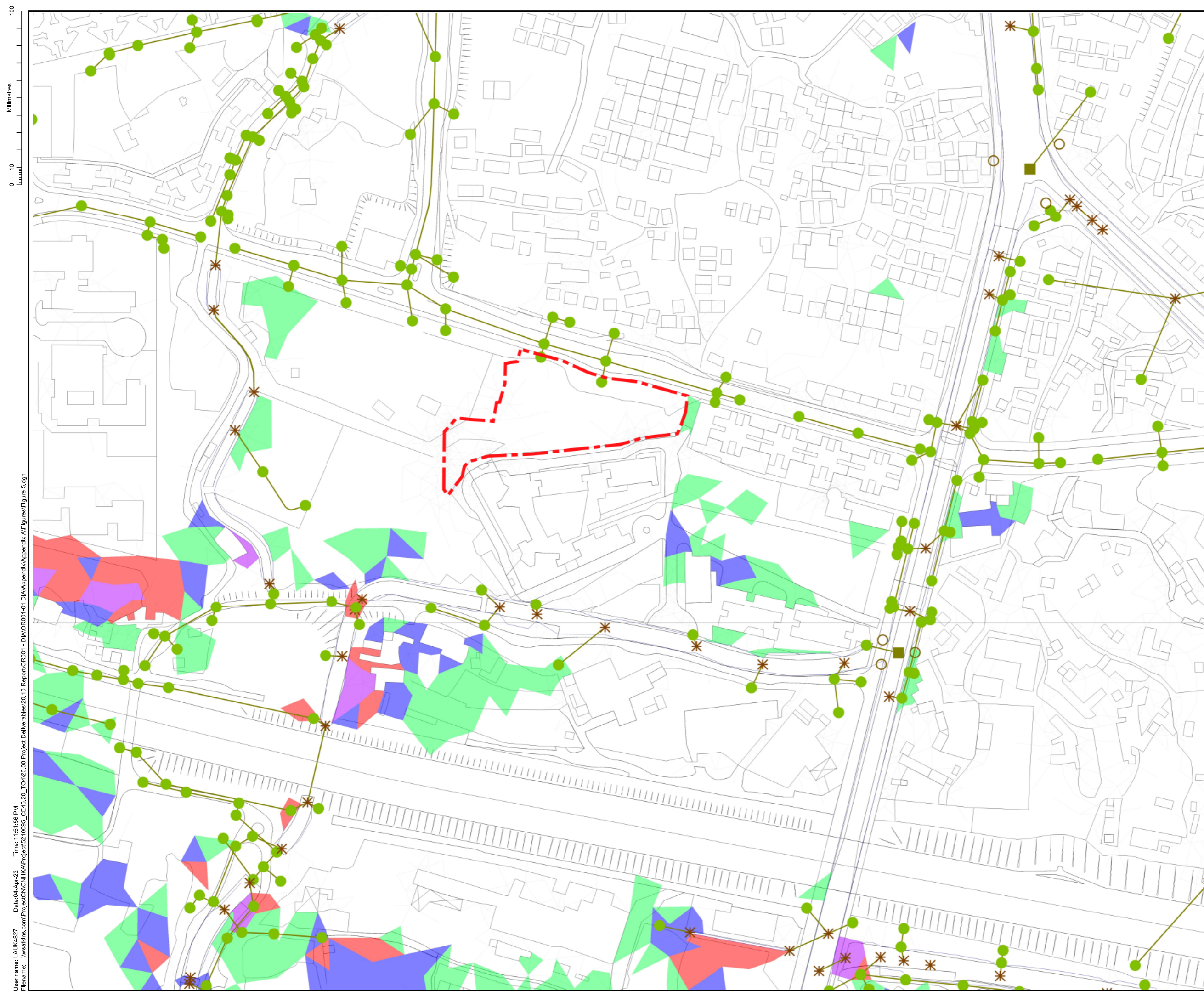
Client
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 Civil Engineering and Development Department
 土木工程處
 房屋工程3部
 Civil Engineering Office
 Housing Projects 3 Division

Project Title
 AGREEMENT NO. 46/2020 (CE)
 TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title
FLOOD EXTENT MAP OF BASELINE CONDITION UNDER 1 IN 200 YEARS RETURN PERIOD CASE B (MID 21 CENTURY)

Scale	Designed	Drawn	Checked	Authorised
N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
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Drawing Number	FIGURE 4			Revision
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Depth Interval [m]	
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0.3 < Depth < 0.6	▲
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Depth > 1.0	▲

Proposed Housing Site Boundary
(Subject to Detailed Survey and Design)

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -



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Housing Projects 3 Division

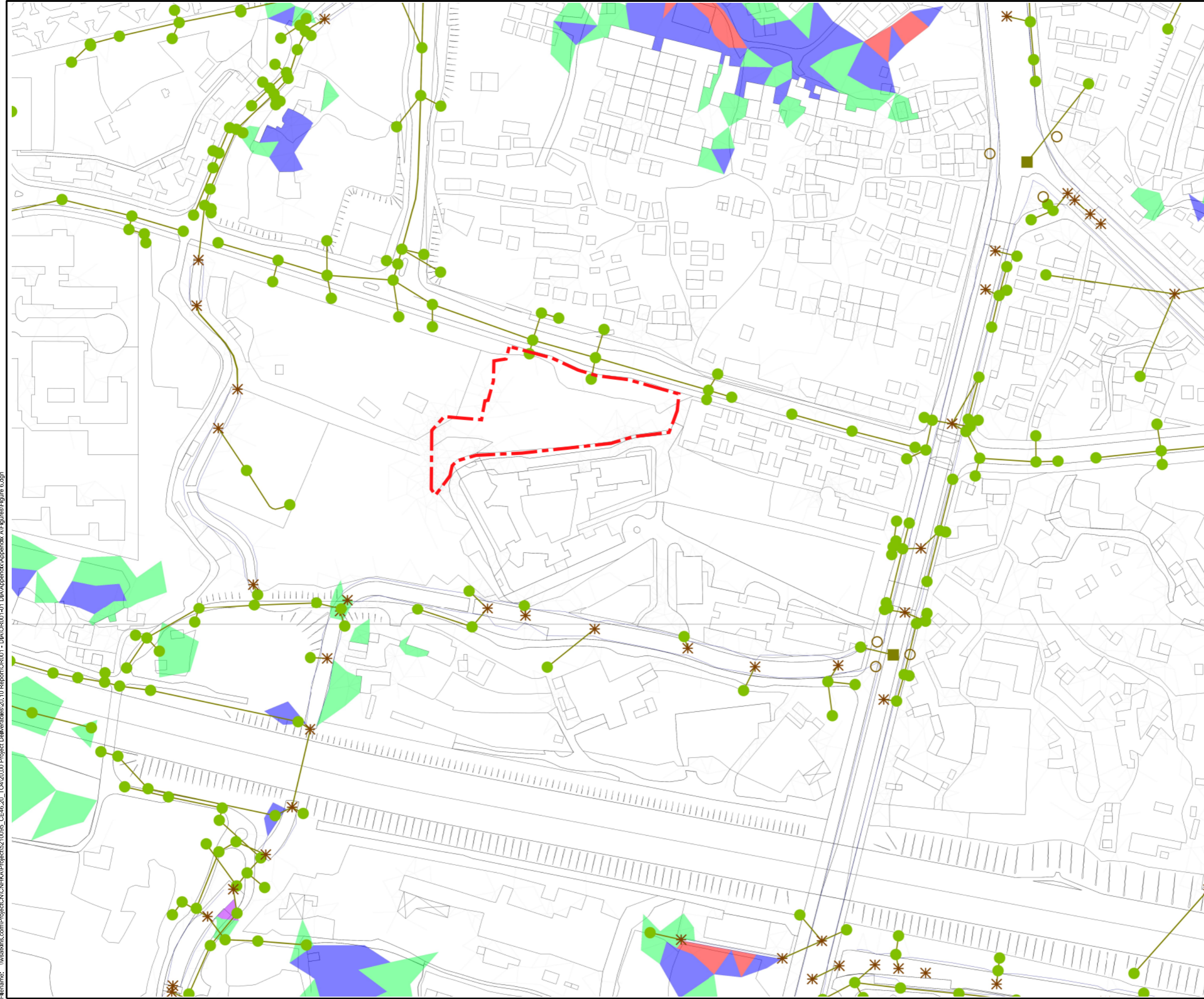
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TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **FLOOD EXTENT MAP OF PROPOSED CONDITION UNDER 1 IN 50 YEARS RETURN PERIOD CASE A (MID 21 CENTURY)**

Scale	Designed	Drawn	Checked	Authorised
N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
A3	DEC 2021	DEC 2021	DEC 2021	DEC 2021
Drawing Number	FIGURE 5			Revision
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Depth Interval [m]	
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0.3 < Depth < 0.6	▲
0.6 < Depth < 1.0	▲
Depth > 1.0	▲

Proposed Housing Site Boundary
 (Subject to Detailed Survey and Design)

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -



Client: **CEDD** 土木工程拓展署
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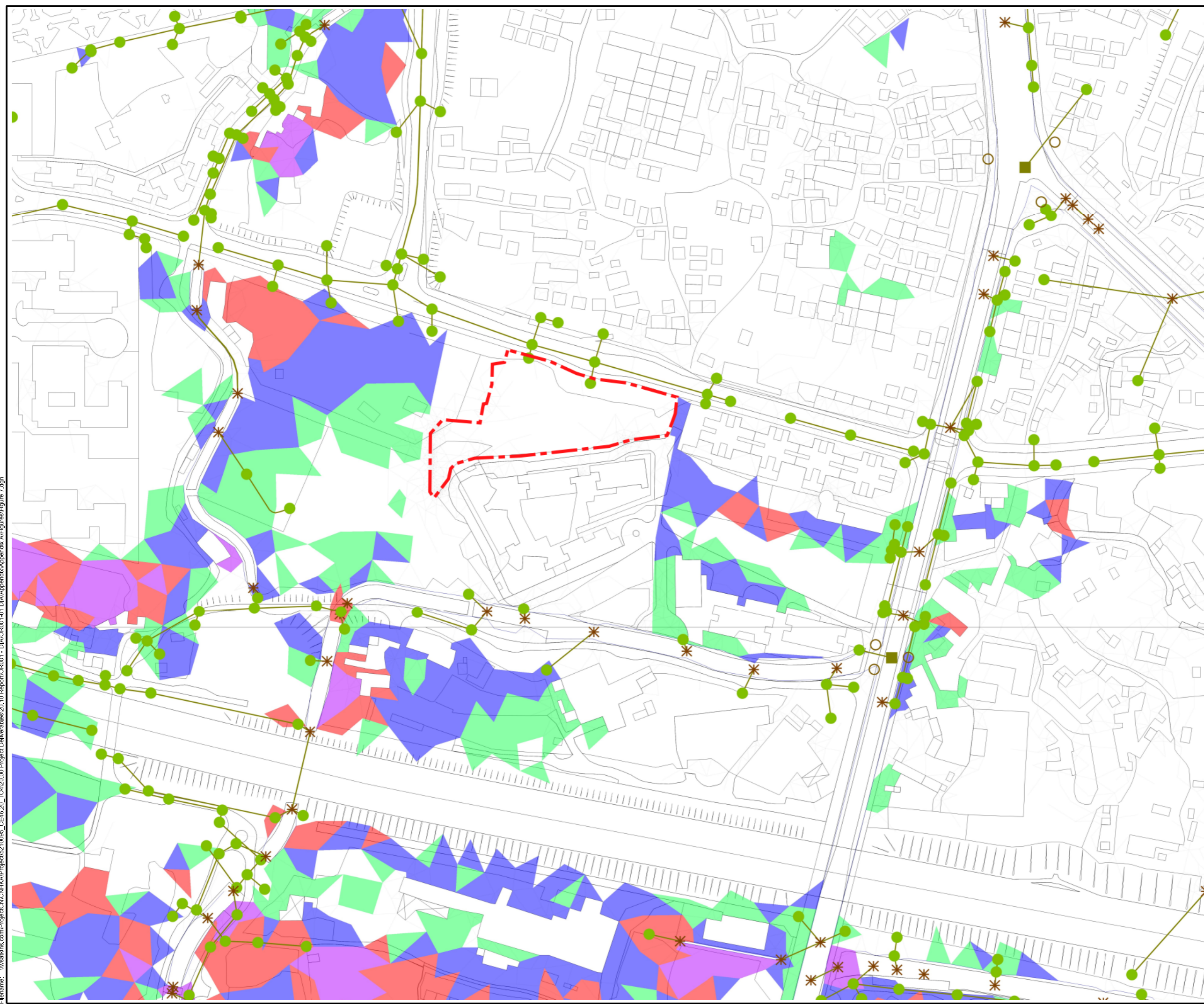
土木工程處
 房屋工程3部
 Civil Engineering Office
 Housing Projects 3 Division

Project Title: AGREEMENT NO. 46/2020 (CE)
 TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **FLOOD EXTENT MAP OF PROPOSED CONDITION UNDER 1 IN 50 YEARS RETURN PERIOD CASE B (MID 21 CENTURY)**

Scale	Designed	Drawn	Checked	Authorised
N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
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Drawing Number	FIGURE 6			Revision
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Depth Interval [m]	
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0.3 < Depth < 0.6	▲
0.6 < Depth < 1.0	▲
Depth > 1.0	▲

Proposed Housing Site Boundary
 (Subject to Detailed Survey and Design)

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -



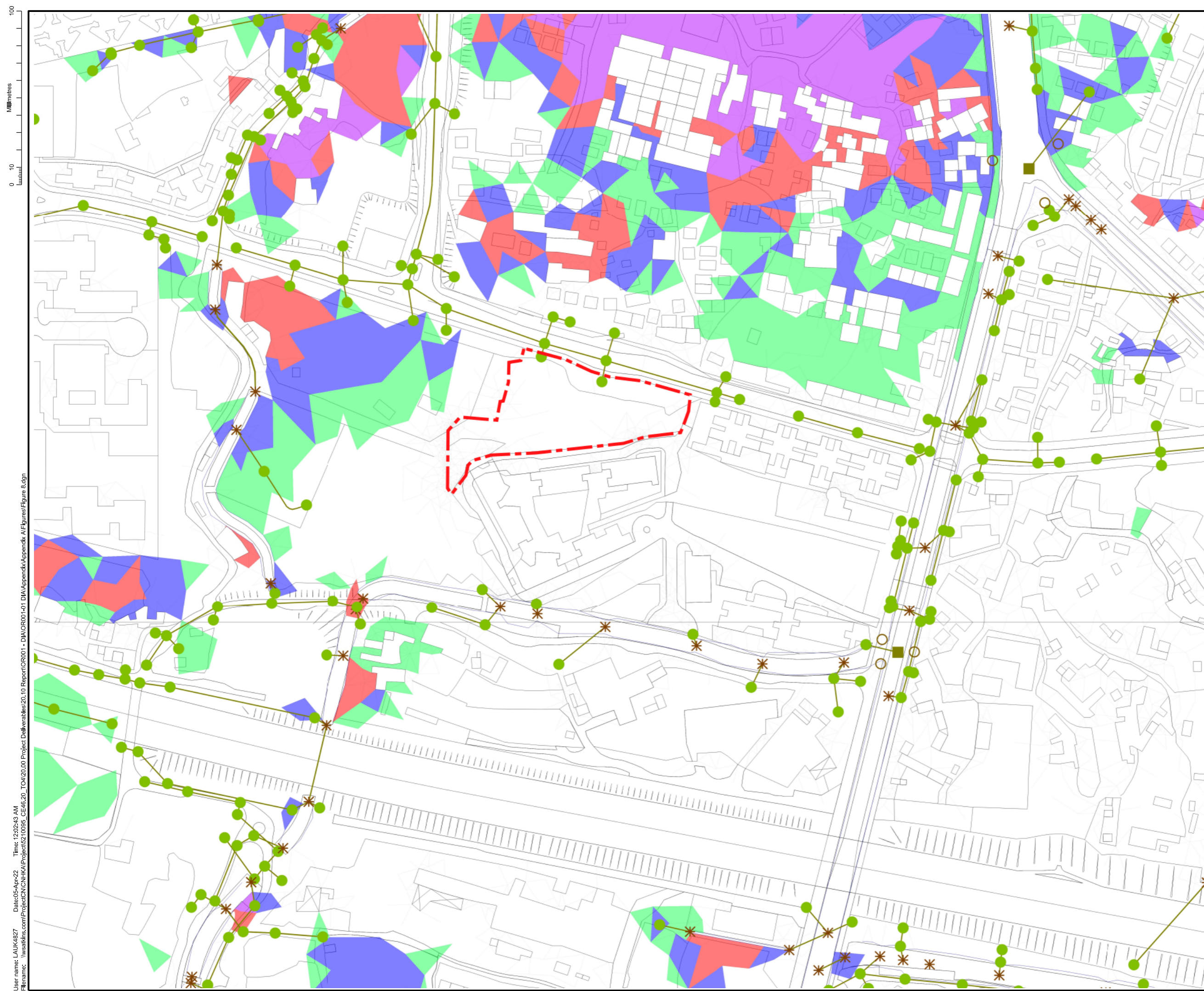
Client: **CEDD** 土木工程拓展署
 Civil Engineering and Development Department
 土木工程處
 房屋工程3部
 Civil Engineering Office
 Housing Projects 3 Division

Project Title: AGREEMENT NO. 46/2020 (CE)
 TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **FLOOD EXTENT MAP OF PROPOSED CONDITION UNDER 1 IN 200 YEARS RETURN PERIOD CASE A (MID 21 CENTURY)**

Scale	Designed	Drawn	Checked	Authorised
N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
A3	DEC 2021	DEC 2021	DEC 2021	DEC 2021

Drawing Number: **FIGURE 7** Revision: -



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0.6 < Depth < 1.0	▲
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- - - Proposed Housing Site Boundary
 (Subject to Detailed Survey and Design)

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Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

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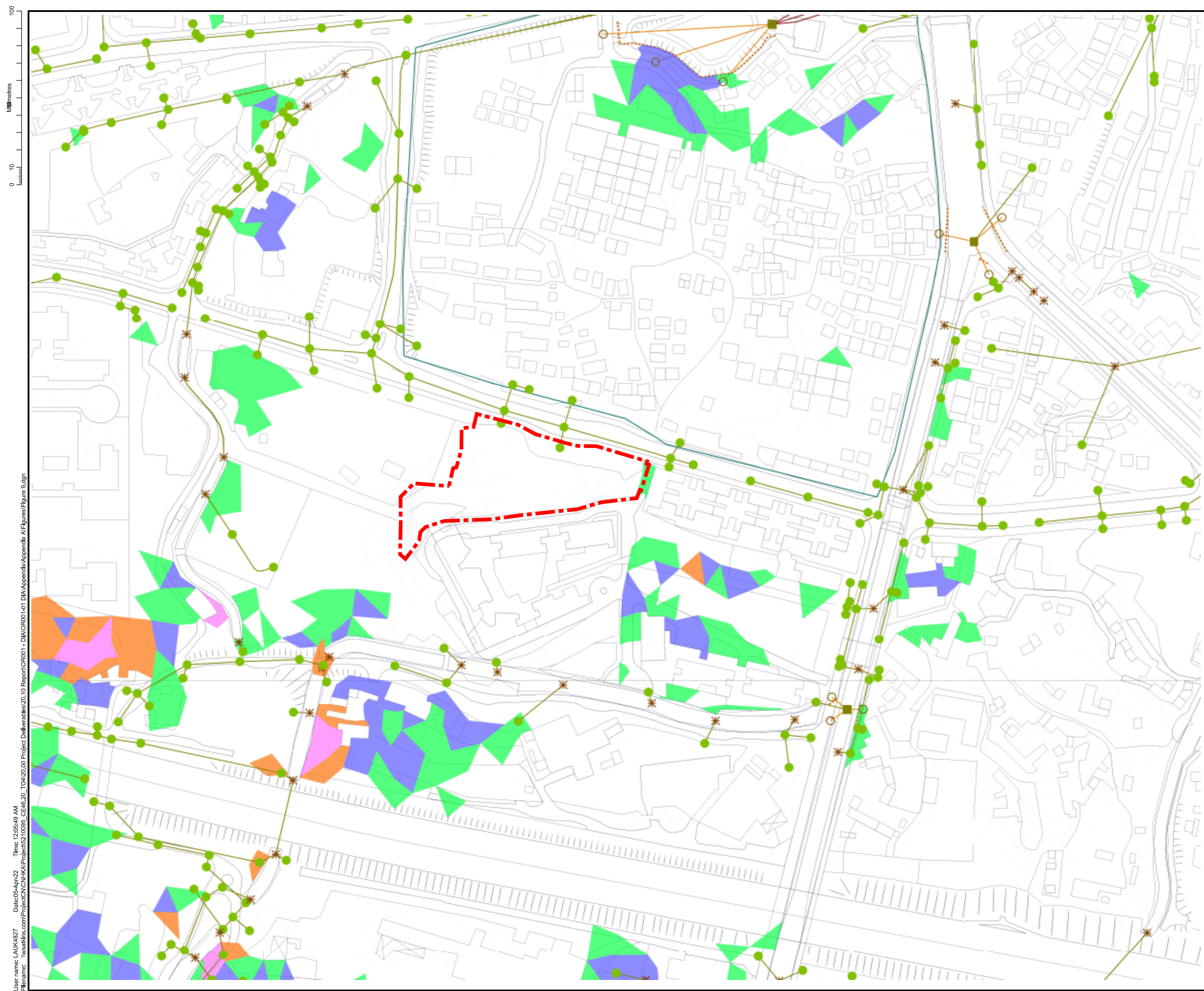


Client: **CEDD** 土木工程拓展署
 Civil Engineering and Development Department
 土木工程處
 房屋工程3部
 Civil Engineering Office
 Housing Projects 3 Division

Project Title: AGREEMENT NO. 46/2020 (CE)
 TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **FLOOD EXTENT MAP OF PROPOSED CONDITION UNDER 1 IN 200 YEARS RETURN PERIOD CASE B (MID 21 CENTURY)**

Scale	Designed	Drawn	Checked	Authorised
N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
A3	DEC 2021	DEC 2021	DEC 2021	DEC 2021
Drawing Number	FIGURE 8			Revision
				-



Depth Interval [m]	
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0.1 < Depth < 0.3	▲
0.3 < Depth < 0.6	▲
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Depth > 1.0	▲

Proposed Housing Site Boundary
(Subject to Detailed Survey and Design)

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -



Client: **CEDD** 土木工程拓展署
Civil Engineering and Development Department
土木工程處
房屋工程3部
Civil Engineering Office
Housing Projects 3 Division

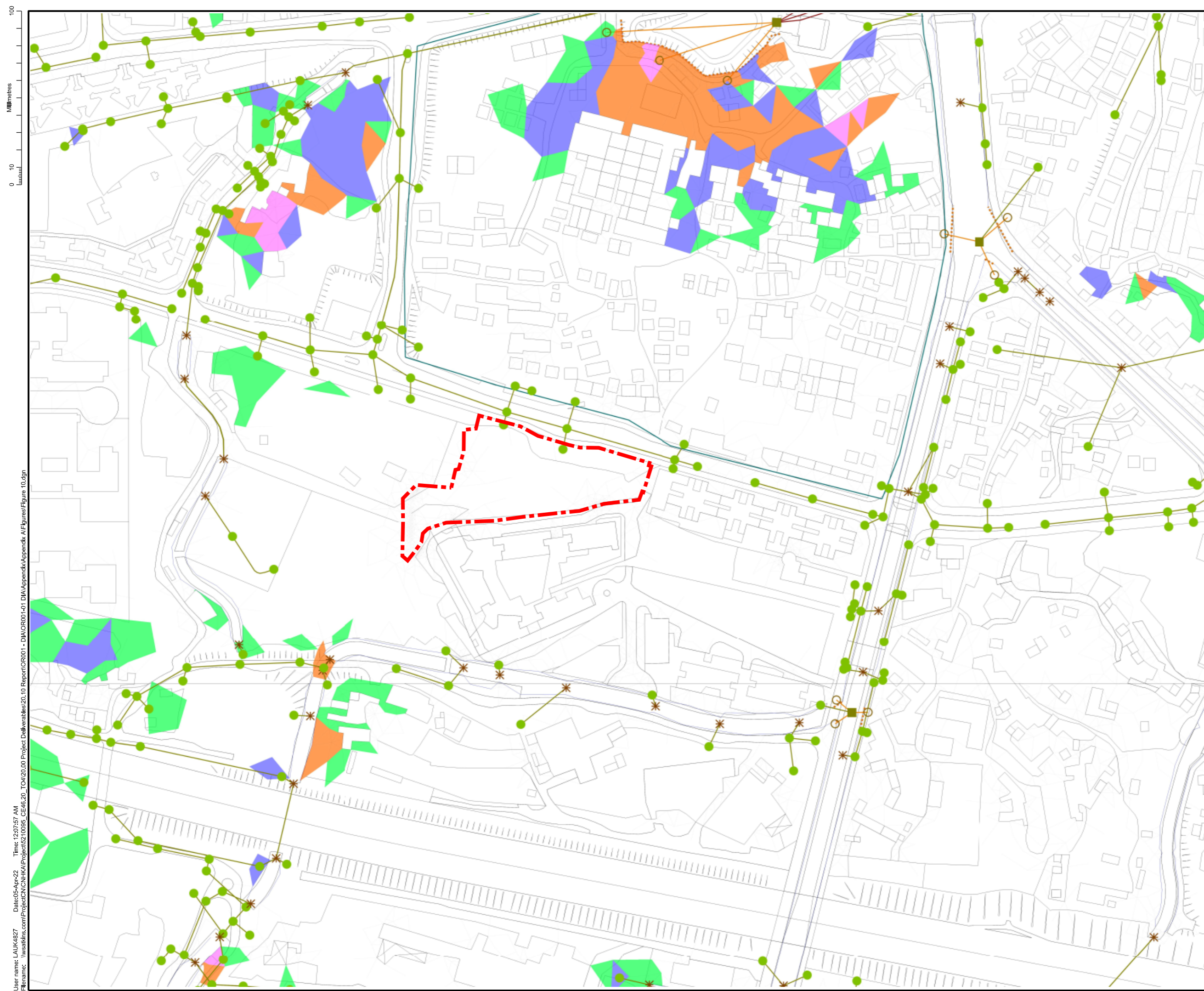
Project Title: AGREEMENT NO. 46/2020 (CE) TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **FLOOD EXTENT MAP OF PROPOSED CONDITION UNDER 1 IN 50 YEARS RETURN PERIOD CASE A (END 21 CENTURY)**

Scale	Designed	Drawn	Checked	Authorised
N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
A3	DEC 2021	DEC 2021	DEC 2021	DEC 2021

Drawing Number: **FIGURE 9** Revision: -

User name: LAUK4827 Date: 05-Apr-22 Time: 12:05:49 AM
Filename: \\ussakins.com\Project\CNC\HK\Project\5210095_CE46_20_TO4\20.00.Project\Deliverables\20.10.Report\OR001 - DIA\OR001-07 DIA\Appendix A\Figures\Figure 9.dgn



Depth Interval [m]	
Depth < 0.1	
0.1 < Depth < 0.3	▲
0.3 < Depth < 0.6	▲
0.6 < Depth < 1.0	▲
Depth > 1.0	▲

- - - Proposed Housing Site Boundary
 (Subject to Detailed Survey and Design)

User name: LAUK4827 Date: 05-Apr-22 Time: 12:07:57 AM
 Filename: \\ussakins.com\Project\CNC\HK\Project\5210095_CE46_20_TO4\20.00.Project.Deliverables\20.10.Report\OR001 - DIA\OR001-07 DIA\Appendix A\Figures\Figure 10.dgn

Rev.	Date	Description	By	Crkd	App'd
A	DEC 2021	FIRST ISSUED		VAR	VAR

Drawing Status: **FEASIBILITY STUDY** Suitability: -



Client: **CEDD** 土木工程拓展署
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Project Title: AGREEMENT NO. 46/2020 (CE)
 TERM CONSULTANCY FOR SITE FORMATION AND INFRASTRUCTURE WORKS FOR PROPOSED HOUSING DEVELOPMENT IN ZONE 1 (2021-2024) - FEASIBILITY STUDY (TASK ORDER 4 - SHAP PAT HEUNG ROAD)

Drawing Title: **FLOOD EXTENT MAP OF PROPOSED CONDITION UNDER 1 IN 50 YEARS RETURN PERIOD CASE B (END 21 CENTURY)**

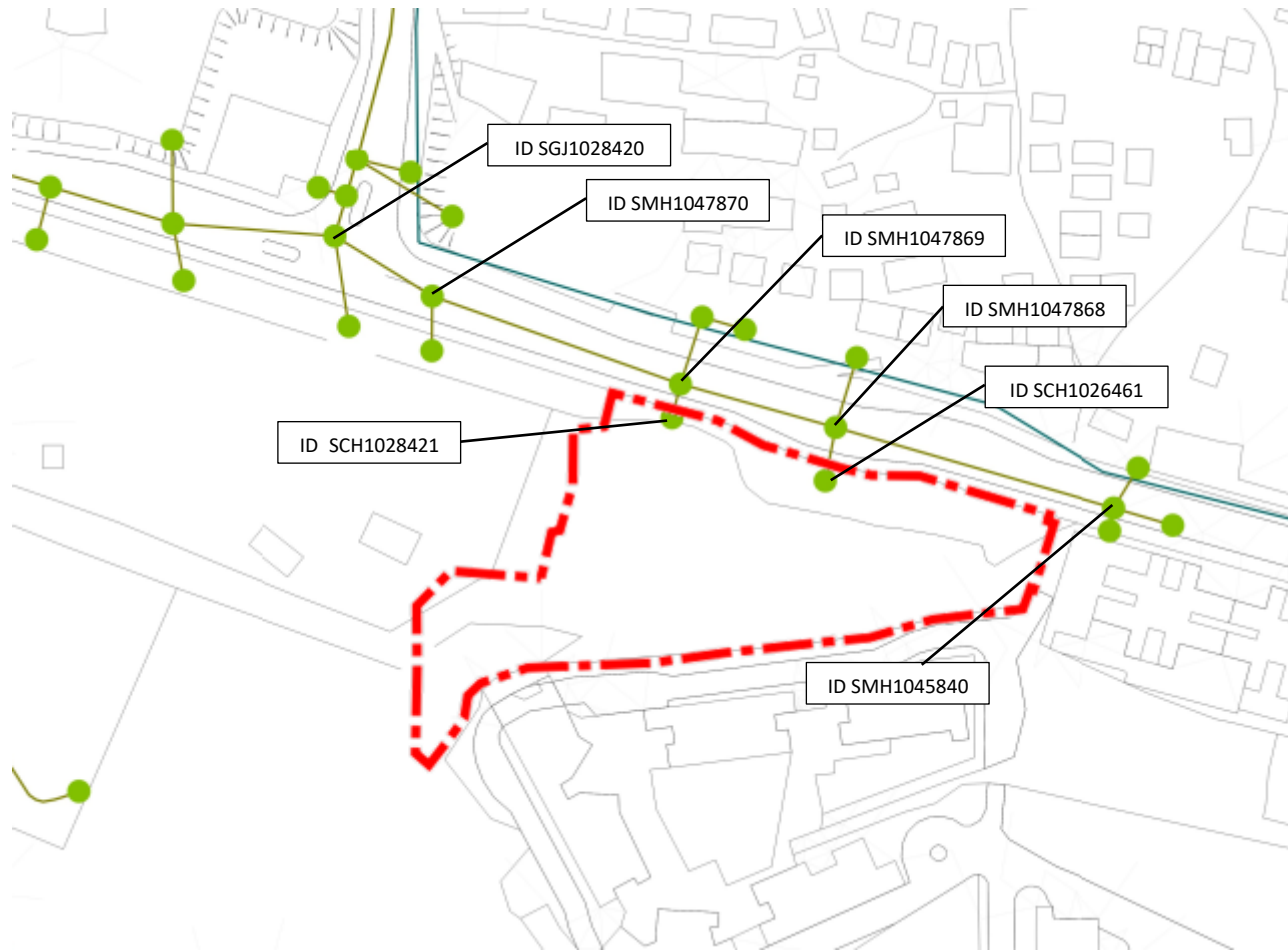
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N.T.S.	SHC	AC	NP	SW
Original Size	Date	Date	Date	Date
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Drawing Number: **FIGURE 10** Revision: -

Appendix A2

Hydraulic Modelling Results – Baseline and Proposed

CRITICAL NODE LOCATION PLAN



RESULTS AT CRITICAL NODES:

Node name	Baseline (Mid 21st Century Climate Change)						Proposed (Mid 21st Century Climate Change)						Difference (Proposed-Baseline)
	Ground level	50Yrs Rain + 10Yrs Sea Level		10Yrs Rain + 50Yrs Sea Level		Maximum Water Level	Ground level	50Yrs Rain + 10Yrs Sea Level		10Yrs Rain + 50Yrs Sea Level		Maximum Water Level	
		Water Level	Freeboard	Water Level	Freeboard			Water Level	Freeboard	Water Level	Freeboard		
[-]	[mPD]	[mPD]	[m]	[mPD]	[m]	[mPD]	[mPD]	[m]	[mPD]	[m]	[mPD]	[mPD]	
SCH1026461/ Proposed STMH2	5.54	5.56	-0.02	5.39	0.15	5.56	6.50	4.96	1.54	4.99	1.51	4.99	-0.57
SCH1028421/ Proposed STMH1	5.57	5.91	-0.34	5.62	-0.05	5.62	6.50	4.95	1.55	4.96	1.54	4.96	-0.67
SMH1045840	6.60	5.99	0.61	5.71	0.89	5.99	6.60	4.95	1.65	4.95	1.65	4.95	-1.04
SMH1047868	6.97	5.53	1.44	5.36	1.61	5.53	6.97	4.94	2.03	4.94	2.03	4.94	-0.59
SMH1047869	6.75	5.42	1.33	5.28	1.47	5.42	6.75	4.94	1.81	4.95	1.80	4.95	-0.47
SMH1047870	6.41	5.40	1.01	5.15	1.26	5.40	6.41	4.95	1.46	4.95	1.46	4.95	-0.45
SGJ1028420	6.54	5.35	1.19	5.06	1.48	5.35	6.54	4.97	1.57	4.96	1.58	4.97	-0.38

Proposed (End 21st Century Climate Change)						Difference (Proposed-Baseline)
Ground level	50Yrs Rain + 10Yrs Sea Level		10Yrs Rain + 50Yrs Sea Level		Maximum Water Level	
	Water Level	Freeboard	Water Level	Freeboard		
[mPD]	[mPD]	[m]	[mPD]	[m]	[mPD]	[mPD]
6.50	5.10	1.40	5.30	1.20	5.30	-0.26
6.50	5.08	1.42	5.20	1.30	5.20	-0.42
6.60	5.08	1.52	5.21	1.39	5.21	-0.78
6.97	5.07	1.90	5.19	1.78	5.19	-0.34
6.75	5.08	1.67	5.20	1.55	5.20	-0.23
6.41	5.08	1.33	5.29	1.12	5.29	-0.11
6.54	5.10	1.44	5.21	1.33	5.21	-0.14