Appendix E

Drainage and Sewerage Impact Assessment Report

Agreement No. CE 79/2023 (GE)

**Underground Quarrying at Tsing Yi North –
Investigation, Design and Construction**

**Drainage and Sewerage Impact Assessment Report
(Final) (Ref. B21-02)**

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1 Introduction

1.1 Project Background

1.1.1 Rock, principally as aggregates in concrete, is the most predominately used construction material for buildings and infrastructure developments in Hong Kong. Local quarries, where rock is sourced for such uses, are strategically important to the construction industry in Hong Kong. Apart from extraction of virgin rock, surplus rock generated from local construction projects can be processed and recycled at quarries for beneficial reuse. In addition, the quarries are suitable sites for housing manufacturing plants of rock-derived construction materials such as ready-mixed concrete and asphalt. Historically, rock has been quarried in Hong Kong by way of surface quarrying – open/pit extraction at the ground surface. By doing this, the quarries have been operating as self-financing business entities rather than government-funded facilities.

1.1.2 Currently, Lam Tei Quarry (LTQ) at Tuen Mun is the only active local quarry, for which the current quarry contract is scheduled for completion in 2025. Recognising the importance of local quarries in minimizing the risk of irregularities in the supply of imported rock, the Government has been searching for suitable sites to set up new surface quarries in order to maintain local rock supply, with a view to have at least one new quarry to dovetail with the closure of Lam Tei Quarry.

1.1.3 Apart from rock materials, Hong Kong is also desperately in need of developable land to meet socio-economic needs. Creating spaces in underground rock caverns is one of the solutions in boosting land supply in the medium to long terms. To create land in this manner, the cavern formation will not only generate a large amount of good quality rock, but this process is also a source of rock materials which could be an integral part of the local rock supply in future. This is the underlying concept of the initiative of underground quarry-cum-cavern development, which is unprecedented in Hong Kong. There are, nevertheless, successful examples of this approach in other countries, e.g. Switzerland, Norway and the United States of America, where the entire operation combining quarrying and subsequent uses of the cavern spaces created (e.g. cold storage, data centres, warehousing and recreational complexes) is confirmed to be commercially viable.

1.1.4 Preliminary reviews under the Strategic Cavern Study identified the prospect of this concept and thereby proposed it as one of the initiatives under the long-term strategy for cavern developments in Hong Kong. Accordingly, in November 2018, when formulating the local quarry strategy for maintaining the local rock supply, the Government also recognized this initiative as a potential long-term solution that is complementary to new surface quarries. In other words, underground quarrying in Hong Kong is being pursued as a dual-benefit policy initiative contributing to enhanced land supply and sustainable use of local rock resources.

1.1.5 In 2017, CEDD commissioned the Underground Quarry Study to evaluate the feasibility of this initiative, covering various aspects including technical acceptability, statutory and regulatory requirements, business model analyses and implementation mechanisms. Based on the results of a systematic territory-wide site search, the hillside at Tsing Yi North, which is one of the 48 Strategic Cavern Areas (SCVAs) as delineated in the Cavern Master Plan (CMP) jointly promulgated by CEDD and PlanD in 2017, was recommended to take forward.

1.1.6 In 2019, the CEDD and PlanD jointly commissioned the Pilot Planning and Engineering Study on Development of Selected Strategic Cavern Areas – Feasibility Study (“Pilot Study”) to enable the Government to earmark sites for cavern development and to facilitate the implementation of cavern development. The study findings concluded that it is worthwhile launching a scheme of underground quarrying at Tsing Yi North. It is envisioned as an integral part of the long-term local quarry strategy. Shortage of rock import from the mainland China due to lockdown arising from COVID-19 outbreak in early 2020 caused substantial impacts across the construction industry in Hong Kong, heightening the importance of local quarries in the supply chain. To enhance crisis preparedness, it is timely to proceed with the scheme, along with other quarry related initiatives to maintain local rock supply.

1.1.7 Following the commencement of the IDC assignment for developing and designing the pilot underground quarry at Lam Tei, Tuen Mun in 2021, CEDD launched an IDC assignment for developing a new underground quarry at Tsing Yi North in 2023.

1.1.8 To implement the proposed underground quarry-cum-cavern development at Tsing Yi North, it is necessary to conduct a site-specific investigation and design for the scheme, building on the work completed under the Underground Quarry Study and the pilot study.

1.1.9 This Assignment aims to complete all the tasks necessary and sufficient to undertake the assignments including statutory procedures, public consultation, detailed technical assessments, broad design for potential facilities, formulation of implementation arrangement etc. at the investigation, design and early construction stages, in order to enable commencement of the underground quarrying tentatively targeted at 2027. These include various impact assessments, reference design of caverns and the underground quarrying-related activities (e.g. the materials processing/manufacturing plants and their operations) coordinated or implemented by the Government, business case analyses, implementation strategy and procurement arrangements. Consultation within the Government and with public and relevant stakeholders/industry players will also be carried out.

1.1.10 This Assignment will also look into any works potentially required by the quarry operators during the operation stage of the proposed underground quarrying. Given its pilot nature, the underground quarrying operation will be subject to the prevailing and/or new implementation mechanisms such as contract form, site supervision and any independent audits required. These will be examined and tailor-designed under this Assignment. Depending on the findings, it may call for works or tasks for which the Government may procure consultancy services separately during the operation stage.

1.1.11 AECOM Asia Co. Ltd. has been commissioned by the Civil Engineering and Development Department (CEDD) on 13 June 2024 to undertake Agreement No. CE 79/2023 (GE) – Underground Quarrying at Tsing Yi North – Investigation, Design and Construction. It is targeted to commence the construction works in Year 2027.

1.2 Objectives of the Drainage and Sewerage Impact Assessment

1.2.1 According to Clause 6.16 of the Brief, a Drainage and Sewerage Impact Assessment (DSIA) shall be carried out for introducing a structural and systematic approach to identifying, assessing and mitigating potential adverse drainage and sewerage impacts which might arise from the operation of the underground quarry.

1.3 Nomenclature and Abbreviations

1.3.1 The following table lists the abbreviated titles of government bureaux, departments, offices, statutory bodies and public organisations mentioned in this Report.

Table 1.1 Abbreviations for Government Bodies

Abbreviations for Bureaux/Departments/ relevant organisations	Full title
CEDD	Civil Engineering and Development Department
DSD	Drainage Services Department
EPD	Environmental Protection Department
GEO	Geotechnical Engineering Office
PlanD	Planning Department

1.3.2 The following table lists the meanings of abbreviations for expressions adopted in this Report.

Table 1.2 Abbreviations Adopted in this Report

Abbreviations	Full Meaning
ADWF	Average Dry Weather Flow
DIA	Drainage Impact Assessment
GESF	Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning
LTQ	Lam Tei Quarry
SCVA	Strategic Cavern Area
SDM	Stormwater Drainage Manual
SIA	Sewerage Impact Assessment
TPEDM	Territorial Population and Employment Data Matrices
TSE	Treated Sewage Effluent
TYNUQ	Tsing Yi North Underground Quarry
TYPTW	Tsing Yi Preliminary Treatment Works
UFF	Unit Flow Factor
UQ	Underground Quarry
WENT	West New Territories
WTW	Water Treatment Works

2 Project Profile

2.1 Site Location

2.1.1 The proposed site is located in the northwestern area of Tsing Yi Island between the North West Tsing Yi Interchange to the west and Yau Kom Tau to the east. The proposed underground quarry will be undertaken in the Strategic Cavern Area (SCVA) No. 10, beneath the mountain of Shek Wan. The location plan of the Project is shown in **Figure 2.1**.

2.2 Proposed Development

2.2.1 For the purpose of underground quarrying, there is no permanent drainage and sewerage works in the project. All the proposed drainage and sewerage works, if any, are temporary works under the project. The drainage and sewerage assessment for the future land use and the corresponding permanent works shall be carried out by others under separate study.

Portals and Access Tunnels Leading to Underground Quarry

2.2.2 The formation of portals at Ngau Kok Wan and Tam Kon Shan Road will require soil and rock slope cutting works. It is envisaged that excavation in soil and rock is involved at the section of access tunnel near portal. After excavation of the Main Access Tunnels near portals, the remaining excavation is anticipated to be conducted in rock using drill and blast method.

Underground Quarry

2.2.3 Connection Tunnels will be built around the perimeter of the underground quarry. Subject to the need of the quarry operator, the underground quarry is allowed for housing rock processing facilities, stockpiling the excavated rocks / aggregates and storage of construction materials. To the southeast of the proposed cavern extent, an area of potential cavern expansion is identified.

Expansion of Surface Land at Ngau Kok Wan

2.2.4 To facilitate a more flexible site setup, it is proposed to carry out surface land expansion at the western side of the existing surface land of Ngau Kok Wan by means of site formation in order to enlarge the surface land area. The site formation will require soil and rock excavation by mechanical means with piling works to form a retaining structure.

Provision of Loading / Unloading Area with Conveyor Belt near Wok Tai Wan

2.2.5 To develop a connection by means of conveyor belt to Wok Tai Wan to enable a more flexible site setup by the future operator and enhance synergy between Wok Tai Wan and Ngau Kok Wan, it is proposed to create a loading / unloading point near the access road for transporting rock to/from Wok Tai Wan through a conveyor belt system along the hillside. To facilitate the rock storage needs of the project, Wok Tai Wan is identified as the stockpiling area.

2.3 Ancillary Facilities Area

2.3.1 Initially before any underground space is created, for the operation of the underground quarry, surface works area shall be provided to set up the following:

- Site office for staff
- Workshop for machinery
- Installation of blasting mitigation measures at portals
- Stockpiling area
- Tunnel ventilation facilities
- Setting up of ancillary operations

2.3.2 The Contractor will be responsible to develop their own arrangement of the site setup to suite their operational needs. With reference to the existing site set up of Lam Tei Quarry and Lam Tei Underground Quarry, the major activities for supporting the ancillary operations would include the following:

- Rock processing
- Raw material storage
- Stockpiling area for preliminary crushed rock and C&D material
- Concrete production
- Asphalt production

2.4 Construction Phase

2.4.1 After quarrying contract award and before any production is made, the quarry operator will need to carry out site set up works. During this construction phase, machineries and plants will be transported to surface land for installation. In parallel, initial site establishment and construction works including construction of portals and short portions of the main access tunnels will be conducted by mechanical means. No blasting, crushing, concrete or asphalt production will be carried out during the construction phase.

2.4.2 The construction phase will take approximately one to two years, including the period required for procurement, delivery, installation and license application for plants.

2.5 Operation Phase

2.5.1 Once the initial set up is ready, drill and blast method will be adopted for excavation of rock. Drill and blast operation involves drilling of rock, charging of explosives, blasting and removal of as-blasted rock. The as-blasted rock fragments are crushed on site down to suitable sizes for use as aggregates. Aggregates will go through further processing in concrete or asphalt batching facilities within the rock processing area of the quarry site before being delivered off site as products to construction sites.

2.5.2 The operational phase will commence after the construction phase and will continue until the rock reserves are depleted.

3 Drainage Impact Assessment

3.1 Objectives

3.1.1 The purpose of this Drainage Impact Assessment (DIA) is to assess the potential drainage impact to drainage catchments arising from the proposed site under the Project and recommend appropriate mitigation measures where adverse impacts are identified.

3.2 Methodology

3.2.1 The drainage impact assessment is conducted with reference to ETWB TCW No. 2/2006 and DSD Stormwater Drainage Manual (SDM) and DSD relevant technical circulars.

3.2.2 In the first place, the DSD drainage records or hydraulic models obtained from DSD shall be reviewed. Then the baseline or existing scenario shall be set up as a basis. Afterwards, the future scenario is set up based on the proposed land use plan. Impact arising from the proposed development to the existing drainage system shall be identified and assessed and all necessary measures to mitigate adverse drainage impacts arising from the development will be recommended.

3.2.3 For catchments, two types of runoff surfaces will be used in the assessment to respectively represent an impervious surface with the fixed runoff coefficient of 0.95 and a pervious surface with the fixed runoff coefficient of 0.5.

3.2.4 The hydrological and hydraulic parameters shall in general follow the requirements of the Stormwater Drainage Manual (SDM) of DSD.

3.2.5 The assessment is based on a 1 in 200-year rainstorm return period.

3.2.6 Existing and predicted flows have been estimated using the Rational Method and the surface runoff is calculated using the following equation:

$$Q_p = 0.278\, C\, i\, A$$

Where Q_p = peak runoff in m^3/s
C = runoff coefficient (dimensionless),
i = rainfall intensity in mm/hr, and
A = catchment area in km^2

3.2.7 The rainfall intensity is determined based on the equation as mentioned in Clause 4.3.3 of SDM (Corrigendum No. 1/2024) where storm constants (a, b, c) are given in Table 3a of SDM for the corresponding sites:

$$i = \frac{a}{(t_d + b)^c}$$

Where i = extreme mean intensity in mm/hr,
t_d = duration in minutes (td ≤ 240), and
a, b, c = storm constants given in SDM Tables 3a

3.2.8 The storm constants for 200-year return period are shown in the Table below:

Table 3.1 Storm Constants for 200 Years Return Periods

Return Period T	200 years
a	508.8
b	3.46
c	0.322

3.3 Existing Drainage System

3.3.1 The proposed TYNUQ is located at Shek Wan in the north-western region of Tsing Yi. Existing drainage system were identified in the vicinity of TYNUQ. The existing runoff from the northern and western slope of Shek Wan will be discharged to the existing Outfall 2 and 5 as shown on **Figure 3.1**.

3.3.2 6 nos. of outfalls were identified to discharge flows from catchments in the vicinity of TYNUQ and the proposed road. The catchments A1 to A11 and B1 to B6 are delineated according to the existing site topography, as shown on **Figure 3.1**.

Table 3.2 Summary of Existing Catchments

Catchment No.	Catchment Area (ha)	Outfall
A1	3.82	1
A2	1.62	2
A3	0.68	
A4	1.35	
A5	4.69	
A6	6.91	
A7	2.38	
A8	4.94	
A9	1.07	-*
A10	1.34	3
A11	0.49	4
B1	5.77	5
B2	4.34	-*
B3	2.68	6
B4	1.34	
B5	18.8	
B6	4.93	

Remarks:

* No outfall is identified for these catchments. The surface runoff from these catchments will follow the existing condition to discharge into the sea along their adjacent coastline.

Ngau Kok Wan

3.3.3 Based on the existing site topography, the nullahs to the northeast of TYNUQ near Ngau Kok Wan shall receive the surface run-off from the catchments above the site (**Figure 3.2** refers). Drainage from catchments of about 23 ha (Catchment No. A2 to A8) is discharged to the existing nullahs near Ngau Kok Wan and exit via the existing Outfall 2. The sizes of the nullahs are unknown as there is no as-built record of the infrastructures. With the change of the drainage characteristics after the proposed site formation, drainage system would be designed and constructed within the Ngau Kok Wan site.

Tam Kon Shan Road Portal

3.3.4 As shown in the as-built record in **Figures 3.3**, the existing drainage of 300 mm to 1200 mm (i.e. SMH4021973) located to the east of TYNUQ at Tam Kon Shan Road carries discharge to a 2 cell 2500 × 2000 box culvert. Surface runoff from the slopes and proposed site formation area surrounding Tam Kon Shan Road Portal is discharged to this existing drainage system, which consists of a catchment of about 0.5 ha (Catchment No. A11).

Wok Tai Wan

3.3.5 No as-built record of drainage is found within and in the vicinity of Wok Tai Wan. However, it is identified on the topological map that there is an existing nullah to the east of the Site which intercepts the surface runoff from catchments of about 28 ha (Catchment No. B3 to B6) to the

east of the site and exit via the existing Outfall 6 (**Figure 3.1** refers) or directly discharged to the sea. No drainage system is identified within the site area in Wok Tai Wan.

3.4 Drainage Flow Estimation

3.4.1 The proposed TYNUQ is located in the cavern beneath Shek Wan Hill. Albeit no change of the surface drainage characteristics is anticipated, groundwater seepage in cavern shall generate additional drainage flow. Estimation of the flow of seepage in construction phase and operation phase is listed in **Table 2.2** below.

Table 3.3 Groundwater Inflow of TYNUQ

		Construction and Operation Stage		
Discharge Point	**Tunnel / Cavern**	**Estimated Groundwater Inflow # (L/min/100m)**	**Approx. Length (m)**	**Estimated Groundwater Inflow (Total) (L/min)**
Ngau Kok Wan - East	**Cavern & Access Tunnel**	50	2450	1225
	Cavern (Potential Expansion)	50	770	385
Ngau Kok Wan - West	**Cavern & Access Tunnel**	50	3430	1715
	Total			3325 (Ngau Kok Wan)
Tam Kon Shan Road	**Access Tunnel**	50	150	75
	Total			75 (Tam Kon Shan Road)

Remarks:

The targeted residual inflow is estimated with reference to Tunnel Construction Guidelines 05 by Association of Geotechnical & Geoenvironmental Specialists (Hong Kong). Grouting works would be carried out during construction stage to limit the groundwater inflow.

3.4.2 The groundwater inflow will be conveyed from underground to the tunnel portal by gravity flow.

3.5 Assessment of Drainage Impacts

3.5.1 The potential drainage impact incurred by the proposed TYNUQ is that there would be an increase in drainage flow due to groundwater seepage inside the cavern.

3.5.2 As the proposed TYNUQ is located in a cavern, no change in surface drainage characteristics is anticipated and insignificant disruption to the existing drainage system is expected. Moreover, the access of TYNUQ at Ngau Kok Wan and the site area at Wok Tai Wan are located near the coast, the collected seepage and surface runoff could be discharged to the sea. As for the access at Tam Kon Shan Road, only insignificant amount of groundwater will be discharged to the existing drainage system. Discharge points for the collected seepage at the portals at Ngau Kok Wan and Tam Kon Shan Road were identified as shown on **Figure 3.6** and **Figure 3.7**.

3.5.3 Although the access of TYNUQ at Ngau Kok Wan is adjacent to the existing drainage system collecting the surface runoff generated from Catchment No. A2 to A8, the cavern and related ancillary activities will have minimal disruption to the existing drainage system. The existing nullah outside the portals at Ngau Kok Wan as shown in **Figure 3.2** will cross underneath the access to portals, which shall be protected for crossing over it during the construction and operation stage.

3.5.4 However, as site formation work is proposed at the western side of the Ngau Kok Wan site area, some reprovision of the drainage system is required, it is proposed to remove part of the existing nullah from the western side of Ngau Kok Wan. **Table 3.4** shows the reduction in the catchment area of Catchment No. A3 due to the proposed site formation works. As shown in **Figure 3.6**, new drainage channel will be constructed at the boundary of the site formation area to collect the runoff from catchment area A2 and A3, then discharge to the existing nullah.

Table 3.4 Summary of Change in Catchment A3

Catchment No.	Existing Catchment Area (ha)	Outfall	Proposed Catchment Area (ha)	Outfall
A3	0.68	2	0.26	2

3.5.5 To assess the drainage impact of the additional groundwater seepage from TYNUQ on the existing drainage system, the surface runoff from existing catchment to the drainage system has been calculated as shown in **Appendix A**. The estimated drainage impact due to the groundwater seepage from cavern is shown in **Table 3.5** below.

Table 3.5 Drainage Impact due to Groundwater Seepage

Portal Location	Source of Runoff Discharge (Catchment)	Runoff Collected by Existing Drainage System (m^3/s)	Additional Estimated Groundwater Inflow from Cavern (m^3/s)	Total Estimated Discharge (m^3/s)	Percentage Change
Ngau Kok Wan	A2 – A8	8.243	0.055	8.298	+ 0.67%
Tam Kon Shan Road	A11	0.196	0.0013	0.197	+ 0.66%

3.5.6 **Table 3.5** shows that the seepage flow has insignificant increase of less than 1% to the discharge compared to the surface runoff of the existing catchment. No drainage impact arising from the proposed TYNUQ is expected to incur on the existing drainage system at both Ngau Kok Wan and Tam Kon Shan Road.

3.5.7 Due to the proposed site formation works on the western side of Ngau Kok Wan, which will alter Catchment No. A3, as well as the proposed site formation at the Tam Kon Shan Road portal, the design flow and hydraulic checking of the proposed drainage channels are provided in **Appendix B**. The results are summarised in **Table 3.6** below. The results show that the proposed system is capable to handle the peak runoff from the catchment. Since the remaining portions of the existing nullah or drainage system are unaffected by the proposed site formation work, and with no additional source of runoff discharge, it is deemed there would be no impact to the existing nullah or drainage system.

Table 3.6 Summary of Hydraulic Checking of the Proposed Drainage Channel

Channel ID	Source of Runoff Discharge (Catchment)	Channel Size (mm)	Gradient	Capacity (m^3/s)	Design Flow	
					Peak Runoff (m^3/s)	% of Capacity
DC 1	A3	500	1 in 400	0.29	0.16	54.3%
DC 2	A2, A3	800	1 in 400	1.02	0.84	81.9%
UC 1	A11	400	1 in 200	0.21	0.19	88.9%

3.5.8 Following the existing site condition and without change of drainage characteristics, the surface runoff from the surface land at Ngau Kok Wan and Wok Tai Wan would discharge to the sea. No drainage impact is expected to incur on the existing drainage system.

3.6 Temporary Drainage System of Underground Quarry

3.6.1 Water will be generated from the underground quarry construction/operation. The majority of the construction / operation water to be discharged will be groundwater permeating through the excavated ground.

3.6.2 The contractor will be required to provide temporary site drainage in order to mitigate the risk of potential flooding of the works areas and excavations. Temporary drainage arrangements

will be implemented to ensure the safe discharge of construction water generated from the quarry construction/operation.

3.6.3 A specification will be developed to ensure the provision of adequate site drainage during construction/operation. Guidelines presented in the EPD ProPECC PN 2/23 – Construction Site Drainage will be included in the contract documents for the handling and disposal of construction site discharges with respect to minimising impacts on storm drainage and natural watercourses caused by construction site run-off.

3.6.4 In minimizing the groundwater infiltration during construction, probing ahead of excavation work and pre-grouting could be conducted. Where water inflow quantities are excessive, post-grouting will be conducted as far as practical to reduce the water inflow into the tunnels. Any uncontaminated groundwater from seepage or dewatering processes should be discharged to the storm water system via silt removal facilities.

3.6.5 Pollution control clauses governing discharges into the storm water drainage system and the removal of waste material will be incorporated into the contract.

3.6.6 Proposed construction drainage and measures to control construction runoff will include:

- Perimeter channels to intercept storm water run-off from outside the site will be constructed in advance of portal formation works and earthworks;
- Exposed soil surface will be covered as soon as possible to reduce the potential for soil erosion;
- Open stockpiles of construction materials on site will be covered during rainstorms;
- Surface run-off from the construction site will be directed into an existing stream channel 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;
- Silt removal facilities, channels and manholes will 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;
- Construction works should be programmed to minimize soil excavation works in rainy seasons (April to September) as far as practical. If excavation in soil cannot be avoided in these months or at any time of year when rainstorms are likely, for the purpose of preventing soil erosion, temporary exposed slope surfaces should be covered e.g. by tarpaulin, and temporary haul roads should be protected by crushed stone or gravel, as excavation proceeds.
- During excavation in the wet season, temporarily exposed soil surfaces will be covered, and temporary access roads will 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 safety carried out well before the arrival of a rainstorm; and
- 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 excavations will be discharged into storm drains via silt removal facilities.

3.7 Maintenance Responsibilities

3.7.1 The quarry operator should be responsible for all maintenance works to the drainage system of TYNUQ site.

3.8 Conclusion of Drainage Impact Assessment

3.8.1 The latest information on the existing drainage network in the vicinity of the proposed TYNUQ has been collected and reviewed in the DIA Report.

3.8.2 The proposed TYNUQ would include site formation works at Ngau Kok Wan, Tam Kon Shan Road, Wok Tai Wan, and cavern excavation in Shek Wan Hill. However, these works would not interfere with the existing drainage system which collects the surface runoff from northern slopes of Shek Wan Hill.

3.8.3 In general, the flow path and catchments after development of TYNUQ will be similar to those before development. The catchment areas and drainage characteristics of the concerned drawing catchments have no change. Albeit no change of the surface drainage characteristics is anticipated, groundwater seepage in cavern shall generate additional drainage flow.

3.8.4 Due to the coastal location of the TYNUQ, the majority of groundwater seepage from the cavern during construction and operation phase would be discharged to sea via the existing outfall through the existing nullah at Ngau Kok Wan, while some of the groundwater seepage would be discharged to the existing culvert at Tam Kon Shan Road.

3.8.5 Based on the assessment, the groundwater seepage to be discharged from the cavern during construction and operation phase is anticipated to be insignificant, with only <1% increase compared with the existing surface runoff from the catchment to the existing drainage system.

3.8.6 With the proposed drainage channels in place, no potential drainage impacts arising from the proposed TYNUQ are expected to incur on the existing drainage system.

4 Sewerage Impact Assessment

4.1 Objectives

4.1.1 The purpose of this Sewerage Impact Assessment (SIA) is to assess the potential sewerage impact to the existing system arising from the proposed site under the Project and recommend appropriate mitigation measures where adverse impacts are identified.

4.2 Methodology

4.2.1 The volume of sewage generated from the proposed Quarry Sites is estimated in accordance with the Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF) published by EPD.

4.2.2 The unit flow factors (UFF) shown in **Table 4.1** are based on the commercial UFFs in Table T-2 and T-3 of GESF. The peaking factors shown in **Table 4.2** are based on the recommended peaking factors in Table T-5 of GESF. A summary of the unit flow factors and the peaking factors used for different development types are shown below:

Table 4.1 Unit Flow Factors

Activity	Development Type	Unit Flow Factor (m^3/head/day)
-	Employee	0.080
Commercial	Commercial – Mining and Quarrying (J8)	-
Industrial	Industrial activities – Tsing Yi	1.500

Table 4.2 Peaking Factors

Population Range	Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage	Peaking Factor (excluding stormwater allowance) for facility with new upstream sewerage
(a) For sewers		
<1,000	8	6
1,000 – 5,000	6	5
(b) Sewage Treatment Works, Preliminary Treatment Works and Pumping Stations		
<10,000	4	3

4.3 Existing Sewerage System

4.3.1 The DSD drainage record plans was reviewed. No existing sewerage system is available within and in the vicinity of the TYNUQ. The closest sewerage system is located at approximately 620m away to the east of the proposed TYNUQ on Tam Kon Shan Road.

4.3.2 The existing sewerage layout is shown on **Figure 4.1**. In general, an existing sewerage system ranging from dia. 225 mm to 1050 mm pipes conveys sewage from the northwest of Tsing Yi to the Tsing Yi Sewage Pumping Station (TYSPS) at Tsing Yi Heung Sze Wui Road/ Fung Shue Wan Road, then connected to Tsing Yi Preliminary Treatment Works (TYPTW) via pipes ranging from dia. 1200 mm to 1500 mm pipes, before being discharged to Stonecutters Island Sewerage Treatment Works via HATS tunnel.

4.3.3 The design capacity and design maximum flow capacity of TYSPS are 30,240 m^3/day and 1.05 m^3/s respectively. During the period from Jan 2016 to Dec 2017, TYSPS has a recorded maximum average daily flow of 33,733 m^3/d.

4.3.4 The TYPTW is located at Tsing Yi Road to the north of Hong Kong International Terminal. The design capacity and design maximum flow capacity of TYPTW are 87,943 m^3/day and 2.01 m^3/s respectively. During the period from Jan 2016 to Dec 2017, TYPTW has a recorded maximum average daily flow of 58,675 m^3/d.

4.4 Development Population and Sewage Flow Estimation

4.4.1 With reference to an existing local quarry of similar scale, the maximum number of employees working on site in the quarry is estimated to be 100 during construction and operation phase.

4.4.2 The unit flow factor under the category of "J8 Mining and Quarrying" in Table T-2 of EPD's GESF is adopted as described in **Section 4.2**. The total unit flow generated from an employee in a particular trade is the sum of the UFF of the employee and the UFF of commercial activities of a particular trade under consideration.

4.4.3 From the licensed flow data, there were very low or no licensed flows for job types J5 (Import/Export), J7 (Agriculture and Fishing), J8 (Mining and Quarrying) and J12 (Public Administration). The flows from the commercial activities of these job types are either small or incorporated in the unit flow of employees. The activity UFF of these job types is recommended to be zero and thus, the UFF of only a commercial employee of 0.08m^3/head/day can be adopted for estimating the total sewage flow of the quarry activity.

4.4.4 In addition, the concrete batching and asphalt production will be carried out to produce fresh concrete and asphalt within the proposed Quarry Site, and they are categorised as industrial flow. With reference to Table T-3 of EPD's GESF, the catchment-wide UFF for a concrete batching and asphalt production employee in the Tsing Yi area is 1.500m^3/head/day.

4.4.5 The Average Dry Weather Flow (ADWF) is obtained by multiplying the number of employees by the UFF. The ADWF of the proposed quarry development is summarized in **Table 4.3**.

Table 4.3 Estimated Sewage Flow

Activities	Type of Sewage	No. of Employees	UFF (m^3/head/day)	ADWF (m^3/day)
Quarrying	Commercial Flows	70	0	0
	Domestic Sewage		0.08	5.6
Concrete Batching and Asphalt Production	Industrial Wastewater	30	1.50	45.0
	Domestic Sewage		0.08	2.4
Total:	-	100	-	53.0

4.4.6 During the operation stage of the proposed quarry development, works mainly involve quarrying, rock processing, concrete and asphalt production. The sewage generated from the Quarry Site is estimated to be a total of 53.0 m^3/d (ADWF), which is minimal.

4.4.7 The Peak Wet Weather Flow (PWWF) is obtained by multiplying the ADWF by the peaking factor of 8 as stated in Table T-5 of the EPD's GESF. The PWWF of the proposed Quarry Site is 0.005 m^3/s.

4.5 Identification of Potential Sewerage Impacts

4.5.1 The sewage generated by the proposed Quarry Site would not be discharged to the existing sewerage network. Sewage will be treated by the on-site sewage treatment facility with discharge license for the discharge of effluent from the site under the Water Pollution Control Ordinance (WPCO), or tanked away by registered waste collector, which will be described in **Section 4.6**. No impact to the existing sewerage system is thus anticipated.

4.6 Proposed Sewerage Arrangement and Mitigation Measures

4.6.1 The sewage generated from the proposed quarry development can be generally classified into domestic sewage generated by employees and industrial wastewater generated from the concrete batching.

Domestic sewage generated by employees

4.6.2 It is anticipated that the domestic sewage would be collected by proposed chemical toilets and holding tanks, and transferred off site by a registered waste collector. As shown in **Table 4.3**, the domestic sewage generated by employees is about 8 m^3/d. Assuming the holding tank is

to be emptied by the registered waste collector every three days, the required volume of holding tank is about 24 m^3. The dimensions of the proposed holding tank will be 4 m (L) x 4 m (W) x 1.8 m (D), providing storage capacity of 28.8 m^3. Then, sewage will be transported to sewage treatment works for further treatment. The destination will be decided by the Water Pollution Control Ordinance (WPCO) license holder, ideally, Tsing Yi Preliminary Treatment Works.

Industrial wastewater generated from the concrete and asphalt production

4.6.3 The wastewater and slurry generated from the concrete batching will be collected to an on-site wastewater/slurry treatment system. The collected wastewater or slurry containing fine particles is further treated by the facilities of reclaimer and filter press system. Recycled water can be used for dust control measures at the quarry site and recycled aggregates from the concrete batching can be re-used for concrete production. If necessary, discharge license for the discharge of effluent from the site under the Water Pollution Control Ordinance (WPCO) shall be obtained.

4.6.4 Due to special nature of asphalt production, products are produced under high temperature. No wastewater is anticipated to be generated from asphalt production.

4.7 Conclusions of Sewerage Impact Assessment

4.7.1 During the operation phase, the average daily sewage generated from the proposed Quarry Site is minimal.

4.7.2 Domestic sewage will be tanked away by registered waste collector. Industrial wastewater from concrete production will be treated by the on-site wastewater treatment plant and then reuse for production. If necessary, discharge license for the discharge of effluent from the site under the Water Pollution Control Ordinance (WPCO) shall be obtained.

4.7.3 Based on the assessment, no adverse sewerage impact is anticipated from the proposed TYNUQ.

Figures

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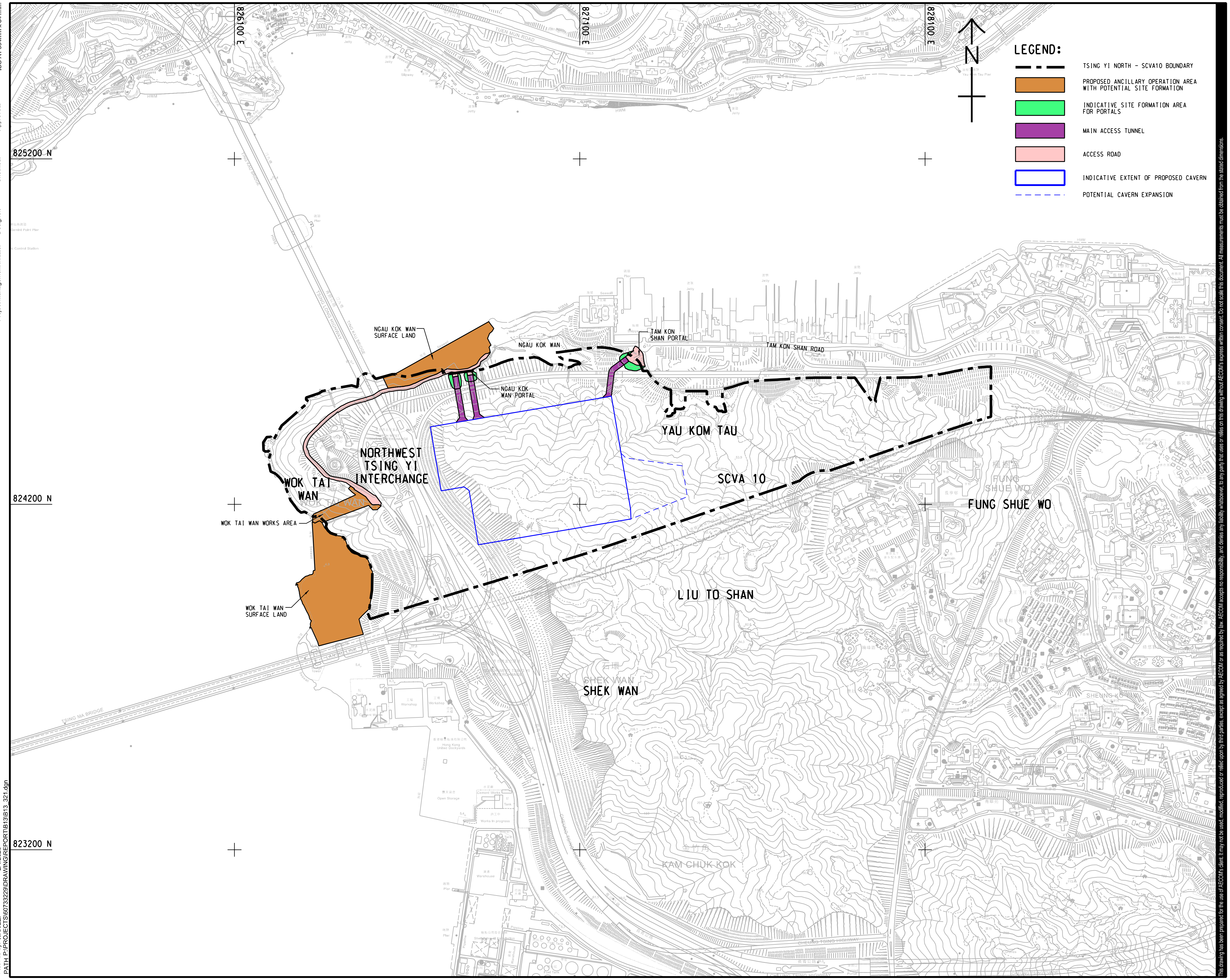
Designer:

Project Management Initials:



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UNDERGROUND QUARRYING AT TSING YI NORTH – INVESTIGATION, DESIGN AND CONSTRUCTION

CLIENT 業主

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STATUS 狀況

SCALE 比例	DIMENSION UNIT 尺寸單位
A3 1 : 10000	METRES

KEY PLAN 索引圖

PROJECT NO. 項目編號	AGREEMENT NO. 協議編號
60733229	CE 79/2023 (GE)

SHEET TITLE 圖紙名稱

PROJECT LOCATING PLAN

SHEET NUMBER 圖紙編號

60733229/B21/FIGURE 2.1

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Designer:

Project Management Initials:

LEGEND:

- TSING YI NORTH - SCVA10 BOUNDARY
- PROPOSED ANCILLARY OPERATION AREA WITH POTENTIAL SITE FORMATION
- PROPOSED PORTAL SITE FORMATION AREA
- ACCESS ROAD
- INDICATIVE EXTENT OF PROPOSED CAVERN
- PROPOSED ACCESS TUNNEL
- POTENTIAL CAVERN EXPANSION

826400 E

826800 E

827200 E

824400 N

824000 N

TSING LONG HIGHWAY

TAM KON SHAN ROAD

OUTFALL 1

OUTFALL 2

OUTFALL 3

OUTFALL 4 (CONNECT TO EXISTING DRAINAGE SYSTEM)

OUTFALL 5

OUTFALL 6

AREA A1

AREA A2

AREA A3

AREA A4

AREA A5

AREA A6

AREA A7

AREA A8

AREA A9

AREA A10

AREA A11

AREA B1

AREA B2

AREA B3

AREA B4

AREA B5

AREA B6

WOK TAI WAN

CATCHMENT NO.	AREA (m^2)	OUTFALL
A1	38175	1
A2	16239	2
A3	6755	
A4	13448	
A5	46919	
A6	69124	
A7	23805	
A8	49353	
SUBTOTAL:	225643	
A9	10678	-
A10	13406	3
A11	4888	4 (EXISTING)
B1	57707	5
B2	43421	-
B3	26815	6
B4	13430	
B5	187992	
B6	49251	
SUBTOTAL:	277488	

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UNDERGROUND QUARRYING AT TSING YI NORTH – INVESTIGATION, DESIGN AND CONSTRUCTION

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SCALE
比例

A3 1 : 4000

DIMENSION UNIT
尺寸單位

METRES

KEY PLAN
索引圖

PROJECT NO.
項目編號

60733229

AGREEMENT NO.
協議編號

CE 79/2023 (GE)

SHEET TITLE
圖紙名稱

DRAINAGE CATCHMENT PLAN (EXISTING SCENARIO)

SHEET NUMBER
圖紙編號

60733229/B21/FIGURE 3.1

ISO A1 594mm x 841mm

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Checked:

Designer:

Project Management Initials:

LEGEND:

- TSING YI NORTH – SCVA10 BOUNDARY
- PROPOSED ANCILLARY OPERATION AREA WITH POTENTIAL SITE FORMATION
- PROPOSED PORTAL SITE FORMATION AREA
- ACCESS ROAD
- INDICATIVE EXTENT OF PROPOSED CAVERN
- PROPOSED ACCESS TUNNEL
- EXISTING NULLAH

826500 E

826700 E

826900 E

824600 N

824400 N

824200 N

EXISTING NULLAH

EXISTING NULLAH

TING KAU BRIDGE

TSING LONG HIGHWAY

青龍公路

TSING YI NORTH COASTAL

青衣北岸公路

NORTH WEST TSING YI INTERCHANGE

青衣西北交匯處

WOK TAI WAN

鑊底灣

CUT LINE A-A

SEE DRAWING NO. 60733229/B21/FIGURE 3.3

CUT LINE B-B

SEE DRAWING NO. 60733229/B21/FIGURE 3.4

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SCALE 比例
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DIMENSION UNIT 尺寸單位
METRES

KEY PLAN
索引圖

PROJECT NO. 項目編號
60733229

AGREEMENT NO. 協議編號
CE 79/2023 (GE)

SHEET TITLE
圖紙名稱

EXISTING DRAINAGE LAYOUT PLAN

SHEET 1 OF 3

SHEET NUMBER
圖紙編號

60733229/B21/FIGURE 3.2

ISO A1 594mm x 841mm

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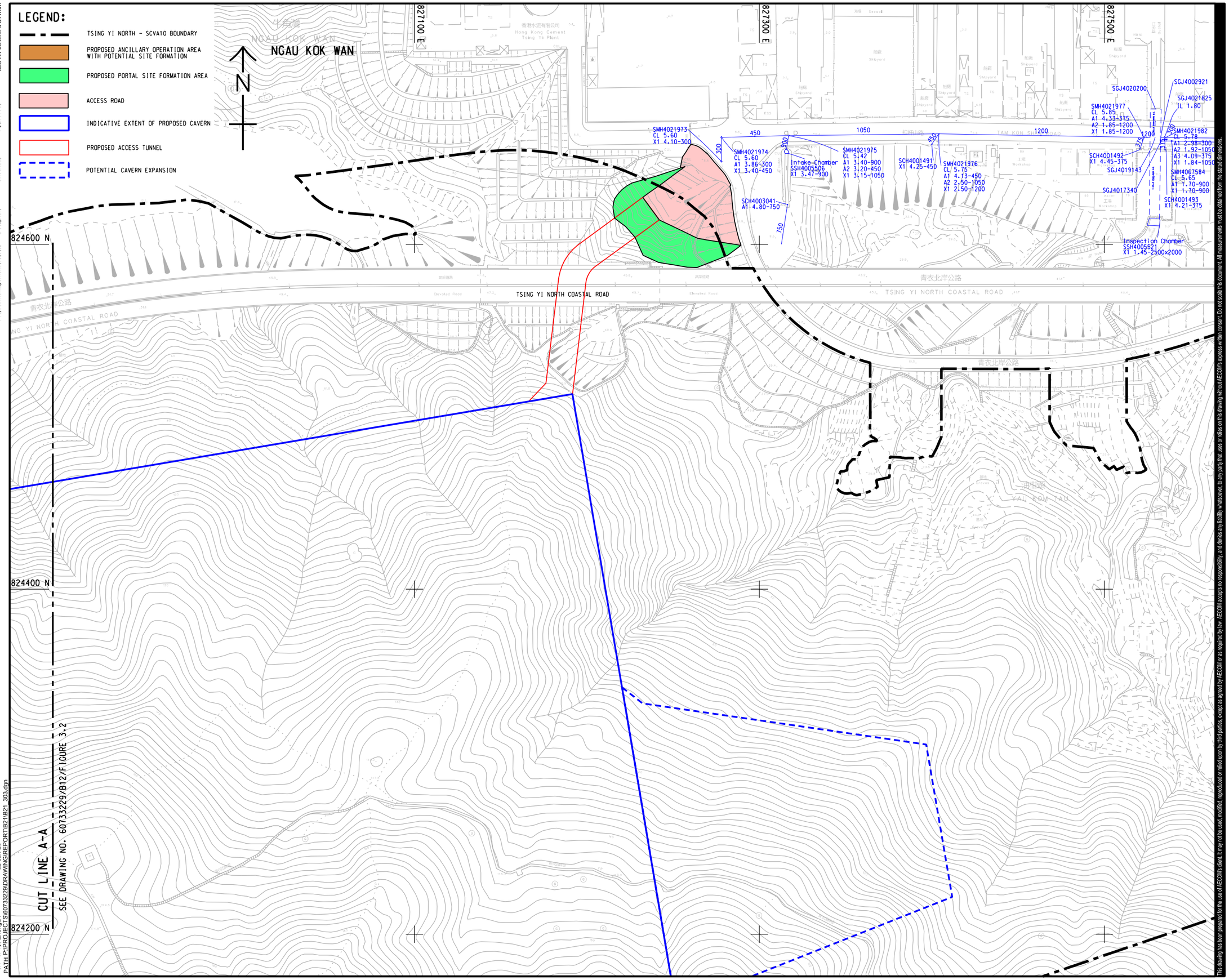
Designer:

Project Management Initials:



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SCALE 比例
A3 1 : 2000

DIMENSION UNIT 尺寸單位
METRES

KEY PLAN
索引圖

PROJECT NO. 項目編號
60733229

AGREEMENT NO. 協議編號
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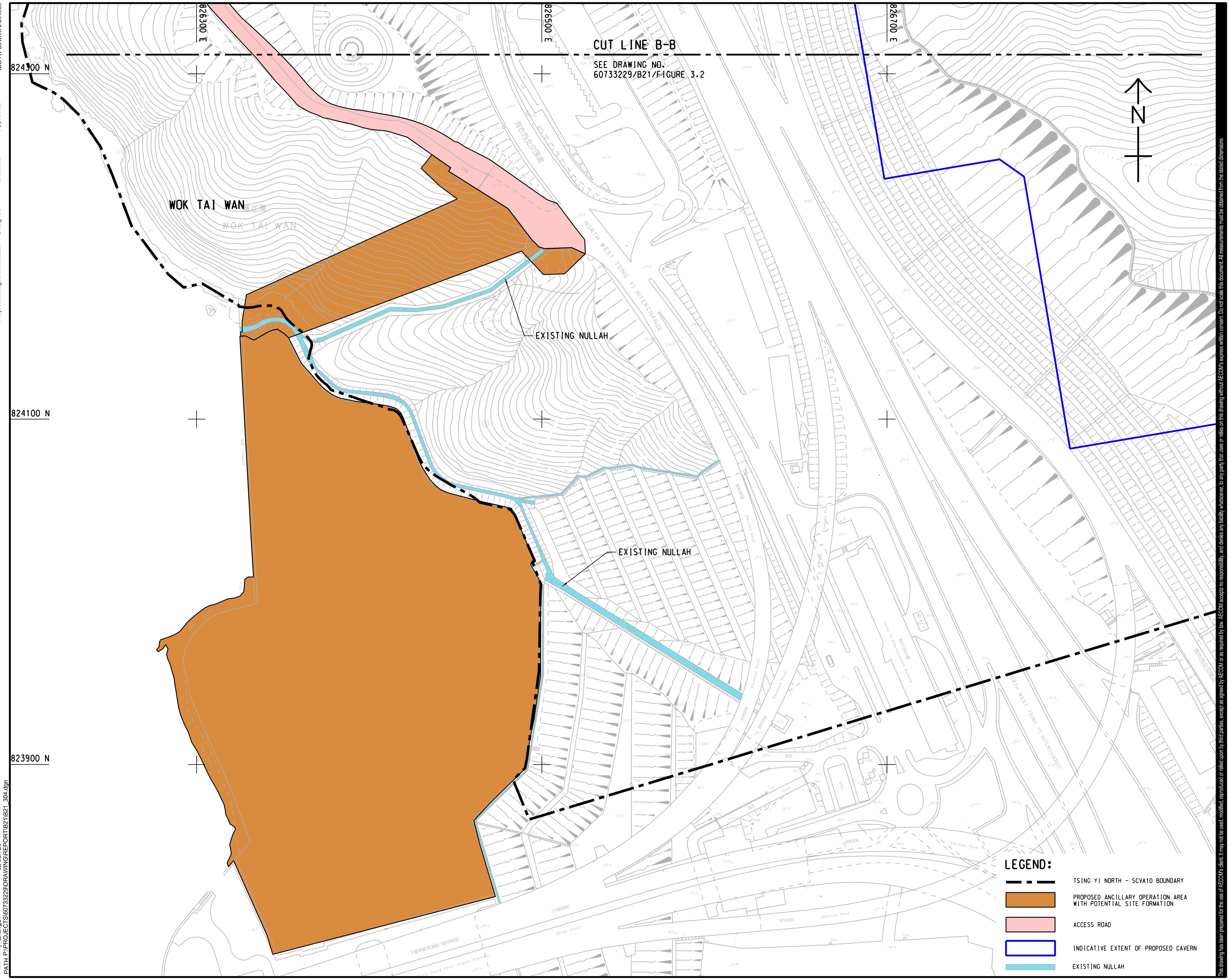
SHEET TITLE
圖紙名稱
EXISTING DRAINAGE LAYOUT PLAN

SHEET NUMBER
圖紙編號
60733229/B21/FIGURE 3.3



ISO A1 594mm x 841mm

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SCALE: A3 1 : 2000

DIMENSION UNIT: METRES

KEY PLAN

PROJECT NO.: 60733229

AGREEMENT NO.: CE 79/2023 (GE)

SHEET TITLE

EXISTING DRAINAGE LAYOUT PLAN

SHEET 3 OF 3

SHEET NUMBER

60733229/B21/FIGURE 3.4

ISO A1 594mm x 841mm

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Designer:

Project Management Initials:

LEGEND:

- TSING YI NORTH - SCVA10 BOUNDARY
- PROPOSED ANCILLARY OPERATION AREA WITH POTENTIAL SITE FORMATION
- PROPOSED PORTAL SITE FORMATION AREA
- ACCESS ROAD
- INDICATIVE EXTENT OF PROPOSED CAVERN
- PROPOSED ACCESS TUNNEL
- POTENTIAL CAVERN EXPANSION

826400 E

826800 E

827200 E

824400 N

824000 N

TSING LONG HIGHWAY

TAM KON SHAN ROAD

OUTFALL 1

OUTFALL 2

OUTFALL 3

OUTFALL 4 (CONNECT TO EXISTING DRAINAGE SYSTEM)

OUTFALL 5

OUTFALL 6

AREA A1

AREA A2

AREA A3

AREA A4

AREA A5

AREA A6

AREA A7

AREA A8

AREA A9

AREA A10

AREA A11

AREA B1

AREA B2

AREA B3

AREA B4

AREA B5

AREA B6

WOK TAI WAN

CATCHMENT NO.	AREA (m^2)	OUTFALL
A1	38175	1
A2	16239	2
A3	2647	
A4	13448	
A5	46919	
A6	69124	
A7	23805	
A8	53461	
SUBTOTAL:	225643	
A9	10678	-
A10	13406	3
A11	4888	4 (EXISTING)
B1	57707	5
B2	43421	-
B3	26815	6
B4	13430	
B5	187992	
B6	49251	
SUBTOTAL:	277488	

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SCALE 比例: A3 1 : 4000

DIMENSION UNIT 尺寸單位: METRES

KEY PLAN
索引圖

PROJECT NO. 項目編號: 60733229

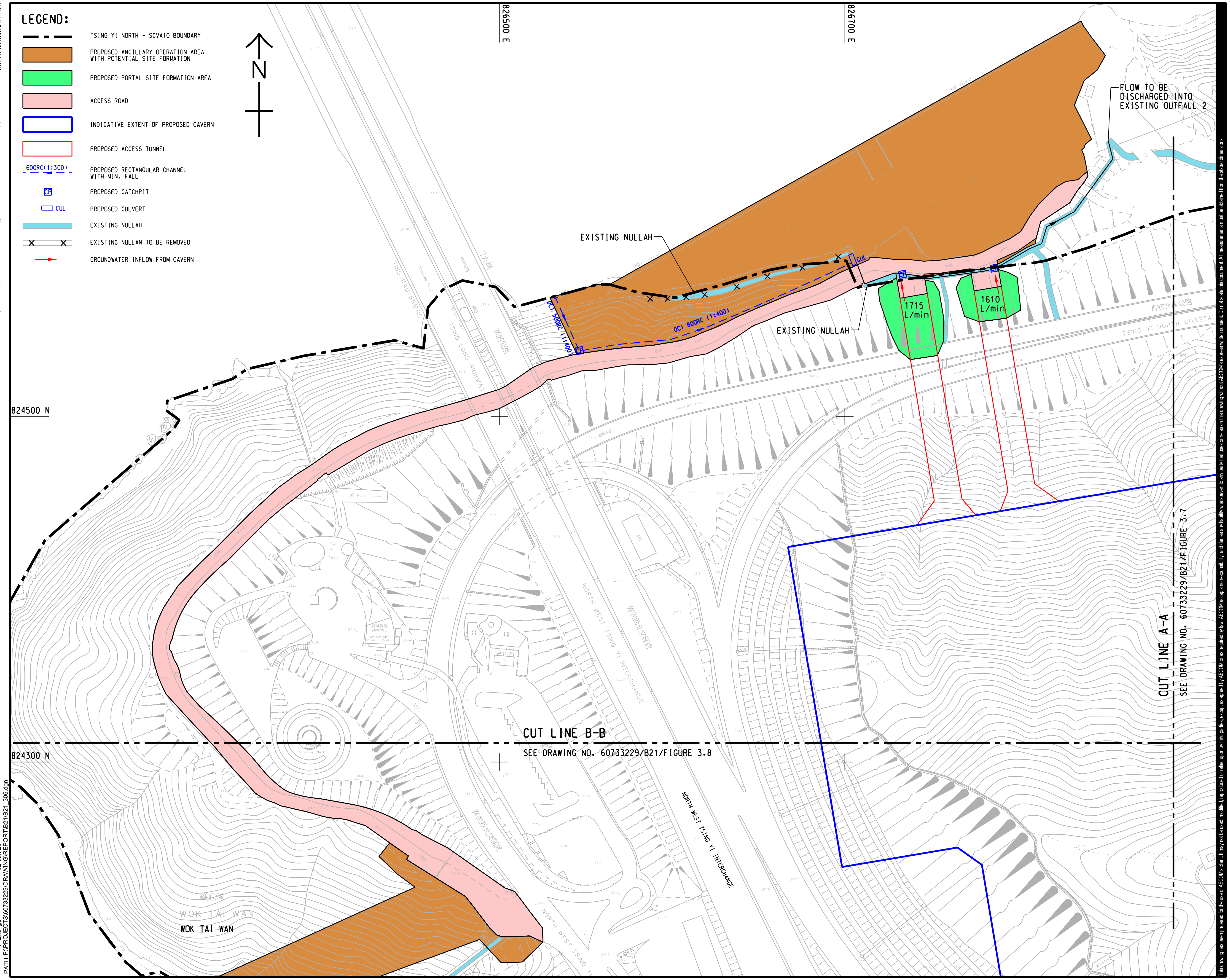
AGREEMENT NO. 協議編號: CE 79/2023 (GE)

SHEET TITLE
圖紙名稱

DRAINAGE CATCHMENT PLAN (FUTURE SCENARIO)

SHEET NUMBER
圖紙編號

60733229/B21/FIGURE 3.5



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SCALE 比例	DIMENSION UNIT 尺寸單位
A3 1 : 2000	METRES

KEY PLAN
索引圖

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60733229	CE 79/2023 (GE)

SHEET TITLE
圖紙名稱

PROPOSED DRAINAGE LAYOUT PLAN

SHEET 1 OF 3

SHEET NUMBER
圖紙編號

60733229/B21/FIGURE 3.6

ISO A1 594mm x 841mm

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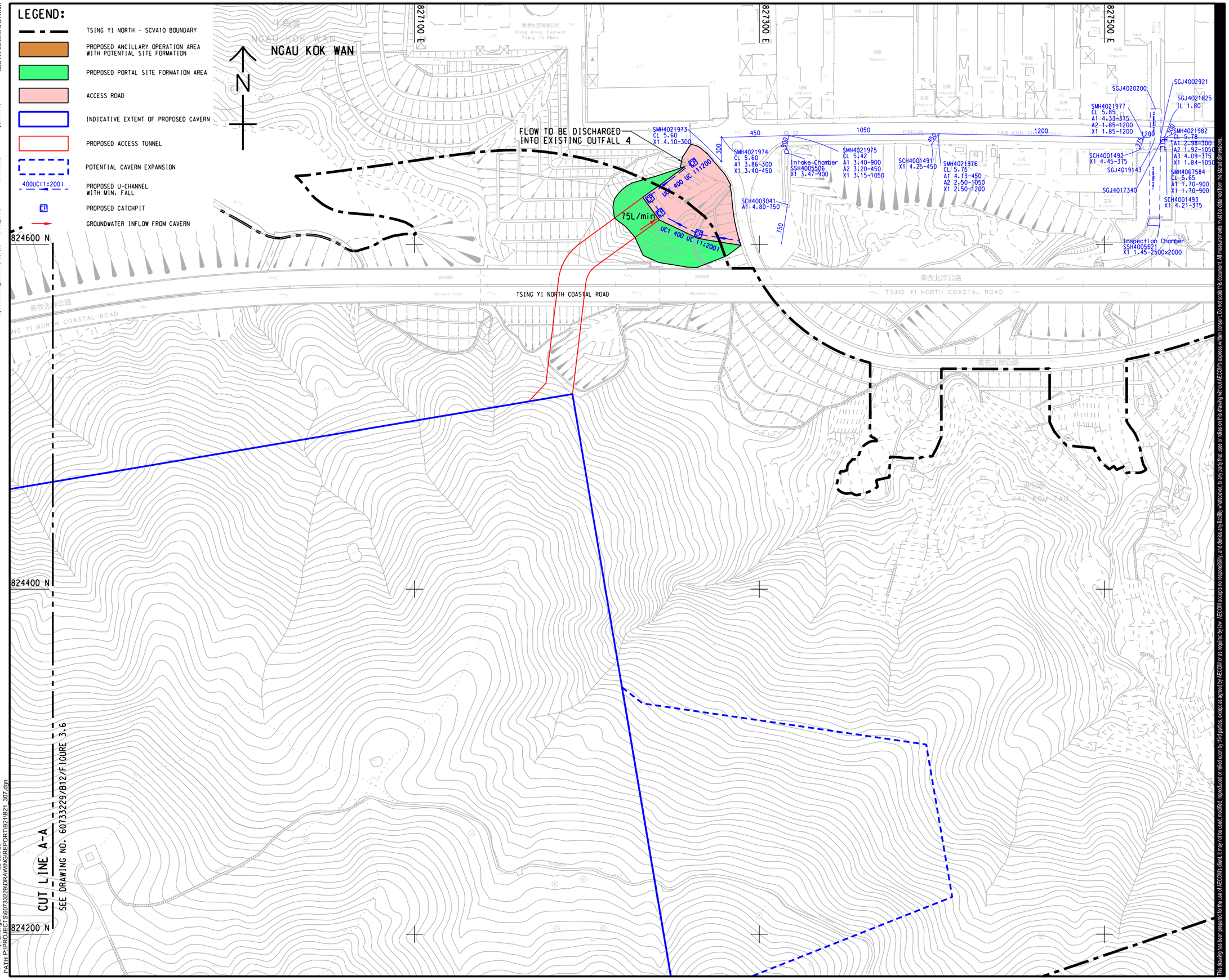

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SCALE 比例
A3 1 : 2000

DIMENSION UNIT 尺寸單位
METRES

KEY PLAN
索引圖

PROJECT NO. 項目編號
60733229

AGREEMENT NO. 協議編號
CE 79/2023 (GE)

SHEET TITLE
圖紙名稱
PROPOSED DRAINAGE LAYOUT PLAN

SHEET 2 OF 3

SHEET NUMBER
圖紙編號
60733229/B21/FIGURE 3.7

ISO A1 594mm x 841mm

Approved:

Checked:

Designer:

Project Management Initials:

826300 E

826500 E

826700 E

CUT LINE B-B

SEE DRAWING NO.
60733229/B21/FIGURE 3.6

824300 N

824100 N

823900 N

N

WOK TAI WAN

WOK TAI WAN

NORTH WEST TSING YI INTERCHANGE

EXISTING NULLAH

FLOW TO BE DISCHARGED INTO
EXISTING OUTFALL 6

EXISTING NULLAH

LEGEND:

- TSING YI NORTH - SCVA10 BOUNDARY
- PROPOSED ANCILLARY OPERATION AREA WITH POTENTIAL SITE FORMATION
- ACCESS ROAD
- INDICATIVE EXTENT OF PROPOSED CAVERN
- EXISTING NULLAH

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UNDERGROUND QUARRYING AT TSING YI NORTH – INVESTIGATION, DESIGN AND CONSTRUCTION

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地位

SCALE
比例

A3 1 : 2000

DIMENSION UNIT
尺寸單位

METRES

KEY PLAN
索引圖

PROJECT NO.
項目編號

60733229

AGREEMENT NO.
合約編號

CE 79/2023 (GE)

SHEET TITLE
圖紙名稱

PROPOSED DRAINAGE LAYOUT PLAN

SHEET 3 OF 3

SHEET NUMBER
圖紙編號

60733229/B21/FIGURE 3.8

ISO A1 594mm x 841mm

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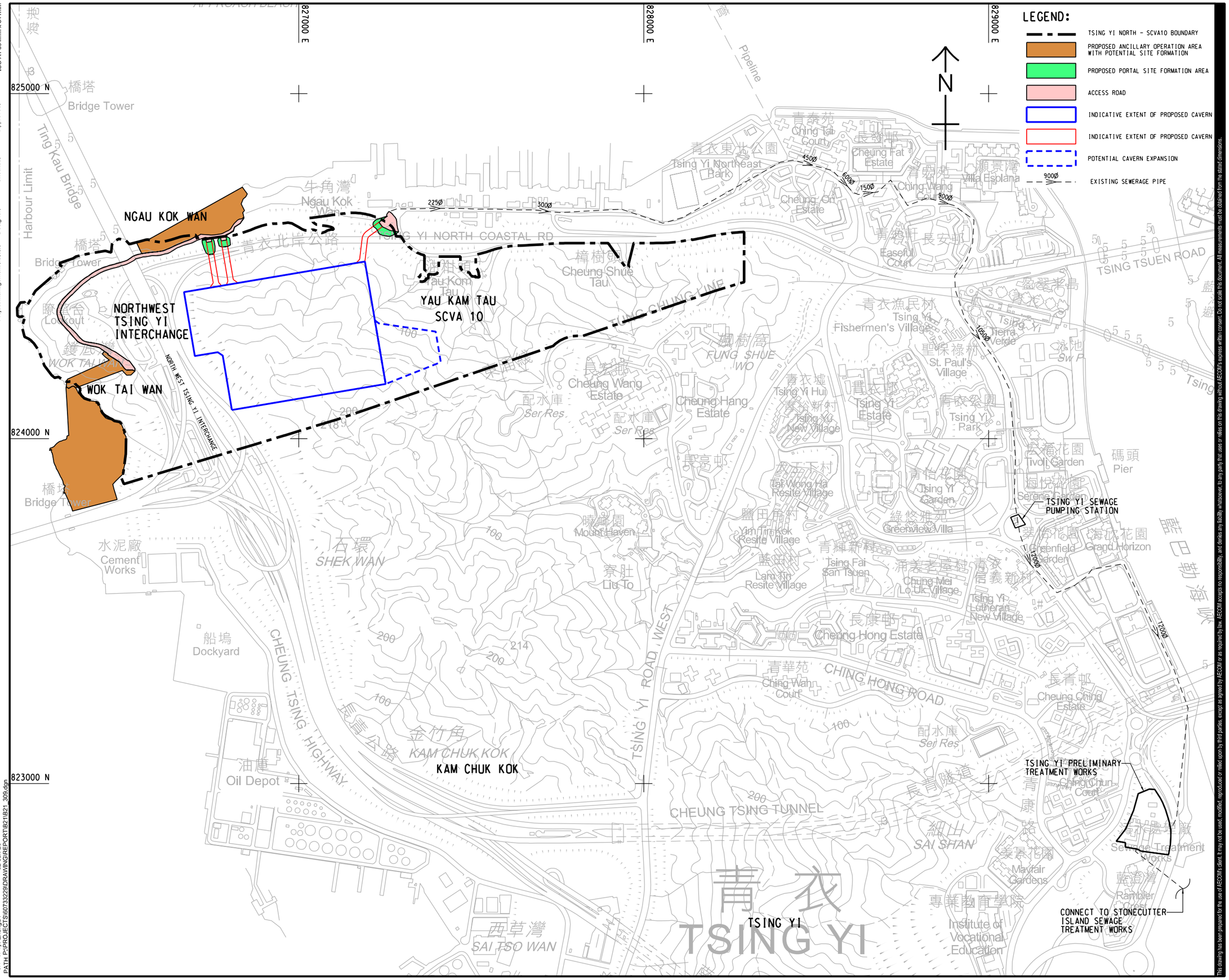
Checked:

Designer:

Project Management Initials:



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SCALE 比例
A3 1 : 10000

DIMENSION UNIT 尺寸單位
METERS

KEY PLAN
索引圖

PROJECT NO. 項目編號
60733229

AGREEMENT NO. 協議編號
CE 79/2023 (GE)

SHEET TITLE
圖紙名稱

EXISTING SEWERAGE LAYOUT PLAN

SHEET NUMBER
圖紙編號

60733229/B21/FIGURE 4.1

Appendix A
Estimation of the Existing Catchment Runoff

Runoff Coefficient, C = 0.5 (unpaved) 0.95 (paved)

a = 508.8
b = 3.46
c = 0.322

Catchment No.	Existing Catchment Area (m^2)	Outfall	Unpaved	Paved	Cumul. CA (m^2)	Length (m)	Height (m)	Gradient	Time of Concentration (min)	Intensity (mm/hr)	Runoff (m^3/s)
A1	38175	1	38175	0	19087.5	121	90	0.744	2.574	285.226	1.514
A2	16239	2	13683	2556	9269.7	80	42.5	0.531	1.983	294.856	0.760
A3	6755		5499	1256	3942.7	40	16.7	0.418	1.136	311.364	0.341
A4	13448		13448	0	6724	260	122	0.469	6.732	240.928	0.450
A5	46919		46919	0	23459.5	283	125	0.442	6.546	242.365	1.581
A6	69124		68008	1116	35064.2	433	142	0.328	10.225	219.115	2.136
A7	23805		21238	2567	13057.65	125	44.5	0.356	3.231	275.898	1.002
A8	49353		44223	5130	26985	200	125	0.625	4.294	263.102	1.974
Subtotal	225643	2									8.243
A9	10678	-	10678	0	5316.5	60	40	0.667	1.482	304.166	0.450
A10	13406	3	13406	0	6611	60	45	0.750	1.415	305.508	0.561
A11	4888	4	4888	0	2444	85	44	0.518	2.388	288.120	0.196
B1	57707	5	57707	0	28853.5	393	51	0.130	11.375	213.497	1.713
B2	43421	-	43421	0	21710.5	105	57	0.543	2.349	288.747	1.743
B3	26815	6	26815	0	13407.5	132	59	0.447	3.221	276.024	1.029
B4	13430		13430	0	6715	110	56	0.509	2.802	281.835	0.526
B5	187992		187992	0	93996	700	215	0.307	15.154	198.453	5.186
B6	49251		49251	0	24625.5	90	0.3	0.003	5.505	251.090	1.719
Subtotal	277488	6									8.460

Appendix B
Hydraulic Checking of the Proposed Drainage System

Hydraulic Checking of Channels

a = 508.8
b = 3.46
c = 0.322

Runoff Coefficient, C = 0.5 (unpaved) 0.95 (paved) n = 0.013

	Catchment Parameter					Channel Parameters								Capacity Checking					
Name of Channel	Catchment	Area (m^2)	Unpaved area (m2)	Paved area (m2)	Cumul. CA (m^2)	Length (m)	Size (mm)	Gradient		R (m)	A (m^2)	Velocity (m/s)	Capacity (m^3/s)	Time of Entry (min)	Time of Flow (min)	Time of Concentration (min)	Intensity (mm/hr)	Runoff (m^3/s)	% of Channel Capacity
DC 1	A3	2647	1391	1256	1888.7	35	500	1 in 400	0.0025	0.17	0.25	1.16	0.29	1.136	0.501	1.637	301.165	0.158	54.30%
DC 2	A2 + A3	18886	15074	3812	11158.4	170	800	1 in 400	0.0025	0.27	0.64	1.59	1.02	1.983	1.778	3.761	269.203	0.835	81.89%
UC 1	A11	4888	4888	0	2444	95	400	1 in 200	0.0050	0.14	0.14	1.46	0.21	2.388	1.085	3.473	272.750	0.185	88.94%