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Agreement No. CE40/2023 (CE)

Development of Tseung Kwan O Area 137 and Associated Reclamation Sites - Investigation, Design and Construction

Sediment Sampling and Testing Plan (Final)

February 2024



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7 February 2024

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1 INTRODUCTION

1.1 Background

- 1.1.1 Tseung Kwan O Area 137 (TKO 137), located to the south of Tseung Kwan O InnoPark (TKOIP), is a sizeable piece of formed land of around 80 hectares (ha). Most of the land is currently being used as a temporary fill bank for storing public fill for reuse in reclamation. In anticipation of future reclamation works that might take up the public fill from TKO 137 progressively, the opportunity to re-plan TKO 137 for gainful uses arises.
- 1.1.2 With the growing concern on making the best use of the limited land resource, the 2016-17 Policy Address (PA) announces to carry out the re-planning for the development of the land at TKO 137 and examine the feasibility of using the site for residential, commercial and other development purposes.
- 1.1.3 To take forward the re-planning process, CEDD and PlanD jointly commissioned the “Planning and Engineering Study for Re-planning of TKO 137” (the P&E Study) in December 2016, with a view to ascertaining and maximising the development potential of the available land in TKO 137.
- 1.1.4 The Government has announced in the 2022 PA that TKO 137 would be developed into a new community primarily for housing purpose providing about 50,000 residential units, to be served by the existing road network, as well as the TKO Line Southern Extension (TKOLSE) and the Tseung Kwan O – Yau Tong Tunnel (TKO-YTT) recommended under the Strategic Studies on Railways and Major Roads beyond 2030 (RMR 2030+) by Transport and Logistics Bureau (TLB). At the same time, to make way for the housing development at TKO 137, a review has been conducted to identify suitable locations for accommodating existing public facilities in TKO 137 and other location-specific public facilities. The works for TKO 137 shall commence in 2025, with the first population intake in 2030.

TKO 137

- 1.1.5 Making good use of this rare, vast piece of formed land in the metro area, TKO 137 would be developed into a new community with a maximum domestic plot ratio of 7.5 that translates into about 50,000 housing units for a total population of around 135,000. With a public-to-private housing split of 70:30, around 34,500 public housing units and 15,500 private residential units could be provided. As a major source of housing supply in the short to medium term, these housing units will start coming on stream with first population intake of around 34,000 people involving 12,600 units in 2030.
- 1.1.6 To build a community well supported by ancillary facilities, available land in TKO 137 would be made for retail and other commercial facilities, government, institution and community (GIC) uses, recreational and open space, as well as infrastructure. The vision of more spacious and better living space in the “Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030” Study has been factored in and reflected in the development parameters by the assumption of larger flat sizes for land use planning (a 10% home space enhancement for both public and private housing) and adoption of higher open space planning ratio (3.5m² per person compared with existing 2m²). Government, Institution and Community (GIC) facilities include healthcare and welfare facilities, schools, community hall, public transport interchanges (PTI), sports centres, swimming pool complex, etc. Having regard to its waterfront location, a stepped building height profile descending from northeast to southwest and towards the waterfront should be created. The roads and development sites would be aligned with the prevailing wind directions, such that the visual interest and air ventilation could be enhanced.

Land to be created off Tseung Kwan O Area 132 (TKO 132)

- 1.1.7 About 25 ha of land off TKO 132 through reclamation and slope-cutting is proposed for accommodating six location-specific public facilities that all require marine frontage for daily operation. Other than the need to re-provision a public fill transfer facility (PFTF) and a concrete batching plant (CBP) from TKO 137, the land to be created off TKO 132 will be used to accommodate an important strategic Electricity Facilities (EFs) for enhancing Hong Kong’s capability to import zero-carbon energy through regional cooperation and meeting the decarbonisation target of reducing Hong Kong’s carbon emissions by 50% before 2035 as compared to the 2005 level, with a view to achieving carbon neutrality before 2050. A

construction waste handling facility (CWHF), a refuse transfer station (RTS) and a marine refuse collection point (MRCP) are also proposed for serving the territory east area including TKO. The land in-take and layout design should be further optimised in the investigation phase.

- 1.1.8 Location-wise, the land to be created off TKO 132 is at a relatively obscure area and with a buffer distance of around 1 kilometre (km) from the nearest residential development in TKO. With direct access to the TKO – Lam Tin Tunnel (TKOLT), when commuting to and from Kowloon, the traffic induced by the public facilities would not route through existing road network in the TKO town centre, thus minimising any possible nuisance to local residents.

1.2 The Project

- 1.2.1 AECOM-BINNIES JV (hereafter refers as the Consultants) has been commissioned by CEDD to undertake Agreement No. CE 40/2023 (CE) – Development of Tseung Kwan O Area 137 and Associated Reclamation Sites – Investigation, Design and Construction. The consultancy commenced on 14 November 2023 for a contract period of 158 months.

- 1.2.2 The proposed scope of the Project includes reclamation, slope-cutting, site formation and engineering infrastructure works for the development at TKO 137, off TKO 132 and within TKO as shown on the general layout plan in **Appendix A**, comprises the following principal works elements:

(a) Works in TKO 137

- i. Reclamation of about 20 ha of seabed abutting the coastal area and associated site formation works;
- ii. Site formation works of the existing land area at TKO 137;
- iii. Engineering infrastructure works including roads, drainage, sewerage including sewage pumping stations and waterworks including pumping stations, service reservoirs and the associated water mains, access roads and other facilities to support the proposed developments;
- iv. A Sewage Treatment Works (STW) at TKO 137 and associated effluent pipeline and submarine outfall (The Consultant carries out preliminary design and conducts statutory Environmental Impact Assessment (EIA) for the STW under this Designated Project under Schedule 2 in the Investigation Phase. The subsequent design and construction would be handed over to Drainage Services Department (DSD));
- v. Landscaping, streetscaping and ancillary works; and
- vi. Provision of environmental mitigation measures for the works mentioned above;

(b) Works in TKO 132

- i. Formation of about 25 ha of land off TKO 132 through reclamation and slope-cutting and associated site formation works for the proposed developments;
- ii. Construction of marine viaducts to connect the land to be created off TKO 132 to existing Tseung Kwan O Cross Bay Link and/or TKO-LTT; and
- iii. Engineering infrastructure works including roads, drainage, sewerage and

(c) Ancillary works within TKO

- i. Road/ junction improvement works;
- ii. Hiking trails/ connection to recreational facilities; and
- iii. Open space works.

- 1.2.3 The scope of the Project is not limited to the details above. The Project refers to those works including reclamation, site formation, engineering infrastructure, environmental mitigation measures, geotechnical works, natural terrain hazard mitigation measures, landscaping and associated works which are necessary or desirable for the successful implementation of the proposed development. For the avoidance of doubt, GIC facilities for leisure, cultural, municipal, health, education, community service and utility, premises and associated facilities for the operation of the private housing construction shall be deemed to be outside the scope of the Project.

- 1.2.4 The land to be created off TKO 132 is designated for relocation of public facilities to allow the site at TKO 137 to be vacated for residential development and accommodating other public facilities in 2028 earliest. The first phase of TKO 137 shall be handed over for land development by 2025 for subsequent housing construction while infrastructure works will be

carried out in parallel. The development at TKO 137 would also be affected by the decanting programme of TKOFB and CBP as well as the actual decommissioning date of the SENT Landfill extension nearby. A detailed interface programme is required and to be agreed with relevant departments.

- 1.2.5 With a view to fast-tracking the land formation works (including slope-cutting and/or reclamation) at both TKO 137 and TKO 132 and the construction of viaducts connecting TKO 132 to TKO-LTT and/or TKO Cross Bay Link to facilitate timely provision of lands and relocation/construction of facilities, the land formation works and the construction of viaducts should be procured by means of D&B contract(s) unless otherwise agreed with the Employer's Agent. The construction works shall commence in 2025.

1.3 Objective of this Plan

- 1.3.1 In accordance with Clause 3 in Appendix F of the EIA Study Brief (EIA Study Brief No. ESB-360/2023), the Applicant shall identify and estimate dredging/excavation, dredged/excavated sediment/mud transportation and disposal activities and requirements. Potential dumping ground to be involved shall also be identified. Appropriate field investigation, sampling, and chemical and biological laboratory tests to characterise the sediment/mud concerned shall be conducted for marine disposal option. The ranges of parameters to be analysed; the number, type and methods of sampling; sample preservation; chemical and biological laboratory test methods to be used shall be agreed with the Director of Environmental Protection (DEP) (with reference to Section 4.4.2(c) of the Technical Memorandum on the Environmental Impact Assessment Process (EIAO-TM)) prior to the commencement of the tests and document in the EIA report for consideration.
- 1.3.2 Following the above, this Sediment Sampling and Testing Plan (SSTP) is to present the sediment sampling and testing requirements according to Clause 3 in Appendix F of the EIA Study Brief for DEP agreement for the potential sediment dredging/excavation. The SSTP is prepared with reference to paragraph 4.2.1 of Chapter 4 of the Project Administration Handbook for Civil Engineering Works (PAH) (subsumed from *ETWB TCW No. 34/2002 – Management of Dredged/Excavated Sediment* (ETWB TCW No. 34/2002)). Findings from the sediment sampling and testing exercise will be used to assess the waste management implications associated with the potential sediment dredging/excavation (if any) under the EIA Study.
- 1.3.3 This SSTP and the related sediment sampling and testing would only serve the purpose of fulfilling the EIA Study of this Project. It should be noted that to fulfil the requirements under the Dumping at Sea Ordinance (DASO), a separate SSTP may need to be submitted to the Marine Dumping Control Section of Environmental Protection Department (EPD) for agreement for the application of the dumping permit at a later stage of the Project. If necessary, Preliminary Sediment Quality Report (PSQR) and Sediment Quality Report (SQR) will also need to be submitted to the Marine Dumping Control Section of EPD for the dumping permit application as per paragraph 4.2.1 of the PAH. Furthermore, the rationale for sediment removal should also be provided to the Secretary of Marine Fill Committee (MFC) for agreement in accordance with paragraph 4.2.1 of the PAH.

1.4 Structure of Plan

- 1.4.1 Apart from this introductory section, the other sections of the SSTP are as follows:
- **Section 2** presents the guidelines and criteria for the sediment assessment;
 - **Section 3** describes the possible sediment removal works and reclamation areas;
 - **Section 4** reviews the existing sediment quality;
 - **Section 5** discusses the sediment sampling plan;
 - **Section 6** presents the laboratory analysis requirements;
 - **Section 7** outlines the tentative programme for the sediment sampling and testing; and
 - **Section 8** presents the conclusion.

2 ENVIRONMENTAL GUIDELINES AND CRITERIA

2.1 Legislation and Guidelines

2.1.1 Paragraph 4.2.1 of Chapter 4 of the PAH (subsumed from ETWB TCW No. 34/2002) sets out the procedure for seeking approval to and the management framework for marine disposal of dredged/excavated sediment. It outlines the requirements to be followed in assessing and classifying the sediment and explains the marine disposal arrangement for the classified material. Based on paragraph 4.2.1 and Appendix 4.30 of the PAH, there are 3 types of disposal options for dredged/excavated sediments.

- Type 1 - Open Sea Disposal or Open Sea Disposal in Dedicated Sites;
- Type 2 - Confined Marine Disposal; and
- Type 3 – Special Treatment / Disposal

2.1.2 According to Appendix 4.30 of the PAH, the management framework of dredged/excavated sediment in Hong Kong is implemented under the following three-tier approach.

2.2 Tier I Screening

2.2.1 Tier I screening is a desktop study to review the available information and to determine whether the sediment of concern belongs to Category L materials that are suitable for open sea disposal. If there is insufficient information to arrive at such conclusion, Tier II chemical screening should be proceeded accordingly.

2.3 Tier II Chemical Screening

2.3.1 The Tier II chemical screening is designed to categorise the sediment based on its chemical contaminant levels and to determine whether the sediment is suitable for open sea disposal without further testing. Sediment will be assessed according to the sediment quality criteria for the classification of sediment as stipulated in Appendix 4.28 of the PAH and as shown in **Table 2.1** below.

Table 2.1 Sediment Quality Criteria for the Classification of Sediment

Contaminants	Lower Chemical Exceedance Level (LCEL)	Upper Chemical Exceedance Level (UCEL)
Metals (mg/kg dry wt.)		
Cadmium (Cd)	0.8	4
Chromium (Cr)	80	160
Copper (Cu)	65	110
Mercury (Hg)	0.3	1
Nickel (Ni)*	40	40
Lead (Pb)	75	110
Silver (Ag)	1	2
Zinc (Zn)	200	270
Metalloid (mg/kg dry wt.)		
Arsenic (As)	20	42
Organic-PAHs (µg/kg dry wt.)		
Low Molecular Weight PAHs	550	3160
High Molecular Weight PAHs	1700	9600
Organic-non-PAHs (µg/kg dry wt.)		
Total PCBs	23	180
Organometallics (µg TBT/L in Interstitial water)		
Tributyltin*	0.15	0.15

Remark:

* The contaminant level is considered to have exceeded the UCEL if it is greater than the value shown.

Sediment will be classified into the following 3 categories based on the sediment quality criteria:

- Category L Sediment with all contaminant levels not exceeding the Lower Chemical Exceedance Level (LCEL). The material must be dredged, transported and disposed of in a manner which minimizes the loss of contaminants either into solution or by resuspension.
- Category M Sediment with any one or more contaminant levels exceeding the LCEL and none exceeding the Upper Chemical Exceedance Level (UCEL). The material must be dredged and transported with care, and must be effectively isolated from the environment upon the final disposal.
- Category H Sediment with any one or more contaminant levels exceeding the (UCEL). The material must be dredged and transported with great care, and must be effectively isolated from the environment upon the final disposal.

2.3.2 Category L sediment will require Type 1 disposal. Category M sediment and Category H sediment with all contaminant levels at or below the 10 times the LCEL will require Type 2 disposal. For Category H sediment with one or more contaminant levels exceeding 10 times the LCEL, Tier III biological screening will be required to determine the disposal options.

2.4 Tier III Biological Screening

2.4.1 The Tier III biological screening is to identify the most appropriate disposal option for Category H sediment with one or more contaminant levels exceeding 10 times the LCEL (either Type 2 or Type 3 disposal).

2.4.2 Sediment classified as Category H and with one or more contaminant levels exceeding 10 times the LCEL will be subjected to the following two toxicity tests in a diluted manner (dilution test):

- A 10-day burrowing amphipod toxicity test; or
- A 20-day burrowing polychaete toxicity test.
- and
- A 48-96 hour larvae (bivalve or echinoderm) toxicity test.

2.4.3 **Table 2.2** summarises the details of the test endpoints and failure criteria of the toxicity tests. The sediment is deemed to have failed the biological test if it fails in any one of the two selected toxicity tests:

Table 2.2 Test Endpoints and Decision Criteria for Tier III Biological Screening

Toxicity Test	Endpoints Measured	Test Methods	Failure Criteria
10-day amphipod	Survival	USEPA Standard Methods for Assessing Toxicity of Sediment-associated Contaminants with Estuarine and Marine Amphipods, 1994	Mean survival in test sediment is significantly different ($p \leq 0.05$) ¹ from mean survival in reference sediment and mean survival in test sediment <80% of mean survival in reference sediment.
		GB 30980-2014 - The assessment procedure for marine dumping of dredged material.	

Toxicity Test	Endpoints Measured	Test Methods	Failure Criteria
20-day polychaete worm	Dry Weight ²	PSEP Standard Recommended Guidelines for Conducting Laboratory Bioassays on the Puget Sound Sediments – Juvenile Polychaete Sediment Bioassay, 1995	Mean dry weight in test sediment is significantly different ($p \leq 0.05$) ¹ from mean dry weight in reference sediment and mean dry weight in test sediment <90% of mean dry weight in reference sediment.
		GB 30980-2014 - The assessment procedure for marine dumping of dredged material.	
48-96 hour larvae (bivalve or echinoderm)	Normality Survival ³	PSEP Standard Recommended Guidelines for Conducting Laboratory Bioassays on the Puget Sound Sediments – Bivalve Larvae or Echinoderm Embryo Sediment Bioassay, 1995	Mean normality survival in test sediment is significantly different ($p \leq 0.05$) ¹ from mean normality survival in reference sediment and mean normality survival in test sediment <80% of mean normality survival in reference sediment.
		GB 30980-2014 - The assessment procedure for marine dumping of dredged material.	

Remarks:

1. Statistically significant differences should be determined using appropriate two-sample comparisons (e.g. *t*-tests) at a probability of $p \leq 0.05$.
2. Dry weight means total dry weight after deducting dead and missing worms.
3. Normality survival integrates the normality and survival end points, and measures survival of only the normal larvae relative to the starting number.

2.4.4 Category H sediment that fails the dilution test will require Type 3 special treatment / disposal.

3 POSSIBLE SEDIMENT REMOVAL WORKS

3.1.1 Based on the latest engineering design, sediment may need to be removed at/off TKO 137 and TKO132. Details of the sediment removal works are discussed below.

TKO 137

3.1.2 Marine-based sediment may need to be removed for the reclamation works and marine section of the submarine outfall construction at TKO 137. For the reclamation works, the proposed maximum depth of marine-based sediment removal is 5 m below seabed level. For the marine section of the submarine outfall construction, the proposed maximum excavation depth is -50 mPD (likely below the base of marine deposit layer). Subject to further engineering design, the total estimated volume of marine-based sediment to be removed is roughly 1,222,630 m³. The tentative layout plan and potential area of sediment removal are shown in **60720423/B09B/701** and are subjected to further engineering review under this Project.

3.1.3 In addition to the above, the existing land area at TKO 137 is reclaimed land and there could be land-based marine deposits underneath the fill stratum within the area. Based on available geological records and ground investigation works conducted (refer to **Appendix B**), marine deposits / disturbed marine deposits (with top level ranging from -10.43 mPD to -17.73 mPD) are present within / in the vicinity of the STW and submarine outfall (land section) (refer to **60720423/B09B/701**). The land-based marine deposits may need to be excavated during the construction works for the STW and submarine outfall (land section) if deep excavation works are required. For the submarine outfall (land section) construction, the proposed maximum excavation depth is -50 mPD (likely near the base of marine deposit layer). Subject to further engineering design, the estimated volume of land-based sediment to be removed is roughly 1,025 m³. For the STW construction, subject to the foundation design at a later detailed design stage, roughly 2,000 m³ of land-based sediment may need to be removed for the piling works.

TKO 132

3.1.4 Marine-based sediment may need to be removed for the reclamation works, breakwater construction and dredging operation for marine traffic access at / off TKO132. Depending on the geological conditions, the proposed maximum depths of sediment removal will either be 0.5 m, 2 m, or 5 m below seabed level. Subject to further engineering design, the total estimated volume of marine-based sediment to be removed is roughly 642,618 m³. The tentative layout plan and potential area of sediment removal are shown in **60720423/B09B/702** and are subjected to further engineering review under this Project.

3.1.5 The construction works that may require sediment removal for TKO 137 and TKO 132 under the Project and the corresponding estimated volumes of sediment to be removed are summarised in **Table 3.1**. Ways for reducing the amount of removed sediment and the reuse of the removed sediment would be further explored under the EIA Study.

Table 3.1 Summary of Construction Works that may Require Sediment Removal and the Corresponding Estimated Volumes of Sediment to be Removed under the Project

Types of Construction Works	Types of Sediment to be Removed	Proposed Maximum Depth of Sediment Removal / Excavation	Estimated Sediment Removal Volume (m ³)
TKO 137			
Reclamation works	Marine-Based Sediment	5 m below seabed level	1,222,630
Submarine outfall construction for the STW (Marine Section)	Marine-Based Sediment	- 50 mPD ¹	
Submarine outfall construction for the STW (Land Section)	Land-Based Sediment	- 50 mPD ¹	1,025
STW construction	Land-Based Sediment	- ¹	2,000
TKO 132			

Types of Construction Works	Types of Sediment to be Removed	Proposed Maximum Depth of Sediment Removal / Excavation	Estimated Sediment Removal Volume (m ³)
Reclamation works	Marine-Based Sediment	0.5 m/2 m/5 m below seabed level	642,618
Breakwater construction	Marine-Based Sediment		
Dredging operation off TKO 132 to allow sufficient water depth for marine traffic access.	Marine-Based Sediment		

Remarks:

1. Excavation level likely near or below the base of marine deposit layer

4 REVIEW OF EXISTING SEDIMENT QUALITY

4.1 General

4.1.1 EPD conducts routine monitoring of the bottom sediment quality at 60 stations across the territory of Hong Kong waters. Among these 60 stations, the closest monitoring stations to TKO 137 are ES1 and ES4 located in Eastern Buffer Water Control Zone, while the closest monitoring station to TKO 132 is JS2 located in Junk Bay Water Control Zone. Locations of ES1, ES4 and JS2 are shown in **60720423/B09B/701** and **60720423/B09B/702**. The monitoring data are discussed in this section.

4.1.2 In addition to the above, sediment quality data were collected under the EIA study for *Desalination Plant at Tseung Kwan O – Feasibility Study* (AEIAR-192/2015) (near TKO 137) and the EIA studies for *Cross Bay Link, Tseung Kwan O – Investigation* (AEIAR-172/2013) and *Tseung Kwan O – Lam Tin Tunnel – Investigation* (AEIAR-173/2013) (near TKO 132). However, the relevant sediment samples were collected over 10 years ago and were outside the potential area of sediment removal under this Project. The available sediment quality data is thus considered not representative to the sediment of concern under this Project.

4.2 TKO 137

4.2.1 The sediment quality data at ES1 and ES4 from year 2018 to 2022, as extracted from the latest available EPD’s Annual Marine Water Quality Report¹, is summarised in **Table 4.1**.

4.2.2 As shown in **Table 4.1**, except for copper, silver and zinc, all the levels of metals, organic-PAHs and non-organic PAHs were below the LCEL. For mercury, the highest level measured at ES1 and ES4 (mercury at ES1: 0.41 mg/kg; ES4: 0.31 mg/kg) were above the LCEL but below UCEL. For copper, silver and zinc, the highest levels measured at ES4 (copper: 83 mg/kg, silver: 1.6 mg/kg and zinc: 210 mg/kg) were above the LCEL but below UCEL.

Table 4.1 Summary of Sediment Quality Data at EPD Monitoring Station ES1 and ES4 (Year 2018 to 2022)¹

Contaminants	LCEL	UCEL	Arithmetic Mean Concentration (Data in Brackets Indicate Ranges) ²	
			ES1	ES4
Metals (mg/kg dry wt.)				
Cadmium (Cd)	0.8	4	<0.1 (<0.1 - <0.1)	0.1 (<0.1 – 0.2)
Chromium (Cr)	80	160	28 (16 – 42)	34 (17 – 51)
Copper (Cu)	65	110	29 (14 – 50)	50 (23 – <u>83</u>)
Mercury (Hg)	0.3	1	0.14 (<0.05 – <u>0.41</u>)	0.17 (0.10 – <u>0.31</u>)
Nickel (Ni)	40	40	16 (10 – 25)	18 (9 – 25)
Lead (Pb)	75	110	32 (21 – 40)	41 (22 – 55)
Silver (Ag)	1	2	0.3 (0.2 – 0.6)	0.7 (0.3 – <u>1.6</u>)
Zinc (Zn)	200	270	95 (53 – 150)	140 (63 – <u>210</u>)
Metalloid (mg/kg dry wt.)				

¹ Environmental Protection Department, Marine Water Quality in Hong Kong in 2022.

Contaminants	LCEL	UCEL	Arithmetic Mean Concentration (Data in Brackets Indicate Ranges) ²	
			ES1	ES4
Arsenic (As)	20	42	6.8 (5.1 – 8.5)	7.8 (4.2 – 11.0)
Organic-PAHs (µg/kg dry wt.)				
Low Molecular Weight PAHs ³	550	3160	94 (90 – 100)	100 (90 – 150)
High Molecular Weight PAHs ⁴	1700	9600	160 (37 – 440)	230 (43 – 560)
Organic-non-PAHs (µg/kg dry wt.)				
Total PCBs ⁵	23	180	18 (18 – 18)	18 (18 – 21)
Organometallics (µg TBT/L in interstitial water)				
Tributyltin	0.15	0.15	N/A ⁶	

Remarks:

1. Data extracted from EPD's Marine Water Quality in Hong Kong in 2022.
2. Underline value denotes the contaminant level exceeds the LCEL but below the UCEL.
3. Low molecular weight PAHs include 6 congeners of molecular weight below 200, namely: Acenaphthene, Acenaphthylene, Anthracene, Fluorene, Naphthalene and Phenanthrene.
4. High molecular weight PAHs include 10 congeners of molecular weight above 200, namely: Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene and Indeno(1,2,3-cd)pyrene.
5. Total PCBs results are derived from the summation of 18 congeners. If the concentration of a congener is below reporting limit (RL), the result will be taken as 0.5xRL in the calculation.
6. Sediment data is not available.

4.3 TKO 132

4.3.1 The sediment quality data at JS2 from year 2018 to 2022, as extracted from the latest available EPD's Annual Marine Water Quality Report¹, is summarised in **Table 4.2**.

4.3.2 As shown in **Table 4.2**, except for copper, mercury and silver, all the levels of metals, organic-PAHs and non-organic PAHs were below the LCEL. For copper, the mean level (69 mg/kg) was above the corresponding LCEL but below the UCEL and the highest level (130 mg/kg) was above the corresponding UCEL but below 10 times of LCEL. For mercury and silver, the highest levels (mercury: 0.64 mg/kg and silver: 1.3 mg/kg) were above the corresponding LCEL but below the UCEL.

Table 4.2 Summary of Sediment Quality Data at EPD Monitoring Station JS2 (Year 2018 to 2022)¹

Contaminants	LCEL	UCEL	Arithmetic Mean Concentration (Data in Brackets Indicate Ranges) ^{2,3}
			JS2
Metals (mg/kg dry wt.)			
Cadmium (Cd)	0.8	4	0.1 (<0.1 – 0.2)
Chromium (Cr)	80	160	39 (12 – 54)

¹ Environmental Protection Department, Marine Water Quality in Hong Kong in 2022.

Contaminants	LCEL	UCEL	Arithmetic Mean Concentration (Data in Brackets Indicate Ranges) ^{2,3}
			JS2
Copper (Cu)	65	110	<u>69</u> (19 – 130)
Mercury (Hg)	0.3	1	0.24 (0.10 – <u>0.64</u>)
Nickel (Ni)	40	40	20 (6 – 25)
Lead (Pb)	75	110	46 (24 – 55)
Silver (Ag)	1	2	0.8 (0.2 – <u>1.3</u>)
Zinc (Zn)	200	270	150 (52 – 200)
Metalloid (mg/kg dry wt.)			
Arsenic (As)	20	42	8.7 (4.1 – 12.0)
Organic-PAHs (µg/kg dry wt.)			
Low Molecular Weight PAHs ⁴	550	3160	94 (90 – 99)
High Molecular Weight PAHs ⁵	1700	9600	200 (54 – 350)
Organic-non-PAHs (µg/kg dry wt.)			
Total PCBs ⁶	23	180	18 (18 – 18)
Organometallics (µg TBT/L in interstitial water)			
Tributyltin	0.15	0.15	N/A ⁷

Remarks:

1. Data extracted from EPD's Marine Water Quality in Hong Kong in 2022.
2. Underline value denotes the contaminant level exceeds the LCEL but below the UCEL.
3. Bold value denotes the contaminant level exceeds the UCEL.
4. Low molecular weight PAHs include 6 congeners of molecular weight below 200, namely: Acenaphthene, Acenaphthylene, Anthracene, Fluorene, Naphthalene and Phenanthrene.
5. High molecular weight PAHs include 10 congeners of molecular weight above 200, namely: Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene and Indeno(1,2,3-cd)pyrene.
6. Total PCBs results are derived from the summation of 18 congeners. If the concentration of a congener is below reporting limit (RL), the result will be taken as 0.5xRL in the calculation.
7. Sediment data is not available.

5 PROPOSED SEDIMENT SAMPLING PLAN

5.1 Proposed Sampling Locations

- 5.1.1 Sediment sampling and testing works are recommended to be carried out within the potential area of sediment removal works as discussed in **Section 3**. Based on Section 2 of Appendix 4.29 of the PAH, a volume-based approach is recommended for determining the minimum sampling stations.

TKO 137

Marine-Based Sampling Locations

- 5.1.2 Based on the sediment quality review in **Section 4**, there are no previous sediment quality data available within the potential area of sediment removal at TKO 137. Three (3) outfalls were identified along the existing TKO 137 shoreline (refer to **60720423/B09B/703**) but were situated at least 50 m away from the potential area of sediment removal works.
- 5.1.3 The total estimated volume of marine-based sediment to be removed for reclamation works and marine section of the submarine outfall construction is roughly 1,222,630 m³. According to Section 2 of Appendix 4.29 of the PAH, a minimum of 20 sampling stations is required for the marine-based sediment removal works at TKO 137. The sampling stations are proposed to be evenly distributed across the entire potential area of sediment removal using a grid pattern. Referring to the above, as the outfalls were situated at least 50 m away from the potential area of sediment removal works, no specific/additional sampling locations were proposed near the outfalls. **Other than the outfalls, no source of anthropogenic contamination were identified.**
- 5.1.4 Based on the above, a total of 24 marine-based sampling locations, **in approximately 148 m sampling grid arrangement**, are proposed within the potential area of sediment removal at TKO 137. The sampling locations with Hong Kong metric grid coordinates are shown in **Table 5.1** below and in **60720423/B09B/703**.
- 5.1.5 Referring to **Table 3.1**, the proposed maximum depths of sediment removal / excavation will be 5 m below seabed level for reclamation works and -50 mPD (likely below the base of marine deposit layer) for the submarine outfall (marine section) construction. Both surface grab sampling method and vibrocoring / borehole drilling method will be used to collect sediment samples to depth of at least 1 m below the maximum sediment removal depth for reclamation works (i.e. 6 m below seabed level) and 1 m below the base of marine deposit layer for the submarine outfall (marine section) construction.

Land-Based Sampling Locations

- 5.1.6 For the submarine outfall (land section) and STW construction, the total estimated volume of land-based sediment to be removed is roughly 3,025 m³. **No source of anthropogenic contamination were identified near the depth of the marine deposit / disturbed marine deposits layer.** According to Section 2 of Appendix 4.29 of the PAH, a minimum of 3 sampling stations are required for the land-based sediment removal works. The sampling stations are proposed to be evenly distributed across the entire potential area of sediment removal using a grid pattern.
- 5.1.7 Based on the above, a total of 4 land-based sampling locations, **in approximately 198 m sampling grid arrangement**, are proposed within the potential area of sediment removal at TKO 137. The sampling locations with Hong Kong metric grid coordinates are shown in **Table 5.1** below and in **60720423/B09B/703**.
- 5.1.8 Borehole drilling method will be used to collect sediment samples to depth of at least 1 m below the base of marine deposit layer for both the submarine outfall (land section) construction and the STW construction.

TKO 132

- 5.1.9 Based on the sediment quality review in **Section 4**, there are no previous sediment quality data available within the potential area of sediment removal at TKO 132. Furthermore, no source of anthropogenic contamination (i.e. near outfalls / nullahs) were identified within the potential area of sediment removal.

- 5.1.10 The estimated volume of marine-based sediment to be removed is roughly 642,618 m³. According to Section 2 of Appendix 4.29 of the PAH, a minimum of 20 sampling stations is required for the marine-based sediment removal works at TKO 132. The sampling stations are proposed to be evenly distributed across the entire potential area of sediment removal using a grid pattern.
- 5.1.11 Based on the above sampling arrangement, a total of 30 marine-based sediment sampling locations, **in approximately 152 m sampling grid arrangement**, are proposed within the potential area of sediment removal at TKO 132. The marine-based sampling locations with Hong Kong metric grid coordinates are shown in **Table 5.1** below and in **60720423/B09B/704**.
- 5.1.12 Referring to **Table 3.1**, the proposed maximum depths of sediment removal will either be 0.5 m, 2 m or 5 m below seabed level. For maximum 0.5 m sediment removal, surface grab sampling method will be used to collect sediment samples at the sampling locations (i.e. at **sampling locations MEB2, MEB3, MEB4, MEB8, MEB12, MEB14, MEB15, MEB16, MEB29 and MEB30**). For maximum 2 m and 5 m sediment removal, both surface grab sampling method and vibrocoreing / borehole drilling will be used to collect sediment samples to depth of at least 1 m below the proposed maximum sediment removal depth.

Table 5.1 Details of Proposed Sediment Sampling Locations

Proposed Sampling Location ID	Sampling Method	Sampling Depth	Coordinates ¹	
			Easting	Northing
TKO 137				
<i>Marine-based Sampling Locations</i>				
MEA1	Surface Grab and Vibrocoreing or Borehole Drilling	Seabed surface, 0.9m down, 1.9m down, 2.9m down, thereafter 3m to 1m below the maximum sediment removal depth (i.e. 6 m below seabed level)	845537.113	814957.026
MEA2			845676.025	815010.361
MEA3			845566.712	814878.348
MEA4			845705.848	814932.034
MEA5			845585.508	814696.156
MEA6			845652.340	814548.432
MEA7			845717.180	814574.764
MEA8			845712.519	814424.785
MEA9			845780.817	814452.692
MEA10			845755.697	814283.557
MEA11			845851.329	814321.287
MEA12			845858.086	814003.692
MEA13			845994.686	814057.864
MEA14			845934.687	813874.267
MEA15			846075.945	813925.996
MEA16			845988.624	813736.965
MEA17			846128.693	813787.955
MEA18			846071.401	813655.395
MEA19			846167.899	813692.711
MEA20	Surface Grab and Vibrocoreing or Borehole Drilling	Seabed surface, 0.9m down, 1.9m down, 2.9m down, thereafter 3m to 1m below the base of marine deposit layer	845931.097	814192.986
MEA21			845804.068	814143.833
MEA22			845657.432	814103.156
MEA23*	Surface Grab Only	Seabed surface	845518.153	814050.422

Proposed Sampling Location ID	Sampling Method	Sampling Depth	Coordinates ¹	
			Easting	Northing
MEA24*			845379.437	813995.438
<i>Land-based Sampling Locations</i>				
EA1	Borehole Drilling	Top of marine deposit, 0.9m down, 1.9m down, 2.9m down, thereafter every 3m to 1m below the base of marine deposit layer	846522.858	814578.264
EA2			846384.723	814518.305
EA3			846218.205	814372.398
EA4			846043.330	814291.144
TKO 132				
<i>Marine-based Sampling Locations</i>				
MEB18	Surface Grab and Vibrocoreing or Borehole Drilling	Seabed surface, 0.9m down, 1.9m down, 2.9m down, thereafter 3m to 1m below the maximum sediment removal depth (i.e. 6 m below seabed level)	843620.337	816622.894
MEB19			843711.620	816539.952
MEB20			843794.977	816463.548
MEB22			843517.042	816511.930
MEB23			843608.644	816428.791
MEB24			843691.567	816353.021
MEB26			843411.638	816395.058
MEB27			843501.487	816315.263
MEB28			843586.809	816237.046
MEB1	Surface Grab and Vibrocoreing or Borehole Drilling	Seabed surface, 0.9m down, 1.9m down, 2.9m down, thereafter 3m to 1m below the maximum sediment removal depth (i.e. 3 m below seabed level)	843921.734	817153.030
MEB5			843842.478	817068.716
MEB6			843947.664	816941.754
MEB7			844018.523	816873.348
MEB9			843679.545	816967.335
MEB10			843863.824	816864.328
MEB11			843916.234	816764.871
MEB13			843576.687	816855.127
MEB17			843503.654	816728.081
MEB21	Surface Grab Only	Seabed surface	843387.886	816636.492
MEB25			843349.642	816545.930
MEB2			844052.115	817051.787
MEB3			844116.695	816981.213
MEB4			844201.259	816903.181
MEB8			844105.896	816795.750
MEB12			843999.932	816688.081
MEB14			843730.035	816725.083
MEB15			843813.525	816652.868
MEB16	843898.940	816573.594		
MEB29	843433.138	816165.304		

Proposed Sampling Location ID	Sampling Method	Sampling Depth	Coordinates ¹	
			Easting	Northing
MEB30			843479.630	816123.678
Reference Sample (Port Shelter)				
PS6 (Reference) ²	Surface Grab Only	Seabed surface	850234.0	820057.0

Remarks:

1. Actual locations subject to fine adjustments on-site.
 2. Reference sample will be collected at Port Shelter if biological testing is required.
- * Marine-based sampling locations MEA23 and MEA24 and the corresponding sampling grids are located within the Tathong Channel Traffic Separation Scheme. In order to avoid significant marine traffic impact, only surface grab samples will be collected at MEA23 and MEA24.

- 5.1.13 The sampling locations are proposed taken into consideration the existing site constraints (e.g. existing utilities and structures). All proposed sampling locations are located within the corresponding sampling grids. If biological screening is required, grab sample will also be collected from EPD's routine sediment monitoring station PS6 at Port Shelter (E850234, N820057) as the reference sediment sample.
- 5.1.14 The exact sampling locations will be determined on site and subject to fine adjustment due to site specific conditions (e.g. locations, underwater utilities, structures, delivery pipes and services). Details of the adjustments, if any, will be reported in the EIA Report.

5.2 Sediment Sampling Procedures

Marine-based Sampling

- 5.2.1 Sediment samples will be collected by means of grab sampling at the seabed level and vibrocoring or borehole drilling method for the vertical sediment profiles below. Vibrocoring and borehole drilling should terminate at least 1 m below the maximum sediment removal depth or base of marine deposit layer as shown in **Table 5.1**. For sampling locations MEA23 and MEA24 at TKO 137, as the sampling locations and the corresponding sampling grids are located within the Tathong Channel Traffic Separation Scheme, only surface grab samples will be collected at MEA23 and MEA24 to avoid significant marine traffic impact.
- 5.2.2 Prior to sampling at each location, the sampling location will be set out with the aid of a differential global positioning system (DGPS) or equivalent device. After setting out, the water depth and sea levels, in metres below the Principal Datum (mPD), will be measured.

Grab Sampling

- 5.2.3 Surface sediment will be taken by a closed grab sampler. The surface sediment samples will be recovered on site and placed in laboratory-provided clean high-density polyethylene containers, wide mouth borosilicate glass bottles with Teflon lined lids or other appropriate containers and sealed to prevent leakage. Only new or pre-cleaned sample containers will be used to hold the sediment samples. The containers will be labelled with station number, sample depth, sampling date and time, together with full description of the sample.

Vibrocoring

- 5.2.4 Vertical profiles of sediment samples will be taken continuously by means of vibrocoring, from top level of marine deposits, 0.9 m down, 1.9 m down, 2.9 m down and thereafter every 3 m to the bottom of the termination depth. The vibrocore sample should be sub-sampled and cut on-site into sections. The top levels of the sub-samples should be top level of marine deposits, 0.9 m down, 1.9 m down, 2.9 m down and then every 3 m to the proposed termination depth. The depth of sediment sampling will be terminated at least 1 m below the maximum sediment removal depth or base of marine deposit layer as shown in **Table 5.1**. Both cut ends of each vibrocore sub-sample will be sealed up with tight fitting rubber caps and duct-taped in place. Each sub-sample will be clearly labelled 'top' and 'bottom' and with station number, sample depth, sampling date and time, together with full description of the sample.

Borehole Drilling

- 5.2.5 Given the possibility of encountering hard materials within the potential sediment removal areas, borehole drilling method is proposed as an alternative method to vibrocoring to collect the vertical profiles of sediment samples. Undisturbed samples using U100 sampler (made of stainless steel or other appropriate materials) or other appropriate sampler will be collected at the top level of marine deposits and samples will be taken at that particular depth (i.e. top level of marine deposit), 0.9 m down, 1.9 m down, 2.9 m down and thereafter every 3m down to the bottom of the termination depth. The depth of sediment sampling will be terminated at least 1 m below the maximum sediment removal depth or base of marine deposit layer as shown in **Table 5.1**. Sufficient amount of sediment sample will be taken for both chemical and biological testing. The undisturbed samples will be sealed up with tightly fitting rubber caps and duct-taped in place. Each sample will be clearly labelled 'top' and 'bottom' and with station number, sample depth, sampling date and time, together with full description of the sample.

Decontamination Procedures

- 5.2.6 All equipment in contact with the seabed will be thoroughly decontaminated between each sampling location and sampling attempt to minimize the potential for cross contamination. The equipment (including vibrocoring/drilling equipment and sediment samplers) should be decontaminated by steam cleaning or high-pressure hot water jet, then rinsed by seawater.

Land-based Sampling

- 5.2.7 Upon determination of the exact sampling locations, a survey will be undertaken to measure the Hong Kong Grid Coordinates and metres above the Principal Datum (mPD) of the sampling locations.

5.2.8 Sediment samples will be collected using borehole drilling method. The borehole will be undertaken by means of dry rotary drilling method (i.e. without the use of flushing medium) as much as possible. For safety reasons, an inspection pit will be excavated down to 1.5m below ground level (m bgl) to inspect for underground utilities at the proposed borehole locations.

5.2.9 Undisturbed samples using U100 sampler (made of stainless steel or other appropriate materials) will be collected at depth where marine sediments are firstly encountered and samples will be taken at that particular depth (i.e. level of marine deposit), 0.9 m down, 1.9 m down, 2.9 m down and then every 3m down to the borehole termination depth. The depth of sediment sampling will be terminated at least 1m below the base of marine deposit layer as shown in **Table 5.1**. Sufficient amount of sediment sample will be taken for both chemical and biological testing. The undisturbed samples will be sealed up with tightly fitting rubber caps and duct-taped in place. Each sample will be clearly labelled ‘top’ and ‘bottom’ and with sample identity (e.g. station number, sample depth, sampling date and time, together with full description of the sample).

Decontamination Procedures

All equipment in contact with the sediment should be thoroughly decontaminated between each sampling location and sampling attempt to minimize the potential for cross contamination. The equipment (including drilling equipment and sediment samplers) should be decontaminated by steam cleaning or high-pressure hot water jet, then washed by phosphate-free detergent and finally rinsed by distilled water.

Strata Logging

5.2.10 Strata logging for vibrocores and/or boreholes should be undertaken during the course of vibrocoreing / borehole drilling and sampling by a qualified geologist. The logs should include the general stratigraphic description, depth of sampling and sample notation. The presence of rocks/boulders/cobbles and foreign materials should also be recorded.

5.3 Sample Size and Sample Handling

5.3.1 Prior to sampling, the laboratory responsible for analysis should be consulted for the particular sample size for chemical / biological testing. According to Appendix 4.29 of the PAH, the recommended sample sizes for each parameter and test for chemical / biological testing are as shown in **Table 5.2**.

Table 5.2 Sample Size

Parameters to be Tested	Sample Size*
Metals and Metalloid	0.5 L
Organic	0.5 L
Biological response	6 L

Remarks:

* Quantity to be confirmed by testing laboratory. The quantity of reference sediment to be collected needs to be separately worked out for each case, especially if biological dilution tests are anticipated.

5.3.2 The sample storage and pre-treatment procedure will be in accordance with Appendix 4.29 of the PAH. The samples will be stored, transported and maintained at 4°C or lower without being frozen in the dark prior to any laboratory testing. All samples will be packed and transported in such manner as to avoid shock, vibration or any other disturbance of the samples. Samples will be delivered to laboratory within 24 hours after collection and analysed within 14 days of delivery for chemical testing. The chain-of-custody procedure will be followed to record the flow of sample handling, from collection of samples to delivery of samples to the designated laboratory.

6 PROPOSED LABORATORY ANALYSIS

6.1 Tier II Chemical Screening

6.1.1 Sediment samples collected will be tested for parameters stated in Table 1 – Analytical Methodology in Appendix 4.29 of the PAH. The parameters to be analysed, methodology used and reporting limits are presented in **Table 6.1** below. The samples should be promptly analysed with maximum holding time of 2 weeks for chemical test.

Table 6.1 Chemical Testing Parameters

Parameters	Reporting Limit	Preparation Method USEPA Method [^]	Determination Method USEPA Method [^]
Metals (mg/kg dry weight)			
Cadmium (Cd)	0.2	3050B	6020A or 7000A or 7131A
Chromium (Cr)	8	3050B	6010C or 7000A or 7190
Copper (Cu)	7	3050B	6010C or 7000A or 7210
Mercury (Hg)	0.05	7471A	7471A
Nickel (Ni)	4	3050B	6010C or 7000A or 7520
Lead (Pb)	8	3050B	6010C or 7000A or 7420
Silver (Ag)	0.1	3050B	6020A or 7000A or 7761
Zinc (Zn)	20	3050B	6010C or 7000A or 7950
Metalloid (mg/kg dry weight)			
Arsenic (As)	1	3050B	6020A or 7000A or 7061A
Organic-PAHs (µg/kg dry weight)			
Low Molecular Weight PAHs ⁺	55	3550B or 3540C and 3630C	8260B or 8270C
High Molecular Weight PAHs ⁺⁺	170	3550B or 3540C and 3630C	8260B or 8270C
Organic-non-PAHs (µg/kg dry weight)			
Total PCBs ⁺⁺⁺	3	3550B or 3540C and 3665A	8082
Organometallics (µg TBT/L in interstitial water)			
Tributyltin	0.015	Krone et al. (1989)* - GC/MS UNEP/IOC/IAEA**	Krone et al. (1989)* - GC/MS UNEP/IOC/IAEA**

Notes:

[^] Other equivalent methods such as “The Specification for Marine Monitoring – Part 5: Sediment Analysis” (GB17378.5-2007) may be used subject to the approval of DEP.

⁺ Low molecular weight PAHs include acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene.

⁺⁺ High molecular weight PAHs include benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene and benzo(g,h,i)perylene.

⁺⁺⁺ The reporting limit is for individual PCB congeners. Total PCBs include 2,4' diCB, 2,2',5 triCB, 2,4,4' triCB, 2,2',3,5' tetraCB, 2,2',5,5' tetraCB, 2,3',4,4' tetraCB, 3,3',4,4' tetraCB, 2,2',4,5,5' pentaCB, 2,3,3',4,4' pentaCB, 2,3',4,4',5 pentaCB, 3,3',4,4',5 pentaCB, 2,2',3,3',4,4' hexaCB, 2,2',3,4,4',5' hexaCB, 2,2',4,4',5,5' hexaCB, 3,3',4,4',5,5' hexaCB, 2,2',3,3',4,4',5 heptaCB, 2,2',3,4,4',5,5' heptaCB, 2,2',3,4',5,5',6 heptaCB (ref: the "summation" column of Table 9.3 of Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (The Inland Testing Manual) published by USEPA).

^{*} Krone et al. (1989), A method for analysis of butyltin species and measurement of butyltins in sediment and English Sole livers from Puget Sound, Marine Environmental Research 27 (1989) 1-18. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.

^{**} UNEP/IOC/IAEA refers to IAEA's Marine Environment Laboratory reference methods. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.

6.2 Tier III Biological Screening

- 6.2.1 In accordance with paragraph 4.2.1 of the PAH, Tier III biological screening will be necessary for Category H sediment samples in which one or more contaminants exceed 10 times the Lower Chemical Exceedance Level (LCEL) as identified in the Tier II chemical screening. The methods will follow Appendix 4.29 of the PAH.
- 6.2.2 The biological screening will either be conducted on the composite samples or individual samples, depending on the category and distribution profile. If composite samples are to be tested, they should be prepared by mixing up to 5 samples of the same category, which are continuous in vertical or horizontal profile.
- 6.2.3 According to Appendix 4.29 of the PAH, sediment classified as Category H and with one or more contaminant levels exceeding 10 times LCEL shall be subjected to the following two toxicity tests (to be considered as one set) in a diluted manner (dilution test).

Toxicity Tests	
1.	a 10-day burrowing amphipod toxicity test; or a 20-day burrowing polychaete toxicity test.
2.	a 48-96 hour larvae (bivalve or echinoderm) toxicity test.

- 6.2.4 The samples shall be prepared prior to toxicity testing as follows:

Sediment characteristics	Preparation method
Category H sediment (> 10 x LCEL)	Sample to be mixed with 9 portions of reference sediment
Category H sediment (> 10 x LCEL) suspected of ammonia contamination	Additional set of sample (after dilution for Cat. H sediment) to be purged [#] for ammonia removal (for amphipod test only).

[#] If the ammonia concentration in the overlying water of the test system is ≥ 20 mg/L, purging of sediment is required. This is performed by replacing the overlying water at a rate of 6 volume replacements/24 h for 24 hours, and repeated once only if the ammonia level still exceeds 20 mg/L.

- 6.2.5 The species to be used for each type of biological test and the test conditions are listed in **Table 6.2** below.

Table 6.2 Testing Species for Biological Screening

Test Type	Species	Reference Test Condition ⁽¹⁾⁽²⁾⁽³⁾
10-day burrowing amphipod toxicity test	<i>Ampelisca abdita</i>	USEPA (1994) / PSEP (1995)
	<i>Leptocheirus plumulosus</i>	USEPA (1994)
	<i>Eohaustorius estuarius</i>	USEPA (1994) / PSEP (1995)
	<i>Grandidierella japonica</i>	GB 30980-2014
	<i>Ampelisca bocki</i>	GB 30980-2014
	<i>Ampelisca brevicornis</i>	GB 30980-2014
20-day burrowing polychaete toxicity test	<i>Neanthes arenaceodentata</i>	PSEP (1995)
	<i>Neanthes japonica</i>	GB 30980-2014
	<i>Glycera chirori</i>	GB 30980-2014
	<i>Neohytys californiensis</i>	GB 30980-2014
48-96 hour larvae (bivalve or echinoderm) toxicity test	Bivalve: <i>Mytilus</i> spp. <i>Crassostrea gigas</i>	PSEP (1995)
	<i>Acrassostrea rivularis</i>	GB 30980-2014
	Echinoderm: <i>Dendraster excentricus</i> <i>Strongylocentrotus</i> spp.	PSEP (1995)
	<i>Anthocardaris crassipina</i>	GB 30980-2014

Remarks:

- (1) U.S.EPA (U.S. Environmental Protection Agency) 1994. Methods for assessing the toxicity of sediment-associated contaminants with estuarine and marine amphipods. Office of Research and Development. U.S. Environmental Protection Agency, Cincinnati, OH. EPA/600/R94/025.
- (2) PSEP (Puget Sound Estuary Program) 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments.
- (3) GB 30980-2014. The assessment procedure for marine dumping of dredged material.

6.2.6 All biological tests should be conducted by accredited laboratories and include appropriate quality assurance / quality control such as negative control and positive control. Samples of reference sediment will also be tested.

6.2.7 Additional ancillary parameters including moisture content, grain size (% <63µm), total organic content (TOC), ammonia (as mgN/L) and salinity in pore water should also be tested on the composite and reference samples. The ancillary test will provide necessary information on the general characteristic of the sediment. Test organisms will be selected based on their application limits for sediment grain size and porewater salinity. If the ammonia concentration in the overlying water of the test system is ≥ 20 mg/L, purging of sediment is required. This is performed by replacing the overlying water at a rate of 6 volume replacements/24 h for 24 hours, and repeated once only if the ammonia level still exceeds 20 mg/L.

6.2.8 Sediment samples will be thoroughly homogenized prior to initiation of any tests to minimize variance among test replicates. Debris and indigenous organisms present in the sediment will be removed beforehand so that neither false positive results (due to presence of predatory species) nor false negative results (from indigenous species that are taxonomically similar to the test species) will be generated.

6.2.9 The samples should be promptly analysed with maximum holding time of 8 weeks for biological test.

6.3 Quality Assurance / Quality Control Requirements

6.3.1 All tests will be conducted by laboratories accredited by Hong Kong Laboratory Accreditation Scheme (HOKLAS) or, in case of overseas laboratories, by equivalent national accreditation for these tests.

6.3.2 For chemical screening, the following quality control plan will be implemented for the laboratory testing:

- Method Blank;
- Duplicate (at 5% level i.e. one for every 20 samples); and,
- Matrix Spike (at 5% level i.e. one for every 20 samples).

6.3.3 The proposed data quality objectives are shown in **Table 6.3**.

Table 6.3 Data Quality Objectives for Chemical Screening

Quality Controls	Acceptance Criteria
Method Blank	Less than method detection limit (MDL)
Duplicate	Agree within $\pm 25\%$ of the mean of duplicate results
Matrix Spike	Agree within $\pm 25\%$ of the recovery of spike concentration

6.3.4 For biological screening, negative and positive control should be included as appropriate quality assurance/ quality control (QA/QC).

7 TENTATIVE PROGRAMME FOR SEDIMENT SAMPLING AND TESTING

7.1.1 The tentative programme for the sediment sampling and testing is summarised in **Table 7.1**

Table 7.1 Tentative Timetable for Sediment Sampling and Testing

Task Descriptions	Timeframe ⁽²⁾
Carry out sediment sampling works	February to March 2024
Conduct Tier II chemical screening and analytical report ⁽¹⁾	February to April 2024
Conduct Tier III biological screening and analytical report (if required) ⁽¹⁾	March to May 2024
Submission of draft EIA Report	May 2024

Note:

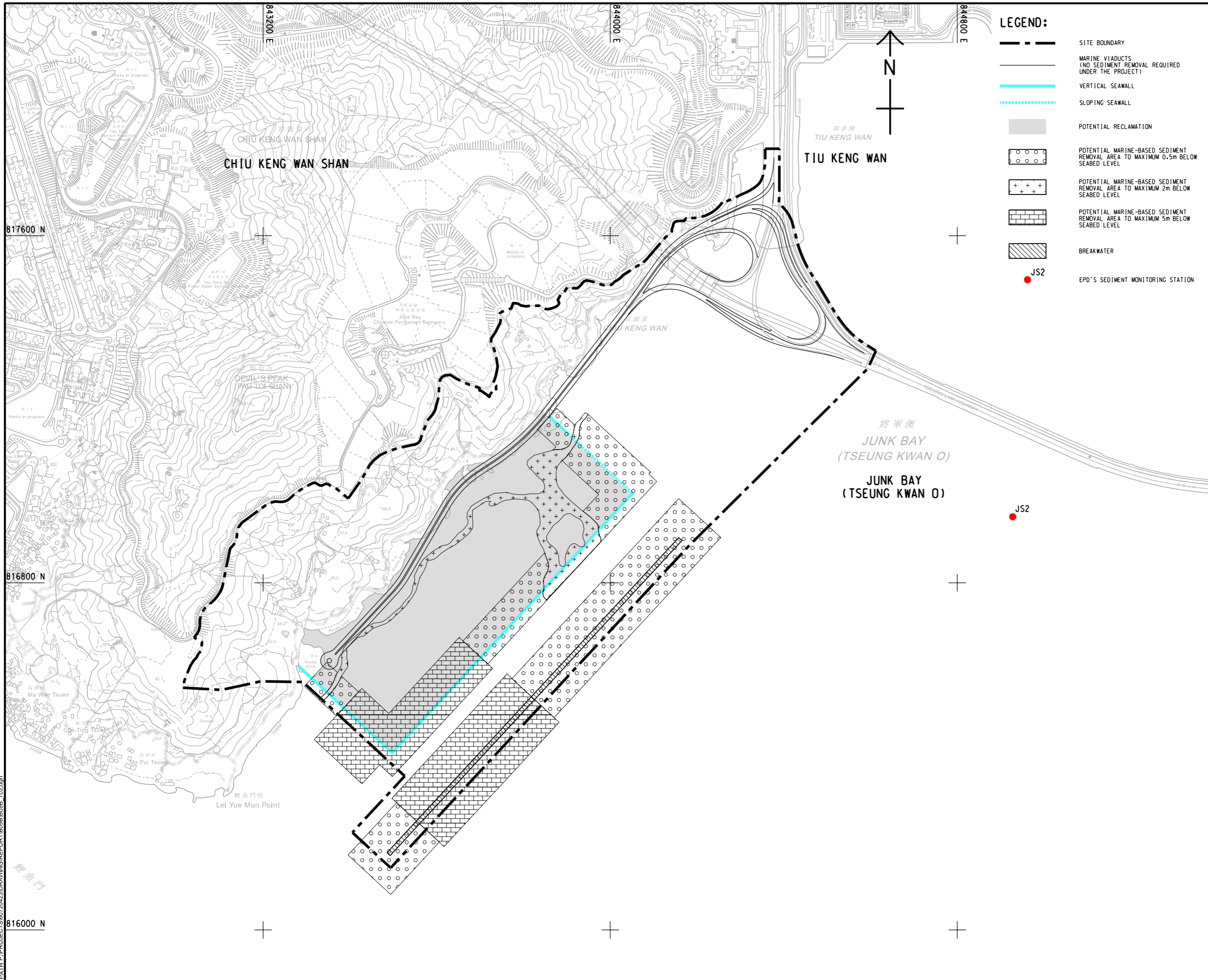
- (1) The chemical and biological tests will commence within the holding time of 2 and 8 weeks respectively as specified in Appendix 4.29 of PAH.
- (2) The timeframe is tentative subject to the actual work programme.

8 CONCLUSION

- 8.1.1 This SSTP presented the sampling and testing requirements for the potential sediment removal under the Project. The plan is prepared according to Clause 3 in Appendix F of the EIA Study Brief and with reference to paragraph 4.2.1 of Chapter 4 of the PAH (subsumed from ETWB TCW No. 34/2002).
- 8.1.2 A total of 28 sediment sampling locations (24 marine-based and 4 land-based) are proposed at TKO 137 and 30 marine-based sediment sampling locations are proposed at TKO 132, with reference to paragraph 4.2.1 of the PAH (subsumed from ETWB TCW No. 34/2002). Findings from the sediment sampling and testing exercise will be used to assess the waste management implications associated with the potential sediment excavation / dredging under the EIA Study.

Figures

ISO A1 594mm x 841mm
 Approved:
 Checked:
 Designer:
 Project Management Initials:
 2024/1/25
 PATH PROJECTS/60720423/DRAWING/REPORT/0909B/09B_702.dgn
 Plot File by: YangJ8



LEGEND:

- SITE BOUNDARY
- MARINE VIADUCTS (NO SEDIMENT REMOVAL REQUIRED UNDER THE PROJECT)
- VERTICAL SEAWALL
- SLOPING SEAWALL
- POTENTIAL RECLAMATION
- POTENTIAL MARINE-BASED SEDIMENT REMOVAL AREA TO MAXIMUM 0.5m BELOW SEABED LEVEL
- POTENTIAL MARINE-BASED SEDIMENT REMOVAL AREA TO MAXIMUM 2m BELOW SEABED LEVEL
- POTENTIAL MARINE-BASED SEDIMENT REMOVAL AREA TO MAXIMUM 5m BELOW SEABED LEVEL
- BREAKWATER
- JS2 EPD'S SEDIMENT MONITORING STATION

PROJECT
 DEVELOPMENT OF TSEUNG KWAN O AREA 137 AND ASSOCIATED RECLAMATION SITES – INVESTIGATION, DESIGN AND CONSTRUCTION

CLIENT
 土木工程拓展署
CEDD Civil Engineering and Development Department

CONSULTANT
 AECOM Binnies (TKO137) JV

SUB-CONSULTANTS
 分列工程顧問公司

ISSUE/REVISION

NO.	DATE	DESCRIPTION	CHK.

SCALE
 A1 1:4000

DIMENSION UNIT
 METRES

KEY PLAN

PROJECT NO.
 60720423

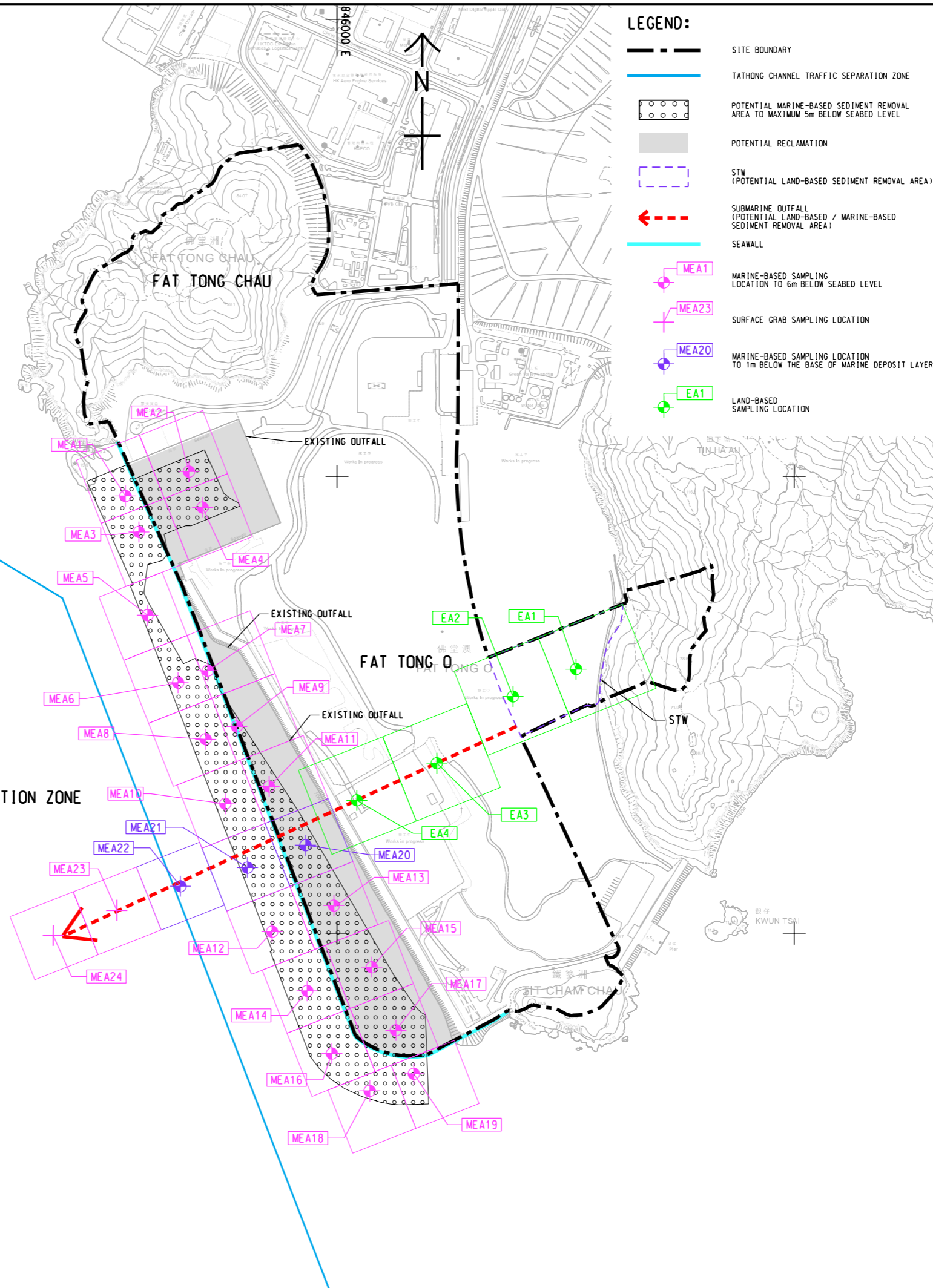
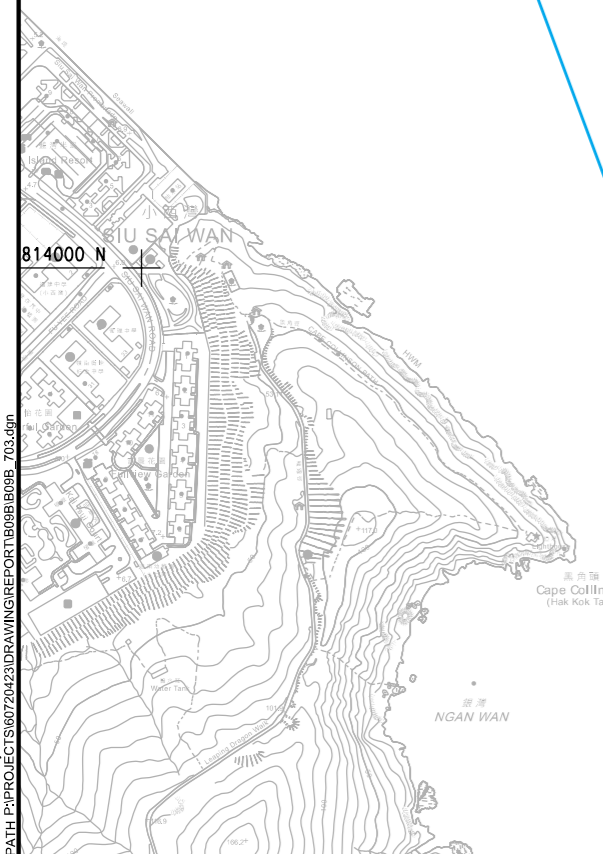
CONTRACT NO.
 CE 40/2023(CE)

SHEET TITLE
 TENTATIVE LAYOUT PLAN AND POTENTIAL AREA OF SEDIMENT REMOVAL (TKO 132)

SHEET NUMBER
 60720423/B09B/702

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SAMPLING LOCATION ID	COORDINATES	
	EASTING	NORTHING
ME A1	845537.113	814957.026
ME A2	845676.025	815010.361
ME A3	845566.712	814878.348
ME A4	845705.848	814932.034
ME A5	845585.508	814696.156
ME A6	845652.340	814548.432
ME A7	845717.180	814574.764
ME A8	845712.519	814424.785
ME A9	845780.817	814452.692
ME A10	845755.697	814283.557
ME A11	845851.329	814321.287
ME A12	845858.086	814003.692
ME A13	845994.686	814057.864
ME A14	845934.687	813874.267
ME A15	846075.945	813925.996
ME A16	845988.624	813736.965
ME A17	846128.693	813787.955
ME A18	846071.401	813655.395
ME A19	846167.899	813692.711
ME A20	845931.097	814192.986
ME A21	845804.068	814143.833
ME A22	845657.432	814103.156
ME A23	845518.153	814050.422
ME A24	845379.437	813995.438
EA1	846522.858	814578.264
EA2	846384.723	814518.305
EA3	846218.205	814372.398
EA4	846043.330	814291.144



LEGEND:

- SITE BOUNDARY
- TATHONG CHANNEL TRAFFIC SEPARATION ZONE
- ○ ○ ○ POTENTIAL MARINE-BASED SEDIMENT REMOVAL AREA TO MAXIMUM 5m BELOW SEABED LEVEL
- POTENTIAL RECLAMATION
- - - - - STW (POTENTIAL LAND-BASED SEDIMENT REMOVAL AREA)
- ← - - - - SUBMARINE OUTFALL (POTENTIAL LAND-BASED / MARINE-BASED SEDIMENT REMOVAL AREA)
- SEAWALL
- ME A1 (pink dot) MARINE-BASED SAMPLING LOCATION TO 6m BELOW SEABED LEVEL
- ME A23 (pink cross) SURFACE GRAB SAMPLING LOCATION
- ME A20 (purple dot) MARINE-BASED SAMPLING LOCATION TO 1m BELOW THE BASE OF MARINE DEPOSIT LAYER
- EA1 (green dot) LAND-BASED SAMPLING LOCATION

ISSUE/REVISION

IR	DATE	DESCRIPTION	CHK.

STATUS

--

SCALE **DIMENSION UNIT**

A1 1:5000 METRES

KEY PLAN

PROJECT NO. **CONTRACT NO.**

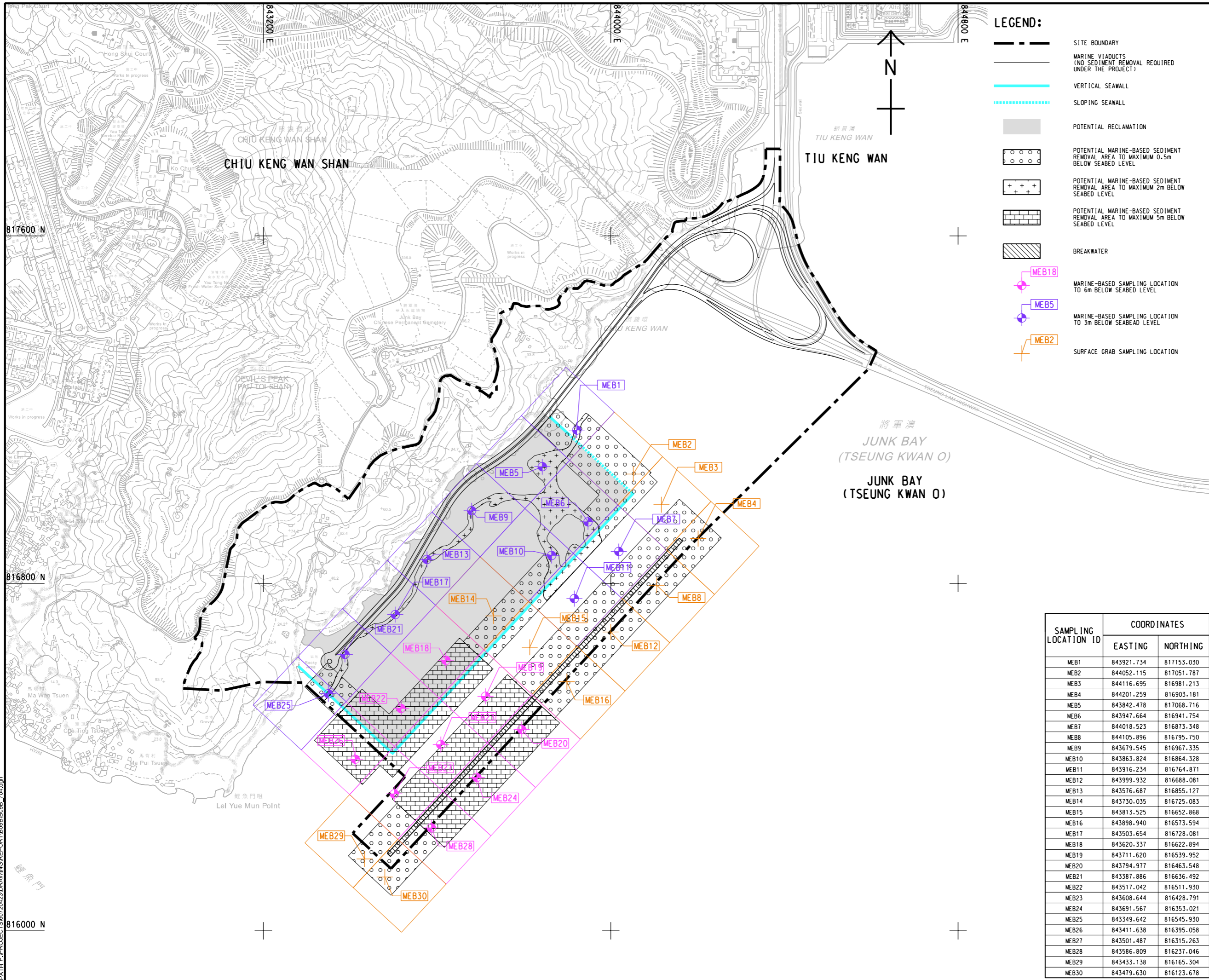
60720423 CE 40/2023(CE)

SHEET TITLE
SEDIMENT SAMPLING LOCATIONS (TKO 137)

SHEET NUMBER
60720423/B09B/703

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ISO A1 594mm x 841mm
 Approved:
 Checked:
 Designer:
 Project Management Initials:
 1/31/2024
 P:\PROJECTS\60720423\DRAWING\REPORT\B09B\B09B_704.dgn
 Plot File by: vicky.xie1
 816000 N



LEGEND:

- SITE BOUNDARY
- MARINE VIADUCTS (NO SEDIMENT REMOVAL REQUIRED UNDER THE PROJECT)
- VERTICAL SEAWALL
- SLOPING SEAWALL
- POTENTIAL RECLAMATION
- POTENTIAL MARINE-BASED SEDIMENT REMOVAL AREA TO MAXIMUM 0.5m BELOW SEABED LEVEL
- POTENTIAL MARINE-BASED SEDIMENT REMOVAL AREA TO MAXIMUM 2m BELOW SEABED LEVEL
- POTENTIAL MARINE-BASED SEDIMENT REMOVAL AREA TO MAXIMUM 5m BELOW SEABED LEVEL
- BREAKWATER
- MEB18 MARINE-BASED SAMPLING LOCATION TO 6m BELOW SEABED LEVEL
- MEB5 MARINE-BASED SAMPLING LOCATION TO 3m BELOW SEABED LEVEL
- + MEB2 SURFACE GRAB SAMPLING LOCATION

AECOM binnies

PROJECT
 DEVELOPMENT OF TSEUNG KWAN O AREA 137 AND ASSOCIATED RECLAMATION SITES – INVESTIGATION, DESIGN AND CONSTRUCTION

CLIENT
 土木工程拓展署
 Civil Engineering and Development Department

CONSULTANT
 AECOM Binnies (TKO137) JV

SUB-CONSULTANTS
 分列工程顧問公司

ISSUE/REVISION

I/R	DATE	DESCRIPTION	CHK.

STATUS

SCALE
 A1 1 : 4000

DIMENSION UNIT
 METRES

KEY PLAN

SAMPLING LOCATION ID	COORDINATES	
	EASTING	NORTHING
MEB1	843921.734	817153.030
MEB2	844052.115	817051.787
MEB3	844116.695	816981.213
MEB4	844201.259	816903.181
MEB5	843842.478	817068.716
MEB6	843947.664	816941.754
MEB7	844018.523	816873.348
MEB8	844105.896	816795.750
MEB9	843679.545	816967.335
MEB10	843863.824	816864.328
MEB11	843916.234	816764.871
MEB12	843999.932	816688.081
MEB13	843576.687	816855.127
MEB14	843730.035	816725.083
MEB15	843813.525	816652.868
MEB16	843898.940	816573.594
MEB17	843503.654	816728.081
MEB18	843620.337	816622.894
MEB19	843711.620	816539.952
MEB20	843794.977	816463.548
MEB21	843387.886	816636.492
MEB22	843517.042	816511.930
MEB23	843608.644	816428.791
MEB24	843691.567	816353.021
MEB25	843349.642	816545.930
MEB26	843411.638	816395.058
MEB27	843501.487	816315.263
MEB28	843586.809	816237.046
MEB29	843433.138	816165.304
MEB30	843479.630	816123.678

PROJECT NO.
 60720423

CONTRACT NO.
 CE 40/2023(CE)

SHEET TITLE
 SEDIMENT SAMPLING LOCATIONS (TKO 132)

SHEET NUMBER
 60720423/B09B/704

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Appendix A

General Layout Plan of Development Sites

土地用途 LAND USE

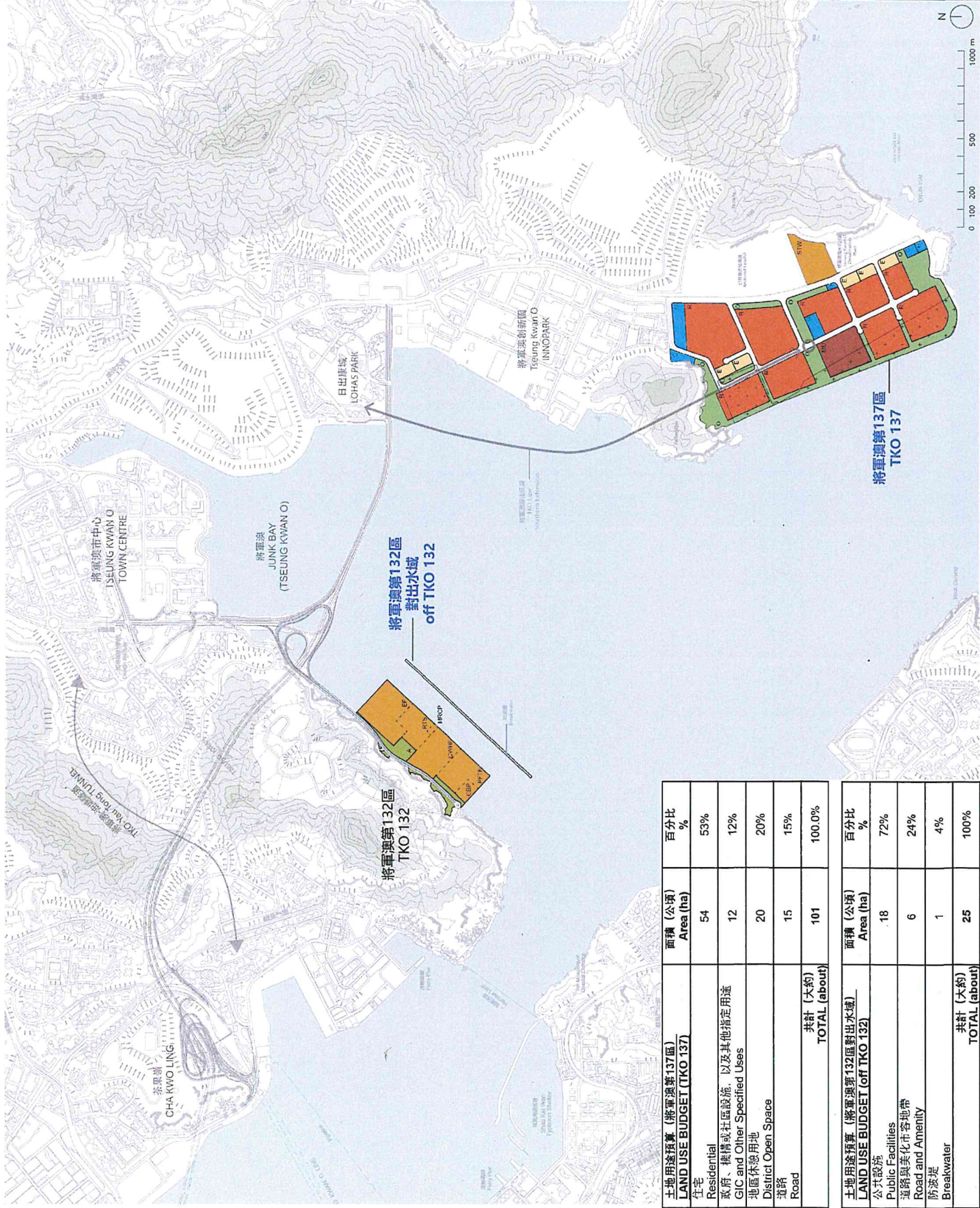
- R** Residential
- MU** Mixed Use
- G** Government
- E** Education
- STW** Sewage Treatment Works
- EF** Electricity Facilities
- RTS** Refuse Transfer Station
- CWIF** Construction Waste Handling Facilities
- MRCP** Marine Refuse Collection Point
- CBP** Concrete Batching Plant
- PFTF** Public Fill Transfer Facility
- O** Open Space
- A** Amenity
- Proposed Reclamation
- Road

圖例 LEGEND

- 將軍澳油塘碼頭 (為《跨越2030年的鐵路及主要幹線運輸研究》涵蓋) Tsung Kwan O - Yau Tong Tunnel (Subject to RMR2030+ Study)
 - 將軍澳南延線 (海底/海底隧道) 鐵路住宅研究 (為《跨越2030年的鐵路及主要幹線運輸研究》涵蓋) Tsung Kwan O Line Southern Extension (Underwater/Underground Tunnel) (Subject to RMR2030+ Study)
 - 擬議車站 (為《跨越2030年的鐵路及主要幹線運輸研究》涵蓋) Proposed Railway Station (Subject to RMR2030+ Study)
- * 建議鐵路站點位僅供參考
The location for proposed railway station is for reference only

圖則一 Plan 1

初步發展大綱圖 - 概況
Preliminary Outline Development Plan - Overview



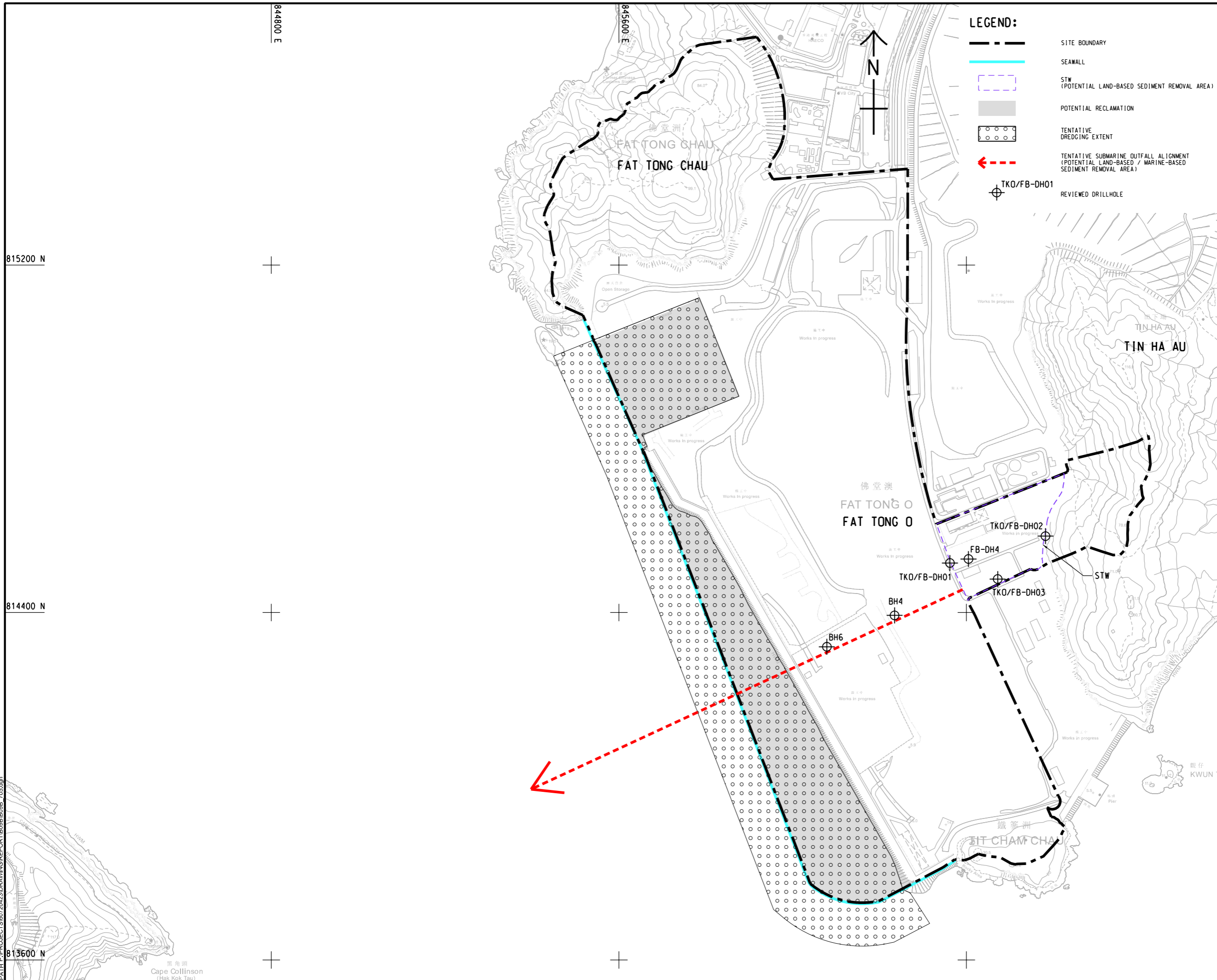
土地用途預算 (將軍澳第137區) LAND USE BUDGET (TKO 137)	面積 (公頃) Area (ha)	百分比 %
住宅 Residential	54	53%
政府、機構或社區設施, 以及其他指定用途 GIC and Other Specified Uses	12	12%
地區休憩用地 District Open Space	20	20%
道路 Road	15	15%
共計 (大約) TOTAL (about)	101	100.0%

土地用途預算 (將軍澳第132區對出水域) LAND USE BUDGET (off TKO 132)	面積 (公頃) Area (ha)	百分比 %
公共設施 Public Facilities	18	72%
道路與美化城市各地帶 Road and Amenity	6	24%
防波堤 Breakwater	1	4%
共計 (大約) TOTAL (about)	25	100%

Appendix B

Relevant Drillhole Records at TKO 137

ISO A1 594mm x 841mm
 Approved:
 Checked:
 Designer:
 Project Management Initials:
 22/12/2023
 PATH PROJECTS/60720423/DRAWING/REPORT/B09B/B09B_705.dgn
 Plot File by: YeeFB



LEGEND:

- SITE BOUNDARY
- SEAWALL
- STW (POTENTIAL LAND-BASED SEDIMENT REMOVAL AREA)
- POTENTIAL RECLAMATION
- TENTATIVE DREDGING EXTENT
- TENTATIVE SUBMARINE OUTFALL ALIGNMENT (POTENTIAL LAND-BASED / MARINE-BASED SEDIMENT REMOVAL AREA)
- + TKO/FB-DH01
REVIEWED DRILLHOLE

AECOM binnies

PROJECT
 項目
 DEVELOPMENT OF TSEUNG KWAN O AREA 137 AND ASSOCIATED RECLAMATION SITES - INVESTIGATION, DESIGN AND CONSTRUCTION

CLIENT
 業主
 土木工程拓展署
 Civil Engineering and Development Department

CONSULTANT
 顧問公司
 AECOM Binnies (TKO137) JV

SUB-CONSULTANTS
 分判工程師/公司

ISSUE/REVISION
 修訂

I/R	DATE	DESCRIPTION	CHK.

STATUS
 狀態

SCALE
 比例
 A1 1 : 4000

DIMENSION UNIT
 尺寸單位
 METRES

KEY PLAN
 索引圖

PROJECT NO.
 項目編號
 60720423

CONTRACT NO.
 合約編號
 CE 40/2023(CE)

SHEET TITLE
 圖紙名稱
 REVIEWED DRILLHOLE LOCATIONS AT TKO 137

SHEET NUMBER
 圖紙編號
 60720423/B09B/705

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ENPACK (H.K.) LIMITED

Civil Engineers & Contractors
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Tel : 23762121 Fax : 23760252



ISO 9002:1994
Certificate No. PG00021

DRILLHOLE RECORD

HOLE NO. **BH 4**

CONTRACT NO. **GE/99/06**

SHEET **1** of **7**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 80**

E 846,238.05

DATE: **07/12/2001** to **27/12/2001**

N 814,390.94

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+12.75** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R.(%)	S.C.R.(%)	R.Q.D.(%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
7.12.01	SX	Dry at 18:00	67					T6-146		0.00			Pinkish grey (7.5YR 7/2), light grey (10R 7/1), angular medium to coarse GRAVEL and much cobble sized moderately strong to strong granite and occasional tuff fragments with occasional brick, wood, metal and plastic paper fragments. (FILL)
1			50					T6-146		0.60			
2			58					T6-146		1.00			
3			45					T6-146		1.74			
4			46					T6-146		2.73			
5			66					T6-146		3.65			
6			67					T6-146		4.26			
7			78					T6-146		4.71			
8			76					T6-146		5.36			
9			38					T6-146		6.10			
8.12.01	5.26m at 18:00	Dry at 08:00	66						+7.45	5.30			Grey (7.5YR 6/1), angular medium to coarse GRAVEL with occasional cobble and boulder sized moderately strong to strong tuff and occasional granite fragments with occasional brick, metal and wood fragments. (FILL)
10			67					T6-146		6.62			
1			52					T6-146		7.55			
2			25					T6-146		8.35			
3			46					T6-146		9.00			
4			51					T6-146		9.75			
5								T6-146					
6								T6-146					
7								T6-146					
8								T6-146					

	Small Disturbed Sample		Standard Penetration Test
	Piston Sample		In-situ Vane Shear Test
	U76 Undisturbed Sample		Permeability Test
	U100 Undisturbed Sample		Impression Packer Test
	Mazier Sample		Packer Test
	SPT Liner Sample		Piezometer Tip
	Water Sample		Standpipe Tip

LOGGED **P. Barry**

DATE **28/12/2001**

CHECKED **J. Morrison**

DATE **29/12/2001**

REMARKS

1. Vane shear tests were carried out at 30.25m, 33.25m, 36.25m and 50.75m depth.



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Certificate No. PC00021

DRILLHOLE RECORD

HOLE NO. **BH 4**

CONTRACT NO. **GE/99/06**

SHEET **2** of **7**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 80**

E 846,238.05

DATE: **07/12/2001** to **27/12/2001**

N 814,390.94

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+12.75** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R. (%)	S.C.R. (%)	R.Q.D. (%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
10			47					T6-146 10.30					As sheet 1 of 7.
11	SX PX		78					T6-146 11.00					
		4.20m at 18:00	60					T6-116 11.30					
10.12.01			67					T6-118 11.75					
11.12.01		8.12m at 08:00	29					T6-116 12.26	+0.49	12.26			
12			64					T2-101 12.70					Yellowish brown (10YR 5/6), light grey (10R 7/1), angular fine to coarse GRAVEL and much cobble sized weak to moderately strong tuff, granite and concrete fragments with a matrix of silty sand. (FILL)
13			46					T2-101 13.35					
14			31					T2-101 14.00					
			48					T2-101 14.25					
15		9.53m at 18:00	53					T2-101 15.15					
11.12.01								T2-101 15.52					
12.12.01		10.65m at 08:00	30					T2-101 16.35					
16		10.13m at 18:00	36					T2-101 17.20	-4.45	17.20			Light grey (10R 7/1) and light yellowish brown (2.5Y 6/4), angular medium to coarse GRAVEL and much cobble sized moderately strong to strong tuff, granite and concrete fragments with occasional brick, steel and wood fragments. (FILL)
12.12.01								T2-101 18.00					
13.12.01		10.82m at 08:00	21					T2-101 18.77					
17			29					T2-101 19.35					
18		9.46m at 18:00	34					T2-101 19.70					
13.12.01								T2-101					
14.12.01		10.64m at 08:00	52										
19			24										
20													

- Small Disturbed Sample
- Piston Sample
- U76 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED **P. Barry**

DATE **28/12/2001**

CHECKED **J. Morrison**

DATE **29/12/2001**

REMARKS



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DRILLHOLE RECORD

HOLE NO. **BH 4**

CONTRACT NO. **GE/99/06**

SHEET **3** of **7**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 80**

E 846,238.05

DATE: **07/12/2001** to **27/12/2001**

N 814,390.94

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+12.75** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R. (%)	S.C.R. (%)	R.Q.D. (%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
20			80					T2-101					As sheet 2 of 7.
21			39					T2-101					
22			43					T2-101					Medium dense, light grey (10YR 7/1), silty fine to medium SAND with occasional fine shell fragments. (DISTURBED MARINE DEPOSIT)
23			20					T2-101					
24		10.45m at 18:00					(6, 6, 5, 4, 5, 4) N=18	1 23.45 2 23.75					Grey (10YR 5/1) to dark grey (10YR 4/1), slightly silty CLAY with occasional fine shell fragments. (DISTURBED MARINE DEPOSIT)
25		10.54m at 08:00	100				(1, 1, 2, 4, 5, 5) N=16	3 24.30 4 24.75 5 24.90 6 25.20					
26								7 26.15					Grey (10YR 5/1) to dark grey (10YR 4/1), slightly silty CLAY with occasional fine shell fragments. (DISTURBED MARINE DEPOSIT)
27								8 27.30					
28			100				(1, 1, 1, 2, 2, 3) N=8	9 27.75 10 27.90 11 28.20					Grey (10YR 5/1) to dark grey (10YR 4/1), slightly silty CLAY with occasional fine shell fragments. (DISTURBED MARINE DEPOSIT)
29								12 28.75					
30		1.25m at						13 29.65					

- Small Disturbed Sample
- Piston Sample
- U76 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED **P. Barry**
DATE **28/12/2001**
CHECKED **J. Morrison**
DATE **29/12/2001**

REMARKS



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ISO 9002:1994
Certificate No. PQ00021

DRILLHOLE RECORD

HOLE NO. **BH 4**

CONTRACT NO. **GE/99/06**

SHEET **4** of **7**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 80**

E 846,238.05

DATE: **07/12/2001** to **27/12/2001**

N 814,390.94

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+12.75** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R. (%)	S.C.R. (%)	R.Q.D. (%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description	
15.12.01 17.12.01		18:00 10.51m at 08:00					V	14 30.25					As sheet 3 of 7. Peak shear strength 34.8 KPa (Soft)	
31							15 31.25							
32			100				16 31.75							
33							17 32.65							
34							V	18 33.25						No peak / failure reached before maximum allowable torque (assumed Firm).
35							19 34.25							
17.12.01 18.12.01		1.02m at 18:00 10.42m at 08:00						20 34.75						Dark grey (10YR 4/1), slightly silty CLAY with some plant fragments. (MARINE DEPOSIT) No peak / failure reached before maximum allowable torque (assumed Firm).
36			100				21 35.65							
37							V	22 36.25	-23.50	36.25				
38							23 37.25							
39	PX HX							24 37.75	-25.00	37.75			Light yellowish brown (10YR 5/4), mottled grey, sandy CLAY. (MARINE / ESTUARINE DEPOSIT)	
40			100				25 38.65							
							(3, 4, 4, 4, 5, 6) N = 19	26 38.85						
								27 39.15						

- Small Disturbed Sample
- Piston Sample
- U76 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED **P. Barry**
 DATE **28/12/2001**
 CHECKED **J. Morrison**
 DATE **29/12/2001**

REMARKS



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ISO 9002:1994
Certificate No. POC00021

DRILLHOLE RECORD

HOLE NO.

BH 4

CONTRACT NO. **GE/99/06**

SHEET **5**

of

7

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 80**

E 846,238.05

DATE: **07/12/2001** to **27/12/2001**

N 814,390.94

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+12.75** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R. (%)	S.C.R. (%)	R.Q.D. (%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description	
40													As sheet 4 of 7.	
41		0.00m at 18:00	95				(4, 4, 4, 6, 8, 8) N = 26	28 40.20 29 40.75 30 41.75 31 41.95 32 42.25						
42		0.23m at 08:00												
43														
44			95					33 43.30 34 43.75 35 44.75 36 44.95 37 45.25						
45							(2, 3, 4, 4, 5, 5) N = 18							
46														
47			100				52blows	38 46.30 39 46.75 40 47.20 41 47.35 42 47.65	-34.00	46.75				Medium dense, white (10YR 8/1), fine SAND with occasional fine shell fragments. (BEACH DEPOSIT)
48							(3, 4, 4, 7, 7, 8) N = 26							
49								43 48.70						
50							41blows	44 49.75	-37.00	49.75			Grey (10YR 5/1), slightly silty CLAY. (MARINE)	

	Small Disturbed Sample		Standard Penetration Test
	Piston Sample		In-situ Vane Shear Test
	U76 Undisturbed Sample		Permeability Test
	U100 Undisturbed Sample		Impression Packer Test
	Mazier Sample		Packer Test
	SPT Liner Sample		Piezometer Tip
	Water Sample		Standpipe Tip

LOGGED **P. Barry**
 DATE **28/12/2001**
 CHECKED **J. Morrison**
 DATE **29/12/2001**

REMARKS



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DRILLHOLE RECORD

HOLE NO. **BH 4**

CONTRACT NO. **GE/99/06**

SHEET **6** of **7**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 80**

E 846,238.05
N 814,390.94

DATE: **07/12/2001** to **27/12/2001**

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+12.75** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R.(%)	S.C.R.(%)	R.Q.D.(%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
50			100										DEPOSIT)
19.12.01 22.12.01		0.00m at 18:00					V	45	50.20				No peak / failure reached before maximum allowable torque (assumed Firm).
51		0.00m at 08:00						46	50.75				
52								47	51.75	-39.00	51.75		Light grey (10YR 7/1), mottled light yellowish brown, silty CLAY with occasional fine shell fragments. (MARINE / ESTUARINE DEPOSIT)
53			95					48	52.25				
54							(3, 4, 6, 7, 8, 10) N = 31	49	53.25				
22.12.01 24.12.01		0.00m at 18:00						50	53.45				Yellowish brown (10YR 5/6), mottled grey, sandy, silty CLAY. (ALLUVIUM)
55		0.00m at 08:00						51	53.75	-41.05	53.80		
56							(3, 6, 6, 8, 9, 11) N = 34	52	54.80				
57								53	55.25	-42.66	55.41		Grey, subangular BOULDER sized strong tuff fragments. (ALLUVIUM)
58			95					54	55.66	-42.91	55.66		Light yellowish brown (10YR 6/4), mottled grey, silty CLAY. (MARINE / ESTUARINE DEPOSIT)
59							(4, 4, 5, 6, 8, 9) N = 28	55	56.20				
24.12.01 27.12.01		0.00m at 18:00						56	56.75				
60		0.00m						57	57.75				
								58	57.95				
								59	58.25				
								60	59.30				
								61	59.75	-47.00	59.75		Grey (10YR 5/1), slightly silty CLAY. (MARINE

	Small Disturbed Sample		Standard Penetration Test
	Piston Sample		In-situ Vane Shear Test
	U76 Undisturbed Sample		Permeability Test
	U100 Undisturbed Sample		Impression Packer Test
	Mazier Sample		Packer Test
	SPT Liner Sample		Piezometer Tip
	Water Sample		Standpipe Tip

LOGGED **P. Barry**
 DATE **28/12/2001**
 CHECKED **J. Morrison**
 DATE **29/12/2001**

REMARKS



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ISO 9002 : 1994
Certificate No. P000021

DRILLHOLE RECORD

HOLE NO. **BH 4**

CONTRACT NO. **GE/99/06**

SHEET **7** of **7**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 80**

E 846,238.05

DATE: **07/12/2001** to **27/12/2001**

N 814,390.94

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+12.75** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R. (%)	S.C.R. (%)	R.Q.D. (%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description	
60		at 08:00	95										DEPOSIT)	
61							(3, 3, 4, 6, 6, 6) N = 22	82 60.75 83 60.95 84 61.25						
62								85 62.30						
63			95					86 62.75						
27.12.01	HX	0.00m at 13:00						87 63.75	-51.10	63.85				
64														End of Investigation hole at 63.85m.
65														
66														
67														
68														
69														
70														

- Small Disturbed Sample
- Piston Sample
- U76 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED P. Barry

DATE 28/12/2001

CHECKED J. Morrison

DATE 29/12/2001

REMARKS



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DRILLHOLE RECORD

HOLE NO.

BH 6

CONTRACT NO. **GE/99/06**

SHEET

1

of

6

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 78**

E 846,082.39

DATE: **05/12/2001** to **13/12/2001**

N 814,318.20

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+5.33** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R.(%)	S.C.R.(%)	R.Q.D.(%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
5.12.01	SX		85					T6-146		0.00			Pinkish grey (7.5YR 7/2), light grey (10R 7/1), with yellowish brown, angular medium to coarse GRAVEL with much cobble and boulder sized moderately strong to strong granite, tuff and occasional brick, concrete fragments within a matrix of silty sand. (FILL)
1			92				T6-146		1.00				
2		1.07m at 18:00	70				T6-146		1.70				
5.12.01		Dry at 08:00	77				T6-146		2.35				
6.12.01			70				T6-146		3.00				
3			70				T6-146		3.50				
4			65				T6-146		4.50				
5			62				T6-146	+0.83	4.50				
6		3.50m at 18:00	68				T6-146		5.30				
6.12.01			73				T6-146		5.90				
7		3.75m at 08:00	89				T6-146		6.60	Light grey (10R 7/1) mottled pinkish grey, yellowish brown, angular medium to coarse GRAVEL with much cobble and boulder sized moderately strong to strong tuff granite and occasional concrete, asphalt, wood and steel fragments. (FILL)			
7.12.01			72				T6-146		7.60				
8			90				T6-146		8.30				
9			70				T6-146		9.10				
10							T6-146		10.00				

- Small Disturbed Sample
- Piston Sample
- U76 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample

- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED P. Barry
 DATE 14/12/2001
 CHECKED J. Morrison
 DATE 20/12/2001

REMARKS

1. Vane shear tests were carried out at 19.50m, 22.50m, 25.50m and 28.50m depth.



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DRILLHOLE RECORD

HOLE NO. **BH 6**

CONTRACT NO. **GE/99/06**

SHEET **2** of **6**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 78**

E 846,082.39

DATE: **05/12/2001** to **13/12/2001**

N 814,318.20

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+5.33** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R.(%)	S.C.R.(%)	R.Q.D.(%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
10			63					T6-146					As sheet 1 of 6.
11			45					T6-146 10.70					
12			64					T6-146 11.50					
			35					T6-146 12.20					
7.12.01 8.12.01		3.17m at 18:00						T6-146 13.00					
		3.91m at 08:00	48					T6-146 13.50					
14			66					T6-146 14.00					
			51					T6-146 14.70					
15			49					T6-146 16.00					
16			50					T6-146 16.60					
17	SX PX		50					T6-146 17.30	-11.97	17.30			
18			100				15blows	1 17.50					
			100					2 17.95					
								3 18.00					
19								4 18.90					
8.12.01 10.12.01		3.07m at 18:00						5 19.40					
20		3.35m at											

Grey (10YR 5/1), slightly silty CLAY with occasional fine shell fragments. (MARINE DEPOSIT)

Peak shear strength 17.0 KPa (Very soft)

- Small Disturbed Sample
- Piston Sample
- U78 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED **P. Barry**

DATE **14/12/2001**

CHECKED **J. Morrison**

DATE **20/12/2001**

REMARKS



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DRILLHOLE RECORD

HOLE NO.

BH 6

CONTRACT NO. **GE/99/06**

SHEET

3

of

6

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 78**

E 846,082.39

DATE: **05/12/2001** to **13/12/2001**

N 814,318.20

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+5.33** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R. (%)	S.C.R. (%)	R.Q.D. (%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
20		08:00											As sheet 2 of 6.
21							V	6 20.40					
22			100					7 21.00					
23								8 21.90					Peak shear strength 15.9 KPa (Very soft)
24								9 22.40					
25								10 23.40					
26			100					11 24.00					
27								12 24.90					
28								13 25.40					Peak shear strength 29.1 KPa (Soft)
29		2.73m at 18:00						14 26.40					
10.12.01 11.12.01		2.22m at 08:00						15 27.00					
29								16 27.90					
30	PX							17 28.40					Peak shear strength 19.2 KPa (Very soft to soft)
								18 29.40	-24.17	29.50			
								19 30.00					Light yellowish brown (10YR 6/4) mottled grey, silty CLAY. (MARINE / ESTUARINE DEPOSIT)

- Small Disturbed Sample
- Piston Sample
- U76 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED P. Barry
 DATE 14/12/2001
 CHECKED J. Morrison
 DATE 20/12/2001

REMARKS



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DRILLHOLE RECORD

HOLE NO. **BH 6**

CONTRACT NO. **GE/99/06**

SHEET **4** of **6**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 78**

E 846,082.39

DATE: **05/12/2001** to **13/12/2001**

N 814,318.20

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+5.33** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R.(%)	S.C.R.(%)	R.Q.D.(%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
30	HX												As sheet 3 of 6.
31			100				(3, 4, 5, 5, 6, 7) N = 23	20 21 22		30.90 31.10 31.40			
32								23		32.35			
33								24		33.00			
34			100				(2, 1, 2, 2, 2, 2) N = 8	25 26 27		34.00 34.20 34.50			
35								28		35.45			
36								29	-30.67	36.00			
37			100					30		37.00			
38							(1, 1, 1, 1, 1, 2) N = 5	31 32		37.20 37.50			
39		4.47m at 18:00						33		38.45			
40		0.00m at 08:00	100					34		39.00			
		139.01 -12.12.01						35		40.00			Grey (10YR 5/1), slightly silty CLAY with occasional fine shell fragments. (MARINE DEPOSIT)

- ↑ Small Disturbed Sample
- Piston Sample
- U76 Undisturbed Sample
- ▨ U100 Undisturbed Sample
- ▩ Mazier Sample
- SPT Liner Sample
- △ Water Sample
- ↓ Standard Penetration Test
- ∇ In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED **P. Barry**

DATE **14/12/2001**

CHECKED **J. Morrison**

DATE **20/12/2001**

REMARKS



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DRILLHOLE RECORD

HOLE NO. **BH 6**

CONTRACT NO. **GE/99/06**

SHEET **5** of **6**

PROJECT **Fill Bank at Tsueng Kwan O Area 137, Ground Investigation**

METHOD **W+RC**

CO-ORDINATES

W.O. No **GE/99/06.64**

MACHINE & No. **DR 78**

E 846,082.39

DATE: **05/12/2001** to **13/12/2001**

N 814,318.20

FLUSHING MEDIUM **WATER**

ORIENTATION **VERTICAL**

GROUND LEVEL **+5.33** mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R.(%)	S.C.R.(%)	R.Q.D.(%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
40							(1, 1, 1, 1, 2, 2) N = 6	36 37	40.20 40.50				As sheet 4 of 6.
41													
42			100					38 39	41.45 42.00				
43							(4, 4, 6, 11, 11, 12) N = 40	40 41 42	43.00 43.20 43.50	-37.77 43.10			Light yellowish brown (10YR 6/4) mottled grey, slightly sandy silty CLAY with occasional fine shell fragments. (MARINE /ESTUARINE DEPOSIT)
44													
45			100					43 44	44.45 45.00				
46							(5, 6, 7, 7, 8, 11) N = 33	45 46 47	46.00 46.20 46.50				
47													
48			100					48 49	47.45 48.00				
49							(5, 7, 8, 10, 13, 15) N = 46	50 51 52	49.00 49.20 49.50				
50													

- Small Disturbed Sample
- Piston Sample
- U76 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED P. Barry

DATE 14/12/2001

CHECKED J. Morrison

DATE 20/12/2001

REMARKS



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DRILLHOLE RECORD

HOLE NO.

BH 6

CONTRACT NO. GE/99/06

SHEET

6

of

6

PROJECT Fill Bank at Tsueng Kwan O Area 137, Ground Investigation

METHOD W+RC

CO-ORDINATES

W.O. No GE/99/06.64

MACHINE & No. DR 78

E 846,082.39

DATE: 05/12/2001 to 13/12/2001

N 814,318.20

FLUSHING MEDIUM WATER

ORIENTATION VERTICAL

GROUND LEVEL +5.33 mPD

Drilling Progress	Casing size	Water level (m) Shift start/end	T.C.R. (%)	S.C.R. (%)	R.Q.D. (%)	F.I.	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
50													As sheet 5 of 6.
1252.01		3.15m at 18:00						53 ↓ 50.45					
13.12.01		0.00m at 08:00	100				(5, 5, 5, 7, 8, 9) N = 29	54 ↓ 51.00 55 ↓ 52.00 56 ↓ 52.20 57 ↓ 52.50					
52													
53													
54								56 ↓ 53.45	-48.22	53.55			
55	HX	3.15m at 18:00					(3, 4, 6, 6, 6, 8) N = 26	59 ↓ 54.00 60 ↓ 55.00 61 ↓ 55.20 62 ↓ 55.50					End of investigation hole at 55.55m.
13.12.01													
56													
57													
58													
59													
60													

- ↑ Small Disturbed Sample
- ↓ Piston Sample
- U76 Undisturbed Sample
- U100 Undisturbed Sample
- Mazier Sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe Tip

LOGGED P. Barry

DATE 14/12/2001

CHECKED J. Morrison

DATE 20/12/2001

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 1 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level +26.50	Depth (m) 0.00	Legend	Grade	Description	
01/03/2014	SW														Brown (7.5YR 5/4), dappled greyish brown, silty fine to coarse SAND with some angular to subangular fine to coarse gravel of moderately decomposed and slightly decomposed rock fragments. (FILL)
01/03/2014 03/03/2014		Dry at 08:00	0	60					A INSPECTION PIT ● 0.50 B ● 1.00 C ● 1.20	+26.30	1.20			Grey (N 5), dappled light brown and greyish brown, angular to subangular COBBLE sized concrete, moderately decomposed and slightly decomposed Granite with some silty sandy angular to subangular fine to coarse gravel of moderately decomposed and slightly decomposed rock fragments, occasional wood pieces and steel bars dia. 15mm. (FILL)	
			0	90					T6-I31		1.80			From 2.45m to 2.65m : Grey, angular BOULDER sized concrete.	
03/03/2014 04/03/2014		0.50m at 18:00							T6-I31		2.80			From 3.15m to 3.48m : Dark grey, angular BOULDER sized slightly decomposed Tuff.	
		Dry at 08:00	0	92					T6-I31		3.50				
			0	85					T6-I31		4.70				
04/03/2014 05/03/2014	SW 4.70 PW	0.70m at 18:00	0	72					T6-I31		5.30	+21.20	5.30		
		Dry at 08:00	0	54					T2IOI		6.50			Grey (N 5), dappled light brown and greyish brown, angular COBBLE sized slightly decomposed Granite and concrete with some sandy angular to subangular fine to coarse gravel of moderately decomposed and slightly decomposed rock fragments and steel bars dia. 15mm. (FILL)	
			0	67					T2IOI		7.20				
			0	53					T2IOI		8.10				
			0	36					T2IOI		9.20				
			0	41					T2IOI						

<ul style="list-style-type: none"> ● Disturbed sample ▣ Piston sample ▤ Split spoon sample ▥ U76 undisturbed sample ▧ U100 undisturbed sample ▨ Mazier sample ▩ SPT liner sample ▲ Water sample En Environmental Sample 	<ul style="list-style-type: none"> ↓ Standard penetration test ↕ In-situ vane shear test ⊥ Permeability test ⊥ Pressuremeter test ⊥ Packer Test ⊥ Acoustic or optical televiwer survey ⊥ Piezometer tip ⊥ Standpipe ⊥ Groundwater Sampling Well ⊥ Vibrating wire piezometer ⊥ Impression packer test 	<p>LOGGED T. C. Yip</p> <p>DATE 26/03/2014</p> <p>CHECKED Y. M. Leung</p> <p>DATE 27/03/2014</p>	<p>REMARKS</p> <ol style="list-style-type: none"> 1. An inspection pit was excavated to 1.20m. 2. A constant head permeability test was carried out from 69.00m to 70.50m. 3. A water sample was taken at 45.00m. 4. A piezometer was installed at 35.00m. 5. Piezometer buckets were installed in piezometer from 20.50m to 25.50m depth at 0.50m intervals.
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DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 2 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level +16.50	Depth (m) 10.00	Legend	Grade	Description
05/03/2014 06/03/2014	PW	1.30m at 18:00 8.20m at 08:00	0	41					T2 IOI 10.30					See sheet 1 of 10
11			0	53					T2 IOI 11.40					From 11.58m to 11.78m : Light brown, angular BOULDER sized moderately decomposed Tuff.
12		2.10m at 18:00 10.50m at 08:00	0	76					T2 IOI 12.50	+14.00	12.50			Brown (7.5YR 5/4), slightly silty fine to coarse SAND with some angular to subangular fine to coarse gravel of moderately decomposed rock fragments and occasional angular cobble sized concrete. (FILL)
06/03/2014 07/03/2014			0	0					1 13.50 13.60	+12.90	13.60			Grey (N 5), dappled light grey and dark grey, locally greyish brown, angular to subangular COBBLE sized slightly decomposed Granite, concrete and wood pieces with some sandy angular to subangular fine to coarse gravel of moderately to slightly decomposed rock fragments. (FILL)
14			0	72					T2 IOI 14.20					
15	PW 15.00 HW		0	0					2 14.90 15.00					
16			0	53					T2 IOI 16.20					
17			0	60					T2 IOI 17.50					
18			0	53					T2 IOI 18.50	+8.00	18.50			Light brown (7.5YR 6/4), dappled greyish brown, silty fine to coarse SAND with some angular to subangular fine to coarse gravel of moderately decomposed rock fragments and occasional angular cobble sized concrete. (FILL)
19			0	0					3 19.20 19.30	+7.20	19.30			Grey (N 5), dappled dark grey and greyish brown, angular to subangular COBBLE sized moderately to slightly decomposed Granite and Tuff with some sandy angular to subangular fine to coarse gravel of moderately to slightly
20			0	72					T2 IOI					

<ul style="list-style-type: none"> ● Disturbed sample ▣ Piston sample ▨ Split spoon sample ▩ U76 undisturbed sample ▧ U100 undisturbed sample ▦ Mazier sample ▤ SPT liner sample ▲ Water sample En Environmental Sample 	<ul style="list-style-type: none"> ↓ Standard penetration test ↕ In-situ vane shear test ⊥ Permeability test ⊥ Pressuremeter test ⊥ Packer Test ⊥ Acoustic or optical televiewer survey ⊥ Piezometer tip ⊥ Standpipe ⊥ Groundwater Sampling Well ⊥ Vibrating wire piezometer ⊥ Impression packer test 	LOGGED T. C. Yip DATE 26/03/2014 CHECKED Y. M. Leung DATE 27/03/2014	REMARKS
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DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 3 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level +6.50	Depth (m) 20.00	Legend	Grade	Description
07/03/2014 08/03/2014	HW	2.80m at 18:00	0	72					T2101 20.50			[Cross-hatched pattern]		decomposed rock fragments and occasional plastic fragments. (FILL) From 20.30m to 20.50m : Grey, angular BOULDER sized slightly decomposed Granite.
21		18.50m at 08:00	0	58				T2101 21.30						From 22.06m to 22.30m : Grey, angular BOULDER sized slightly decomposed Granite.
22			0	52				T2101 22.30						
23			0	62				T2101 23.50						
24			0	60				T2101 24.30						
25		2.20m at 18:00	0	60				T2101 25.00						From 24.78m to 25.00m : Grey, angular BOULDER sized slightly decomposed Granite.
08/03/2014 10/03/2014		24.10m at 08:00	0	51				T2101 26.40	+0.10	26.40				From 26.15m to 26.40m : Grey, angular BOULDER sized concrete.
27			0	0				4 27.20 27.30	-0.80	27.30				Dark grey (N 3), dappled greyish brown and grey, sandy angular to subangular fine to coarse GRAVEL of moderately decomposed and slightly decomposed rock fragments with some angular cobble sized moderately decomposed Granite. (FILL)
28			0	59				T2101 28.50						Grey (N 5), dappled dark grey and light grey, angular COBBLE sized slightly decomposed Granite and Tuff with some angular to subangular fine to coarse gravel of moderately decomposed and slightly decomposed rock fragments and steel bars dia. 20mm. (FILL)
29			0	0				5 29.50 29.60						From 28.18m to 28.50m : Grey, angular BOULDER sized concrete.
30			0	37				T2101						

- Disturbed sample
- ▣ Piston sample
- ▤ Split spoon sample
- ▥ U76 undisturbed sample
- ▧ U100 undisturbed sample
- ▨ Mazier sample
- ▩ SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ▼ Standard penetration test
- ▽ In-situ vane shear test
- ⊥ Permeability test
- ⊕ Pressuremeter test
- ⊖ Packer Test
- ⊗ Acoustic or optical televiewer survey
- ⊘ Piezometer tip
- ⊙ Standpipe
- ⊚ Groundwater Sampling Well
- ⊛ Vibrating wire piezometer
- ⊜ Impression packer test

LOGGED	T. C. Yip
DATE	26/03/2014
CHECKED	Y. M. Leung
DATE	27/03/2014

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 4 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD
		Vertical			

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level -3.50	Depth (m) 30.00	Legend	Grade	Description
	HW		0	37					T2101 30.50	-4.00	30.50			See sheet 3 of 10
31			0	0					6 31.40 31.50	-5.00	31.50			Greyish brown (2.5Y 5/2), slightly sandy angular to subangular fine to coarse GRAVEL of moderately decomposed and slightly decomposed rock fragments, occasional angular cobble sized slightly decomposed Granite and wood pieces. (FILL)
32			0	51					T2101					Grey (N 5), dappled dark grey, angular COBBLE sized slightly decomposed Tuff and concrete. (FILL)
33		10.50m at 18:00 23.80m at 08:00	0	0					7 32.90 34.00	-6.40	32.90			From 32.66m to 32.90m : Dark grey, angular BOULDER sized slightly decomposed Tuff. Grey (N 5), dappled dark grey, angular medium to coarse GRAVEL of moderately decomposed and slightly decomposed rock fragments with occasional subangular cobble sized moderately decomposed Granite, wood pieces and refuse. (FILL)
34			0	0					8 34.90 35.00	-8.50	35.00			Grey (N 5), dappled greyish brown and light grey, subangular COBBLE sized concrete, moderately decomposed and slightly decomposed Granite with some angular to subangular fine to coarse gravel of moderately decomposed and slightly decomposed rock fragments. (FILL)
35			0	46					9 36.00					
36		6.70m at 18:00 24.50m at 08:00	0	0					10 36.90 37.00					
37		11/03/2014 at 18:00 12/03/2014 at 08:00	0	31					T2101					
38		9.10m at 18:00 23.90m at 08:00	0	0					10 38.30 38.40	-11.80	38.30			Light brown (7.5YR 6/4), spotted light grey, fine to coarse SAND with some angular to subangular fine gravel of highly decomposed rock fragments and shell fragments. (FILL)
39			0	0										
40			0	0										

<ul style="list-style-type: none"> ● Disturbed sample ▣ Piston sample ▨ Split spoon sample ▨ U76 undisturbed sample ▨ U100 undisturbed sample ▨ Mazier sample ▨ SPT liner sample ▲ Water sample En Environmental Sample 	<ul style="list-style-type: none"> ▼ Standard penetration test ▽ In-situ vane shear test ⊥ Permeability test ⊥ Pressuremeter test ⊥ Packer Test ⊥ Acoustic or optical televiewer survey ⊥ Piezometer tip ⊥ Standpipe ⊥ Groundwater Sampling Well ⊥ Vibrating wire piezometer ⊥ Impression packer test 	<p>LOGGED T. C. Yip</p> <p>DATE 26/03/2014</p> <p>CHECKED Y. M. Leung</p> <p>DATE 27/03/2014</p>	<p>REMARKS</p>
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DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 5 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(W/S), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD Rotary

CO-ORDINATES

W. O. NO. GE/2013/21.45

MACHINE & NO. VBM40

E 846362.04 N 814513.80

DATE : 03/03/2014 to 25/03/2014

FLUSHING MEDIUM Water

ORIENTATION Vertical

GROUND LEVEL + 26.50 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
	HW		0							-13.50	40.00			See sheet 4 of 10
41		1.50m at 18:00						3,3, 3,4,3,5 N=15	11 40.40 12 40.50	-14.00	40.50			Firm, dark grey (N 3), slightly sandy SILT / CLAY with occasional shell fragments. (FILL)
42		24.80m at 08:00						60 bls	13 40.90 14 41.40 15 41.85 15 41.90	-14.90	41.40			Greyish brown (2.5Y 5/2), dappled dark grey, slightly silty fine to coarse SAND with some angular to subangular fine gravel of highly decomposed rock fragments. (FILL)
43								5,6, 4,3,3,4 N=14	16 42.60 17 42.90 17 42.95	-16.00	42.50			Firm, dark grey (N 3), dappled greyish brown, slightly sandy SILT / CLAY with occasional subangular to subrounded fine to medium gravel of moderately decomposed rock fragments and shell fragments. (FILL)
44								32 bls	18 43.40 19 43.85 19 43.90	-16.90	43.40			Firm, dark grey (N 3), spotted light grey, silty CLAY with occasional shell fragments. (MARINE DEPOSIT)
45								4,4, 5,3,4,6 N=18	20 44.60 21 44.90 21 44.95					
46			50	95					22 45.40					
47								3,4, 4,6,4,5 N=19	23 46.40 24 46.50 25 46.90 25 46.95					
48			50	95					26 47.40					
49								3,3, 4,3,4,6 N=17	27 48.40 28 48.50 29 48.60 29 48.90 29 48.95					
50			50	95					30 49.40					

- Disturbed sample
- ▣ Piston sample
- ▤ Split spoon sample
- ▥ U76 undisturbed sample
- ▧ U100 undisturbed sample
- ▨ Mazier sample
- ▩ SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ▼ Standard penetration test
- ▽ In-situ vane shear test
- ⊥ Permeability test
- ⊕ Pressuremeter test
- ⊖ Packer Test
- ⊗ Acoustic or optical televiewer survey
- ⊘ Piezometer tip
- ⊙ Standpipe
- ⊚ Groundwater Sampling Well
- ⊛ Vibrating wire piezometer
- ⊜ Impression packer test

LOGGED T. C. Yip

DATE 26/03/2014

CHECKED Y. M. Leung

DATE 27/03/2014

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 6 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD
		Vertical			

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples			Reduced Level	Depth (m)	Legend	Grade	Description
									No.	Type	Depth					
51	HW		50					3.3, 5.6, 7.6 N=24	31	Disturbed sample	50.40	50.50			See sheet 5 of 10	
52			50	95				3.4, 5.6, 7.5 N=23	32	Piston sample	50.60				Firm to stiff, grey (N 5), dappled light grey, silty CLAY. (ALLUVIUM)	
53		1.70m at 18:00 0.50m at 08:00						3.4, 5.6, 7.5 N=23	33	Split spoon sample	50.90	50.95				
54			70	95				2.2, 3.4, 6.5 N=18	34	U76 undisturbed sample	51.40					
55								3.2, 4.3, 5.5 N=17	35	U100 undisturbed sample	52.40	52.50			Firm, grey (N 5), locally dappled light grey, silty CLAY. (ALLUVIUM)	
56			70	95				3.2, 4.3, 5.5 N=17	36	Mazier sample	52.60					
57								3.3, 3.4, 6.5 N=18	37	SPT liner sample	52.90	52.95				
58			70	95					3.2, 4.3, 5.5 N=17	38	Water sample	53.40				
59									3.2, 4.3, 5.5 N=17	39	Environmental Sample	54.40	54.50			
60			70	95					3.2, 4.3, 5.5 N=17	40		54.60				
									3.2, 4.3, 5.5 N=17	41		54.90	54.95			
									3.2, 4.3, 5.5 N=17	42		55.40				
			70	95					3.2, 4.3, 5.5 N=17	43		56.40	56.50			
									3.2, 4.3, 5.5 N=17	44		56.60				
									3.2, 4.3, 5.5 N=17	45		56.90	56.95			
									3.2, 4.3, 5.5 N=17	46		57.40				
									3.2, 4.3, 5.5 N=17	47		58.40	58.50			
									3.2, 4.3, 5.5 N=17	48		58.60				
									3.2, 4.3, 5.5 N=17	49		58.90	58.95			
			70	95					3.2, 4.3, 5.5 N=17	50		59.40				

<ul style="list-style-type: none"> ● Disturbed sample ▣ Piston sample ▤ Split spoon sample ▥ U76 undisturbed sample ▧ U100 undisturbed sample ▨ Mazier sample ▩ SPT liner sample ▲ Water sample En Environmental Sample 	<ul style="list-style-type: none"> ▼ Standard penetration test ▽ In-situ vane shear test ⊥ Permeability test ⊕ Pressuremeter test ⊖ Packer Test ⊗ Acoustic or optical televiewer survey ⊘ Piezometer tip ⊙ Standpipe ⊚ Groundwater Sampling Well ⊛ Vibrating wire piezometer ⊜ Impression packer test 	<p>LOGGED T. C. Yip</p> <p>DATE 26/03/2014</p> <p>CHECKED Y. M. Leung</p> <p>DATE 27/03/2014</p>	REMARKS
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DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 7 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD
		Vertical			

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples			Reduced Level	Depth (m)	Legend	Grade	Description
									No.	Type	Depth					
61	HW		70					3.2, 3.4, 5.7 N=19	51	●	60.40 60.50	-33.50	60.00			See sheet 6 of 10
62			70	95				3.4, 5.4, 7.7 N=23	52	□	60.60					
63									53	□	60.90 60.95					
64		0.70m at 18:00	70	95					54	▨	61.40					
65		1.30m at 08:00						3.4, 6.5, 6.7 N=24	55	●	62.40 62.50					
66			70	100					56	□	62.60					
67			70	57					57	●	62.90 62.95					
68			70	84					58	▨	63.40	-36.90	63.40		Light grey (N 6), silty fine SAND. (ALLUVIUM)	
69			70	100					59	●	64.40 64.50	-38.00	64.50		Firm, light grey (N 6), clayey SILT. (ALLUVIUM)	
70		0.50m at 18:00	70	100					60	□	64.60					
		1.10m at 08:00	70	57					61	□	64.90 64.95					
			70	84							65.30	-38.80	65.30		Dark grey (N 3), subangular BOULDER sized slightly decomposed Tuff up to 350mm with some subangular to subrounded cobble sized moderately decomposed and slightly decomposed Tuff and occasional silty clay. (ALLUVIUM)	
			70	57					T210I	—	65.77					
			70	84					T210I	—	66.52					
			70	100					T210I	—	66.52					
			70	100					62	▨	67.30	-40.80	67.30		Firm to stiff, light grey (N 6), slightly sandy clayey SILT with occasional subangular fine gravel of highly decomposed rock fragments. (ALLUVIUM)	
			70	79					63	●	67.80 67.90	-41.40	67.90		Dark grey (N 3), angular to subangular BOULDER sized slightly decomposed Tuff up to 280mm with some angular to subangular cobble sized moderately decomposed and slightly decomposed Tuff. (ALLUVIUM)	
			70	50					T210I	—	68.50	-42.00	68.50		Extremely weak, light brown, completely decomposed fine ash crystal TUFF. (SILT with occasional angular to subangular fine gravel)	
			70	50					64	▨	68.50					
			70	50					65	●	69.50					
			70	50					66	●	69.60					

● Disturbed sample	▼ Standard penetration test	LOGGED T. C. Yip DATE 26/03/2014 CHECKED Y. M. Leung DATE 27/03/2014	REMARKS
▨ Piston sample	⊥ In-situ vane shear test		
▨ Split spoon sample	⊥ Permeability test		
▨ U76 undisturbed sample	⊥ Pressuremeter test		
▨ U100 undisturbed sample	⊥ Packer Test		
▨ Mazier sample	⊥ Acoustic or optical televiewer survey		
▨ SPT liner sample	⊥ Piezometer tip		
▲ Water sample	⊥ Standpipe		
En Environmental Sample	⊥ Groundwater Sampling Well		
	⊥ Vibrating wire piezometer		
	⊥ Impression packer test		



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 8 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
18/03/2014 19/03/2014	HW	1.10m at 18:00	70	95					67	70.60 70.70	-43.50 70.00		V	See sheet 7 of 10
19/03/2014 20/03/2014		23.18m at 08:00						3.15, 4.6, 6.8, N=24	68	70.80			V	Extremely weak, brown, completely decomposed fine ash crystal TUFF. (Sandy SILT with occasional angular to subangular fine gravel)
19/03/2014 20/03/2014		1.80m at 18:00							69	71.10 71.15				
		9.50m at 08:00	60	0					70	71.60 72.60 72.70	-45.10 71.60		V	Extremely weak to very weak, brown, dappled dark brown, completely decomposed fine ash crystal TUFF. (Slightly silty fine to coarse SAND with some angular fine to coarse gravel and occasional angular cobbles)
								46 bls	71	73.15 73.20				
									72	73.90	-47.30 73.80		V	Extremely weak, brown, completely decomposed fine ash crystal TUFF. (Silty fine to coarse SAND with occasional angular fine gravel)
								2.2, 3.4, 3.3, N=13	73	74.20 74.25				
20/03/2014 21/03/2014		1.30m at 18:00							74	74.70	-48.20 74.70		V	Extremely weak, light brown, dappled brown, completely decomposed fine ash crystal TUFF. (Slightly sandy SILT with occasional angular to subangular fine gravel)
		19.80m at 08:00	60	95					75	75.70 75.80				
									76	75.90				
								4.5, 5.6, 10.13, N=34	77	76.20 76.25				
									78	76.70				
									79	77.70 77.80				
								4.6, 5.6, 10.12, N=33	80	77.90				
									81	78.20 78.25				
									82	78.70				
									83	79.70 79.80	-53.30 79.80		V	Extremely weak, brown, completely decomposed fine ash
									84	79.90				

- Disturbed sample
- ▣ Piston sample
- ▨ Split spoon sample
- ▩ U76 undisturbed sample
- ▩ U100 undisturbed sample
- ▨ Mazier sample
- SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ↓ Standard penetration test
- ↓ In-situ vane shear test
- ↓ Permeability test
- ↓ Pressuremeter test
- ↓ Packer Test
- ↓ Acoustic or optical televiewer survey
- ↓ Piezometer tip
- ↓ Standpipe
- ↓ Groundwater Sampling Well
- ↓ Vibrating wire piezometer
- ↓ Impression packer test

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DATE	26/03/2014
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DATE	27/03/2014

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 9 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description	
															No.
21/03/2014 22/03/2014	HW	2.10m at 16:00 21.00m at 08:00						4, 4, 6, 7, 9, 13 N=35	85	U	80.20 80.25	-53.50	80.00	V	crystal TUFF. (Silty fine to coarse SAND with occasional angular fine gravel)
81			70	95					86	U	80.70	-54.20	80.70	V	Extremely weak to very weak, brown, dappled dark brown, spotted light grey, completely decomposed fine ash crystal TUFF. (Slightly silty fine to coarse SAND with some angular fine to coarse gravel)
82								9, 15, 20, 30, 50/50mm (100/200mm)	87 88	U	81.70 81.80				
83			70	95					89	U	82.10 82.15				
84								10, 18, 25, 33, 42/40mm (100/190mm)	90 91 92	U	82.70 83.70 83.80				
85			70	95					93	U	84.09 84.14				
86	HW	1.58m at 18:00 20.30m at 08:00	70	100	43	17	16.7		94	U	84.70	-58.20	84.70	V	Extremely weak to very weak, brown, dappled dark brown, completely decomposed fine ash crystal TUFF. (Fine to coarse SAND with much angular fine to medium gravel)
87			70	100	70	54	6.3	>20	95	T2 IOI	85.45 85.55	-59.05	85.55	III	Moderately strong, greyish brown, dappled light brown, moderately decomposed fine ash crystal TUFF. Joints are very closely to closely spaced, rough planar and rough stepped, extremely narrow, iron and manganese stained, dipping 10° to 20°, 40° to 50°, 50° to 60° and occasional 60° to 70°.
88			70	100	93	84	6.5	15.6		T2 IOI	86.15	-59.97	86.47	II	Strong to very strong, dark grey, spotted light grey, slightly decomposed fine ash crystal TUFF. Joints are medium to widely spaced, locally closely spaced, rough planar, tight to extremely narrow, clean, occasional iron stained and calcite coated, dipping 10° to 20°, 40° to 50° and 50° to 60°. From 87.10m to 87.65m : Subvertical joint. From 87.65m to 88.16m : With closely spaced microfractures, dipping subvertically. From 88.16m to 88.40m : Subvertical joint.
89			70	100	100	100	0.8	6.3		T2 IOI	87.35				
90			70	100	100	100	0.8	3.2		T2 IOI	88.81				

- Disturbed sample
- ▣ Piston sample
- ▨ Split spoon sample
- ▨ U76 undisturbed sample
- ▨ U100 undisturbed sample
- ▨ Mazier sample
- ▨ SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ▼ Standard penetration test
- ▽ In-situ vane shear test
- ⊥ Permeability test
- ⊥ Pressuremeter test
- ⊥ Packer Test
- ⊥ Acoustic or optical televiewer survey
- ⊥ Piezometer tip
- ⊥ Standpipe
- ⊥ Groundwater Sampling Well
- ⊥ Vibrating wire piezometer
- ⊥ Impression packer test

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DATE	26/03/2014
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DATE	27/03/2014

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH01

CONTRACT NO. : GE/2013/21

SHEET 10 OF 10

PROJECT Ground Investigation - New Territories East (Term Contract)
 Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846362.04	N 814513.80	DATE :	03/03/2014 to 25/03/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.50 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level -63.50 90.00	Depth (m)	Legend	Grade	Description
24/03/2014 25/03/2014		3.10m at 12:00	70	100	100	100			T2 OI 90.28			✓	II	See sheet 9 of 10
91		21.10m at 08:00	70	100	100	100	0.8		T2 OI			✓		
25/03/2014		5.20m at 18:00								91.50 -65.00 91.50				End of Investigation Hole at 91.50m.
92														
93														
94														
95														
96														
97														
98														
99														
100														

- Disturbed sample
- ▣ Piston sample
- ▨ Split spoon sample
- ▩ U76 undisturbed sample
- ▩ U100 undisturbed sample
- ▨ Mazier sample
- ▣ SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ↓ Standard penetration test
- ↓ In-situ vane shear test
- ↓ Permeability test
- ↓ Pressuremeter test
- ↓ Packer Test
- ↓ Acoustic or optical televiwer survey
- ↓ Piezometer tip
- ↓ Standpipe
- ↓ Groundwater Sampling Well
- ↓ Vibrating wire piezometer
- ↓ Impression packer test

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DATE	26/03/2014
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DATE	27/03/2014

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH03

CONTRACT NO. : GE/2013/21

SHEET 1 OF 6

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846471.51	N 814476.53	DATE :	04/04/2014 to 25/04/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.77 mPD
		Vertical			

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level +26.77	Depth (m) 0.00	Legend	Grade	Description
04/04/2014	SW								A ● 0.50 INSPECTION PIT B ● 1.00 C ● 1.20					Soft, brown (7.5YR 5/4), sandy clayey SILT with some angular to subangular fine to coarse gravel of moderately decomposed and slightly decomposed rock fragments. (FILL)
			0	75					T6-131					Grey (N 5), angular COBBLE sized slightly decomposed Granite and concrete with some angular to subangular medium to coarse gravel of moderately decomposed and slightly decomposed rock fragments, occasional brick fragments and pockets of silty fine to coarse sand. (FILL)
			0	54					T6-131					
04/04/2014 07/04/2014		0.90m at 18:00 Dry at 08:00	0	70					T6-131	+23.27	3.50			Grey (N 5), dappled light grey and brown, sandy angular fine to coarse GRAVEL of moderately decomposed and slightly decomposed rock fragments with some angular to subangular cobble sized moderately decomposed Granite and brick, occasional angular boulder sized concrete up to 220mm and wood fragments. (FILL)
			0	56					T6-131					
			0	51					T6-131					
07/04/2014 08/04/2014		2.10m at 18:00 Dry at 08:00	0	83					T6-131	+20.67	6.10			Grey (N 5), dappled brown, angular COBBLE sized slightly decomposed Granite and concrete with some angular to subangular medium to coarse gravel of moderately decomposed and slightly decomposed rock fragments, occasional angular boulder sized slightly decomposed Granite up to 550mm, occasional asphalt, plastic and pockets of silty fine to coarse sand. (FILL)
			0	78					T6-131					
			0	83					T6-131					
08/04/2014 09/04/2014		3.10m at 18:00 Dry at 08:00	0	81					T6-131					
			0	68					T6-131					
			0	65					T6-131		9.85			

● Disturbed sample	Standard penetration test
▣ Piston sample	In-situ vane shear test
▨ Split spoon sample	Permeability test
▧ U76 undisturbed sample	Pressuremeter test
▩ U100 undisturbed sample	Packer Test
▫ Mazier sample	Acoustic or optical televiwer survey
▬ SPT liner sample	Piezometer tip
▲ Water sample	Standpipe
En Environmental Sample	Groundwater Sampling Well
	Vibrating wire piezometer
	Impression packer test

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DATE	26/04/2014
CHECKED	Y. M. Leung
DATE	28/04/2014

REMARKS

- An inspection pit was excavated to 1.20m.
- A water sample was taken at 50.00m.
- A piezometer was installed at 30.00m.
- Piezometer buckets were installed in piezometer from 21.00m to 26.00m depth at 0.50m intervals.



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH03

CONTRACT NO. : GE/2013/21

SHEET 2 OF 6

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846471.51	N 814476.53	DATE :	04/04/2014 to 25/04/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.77 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level +16.77	Depth (m) 10.00	Legend	Grade	Description
11	SW		0	65					T6-131					See sheet 1 of 6
			0	59					T6-131					
12	SW 12.00 PW		0	65					T6-131					
			0	66					T210I					
13			0	57					T210I					
14			0	60					T210I					
15		6.80m at 18:00	0	52					T210I					
16	09/04/2014 10/04/2014	15.10m at 08:00	0	61					T210I					
17			0	80					T210I					
			0	80					T210I					
18			0	89			36 bls	1		+9.77	17.00			Grey (N 5), spotted brown and dark brown, fine to coarse SAND with some subangular fine to medium gravel of moderately decomposed rock fragments. (FILL)
							2.2, 4.6, 12.15 N=37	2		+9.27	17.50			Dense, dark brown (7.5YR 3/4), clayey / silty fine to coarse SAND with some subangular fine to medium gravel of highly decomposed and moderately decomposed rock fragments. (FILL)
								3			17.60			
								4			17.90 17.95			
19										+7.87	18.90			Grey (N 5), dappled brownish grey, locally dark grey, angular COBBLE sized slightly decomposed Tuff and concrete with some angular to subangular medium to coarse gravel of moderately decomposed and slightly decomposed rock fragments, asphalt fragments and occasional angular boulder sized concrete up to 320mm. (FILL)
20	10/04/2014	7.20m at 18:00	0	56					T210I					

- Disturbed sample
- ▣ Piston sample
- ▤ Split spoon sample
- ▥ U76 undisturbed sample
- ▧ U100 undisturbed sample
- ▨ Mazier sample
- ▩ SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ▼ Standard penetration test
- ▽ In-situ vane shear test
- ⊥ Permeability test
- ⊕ Pressuremeter test
- ⊖ Packer Test
- ⊗ Acoustic or optical televiwer survey
- ⊘ Piezometer tip
- ⊙ Standpipe
- ⊚ Groundwater Sampling Well
- ⊛ Vibrating wire piezometer
- ⊜ Impression packer test

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DATE	26/04/2014
CHECKED	Y. M. Leung
DATE	28/04/2014

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH03

CONTRACT NO. : GE/2013/21

SHEET 3 OF 6

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(W), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846471.51	N 814476.53	DATE :	04/04/2014 to 25/04/2014
FLUSHING MEDIUM	Water	ORIENTATION		Vertical	GROUND LEVEL + 26.77 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level +6.77	Depth (m) 20.00	Legend	Grade	Description
11/04/2014	PW	19.20m at 08:00	50	47					T2IOI					See sheet 2 of 6
			50	51					T2IOI					
			50	53					T2IOI					
			50	55					T2IOI					
			50	64					T2IOI					
			50	64					T2IOI					
		6.90m at 18:00	50	43					T2IOI					
11/04/2014 12/04/2014	PW 21.20 HW	23.10m at 08:00	50	50					T2IOI					
			50	58					T2IOI					
			50	59					T2IOI					
			50	76					T2IOI					
		7.20m at 18:00	50	76					T2IOI					
12/04/2014 14/04/2014		23.40m	50	76					T2IOI					
										-2.73	29.50			Grey (N 5) and dark brown (7.5YR 3/4), slightly sandy angular to subangular fine to coarse GRAVEL of moderately decomposed and slightly decomposed rock

<ul style="list-style-type: none"> ● Disturbed sample ▣ Piston sample ▤ Split spoon sample ▥ U76 undisturbed sample ▦ U100 undisturbed sample ▧ Mazier sample ▨ SPT liner sample ▲ Water sample En Environmental Sample 	<ul style="list-style-type: none"> ▽ Standard penetration test ∇ In-situ vane shear test ∩ Permeability test ∪ Pressuremeter test ⊞ Packer Test ⊟ Acoustic or optical televiwer survey ⊠ Piezometer tip ⊡ Standpipe ⊢ Groundwater Sampling Well ⊣ Vibrating wire piezometer ⊤ Impression packer test 	<p>LOGGED T. C. Yip</p> <p>DATE 26/04/2014</p> <p>CHECKED Y. M. Leung</p> <p>DATE 28/04/2014</p>	<p>REMARKS</p>
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DRILLHOLE RECORD

HOLE NO. TKO/FB-DH03

CONTRACT NO. : GE/2013/21

SHEET 4 OF 6

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(W.S), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846471.51	N 814476.53	DATE :	04/04/2014 to 25/04/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.77 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level -3.23	Depth (m) 30.00	Legend	Grade	Description
31	HW	at 08:00	50	78					T2101 30.45					fragments with some angular cobble sized slightly decomposed Granite and asphalt, occasional angular boulder sized slightly decomposed Granite up to 430mm and occasional wood fragments. (FILL)
			50	60					T2101 31.30					
32		6.70m at 18:00	50	63					T2101 32.05					
		23.30m at 08:00	50	63					T2101 33.10					
33			50	56					T2101 34.20					
34			50	50					T2101 35.30					
35		10.80m at 18:00	50	75					T2101 36.10					
		23.80m at 08:00	50	66					T2101 37.20					
36			50	67					T2101 38.40					
37			50	80					T2101 39.15					
38			50	74					T2101 39.85					
39		6.50m at 18:00	50	75					T2101 39.85	-11.63	38.40			Grey (N 5), dappled brownish grey, angular COBBLE sized slightly decomposed Tuff and concrete with some angular to subangular fine to coarse gravel of moderately decomposed and slightly decomposed rock fragments, occasional brick and metal fragments. (FILL)
40		24.10m	50						T2101					

- Disturbed sample
- ▣ Piston sample
- ▤ Split spoon sample
- ▥ U76 undisturbed sample
- ▧ U100 undisturbed sample
- ▨ Mazier sample
- ▩ SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ▼ Standard penetration test
- ▽ In-situ vane shear test
- ⊥ Permeability test
- ⊕ Pressuremeter test
- ⊖ Packer Test
- ⊗ Acoustic or optical televiwer survey
- ⊘ Piezometer tip
- ⊙ Standpipe
- ⊚ Groundwater Sampling Well
- ⊛ Vibrating wire piezometer
- ⊜ Impression packer test

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DATE	26/04/2014
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DATE	28/04/2014

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH03

CONTRACT NO. : GE/2013/21

SHEET 5 OF 6

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846471.51	N 814476.53	DATE :	04/04/2014 to 25/04/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.77 mPD
		Vertical			

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level	Depth (m)	Legend	Grade	Description
41	HW	at 08:00	50	75					T2101 40.65	-13.23	40.00			See sheet 4 of 6
42			50	70					T2101 41.80	-15.03	41.80			Grey (N 5), dappled brownish grey, slightly sandy angular to subangular fine to coarse GRAVEL of moderately decomposed rock fragments, some angular cobble sized concrete, brick fragments and occasional cloth fragments. (FILL)
43			50	66					T2101 42.50					
44			50	59					T2101 43.35					
45		5.90m at 18:00		42					T2101 44.50	-17.73	44.50			
46	17/04/2014 22/04/2014	24.30m at 08:00		89			61 bls	3.4, 6.8,10,14 N=38	5 6 7 8 44.95 45.00 45.10 45.40 45.45					Very stiff, dark grey (N 3), spotted white, SILT / CLAY with some angular fine to medium gravel and shell fragments. (DISTURBED MARINE DEPOSIT)
47	22/04/2014 23/04/2014	7.20m at 18:00							8 45.55	-18.78	45.55			Dark grey (N 3), spotted grey, angular BOULDER sized slightly decomposed Tuff up to 390mm with occasional angular cobble sized slightly decomposed Tuff and pockets of silt / clay. (FILL)
48		24.10m at 08:00	50	100					T2101 46.30					Moderately strong, dark grey, spotted grey, dappled brown, moderately decomposed coarse ash crystal TUFF. Joints are very closely to closely spaced, rough stepped, narrow, iron stained, dipping 0° to 10°, 30° to 40° and subvertically.
49			50	62					T2101 47.35					
50		6.60m at 18:00		57					T2101 48.50	-21.73	48.50			
51	23/04/2014 24/04/2014	24.10m at 08:00	80	63	24	0		NA 15.0 NA NR	T2101 49.30	-21.85 -22.05 -22.23 -22.53	48.62 48.82 49.00 49.30	V III V		From 48.50m to 48.62m : Extremely weak, brown, completely decomposed TUFF. (Slightly sandy silty CLAY with some angular fine to coarse gravel)
52	24/04/2014	5.80m at 18:00	80	100	86	65		15.4 0.5	T2101 50.01				II	From 48.82m to 49.00m : Extremely weak, brown, completely decomposed TUFF. (Slightly sandy silty CLAY)

- Disturbed sample
- ▣ Piston sample
- ▤ Split spoon sample
- ▥ U76 undisturbed sample
- ▧ U100 undisturbed sample
- ▨ Mazier sample
- ▩ SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ▼ Standard penetration test
- ▽ In-situ vane shear test
- ⊥ Permeability test
- ⊕ Pressuremeter test
- ⊖ Packer Test
- ⊗ Acoustic or optical televiewer survey
- ⊘ Piezometer tip
- ⊙ Standpipe
- ⊚ Groundwater Sampling Well
- ⊛ Vibrating wire piezometer
- ⊜ Impression packer test

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DATE	26/04/2014
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DATE	28/04/2014

REMARKS



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HOLE NO. TKO/FB-DH03

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SHEET 6 OF 6

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45
MACHINE & NO.	VBM40	E 846471.51	N 814476.53	DATE :	04/04/2014 to 25/04/2014
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 26.77 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level -23.23	Depth (m) 50.00	Legend	Grade	Description
25/04/2014		24.20m at 08:00	80	100	100	100	0.5		T2101				II	<p>with some angular fine to coarse gravel and occasional angular cobbles) From 49.00m to 49.30m : No recovery, inferred to be completely decomposed TUFF. Strong, dark grey, spotted grey, locally streaked dark brown, slightly decomposed coarse ash crystal TUFF. Joints are medium to widely spaced, locally very closely to closely spaced, rough planar and rough stepped, very narrow to narrow, manganese and occasional iron stained, dipping 0° to 10°, 10° to 20°, 50° to 60° and occasional subvertically. From 49.30m to 49.56m : With very closely to closely spaced joints. From 52.38m to 53.30m : Subvertical joint.</p>
51							5.9			51.50				
52			80	100	100	100	1.1		T2101	52.43				
53			80	100	91	75	8.7		T2101	53.06				
54			80	100	95	60	2.7		T2101					
							9.1							
25/04/2014		6.30m at 18:00					3.8							
							12.5			54.54	-27.77	54.54		End of Investigation Hole at 54.54m.
55														
56														
57														
58														
59														
60														

- Disturbed sample
- ▣ Piston sample
- ▤ Split spoon sample
- ▥ U76 undisturbed sample
- ▧ U100 undisturbed sample
- ▨ Mazier sample
- ▩ SPT liner sample
- ▲ Water sample
- En Environmental Sample
- ↓ Standard penetration test
- ∨ In-situ vane shear test
- ⊥ Permeability test
- ⊞ Pressuremeter test
- ⊠ Packer Test
- ⊡ Acoustic or optical televiewer survey
- ⊢ Piezometer tip
- ⊣ Standpipe
- ⊤ Groundwater Sampling Well
- ⊥ Vibrating wire piezometer
- ⊦ Impression packer test

LOGGED	T. C. Yip
DATE	26/04/2014
CHECKED	Y. M. Leung
DATE	28/04/2014

REMARKS



DRILLHOLE RECORD

HOLE NO. TKO/FB-DH02

CONTRACT NO. : GE/2013/21

SHEET 1 OF 2

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study (Natural Terrain)

METHOD	Rotary	CO-ORDINATES		W. O. NO.	GE/2013/21.45B
MACHINE & NO.	VBM53	E 846581.83	N 814575.61	DATE :	02/03/2015 to 07/03/2015
FLUSHING MEDIUM	Water	ORIENTATION		GROUND LEVEL	+ 5.40 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level	Depth (m)	Legend	Grade	Description		
																+5.40
02/03/2015	PW														Brown (7.5YR 5/4), silty fine to coarse SAND with some angular to subangular fine gravel of highly decomposed and moderately decomposed rock fragments and occasional brick fragments. (FILL)	
1	PW 1.30 HW		0	55					T2 IOI	0.50					Grey (N 5), dappled light grey, angular COBBLE sized slightly decomposed Tuff with occasional angular to subangular fine to coarse gravel of moderately decomposed rock fragments. (FILL)	
			0	62					T2 IOI	0.65	+4.75	0.65				
			0	64						T2 IOI	1.30					
			0	64						T2 IOI	1.80					
2	PW 1.30 HW		0	0					T2 IOI	2.30	+3.10	2.30			Grey (N 5), dappled light brown, angular COBBLE sized slightly decomposed Tuff with some silty / clayey fine to coarse sand. (FILL)	
			0	0						2.50	+2.80	2.60				
			50	95						T2 IOI	2.60					
			50	76						T2 IOI	3.00					
3	PW 1.30 HW	1.24m at 18:00	50	100					T2 IOI	3.46					Grey (N 5), dappled light grey and dark grey, angular to subangular COBBLE sized slightly decomposed Granite and Tuff with occasional angular to subangular medium to coarse gravel of moderately decomposed and slightly decomposed rock fragments. (FILL)	
			50	100						T2 IOI	3.65					
			50	100						T2 IOI	4.01					
			50	100						T2 IOI	4.18	+1.22	4.18			
4	PW 1.30 HW	2.07m at 08:00	50	100					T2 IOI	4.33					Strong, grey, dappled dark grey, spotted light grey, slightly decomposed fine ash vitric TUFF. Joints are closely to medium spaced, locally very closely spaced, rough planar and rough stepped, extremely narrow to very narrow, iron and manganese stained, occasional clean, dipping 0° to 10°, 10° to 20°, 50° to 60° and 60° to 70°.	
			50	100	73	73				T2 IOI	4.68					
			50	100	88	88				T2 IOI	5.00					
			50	100	92	83		5.2		T2 IOI	5.82					
5	PW 1.30 HW	3.20m at 08:00	50	100					T2 IOI	6.22	-0.82	6.22			From 6.22m to 6.65m : Moderately strong, moderately decomposed TUFF.	
			50	95	28	0		16.0		T2 IOI	6.46					
			50	100	70	33		19.0		T2 IOI	6.65	-1.25	6.65			
			50	100	70	33		19.0		T2 IOI	7.06					
6	PW 1.30 HW	1.50m at 18:00	50	100					T2 IOI	7.83					From 7.80m to 8.08m : Subvertical joint.	
			50	100	88	77		8.0		T2 IOI	8.21					
			50	100	100	76		20.0		T2 IOI	8.53					
			50	100	100	78		5.7		T2 IOI	8.94					
7	PW 1.30 HW	3.21m at 08:00	30	100					T2 IOI	9.33					From 9.70m to 9.85m : Moderately strong, moderately decomposed TUFF.	
			30	100	88	77		8.0		T2 IOI	9.77	-4.30	9.70			
			30	100	72	33		13.0		T2 IOI	9.85	-4.45	9.85			
			30	100	89	66		9.1		T2 IOI	>20					
8	PW 1.30 HW	2.43m at 18:00	30	100					T2 IOI						Strong to very strong, grey, dappled dark grey, spotted light	
			30	100	89	66		9.1		T2 IOI						
			30	100	89	66		9.1		T2 IOI						
			30	100	89	66		9.1		T2 IOI						
9	PW 1.30 HW	3.22m at 08:00	30	100					T2 IOI						Strong to very strong, grey, dappled dark grey, spotted light	
			30	100	89	66		9.1		T2 IOI						
			30	100	89	66		9.1		T2 IOI						
			30	100	89	66		9.1		T2 IOI						
10	PW 1.30 HW	2.43m at 18:00	30	100					T2 IOI						Strong to very strong, grey, dappled dark grey, spotted light	
			30	100	89	66		9.1		T2 IOI						
			30	100	89	66		9.1		T2 IOI						
			30	100	89	66		9.1		T2 IOI						

<ul style="list-style-type: none"> ● Disturbed sample ▣ Piston sample ▤ Split spoon sample ▥ U76 undisturbed sample ▧ U100 undisturbed sample ▨ Mazier sample ▩ SPT liner sample ▲ Water sample En Environmental Sample 	<ul style="list-style-type: none"> ▼ Standard penetration test ⊥ In-situ vane shear test ⊥ Permeability test ⊥ Pressuremeter test ⊥ Packer Test ⊥ Acoustic or optical televiwer survey ⊥ Piezometer tip ⊥ Standpipe ⊥ Groundwater Sampling Well ⊥ Vibrating wire piezometer ⊥ Impression packer test 	<p>LOGGED T. C. Yip</p> <p>DATE 11/03/2015</p> <p>CHECKED Y. M. Leung</p> <p>DATE 12/03/2015</p>	<p>REMARKS</p> <ol style="list-style-type: none"> An inspection pit was excavated to 0.65m. An acoustic televiwer survey was carried out from 4.22m to 14.28m. A piezometer was installed at 3.80m. Piezometer buckets were installed in piezometer from 0.50m to 3.50m depth at 0.50m intervals.
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DRILLHOLE RECORD

HOLE NO. TKO/FB-DH02

CONTRACT NO. : GE/2013/21

SHEET 2 OF 2

PROJECT Ground Investigation - New Territories East (Term Contract)
Agreement No. CE21/2012(WS), Desalination Plant at Tseung Kwan O - Feasibility Study (Natural Terrain)

METHOD Rotary	CO-ORDINATES	W. O. NO. GE/2013/21.45B
MACHINE & NO. VBM53	E 846581.83 N 814575.61	DATE : 02/03/2015 to 07/03/2015
FLUSHING MEDIUM Water	ORIENTATION Vertical	GROUND LEVEL + 5.40 mPD

Drilling Progress	Casing Depth/Size	Water Level (m) Shift start / end	Flush Returns %	TCR %	SCR %	RQD %	FI	Tests	Samples No. Type Depth	Reduced Level -4.60	Depth (m) 10.00	Legend	Grade	Description
11 06/03/2015 07/03/2015	30	2.50m at 18:00 3.22m at 08:00	100	100	76	76	5.3		T2 OI 10.23			[Pattern]	II	grey, slightly decomposed fine ash vitric TUFF. Joints are medium spaced, locally very closely to closely spaced, rough planar and rough stepped, locally smooth planar, extremely narrow, clean, occasional iron and manganese stained and silt coated, dipping 40° to 50°, 50° to 60°, 60° to 70° and occasional 0° to 10°. From 10.23m to 10.65m : Subvertical joint. From 10.56m to 13.77m : Subvertical joint.
									T2 OI 10.85					
									T2 OI 11.15					
									T2 OI 11.82					
									T2 OI 12.36					
									T2 OI 12.64					
									T2 OI 13.56					
									T2 OI 13.93					
									T2 OI 14.51					
									T2 OI 14.51					
									12					
13	30	100	29	0	>20									
14	30	100	100	100	1.4									
14	30	100	100	100										
14	30	2.51m at 18:00	100	95	81	8.9								
15														End of Investigation Hole at 14.51m.

15															
16															
17															
18															
19															
20															

<ul style="list-style-type: none"> ● Disturbed sample ▣ Piston sample ▨ Split spoon sample ▩ U76 undisturbed sample ▩ U100 undisturbed sample ▨ Mazier sample □ SPT liner sample ▲ Water sample En Environmental Sample 	<ul style="list-style-type: none"> ↓ Standard penetration test ↕ In-situ vane shear test ⊥ Permeability test ⊥ Pressuremeter test ⊥ Packer Test ⊥ Acoustic or optical televiwer survey ⊥ Piezometer tip ⊥ Standpipe ⊥ Groundwater Sampling Well ⊥ Vibrating wire piezometer ⊥ Impression packer test 	<p>LOGGED T. C. Yip</p> <p>DATE 11/03/2015</p> <p>CHECKED Y. M. Leung</p> <p>DATE 12/03/2015</p>	<p>REMARKS</p>
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DRILLHOLE RECORD

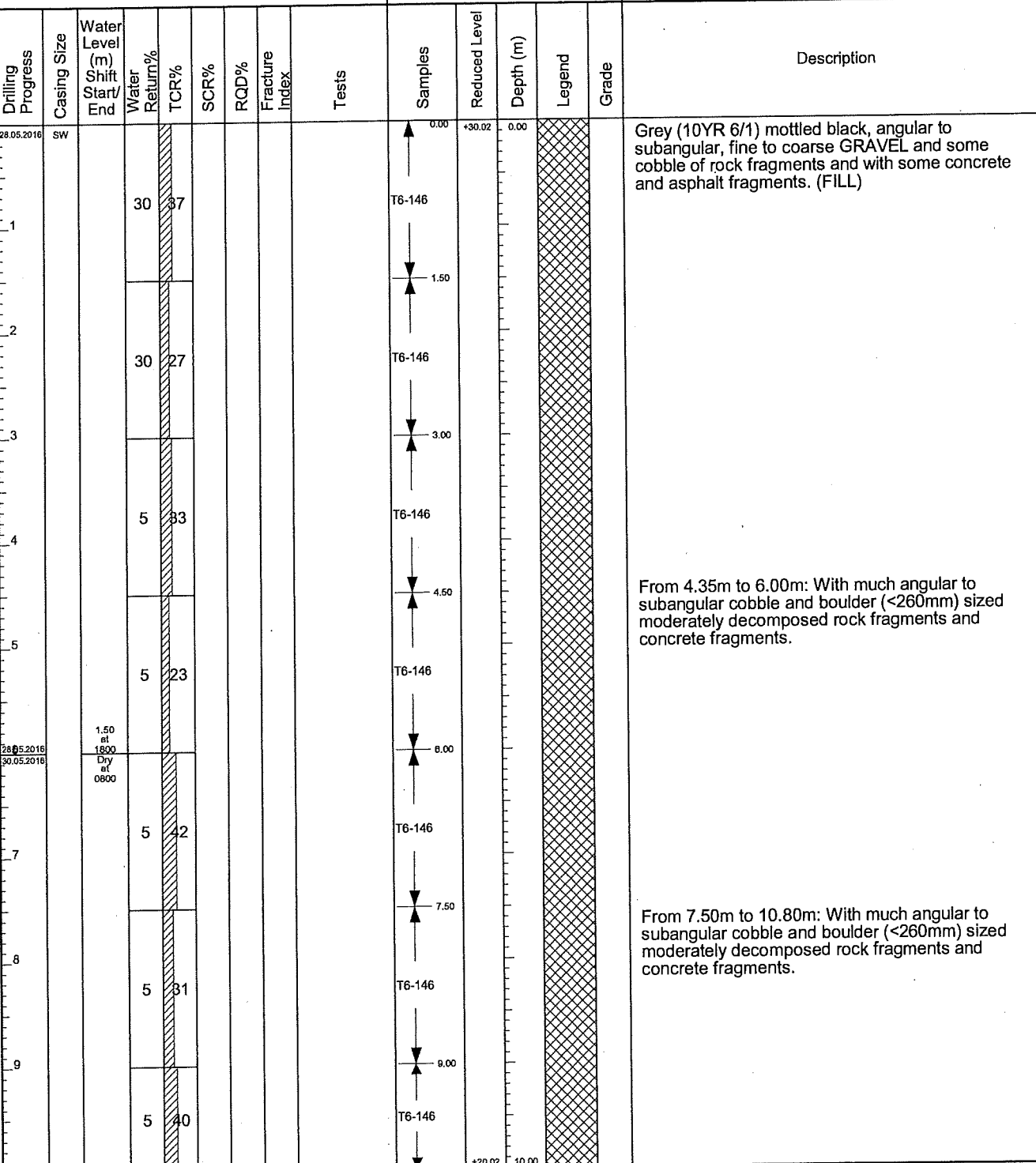
CONTRACT NO. GE/2015/24

HOLE NO. **FB-DH 4**

SHEET 1 of 9

PROJECT Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)

METHOD	ROTARY	CO-ORDINATES	WORKS ORDER NO.
MACHINE	SD38	E 846404.74 N 814523.17	GE/2015/24.3
FLUSHING MEDIUM	WATER	ORIENTATION	VERTICAL
		GROUND LEVEL	+30.02 mPD



<ul style="list-style-type: none"> ⊥ SMALL DISTURBED SAMPLE ↑ LARGE DISTURBED SAMPLE ▨ U76 SAMPLE ▩ PISTON SAMPLE (76mm) ▧ MAZIER SAMPLE □ SPT LINER SAMPLE ▲ WATER SAMPLE ■ U100 SAMPLE 	<ul style="list-style-type: none"> ↓ STANDARD PENETRATION TEST ∨ IN-SITU VANE SHEAR TEST ⊕ PACKER TEST ⊖ PERMEABILITY TEST ⊙ PRESSUREMETER TEST ⊕ BOREHOLE TELEVIEWER ⊖ PIEZOMETER TIP ⊕ STANDPIPE TIP 	<p>LOGGED <u>S.L. Chiu</u></p> <p>DATE <u>22.07.2016</u></p> <p>CHECKED <u>R. Chu</u></p> <p>DATE <u>23.07.2016</u></p>	<p>REMARKS</p> <ol style="list-style-type: none"> 1. No inspection pit was excavated. 2. Constant head permeability tests were carried out at sections from 43.00m to 44.50m, 46.65m to 47.65m and 64.75m to 66.25m. 3. Groundwater sample was taken at 69.90m. 4. Piezometers were installed with tips at 41.50m and 65.00m.
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DRILLHOLE RECORD

CONTRACT NO. GE/2015/24

HOLE NO. **FB-DH 4**

SHEET **2** of **9**

PROJECT **Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)**

METHOD **ROTARY** CO-ORDINATES **E 846404.74** WORKS ORDER NO. **GE/2015/24.3**

MACHINE **SD38** N **814523.17** DATE **28.05.2016** to **11.07.2016**

FLUSHING MEDIUM **WATER** ORIENTATION **VERTICAL** GROUND LEVEL **+30.02 mPD**

Drilling Progress	Casing Size	Water Level (m) Shift Start/End	Water Return%	TCR%	SCR%	RQD%	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
11			5	4					T6-146	10.00				As sheet 1 of 9.
			5	58					T6-146	10.80				
30.02.2016	SW	8.00 at 1600												Light brown (7.5YR 6/4) spotted grey, angular to subangular, slightly clayey silty very sandy fine to coarse GRAVEL and occasional cobble of rock fragments. (FILL)
31.05.2016	PW	Dry at 0800	0	45					T2-120	12.00				
13			0	45					T2-120	13.50				Grey (7.5YR 6/1) mottled very pale brown, spotted dark grey, angular to subangular, slightly silty sandy fine to coarse GRAVEL and COBBLE of rock fragments and with much concrete and refuse fragments. (FILL)
14			0	33					T2-120	15.00				
15			0	28					T2-120	15.02	15.00			Grey (7.5YR 6/1) mottled very pale brown, spotted dark grey, angular to subangular, slightly silty sandy fine to coarse GRAVEL and COBBLE of rock fragments and with much concrete and refuse fragments. (FILL)
16			0	76					T2-120	16.50				
17			0	100					T2-120	+12.87	17.15			Grey (7.5YR 6/1) mottled very pale brown, spotted dark grey, angular to subangular, slightly silty sandy fine to coarse GRAVEL and COBBLE of rock fragments and with much concrete and refuse fragments. (FILL)
18			0	45					T2-120	17.47				
19			0	45					T2-120	18.00				Grey (7.5YR 6/1) mottled very pale brown, spotted dark grey, angular to subangular, slightly silty sandy fine to coarse GRAVEL and COBBLE of rock fragments and with much concrete and refuse fragments. (FILL)
20			0	45					T2-120	19.50				
31.05.2016		Dry at 1800												Grey (7.5YR 6/1) mottled very pale brown, spotted dark grey, angular to subangular, slightly silty sandy fine to coarse GRAVEL and COBBLE of rock fragments and with much concrete and refuse fragments. (FILL)
01.06.2016		Dry at 0800							T2-120	+10.02	20.00			

- ↑ SMALL DISTURBED SAMPLE
- ↓ LARGE DISTURBED SAMPLE
- ▨ U76 SAMPLE
- ▨ PISTON SAMPLE (76mm)
- ▨ MAZIER SAMPLE
- SPT LINER SAMPLE
- ▲ WATER SAMPLE
- U100 SAMPLE
- ↓ STANDARD PENETRATION TEST
- ∨ IN-SITU VANE SHEAR TEST
- ⊥ PACKER TEST
- ⊥ PERMEABILITY TEST
- ⊥ PRESSUREMETER TEST
- ⊥ BOREHOLE TELEVIEWER
- ▲ PIEZOMETER TIP
- STANDPIPE TIP

LOGGED S.L. Chiu
 DATE 22.07.2016
 CHECKED R. Chu
 DATE 23.07.2016

REMARKS



DRILLHOLE RECORD

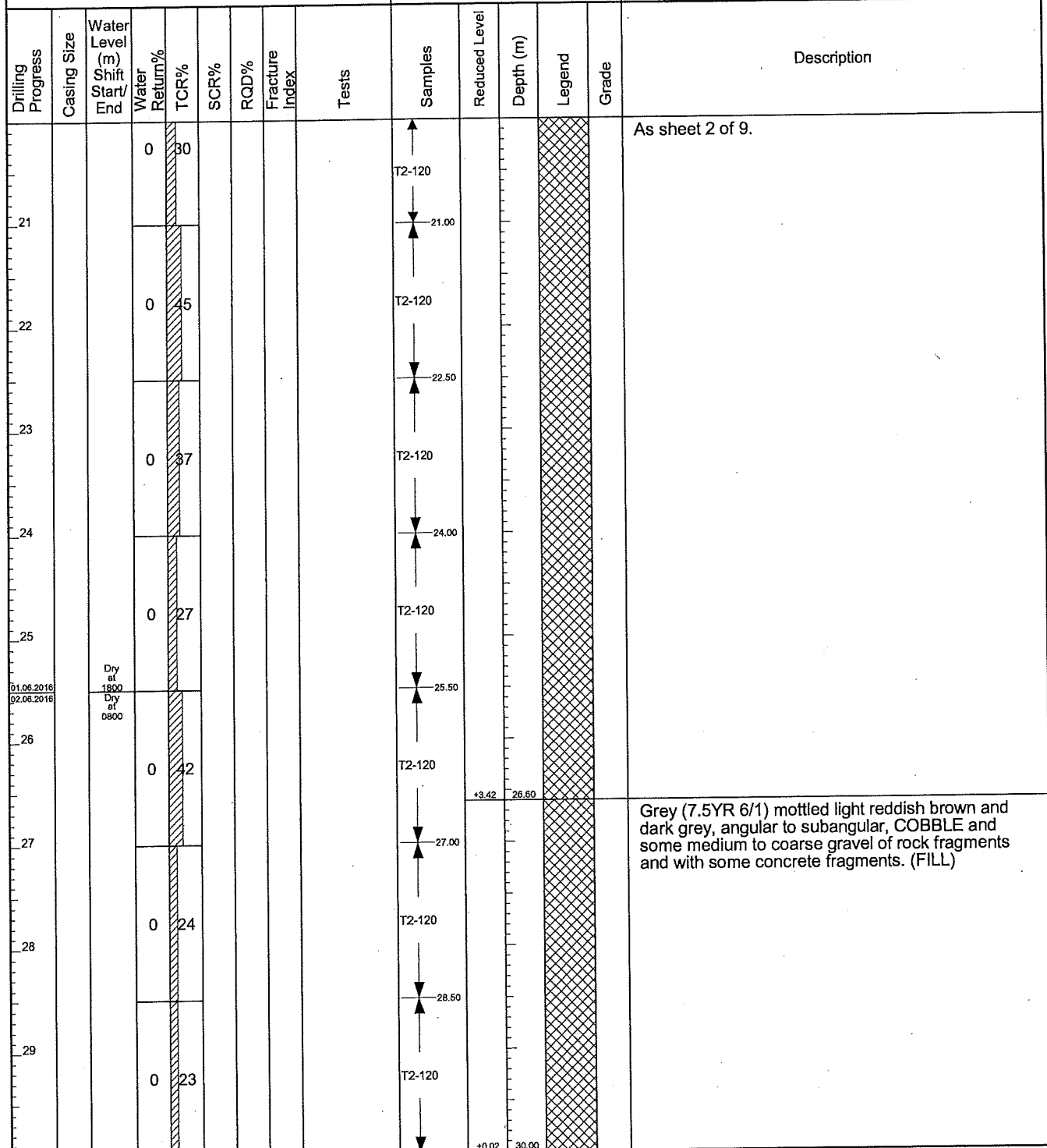
CONTRACT NO. GE/2015/24

HOLE NO. **FB-DH 4**

SHEET 3 of 9

PROJECT Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)

METHOD	ROTARY	CO-ORDINATES	WORKS ORDER NO.	GE/2015/24.3	
MACHINE	SD38	E 846404.74 N 814523.17	DATE	28.05.2016 to 11.07.2016	
FLUSHING MEDIUM	WATER	ORIENTATION	VERTICAL	GROUND LEVEL	+30.02 mPD



- ⊥ SMALL DISTURBED SAMPLE
- ⊥ LARGE DISTURBED SAMPLE
- ▨ U76 SAMPLE
- ▨ PISTON SAMPLE (76mm)
- ▨ MAZIER SAMPLE
- SPT LINER SAMPLE
- ▲ WATER SAMPLE
- U100 SAMPLE
- ↓ STANDARD PENETRATION TEST
- ∨ IN-SITU VANE SHEAR TEST
- ⊥ PACKER TEST
- ⊥ PERMEABILITY TEST
- ⊥ PRESSUREMETER TEST
- ⊥ BOREHOLE TELEVIEWER
- ⊥ PIEZOMETER TIP
- ⊥ STANDPIPE TIP

LOGGED S.L. Chiu
 DATE 22.07.2016
 CHECKED R. Chu
 DATE 23.07.2016

REMARKS



DRILLHOLE RECORD

CONTRACT NO. GE/2015/24

HOLE NO. **FB-DH 4**

SHEET **4** of **9**

PROJECT **Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)**

METHOD	ROTARY	CO-ORDINATES	WORKS ORDER NO.
MACHINE	SD38	E 846404.74 N 814523.17	GE/2015/24.3
FLUSHING MEDIUM	WATER	ORIENTATION	VERTICAL
		GROUND LEVEL	+30.02 mPD

Drilling Progress	Casing Size	Water Level (m) Shift Start/End	Water Return%	TCR%	SCR%	ROD%	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
31			0	25					T2-120					As sheet 3 of 9.
32			0	12					T2-120					
33			0	24					T2-120					
34		02.08.2016 at 1800 03.08.2016 Dry at 0800	6.50						T2-101					
35			50	24					T2-101					
36			55	68					T2-101	-5.18	35.20			Light grey (7.5YR 7/1), CONCRETE. (FILL)
37			65	36					T2-101	-5.88	35.90			Greyish brown (10YR 5/2), angular to subangular, slightly clayey silty sandy fine to coarse GRAVEL and COBBLE of rock fragments and with some concrete fragments. (FILL)
38			70	30					T2-101					From 36.80m to 37.05m: With a boulder (<250mm) of moderately decomposed granite fragment.
39			70	40					T2-101					
40									T2-101	-9.98	40.00			

- ↓ SMALL DISTURBED SAMPLE
- ↓ LARGE DISTURBED SAMPLE
- ▨ U76 SAMPLE
- ▨ PISTON SAMPLE (76mm)
- ▨ MAZIER SAMPLE
- ▨ SPT LINER SAMPLE
- ▲ WATER SAMPLE
- U100 SAMPLE
- ↓ STANDARD PENETRATION TEST
- ∨ IN-SITU VANE SHEAR TEST
- PACKER TEST
- PERMEABILITY TEST
- PRESSUREMETER TEST
- BOREHOLE TELEVIEWER
- PIEZOMETER TIP
- STANDPIPE TIP

LOGGED S.L. Chiu
 DATE 22.07.2016
 CHECKED R. Chu
 DATE 23.07.2016

REMARKS



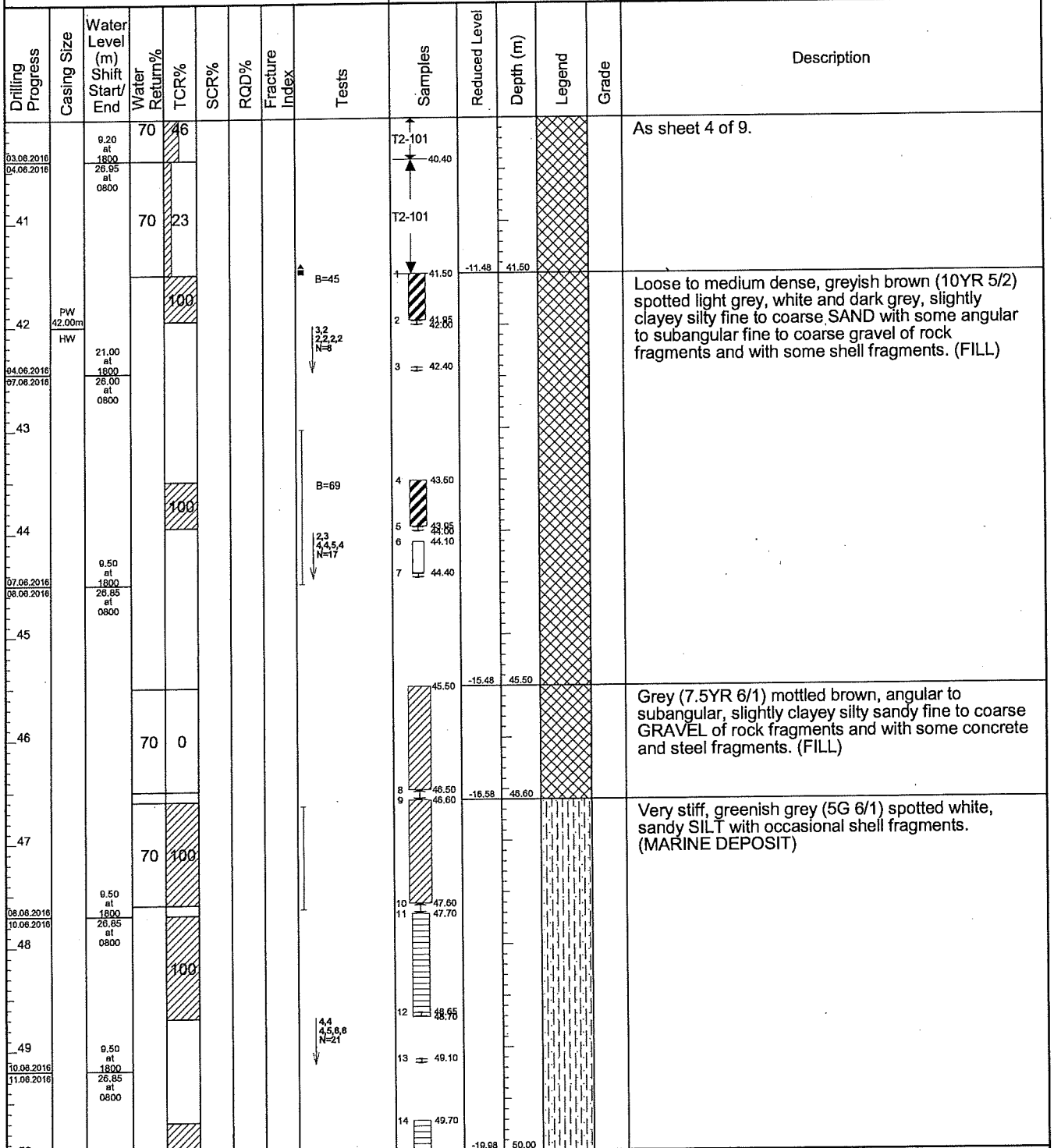
DRILLHOLE RECORD

CONTRACT NO. GE/2015/24

HOLE NO. **FB-DH 4**
SHEET 5 of 9

PROJECT **Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)**

METHOD	ROTARY	CO-ORDINATES	WORKS ORDER NO.	GE/2015/24.3	
MACHINE	SD38	E 846404.74 N 814523.17	DATE	28.05.2016 to 11.07.2016	
FLUSHING MEDIUM	WATER	ORIENTATION	VERTICAL	GROUND LEVEL	+30.02 mPD



- ± SMALL DISTURBED SAMPLE
- ↑ LARGE DISTURBED SAMPLE
- ▨ U76 SAMPLE
- ▩ PISTON SAMPLE (76mm)
- ▧ MAZIER SAMPLE
- SPT LINER SAMPLE
- ▲ WATER SAMPLE
- U100 SAMPLE
- ↓ STANDARD PENETRATION TEST
- ∇ IN-SITU VANE SHEAR TEST
- PACKER TEST
- PERMEABILITY TEST
- PRESSUREMETER TEST
- BOREHOLE TELEVIEWER
- PIEZOMETER TIP
- STANDPIPE TIP

LOGGED S.L. Chiu
DATE 22.07.2016
CHECKED R. Chu
DATE 23.07.2016

REMARKS



DRILLHOLE RECORD

HOLE NO. **FB-DH 4**
 SHEET 6 of 9

PROJECT Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)

METHOD	ROTARY	CO-ORDINATES	WORKS ORDER NO.
MACHINE	SD38	E 846404.74 N 814523.17	GE/2015/24.3
FLUSHING MEDIUM	WATER	ORIENTATION	VERTICAL
		GROUND LEVEL	+30.02 mPD

Drilling Progress	Casing Size	Water Level (m) Shift Start/End	Water Return%	TCR%	SCR%	RCD%	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description	
51				100				3,4 4,5,5,6 N=20	15 16 17	50.95 50.80 51.10				As sheet 5 of 9.	
52		11.06.2016 13.06.2016 12.00 at 1800 26.80 at 0800		100				3,3 4,4,5,6 N=19	18 19 20 21	51.70 52.95 52.80 53.10					
53									22	53.70					
54				100					23 24	54.95 54.80					
55								4,6 6,7,7,8 N=26	25	55.10					
56				100					26	55.70	-25.68	55.70			Very stiff, light greenish grey (5GY 7/1) spotted brown, slightly sandy SILT. (ALLUVIUM)
57								4,5 5,7,7,9 N=28	27	56.95					
58		13.06.2016 14.06.2016 12.40 at 1800 25.93 at 0800		60	76				28 29	57.10 57.70					
59				0	40				30 31	58.70 58.80					
60								17,9	32	59.80 59.90	-29.98	60.00			

- ⇩ SMALL DISTURBED SAMPLE
- ⇩ LARGE DISTURBED SAMPLE
- ▨ U76 SAMPLE
- ▨ PISTON SAMPLE (76mm)
- ▨ MAZIER SAMPLE
- ▨ SPT LINER SAMPLE
- ▲ WATER SAMPLE
- U100 SAMPLE
- ⇩ STANDARD PENETRATION TEST
- ∨ IN-SITU VANE SHEAR TEST
- PACKER TEST
- PERMEABILITY TEST
- PRESSUREMETER TEST
- BOREHOLE TELEVIEWER
- PIEZOMETER TIP
- STANDPIPE TIP

LOGGED S.L. Chiu
 DATE 22.07.2016
 CHECKED R. Chu
 DATE 23.07.2016

REMARKS



DRILLHOLE RECORD

CONTRACT NO. GE/2015/24

HOLE NO. **FB-DH 4**

SHEET 7 of 9

PROJECT Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)

METHOD	ROTARY	CO-ORDINATES	WORKS ORDER NO.	GE/2015/24.3	
MACHINE	SD38	E 846404.74 N 814523.17	DATE	28.05.2016 to 11.07.2016	
FLUSHING MEDIUM	WATER	ORIENTATION	VERTICAL	GROUND LEVEL	+30.02 mPD

Drilling Progress	Casing Size	Water Level (m) Shift Start/End	Water Return%	TCR%	SCR%	RQD%	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
61			50	100				11,11,10,11 N=43	33 H 60.30					As sheet 6 of 9.
62								7,8 12,12,12,11 N=47	34 60.80 35 61.80 36 62.00 37 62.30					
63		14.06.2016 15.06.2016 19.50 at 1800 23.03 at 0800	0	53					T2-101 62.70 63.32	-32.88	62.70			Dark grey (10YR 4/1) streaked light yellowish brown and light grey, angular to subangular, COBBLE and BOULDER (<330mm) of moderately decomposed tuff fragments. (ALLUVIUM)
64			0	55					T2-101 64.05	-34.03	64.05		V	Extremely weak, light yellowish brown (10YR 6/4) streaked very pale brown, completely decomposed fine ash TUFF. (Very stiff, slightly sandy clayey SILT)
65			0	0					38 65.05 65.15					
66		15.06.2016 17.06.2016 25.70 at 1800 25.30 at 0800	0	0				4,10 16,21,23,23 N=83	39 66.15 66.25 40 66.35 41 66.65	-36.23	66.25		V	Extremely weak, light brown (7.5YR 6/4) spotted grey and white, completely decomposed fine ash TUFF. (Slightly clayey very silty fine SAND)
67									42 67.15					From 68.95m to 69.89m: No recovery, assumed to be completely decomposed TUFF.
68			0	100				9,12 17,23,25,28 N=83	43 68.15 68.25 44 68.35 45 68.65					
69									68.95		68.95			
70			0	27	9	9	NR		T2-101 68.95	-39.87	69.89			

<ul style="list-style-type: none"> ↓ SMALL DISTURBED SAMPLE ↓ LARGE DISTURBED SAMPLE ▨ U76 SAMPLE ▨ PISTON SAMPLE (76mm) ▨ MAZIER SAMPLE ▨ SPT LINER SAMPLE ▲ WATER SAMPLE ■ U100 SAMPLE 	<ul style="list-style-type: none"> ↓ STANDARD PENETRATION TEST ∇ IN-SITU VANE SHEAR TEST ○ PACKER TEST ○ PERMEABILITY TEST ○ PRESSUREMETER TEST ○ BOREHOLE TELEVIEWER ○ PIEZOMETER TIP ○ STANDPIPE TIP 	<p>LOGGED <u>S.L. Chiu</u></p> <p>DATE <u>22.07.2016</u></p> <p>CHECKED <u>R. Chu</u></p> <p>DATE <u>23.07.2016</u></p>
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REMARKS



DRILLHOLE RECORD

CONTRACT NO. GE/2015/24

HOLE NO. **FB-DH 4**

SHEET 8 of 9

PROJECT Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)

METHOD	ROTARY	CO-ORDINATES	WORKS ORDER NO.
MACHINE	SD38	E 846404.74 N 814523.17	GE/2015/24.3
FLUSHING MEDIUM	WATER	ORIENTATION	VERTICAL
		GROUND LEVEL	+30.02 mPD

Drilling Progress	Casing Size	Water Level (m) Shift Start/End	Water Return%	TCR%	SCR%	RQD%	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
17.06.2016 18.06.2016	25.00 at 1800 28.00 at 0800	0	18	11	0	NR	NI 8.3		T2-101 70.24	-40.08 -40.32	70.10 70.34		IV II V	Weak to moderately weak, brown (7.5YR 5/4) streaked reddish brown, highly decomposed fine ash TUFF. (Angular, coarse GRAVEL and COBBLE of highly decomposed tuff fragments)
71		0	0				NR		70.80	-40.78	70.80		V	From 70.10m to 70.34m: Strong and slightly decomposed. (CORESTONE)
72		0	43	0	0		NI NR		71.30 71.40	-41.38 -41.68	71.40 71.70		IV V	From 70.34m to 70.80m: No recovery, assumed to be completely decomposed TUFF. Extremely weak, light yellowish brown (10YR 6/4) mottled dark grey, completely decomposed fine ash TUFF. (Very stiff, slightly clayey sandy SILT with some angular fine to coarse coarse gravel and cobble of tuff fragments)
74	25.00 at 1800 25.10 at 0800	50	0				NI NR		72.10 72.90 73.00	-42.08	72.10		V	Weak to moderately weak, brown (7.5YR 4/3) streaked dark grey, highly decomposed fine ash TUFF. (Angular, gravelly BOULDER (<270mm) and some cobble of highly decomposed tuff fragments) From 71.70m to 72.10m: No recovery, assumed to be completely decomposed TUFF.
76	24.30 at 1800 24.10 at 0800	30	52	0	0		NI NR 2.7	5,9 11,13,15,18 N=67	74.00 74.10 74.20	-44.68 -44.85	74.70 74.87		IV V IV IV II II	Extremely weak, pale brown (10YR 6/3) spotted white and very dark brown, completely decomposed fine ash TUFF. (Very stiff, slightly sandy clayey SILT with occasional angular fine to coarse gravel of tuff fragments) Weak to moderately weak, pale brown (10YR 6/3) spotted dark grey, highly decomposed fine ash TUFF. (Angular, slightly silty sandy fine to coarse GRAVEL and COBBLE of highly decomposed tuff fragments)
77	23.50 at 1800 25.10 at 0800	0	100	100	100		1.4		76.39 76.66 77.11	-45.01 -45.12 -45.35 -45.49	75.03 75.14 75.37 75.51			From 74.87m to 75.03m: No recovery, assumed to be completely decomposed TUFF. Strong to very strong, dark grey, slightly decomposed fine ash TUFF. (CORESTONE) From 75.37m to 75.51m and 83.14m to 83.30m: Moderately strong and moderately decomposed.
78	24.00 at 1800 25.10 at 0800	0	66	54	54		NR		77.89	-47.87	77.89		V	From 77.69m to 78.11m, 79.28m to 79.81m, 80.31m to 81.70m and 83.30m to 83.43m and 83.51m to 83.64m: No recovery, assumed to be completely decomposed TUFF.
79	24.00 at 1800 25.10 at 0800	0	100	93	88		8.5		78.36 78.93	-48.09	78.11		II	From 83.43m to 83.51m: Moderately weak and moderately decomposed.
80	24.00 at 1800 25.60 at 0800	0	53	33	33		NR		79.81	-49.79	79.81		V	
									79.81	-49.98	80.00		II	

<ul style="list-style-type: none"> ↓ SMALL DISTURBED SAMPLE ↓ LARGE DISTURBED SAMPLE U76 SAMPLE PISTON SAMPLE (76mm) MAZIER SAMPLE SPT LINER SAMPLE ▲ WATER SAMPLE U100 SAMPLE 	<ul style="list-style-type: none"> ↓ STANDARD PENETRATION TEST ∇ IN-SITU VANE SHEAR TEST PACKER TEST PERMEABILITY TEST PRESSUREMETER TEST BOREHOLE TELEVIEWER PIEZOMETER TIP STANDPIPE TIP 	LOGGED <u>S.L. Chiu</u> DATE <u>22.07.2016</u> CHECKED <u>R. Chu</u> DATE <u>23.07.2016</u>	REMARKS
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DRILLHOLE RECORD

CONTRACT NO. GE/2015/24

HOLE NO. **FB-DH 4**

SHEET 9 of 9

PROJECT Ground Investigation - New Territories East (Term Contract), Agreement No. CE 8/2015 (WS), First Stage of Desalination Plant at Tseung Kwan O - Investigation, Design and Construction (Fill Bank)

METHOD	ROTARY	CO-ORDINATES	WORKS ORDER NO.
MACHINE	SD38	E 846404.74 N 814523.17	GE/2015/24.3
FLUSHING MEDIUM	WATER	ORIENTATION	VERTICAL
		GROUND LEVEL	+30.02 mPD

Drilling Progress	Casing Size	Water Level (m) Shift Start/End	Water Return%	TCR%	SCR%	RQD%	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
81		0800	0	3	40	32	6.0		TNW	-50.28	80.31		II	As sheet 8 of 9.
			0	0	0	0	NR		TNW	-80.98			V	
82	NW 23.20 at 1800 24.20 at 0800	0800	0	100	85	82	4.6		TNW	-51.68	81.70		II	<p>Strong to very strong, dark grey, slightly decomposed fine ash TUFF. Joints are medium to widely spaced, occasionally very closely and closely spaced, rough planar and rough undulating, iron and manganese oxide stained, dipping at 0° to 10°, 35° to 45° and 50° to 60°.</p> <p>From 86.02m to 86.12m: Moderately strong and moderately decomposed.</p> <p>From 86.12m to 86.28m and 87.49m to 87.55m: No recovery, assumed to be completely decomposed TUFF.</p>
			0	75	48	43	4.8		TNW	-82.35			III	
			0	75	48	43	>20		TNW	-82.72			V	
			0	75	48	43	>20		TNW	-83.00			III	
			0	75	48	43	NR		TNW	-53.12	83.14		III	
			0	75	48	43	NR		TNW	-53.28	83.30		V	
			0	75	48	43	NR		TNW	-53.41	83.43		V	
			0	75	48	43	NR		TNW	-53.28	83.51		III	
			0	75	48	43	NR		TNW	-53.62	83.64		V	
			0	75	48	43	NR		TNW	-84.06			II	
84			0	100	100	97	0.6		TNW		84.10			
85			0	100	100	97	0.6		TNW		85.00			
86	24.80 at 0800	0800	0	89	77	74	>20		TNW	-56.00	86.02		III	
			0	89	77	74	NR		TNW	-56.10	86.12		V	
			0	89	77	74	NR		TNW	-56.28	86.28		II	
87			0	96	95	83	5.0		TNW		86.07			
88	23.80 at 1800	0800	0	96	95	83	6.0		TNW	-57.47	87.49		V	
			0	96	95	83	6.0		TNW	-57.53	87.55		II	
89	23.50 at 1800	0800	0	100	100	99			TNW		88.48			
			0	100	100	99			TNW	-59.88	89.90			End of hole at 89.90 m.

<ul style="list-style-type: none"> ⬇ SMALL DISTURBED SAMPLE ⬇ LARGE DISTURBED SAMPLE ▨ U76 SAMPLE ▨ PISTON SAMPLE (76mm) ▨ MAZIER SAMPLE ▨ SPT LINER SAMPLE ▲ WATER SAMPLE ■ U100 SAMPLE 	<ul style="list-style-type: none"> ⬇ STANDARD PENETRATION TEST ⬇ IN-SITU VANE SHEAR TEST ⬇ PACKER TEST ⬇ PERMEABILITY TEST ⬇ PRESSUREMETER TEST ⬇ BOREHOLE TELEVIEWER ▲ PIEZOMETER TIP □ STANDPIPE TIP 	<p>LOGGED <u>S.L. Chiu</u></p> <p>DATE <u>22.07.2016</u></p> <p>CHECKED <u>R. Chu</u></p> <p>DATE <u>23.07.2016</u></p>	REMARKS
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Additional Sediment and Elutriate Testing Plan for
Water Quality Impact Assessment (Final)

1 INTRODUCTION

1.1.1.1 This paper presents the additional sediment testing parameters and requirements of sediment elutriate tests in support of the water quality impact assessment for Development of Tseung Kwan O Area 137 and Associated Reclamation Site (the Project) in accordance with the EIA Study Brief No. ESB-360/2023. This paper should be read in conjunction with the Sediment Sampling and Sediment Plan (SSTP) prepared for the Project.

2 PROPOSED ELUTRIATE TEST LOCATIONS

2.1.1.1 The likelihood of release of sediment-bound contaminants from the marine mud dredging will be assessed by using the results of elutriate tests. Sediment samples will be mixed with the ambient seawater collected from the same site and then be vigorously agitated during the elutriate tests to simulate the disturbance to the seabed sediment during dredging. Pollutants absorbed onto the sediment particles may be released and increasing the pollutant concentrations in the solution. The laboratory testing will be conducted to analyse the contaminants in the solution (elutriate). If the contaminant levels are higher in the elutriates in comparison with the blanks (i.e. marine water from the same site), it can be concluded that the contaminants are likely to be released into the marine waters during dredging activities.

2.1.1.2 Marine construction works of the Project are proposed at Tseung Kwan O Area 137 (TKO 137) and Tseung Kwan O Area 132 (TKO 132). Elutriate tests will be performed for 28 selected sediment sampling locations (namely MEA2, MEA3, MEA5, MEA6, MEA9, MEA10, MEA12, MEA15, MEA16, MEA19, MEA20, MEA22 and MEA24 for TKO 137 and MEB2, MEB4, MEB5, MEB7, MEB10, MEB12, MEB13, MEB15, MEB18, MEB20, MEB21, MEB23, MEB26, MEB28 and MEB29 for TKO 132). Dredging depth of these sampling locations would be 5m from the seabed level. These elutriate test locations are shown in **Appendix A** of this paper. At each selected sampling location, one composite sediment sample will be prepared for elutriate test by combining individual sub-samples from the same vibrocore. For locations where surface grab sediment sampling is proposed in the SSTP, one grab sediment sample will also be collected for elutriate test.

3 ADDITIONAL TESTING PARAMETERS FOR WATER QUALITY IMPACT ASSESSMENT

3.1 Additional Sediment Testing Parameters

3.1.1.1 The sediment sub-samples collected from each of the 18 sampling locations for elutriate test will be analysed for additional sediment quality parameters presented in **Table 3.1**. The associated analytical results will be used to review the nutrient contamination levels in the sediment samples and also the potential of causing oxygen depletion in the marine water during the dredging work.

Table 3.1 Additional Sediment Quality Parameters for Water Quality Impact Assessment

Parameters	Suggested Analytical Method **	Suggested Reporting Limit (mg/kg) **
Sediment Oxygen Demand (SOD), 20 days	APHA 5210B	10
Ammonia Nitrogen (NH ₃ -N)	APHA 4500-NH ₃	10
Nitrate Nitrogen (NO ₃ -N)	APHA 4500-NO ₃	0.1
Nitrite Nitrogen (NO ₂ -N)	APHA 4500-NO ₂	0.1

Parameters	Suggested Analytical Method **	Suggested Reporting Limit (mg/kg) **
Total Kjeldahl Nitrogen (TKN)	APHA 4500-Norg + APHA 4500 NH ₃	20
Total Phosphorus (TP)	APHA 4500-P	20
Otho-phosphate Phosphorus (PO ₄ -P)	APHA 4500-P	10
Particle size distribution (2 mm to 63µm)	BS1377 (1975)	-

Note:

++ The analytical methods and reporting limits are subject to confirmation with the HOKLAS accredited laboratory to be engaged for the marine SI. Any updated information received from the laboratory will be submitted to EPD for agreement prior to carrying out the SI work.

3.2 Elutriate Testing Parameters

3.2.1.1 The elutriate samples as discussed in Section 2.1.1.2 above will be tested for a suite of contaminants as presented in **Table 3.2**.

Table 3.2 Parameters and Analytical Methods for Elutriate Test

Parameters	Suggested Analytical Method – Instrumentation ⁽¹⁾	Reporting Limit ⁽¹⁾
Metals		
Cadmium (Cd)	USEPA 6010/6020 – ICPMS	0.2 µg/L
Chromium (Cr)	USEPA 6010/6020 – ICPMS	1 µg/L
Copper (Cu)	USEPA 6010/6020 – ICPMS	1 µg/L
Mercury (Hg)	USEPA 7470/7471 – ICPAES / CVAAS	0.05 µg/L
Nickel (Ni)	USEPA 6010/6020 – ICPMS	1 µg/L
Lead (Pb)	USEPA 6010/6020 – ICPMS	1 µg/L
Silver (Ag)	USEPA 6010/6020 – ICPMS	1 µg/L
Zinc (Zn)	USEPA 6010/6020 – ICPMS	10 µg/L
Metalloid		
Arsenic (As)	USEPA 6010/6020 – ICPMS	1 µg/L
Organic-Contaminants		
Polynuclear Aromatic Hydrocarbon (PAHs)	USEPA 8082/8270 – GCMS	0.1 µg/L individually
Polychlorinated Biphenyls (PCBs)	USEPA 8270 – GCMS	0.01 µg/L individually
Tributyltin (TBT)	USEPA 3230 or Krone et al. (1989) ⁽²⁾ – GCMS UNEP/IOC/IAEA ⁽³⁾	0.015 µg/L
Nutrients – Nitrogen and Phosphorus		
Ammonia Nitrogen (NH ₃ -N)	APHA 4500-NH ₃ – FIA	0.01 mg/L
Nitrate Nitrogen (NO ₃ -N)	APHA 4500-NO ₃ – FIA	0.01 mg-N/L
Nitrite Nitrogen (NO ₂ -N)	APHA 4500-NO ₂ - FIA	0.01 mg-N/L
Total Kjeldahl Nitrogen (TKN)	APHA 4500-Norg + APHA 4500 NH ₃ - FIA	0.1 mg-N/L
Unionized Ammonia (UIA)	By calculation ⁽⁴⁾	0.01 mg/L
Total Phosphorus (TP)	APHA 4500-P – Colorimetric method	0.1 mg-P/L
Otho-phosphate Phosphorus (PO ₄ -P)	APHA 4500-P – Colorimetric method	0.1 mg-P/L
Chlorinated Pesticides		
Aldrin Alpha-BHC Beta-BHC Delta-BHC Gamma-BHC Heptachlor Heptachlor epoxide Endosulfan I Endosulfan sulphate 4, 4'-DDT 4, 4'-DDD 4, 4'-DDE	USEPA 8270 - GCMS	0.1 µg/L individually

Notes:

- (1) Reporting limits are initially defined with reference to the available water quality criteria in Section 9 or past approved SSTP. The analytical methods, instrumentation and reporting limits are subject to confirmation with the HOKLAS accredited laboratory to be engaged for the marine SI. Any updated information received from the laboratory will be submitted to EPD for agreement prior to carrying out the SI work.
- (2) Krone et al. (1989), A method for analysis of butyltin species and measurement of butyltins in sediment and English Sole livers from Puget Sound, Marine Environmental Research 27 (1989) 1-18. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.
- (3) UNEP/ICO/IAEA refers to IAEA's Marine Environment Laboratory reference methods. These methods are available free of charge from UNEP/Water or Marine Environmental Studies Laboratory at IAEA's Marine Environment Laboratory. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.
- (4) Bowler C.E. and Bidwell J.P. (1978), Ionization of ammonia in seawater: Effect of temperature, pH and salinity. J. Fish. Res. Board Can. Vol.35, pp.1012-1016.

4 PROPOSED SEDIMENT SAMPLING PROCEDURES

- 4.1.1.1 The sediment sampling procedures shall follow those presented in the SSTP for the Project.

5 PROPOSED MARINE WATER SAMPLING PROCEDURES

5.1 Sampling Locations and Water Depths

- 5.1.1.1 Prior to sampling at each location, the sampling location shall be set out with the aid of a differential global positioning system (DGPS) or equivalent device with similar accuracy. The depth of water, in metres below the Principal Datum (mPD), shall then be measured.

5.2 Ambient Marine Water Sampling

- 5.2.1.1 Ambient marine water sample collection shall commence prior to sediment collection to avoid seabed disturbance. At each of the 2 sampling locations, marine water samples will be taken from 1m below the surface, mid-depth and 1m above seabed. Where the water depth is less than 6 m, marine water sampling at the mid-depth may be omitted. Should the water depth be less than 3 m, marine water sampling will be carried out only at the mid-depth of the water column. Water samples collected at different depths of the same sampling station shall then be pooled to form a composite water sample.
- 5.2.1.2 Marine water samples at specific water depths shall be taken using Kahlsico Water Sampler or similar instrument and the sampler shall be thoroughly washed with the ambient seawater prior to each sampling attempt.

6 PROPOSED ELUTRIATE TEST PROCEDURES

- 6.1.1.1 For laboratory analysis, the *in-situ* composite marine water sample will be mixed with the sediment sample collected in the same station in a sediment-to-water ratio of 1:4 on a volume basis. The mixture will be mechanically shaken vigorously for 30 minutes and then settled undisturbed for 1 hour. The liquid phase is then centrifuged at a rotation speed of approximately 2000 rpm for 30 minutes to remove all suspended particulate matter. The extracted liquid filtrate is the elutriate to be used for further analysis.

7 SAMPLE SIZE AND HANDLING

7.1 Sample Size

- 7.1.1.1 Adequate sediment samples and ambient marine water samples will be collected for the additional chemical testing and sediment elutriate test presented in **Table 3.1** and **Table 3.2**. The proposed sampling size for elutriate test is presented in **Table 7.1**. The sediment

sampling size is separately presented in the SSTP for the Project. The actual size of the sediment and marine water samples required for various testing shall be confirmed with the laboratory prior to the commencement of the sampling programme.

Table 7.1 Recommended Sampling Size for Elutriate Test

Parameters	Sampling Size
Elutriate / Blank Test	1 litres of sediment and 6 litres of ambient marine water ⁽¹⁾

Note:

- (1) Four litres of ambient marine water will be mixed with 1 litre of sediment for elutriate test and another 2 litre of ambient marine water will be used for blank test.

7.2 Sampling Bottle and Pre-treatment Methods

- 7.2.1.1 The types of sampling bottle to be used and pre-treatment methods for the collected sediment samples shall follow the recommendations stipulated in ETWB TC(W) No. 34/2002 presented in the SSTP. The types of sampling bottle for elutriate test is shown in **Table 7.2**.

Table 7.2 Types of Sampling Bottle and Pre-treatment Methods

Parameters	Sampling bottle	Pre-treatment Procedure
Elutriate Test	Glass container (for sediment) Glass bottle (for marine water)	Not applicable

7.3 Sample Handling and Holding Time

- 7.3.1.1 All samples necessary for the proposed chemical and elutriate testing shall be stored, transported and maintained at 4°C or lower without being frozen in the dark prior to any laboratory testing. All samples shall be packed and transported in such a manner as to avoid shock, vibration or any other disturbance of the samples. Samples shall be delivered to laboratory within 24 hours after collection and analyzed as soon as possible. The chain-of-custody procedure shall be followed to record the flow of sample handling, from collection of samples to delivery of samples to the designated laboratory. Samples for chemical and elutriate testing shall be analyzed within 14 days after the sample collection.

8 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC) REQUIREMENTS

- 8.1.1.1 All tests will be conducted by laboratories accredited by Hong Kong Laboratory Accreditation Scheme (HOKLAS) or, in case of overseas laboratories, by equivalent accreditation for these tests. The laboratory shall ensure that all equipment and instruments to be used for analysis meet the requirements and specifications of the reference method procedures. The laboratory shall set upper and lower control limits based on statistical analysis of historical performance data to monitor the acceptability of the QA/QC sample data. All instruments shall be calibrated prior to analysis to monitor sensitivity and precision. The QA/QC plan for additional sediment and elutriate testing shall follow those presented in the SSTP for the Project.

9 PROPOSED ASSESSMENT CRITERIA FOR ELUTRIATES

9.1.1.1 Elutriate tests will be conducted to estimate the amount of pollutants that would be released into the water during dredging. The assessment criteria in relation to nitrogen parameters including inorganic nitrogen and unionized ammonia as well as oxygen depletion will be based on the Water Quality Objectives (WQOs) stipulated under the Water Pollution Control Ordinance (WPCO). However, there are no legislative standards in Hong Kong for assessment of acceptable concentrations of heavy metals and micro-pollutants such as total polychlorinated biphenyls (PCBs), total polyaromatic hydrocarbons (PAHs) and tributyltin (TBT) in marine water. It is thus proposed to make reference to the relevant water quality standards in the EU, Australia and USEPA. The proposed assessment criteria for metals and organic micro pollutants are summarized in Table 9-1. Details of the water quality impact assessment methodology for the Project will be separately submitted to EPD for agreement.

Table 9-1 Proposed Assessment Criteria for Elutriate Samples

Parameters	Assessment Criteria (µg/L)	Reference
Arsenic	13	1
Chromium	4.4	1
Copper	1.3	1
Lead	4.4	1
Mercury	0.4	1
Silver	1.4	1
Zinc	8	1
Cadmium	2.5	2
Nickel	30	2
PCBs	0.03	3
PAHs	0.2	3
TBT	0.006	3

References:

1. Australian & New Zealand Guidelines for Fresh & Marine Water Quality (EIA Reference: New Contaminated Sediment Disposal Facility to the West of Lamma Island, Registration No. AEIAR-248/2023).
2. European Union Environmental Quality Standard (EQS) Values to Protect Marine Life (EIA Reference: Lei Yue Mun Waterfront Enhancement Project, Registration No. AEIAR-219/2018).
3. U.S. Environmental Protection Agency (USEPA) National Recommended Water Quality Criteria (EIA Reference: New Contaminated Sediment Disposal Facility to the West of Lamma Island, Registration No. AEIAR-248/2023).

Appendix A

Proposed Elutriate Test Locations for TKO 137 and TKO 132

Figure A-1 Proposed Elutriate Test Locations for TKO 137

SAMPLING LOCATION ID	COORDINATES	
	EASTING	NORTHING
ME A1	845537.113	814957.026
ME A2	845676.025	815010.361
ME A3	845566.712	814878.348
ME A4	845705.848	814932.034
ME A5	845585.508	814696.156
ME A6	845652.340	814548.432
ME A7	845717.180	814574.764
ME A8	845712.519	814424.785
ME A9	845780.817	814452.692
ME A10	845755.697	814283.557
ME A11	845851.329	814321.287
ME A12	845858.086	814003.692
ME A13	845994.686	814057.864
ME A14	845934.687	813874.267
ME A15	846075.945	813925.996
ME A16	845988.624	813736.965
ME A17	846128.693	813787.955
ME A18	846071.401	813655.395
ME A19	846167.899	813692.711
ME A20	845931.097	814192.986
ME A21	845804.068	814143.833
ME A22	845657.432	814103.156
ME A23	845518.153	814050.422
ME A24	845379.437	813995.438
EA1	846522.858	814578.264
EA2	846384.723	814518.305
EA3	846218.205	814372.398
EA4	846043.330	814291.144

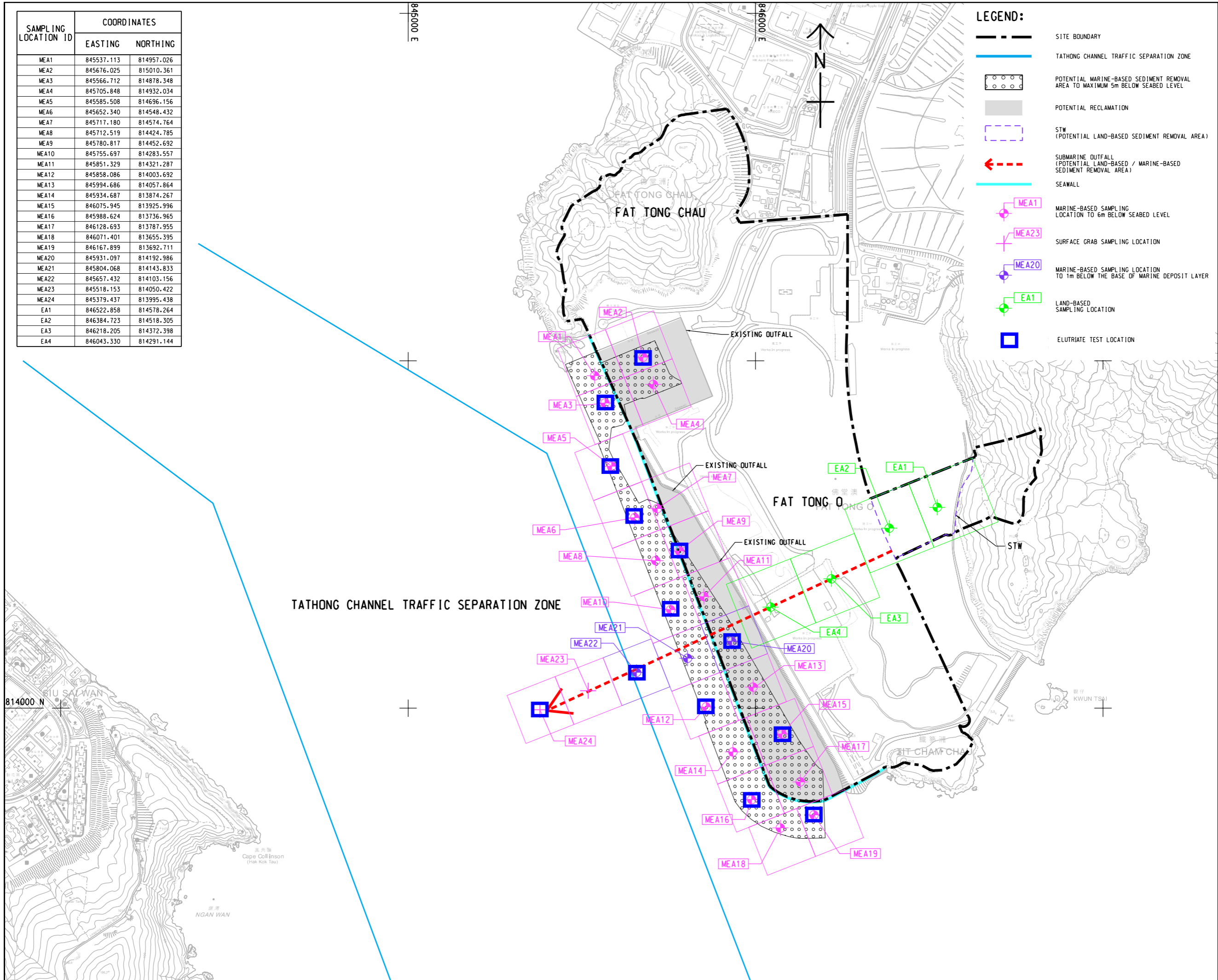


Figure A-2 Proposed Elutriate Test Locations for TKO 132

