Contents

Tables

Appendix

7 Land Contamination

7.1 Legislations, Standards and Guidelines

7.1.1 General

7.1.1.1 The relevant legislation, standards and guidelines applicable to the present study for the assessment of land contamination include:

- Annex 19 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), Guidelines for Assessment of Impact On Sites of Cultural Heritage and Other Impacts (Section 3 – Potential Contaminated Land Issues), Environmental Protection Department (EPD), 2023;
- Guidance Note for Contaminated Land Assessment and Remediation, EPD, Revised in April 2023;
- Guidance Manual for Use of Risk-Based Remediation Goals (RBRGs) for Contaminated Land Management, EPD, Revised in April 2023; and
- Practice Guide for Investigation and Remediation of Contaminated Land, EPD, Revised in April 2023.

7.1.2 Environmental Impact Assessment Ordinance (EIAO) (Cap. 499), Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM)

7.1.2.1 Under Annex 19 of the EIAO-TM, a number of potentially contaminating historical and present land uses should be considered, including oil installations, gas works, metal workshops, car repair and dismantling workshops, which have the potential to cause or have caused land contamination. Nevertheless, any other potential contaminating activities/ installations/ facilities within the boundary of the Project and the works of the Project should be identified and considered based on professional judgement.

7.1.3 Guidance Note for Contamination Land Assessment and Remediation

7.1.3.1 In accordance with EPD's Guidance Note for Contamination Land Assessment and Remediation, a contamination assessment evaluation should:

- Provide a clear and detailed account of the present land use and the relevant past land history, in relation to possible land contamination;
- Identify areas of potential contamination and associated impacts, risks or hazards; and
- Submit a plan to evaluate the actual contamination conditions for soil and/or groundwater, if required.

7.1.4 Guidance Manual for Use of Risk-Based Remediation Goals (RBRGs) for Contaminated Land Management

7.1.4.1 The Guidance Manual introduces the risk-based approach in land contamination assessment and presents instructions for comparison of soil and groundwater data to the RBRGs for 54 chemicals of concern commonly found in Hong Kong. The RBRGs were derived to suit Hong Kong conditions by following the international practice of adopting a risk-based methodology for contaminated land assessment and remediation and were designed to protect the health of people who could

potentially be exposed to land impacted by chemicals under four broad post restoration land use categories. The RBRGs also serve as the remediation targets if remediation is necessary. The RBRGs for soil and groundwater are given in **Table 7.1** and **Table 7.2** respectively.

Table 7.1 RBRGs for soil & soil saturation limit

Chemical	Risk-Based Remediation Goals (RBRGs) for Soil				Soil Saturation Limit (C_{sat}) (mg/kg)
	Urban Residential (mg/kg)	Rural Residential (mg/kg)	Industrial (mg/kg)	Public Park (mg/kg)	
VOCs					
Acetone	9,590	4,260	10,000*	10,000*	***
Benzene	0.704	0.279	9.21	42.2	336
Bromodichloromethane	0.317	0.129	2.85	13.40	1,030
2-Butanone	10,000*	10,000*	10,000*	10,000*	***
Chloroform	0.132	0.0529	1.54	253	1,100
Ethylbenzene	709	298	8,240	10,000	138
Methyl tert-Butyl Ether	6.88	2.80	70.1	505	2,380
Methylene Chloride	1.30	0.529	13.9	128	921
Styrene	3,220	1,540	10,000*	10,000*	497
Tetrachloroethene	0.101	0.0444	0.777	1.84	97.1
Toluene	1,440	705	10,000*	10,000*	235
Trichloroethene	0.523	0.211	5.68	69.4	488
Xylenes (Total)	95.0	36.8	1,230	10,000*	150
SVOCs					
Acenaphthene	3,510	3,280	10,000*	10,000*	60.2
Acenaphthylene	2,340	1,510	10,000*	10,000*	19.8
Anthracene	10,000*	10,000*	10,000*	10,000*	2.56
Benzo(a)anthracene	12.0	11.4	91.8	38.3	-
Benzo(a)pyrene	1.20	1.14	9.18	3.83	-
Benzo(b)fluoranthene	9.88	10.1	17.8	20.4	-
Benzo(g,h,i)perylene	1,800	1,710	10,000*	5,740	-
Benzo(k)fluoranthene	120	114	918	383	-
Bis-(2-Ethylhexyl)phthalate	30.0	28.0	91.8	94.2	-
Chrysene	871	919	1,140	1,540	-
Dibenzo(a,h)anthracene	1.20	1.14	9.18	3.83	-
Fluoranthene	2,400	2,270	10,000*	7,620	-
Fluorene	2,380	2,250	10,000*	7,450	54.7
Hexachlorobenzene	0.243	0.220	0.582	0.713	-
Indeno(1,2,3-cd)pyrene	12.0	11.4	91.8	38.3	-

Chemical	Risk-Based Remediation Goals (RBRGs) for Soil				Soil Saturation Limit (C_{sat}) (mg/kg)
	Urban Residential (mg/kg)	Rural Residential (mg/kg)	Industrial (mg/kg)	Public Park (mg/kg)	
Naphthalene	182	85.6	453	914	125
Phenanthrene	10,000*	10,000*	10,000*	10,000*	28.0
Phenol	10,000*	10,000*	10,000*	10,000*	7,260
Pyrene	1,800	1,710	10,000*	5,720	-
Metals					
Antimony	29.5	29.1	261	97.9	-
Arsenic	22.1	21.8	196	73.5	-
Barium	10,000*	10,000*	10,000*	10,000*	-
Cadmium	73.8	72.8	653	245	-
Chromium III	10,000*	10,000*	10,000*	10,000*	-
Chromium VI	221	218	1,960	735	-
Cobalt	1,480	1,460	10,000*	4,900	-
Copper	2,950	2,910	10,000*	9,790	-
Lead	258	255	2,290	857	-
Manganese	10,000*	10,000*	10,000*	10,000*	-
Mercury	11.0	6.52	38.4	45.6	-
Molybdenum	369	364	3,260	1,220	-
Nickel	1,480	1,460	10,000*	4,900	-
Tin	10,000*	10,000*	10,000*	10,000*	-
Zinc	10,000*	10,000*	10,000*	10,000*	-
Dioxins / PCBs					
Dioxins (I-TEQ)	0.001	0.001	0.005	0.001	-
PCBs	0.236	0.226	0.748	0.756	-
Petroleum Carbon Ranges					
C6 - C8	1,410	545	10,000*	10,000*	1,000
C9 - C16	2,240	1,330	10,000*	10,000*	3,000
C17 - C35	10,000*	10,000*	10,000*	10,000*	5,000
Other Inorganic Compounds					
Cyanide, free	1,480	1,460	10,000*	4,900	-
Organometallics					
TBTO	22.1	21.8	196	73.5	-

Notes:

[1] For Dioxins, the cleanup levels in USEPA Office of Solid Waste and Emergency Response (OSWER) Directive of 1998 have been adopted. The OSWER Directive value of 1 ppb for residential use has been applied to the scenarios of "Urban Residential", "Rural Residential", and "Public Parks", while the low end of the range of values for industrial, 5 ppb, has been applied to the scenario of "industrial".

[2] Soil saturation limits for petroleum carbon ranges taken from the Canada-Wide Standards for Petroleum Hydrocarbons in Soil, CCME 2000.

[3] * indicates a 'ceiling limit' concentration.

[4] *** indicates that the Csat value exceeds the 'ceiling limit' therefore the RBRG applies.

Table 7.2 RBRGs for groundwater and solubility limit

Chemical	Risk-Based Remediation Goals (RBRGs) for Groundwater			Solubility Limit (mg/L)
	Urban Residential (mg/kg)	Rural Residential (mg/kg)	Industrial (mg/kg)	
VOCs				
Acetone	10,000*	10,000*	10,000*	***
Benzene	3.86	1.49	54.0	1,750
Bromodichloromethane	2.22	0.871	26.2	6,740
2-Butanone	10,000*	10,000*	10,000*	***
Chloroform	0.956	0.382	11.3	7,920
Ethylbenzene	1,020	391	10,000*	169
Methyl tert-Butyl Ether	153	61.1	1,810	***
Methylene Chloride	19.0	7.59	224	***
Styrene	3,020	1,160	10,000*	310
Tetrachloroethene	0.250	0.0996	2.95	200
Toluene	5,110	1,970	10,000*	526
Trichloroethene	1.21	0.481	14.2	1,100
Xylenes (Total)	112	43.3	1,570	175
SVOCs				
Acenaphthene	10,000	7,090	10,000*	4.24
Acenaphthylene	1,410	542	10,000*	3.93
Anthracene	10,000*	10,000*	10,000*	0.0434
Benzo(a)anthracene	-	-	-	-
Benzo(a)pyrene	-	-	-	-
Benzo(b)fluoranthene	0.539	0.203	7.53	0.0015
Benzo(g,h,i)perylene	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-
Bis-(2-Ethylhexyl)phthalate	-	-	-	-
Chrysene	58.1	21.9	812	0.0016
Dibenzo(a,h)anthracene	-	-	-	-
Fluoranthene	10,000*	10,000*	10,000*	0.206
Fluorene	10,000*	10,000*	10,000*	1.98
Hexachlorobenzene	0.0589	0.0234	0.695	6.20
Indeno(1,2,3-cd)pyrene	-	-	-	-

Chemical	Risk-Based Remediation Goals (RBRGs) for Groundwater			Solubility Limit (mg/L)
	Urban Residential (mg/kg)	Rural Residential (mg/kg)	Industrial (mg/kg)	
Naphthalene	61.7	23.7	862	31.0
Phenanthrene	10,000*	10,000*	10,000*	1.00
Phenol	-	-	-	-
Pyrene	10,000*	10,000*	10,000*	0.135
Metals				
Antimony	-	-	-	-
Arsenic	-	-	-	-
Barium	-	-	-	-
Cadmium	-	-	-	-
Chromium III	-	-	-	-
Chromium VI	-	-	-	-
Cobalt	-	-	-	-
Copper	-	-	-	-
Lead	-	-	-	-
Manganese	-	-	-	-
Mercury	0.486	0.184	6.79	-
Molybdenum	-	-	-	-
Nickel	-	-	-	-
Tin	-	-	-	-
Zinc	-	-	-	-
Dioxins / PCBs				
Dioxins (I-TEQ)	-	-	-	-
PCBs	0.433	0.171	5.11	0.031
Petroleum Carbon Ranges				
C6 - C8	82.2	31.7	1,150	5.23
C9 - C16	714	276	9,980	2.80
C17 - C35	12.8	4.93	178	2.80
Other Inorganic Compounds				
Cyanide, free	-	-	-	-
Organometallics				
TBTO	-	-	-	-

Notes:

[1] Blank indicates that RBRG could not be calculated because the toxicity or physical/chemical values were unavailable, or the condition of Henry's Law Constant>0.00001 was not met for the inhalation pathway.

[2] Water solubilities for Petroleum Carbon Range aliphatic C9-C16 and greater than C16 generally are considered to be effectively zero and therefore the aromatic solubility for C9-C16 is used.

[3] * indicates a 'ceiling limit' concentration.

[4] *** indicates that the solubility limit exceeds the 'ceiling limit' therefore the RBRG applies.

7.1.5 Practice Guide for Investigation and Remediation of Contaminated Land

7.1.5.1 The EPD's *Practice Guide for Investigation and Remediation of Contaminated Land* includes a summary of the general steps of a contamination assessment study, which include site appraisal, site investigation and remediation.

7.2 Assessment Area

7.2.1.1 As discussed in **Section 2**, the scope of the Project is to provide connection roads (in form of open roads, tunnels, viaducts, and suspended bridge) to enhance the connectivity between NWNT and North Lantau. It will be implemented by phases which involve the key construction activities such as interchanges, public roads, tunnels, suspension bridge, viaducts and associated works.

7.2.1.2 The assessment area for this land contamination assessment includes alignment of the Project as shown in **Appendix 7.1**. It also covers related Project Sites including the proposed elevated or at-grade roads, tunnels, works areas, barging points, explosive magazine sites, building areas and earthwork areas at Lam Tei, So Kwun Wat, Siu Lam, Tai Lam Chung, Tsing Lung Tau, and North Lantau. The tentative works to be involved in the sub-areas are summarized in **Table 7.3**.

Table 7.3 Summary of the tentative works to be involved in the sub-areas of the assessment area

Project Site	Location	Tentative Works
Lam Tei	LTQ-RD1, LTQ-RD2	Main alignment
	LTQ-EA1, LTQ-EA2, LTQ-EA3	Main alignment, earthwork area, site office, work site for ventilation building, administration building and associated facilities
	LTQ-MS1	Magazine site work
So Kwun Wat	SKW-EA1, SKW-EA2, SKW-EA3, SKW-EA4, SKW-EA5, SKW-EA6	Main alignment, earthwork area, construction of ventilation buildings at SKW-EA1, SKW-EA4 and SKW-EA5
	SKW-WA1, SKW-WA2, SKW-WA3	Temporary works area, stockpiling at SKW-WA1, other project elements including reprovision of access road at SKW-WA2 and reprovision of footpath at SKW-WA3
Siu Lam	TMN-EA1, TMN-EA2, TMN-EA3, TMN-EA4, TMN-EA5	Main alignment, earthwork area, construction of ventilation building at TMN-EA4
	TMN-MS1	Site formation required for magazine site expansion
	TMN-WA1, TMN-WA5	Stockpiling, temporary storage of tunnel spoil
	TMN-WA2, TMN-WA3	Site office, stockpiling
	TMN-WA4	Stockpiling, temporary storage of tunnel spoil
	TMN-RD1	Construction of viaducts, temporary works area

Project Site	Location	Tentative Works
Tai Lam Chung	TLC-EA1	Main alignment, earthwork area, construction of ventilation building and tunnel portal
	TLC-RD1, TLC-WA1	Construction haul road, temporary works area for site office, tunnel portal construction and temporary stockpiling of tunnel spoil
Tsing Lung Tau	TLT-EA1	Main alignment, stockpiling, worksite for anchorage construction, earthwork area for slip road construction and stockpiling, construction of ventilation building
	TLT-WA1	Construction haul road
	TLT-WA2	Other project elements including reprovision of footpath
North Lantau	NLT-WA1	Site office, stockpiling with barging point, concrete batching plant
	NLT-WA2	Stockpiling with barging point
	NLT-EA1	Earthwork area, construction of administration building and associated facilities
	NLT -WA3	Construction haul road
	NLT-WA4	Other project elements including subway construction, reprovision of bus interchange and local access
Pillar Point	PLP-MS1	Magazine site work

7.3 Assessment Methodology

7.3.1.1 The land contamination assessment has been conducted according to the abovementioned EIAO-TM, Guidance Note, Practice Guide and Guidance Manual.

7.3.1.2 Desktop review and site survey were conducted to identify the potentially contaminating activities that may pose adverse impact to the Project. For the purpose of conducting the desktop review, the best available relevant information in the public domain is collected. This information includes the following that would illustrate the features of the assessment area as well as any changes in land use over the previous decades. The following have been reviewed:

- Selected historical aerial photographs between Year 1963 and Year 2021;
- Outline Zoning Plans that show the latest land uses of the assessment area and its vicinity; and
- Information from relevant government departments for records on dangerous goods (DGs), chemical wastes and chemical spillage/leakage incidents from Fire Services Department (FSD) and Environmental Protection Department (EPD).

7.3.1.3 A Contamination Assessment Plan (CAP) has been prepared which set out the requirements and methodologies for a land contamination assessment along the

Route 11 (Section between Yuen Long and North Lantau) alignment and enclosed in **Appendix 7.1**.

7.3.1.4 Site surveys were also conducted to verify the findings of the desktop review, review general site conditions and to identify any sources of land contamination or hotspots. Based on the site surveys, soil and groundwater sampling and testing at the potentially contaminated areas have been proposed. The detailed findings of the site surveys and subsequent proposed site investigation (SI) works were shown in **Appendix 7.1**.

7.4 Identification of Potentially Contaminated Area

7.4.1 Historical Land Use

7.4.1.1 Selected historical aerial photographs between Year 1963 and Year 2021 of the assessment area have been reviewed to ascertain any historical land use with potential for land contamination. The historical aerial photographs are shown in Appendix A of **Appendix 7.1**. The findings of the historical aerial photographs are summarized in **Table 7.4** below.

Table 7.4 Summary of the historical aerial photographs' findings

Description	a – Lam Tei	b, c – So Kwun Wat	d - Siu Lam	e - Tai Lam Chung	f - Tsing Lung Tau	g - North Lantau	h – Pillar Point
Year 1963	• The majority of the Project Site comprised natural terrain, agricultural land, and village house in Lam Tei.	• The majority of the Project Site comprised natural terrain, and agricultural land in So Kwun Wat.	• The majority of the Project Site at Siu Lam comprised of natural terrain in Siu Lam.	• The majority of the Project Site comprised natural terrain, agricultural land, and vacant land in Tai Lam Chung.	• The majority of the Project Site comprised natural terrain in Tsing Lung Tau.	• The majority of the Project Site comprised natural terrain, sea and agricultural land were observed for certain portion in North Lantau.	• Natural terrain and sea were observed in Pillar Point.
Year 1973	• Lam Tei Quarry was in construction. • No significant change in land use for other areas (natural terrain, agricultural land, and village house in Lam Tei) in comparison with land use from 1963 aerial photographs.	• Some natural terrain was replaced by agricultural land in So Kwun Wat.	• No significant change in landuse at Siu Lam in comparison with land use from 1963 aerial photographs.	• No significant change was observed in majority of land use for the Project Site in comparison with land use from the 1963 aerial photograph, except a small portion of open storage was observed in Tai Lam Chung.	• No significant change in land use was observed for the Project Site in comparison with land use from the 1963 aerial photograph.	• No significant change in land use was observed for the Project Site in comparison with land use from the 1963 aerial photograph.	• No significant change in land use was observed for the Project Site in comparison with land use from the 1963 aerial photograph.
Year 1986	• Lam Tei Quarry was in operation. • A small portion of natural terrain at northwest of Lam Tei Quarry was developed as part of the access road of the Quarry.	• Some natural terrain and agricultural land were replaced by Tuen Mun Road/ New Territories Circular Road in So Kwun Wat.	• Tuen Mun Road/ New Territories Circular Road were constructed at Siu Lam. • Some vegetation was removed in Siu Lam.	• No significant change was observed in majority of land use for the Project Site in comparison with land use from the 1973 aerial photograph, except the agricultural land was left vacant.	• Tuen Mun Road/ New Territories Circular Road were constructed in Tsing Lung Tau. • Some vegetation was removed in Tsing Lung Tau.	• No significant change in land use was observed for the Project Site in comparison with land use from the 1973 aerial photograph.	• Vegetation was removed and a village house was observed at PLP-MS1.
Year 1999	• Lam Tei Quarry was extended.	• Agricultural land was left vacant in	• Some vacant land was covered by	• No significant change in land use	• Vacant land was replaced by open	• North Lantau Highway was	• Village house was removed, Tuen

Description	a – Lam Tei	b, c – So Kwun Wat	d - Siu Lam	e - Tai Lam Chung	f - Tsing Lung Tau	g - North Lantau	h – Pillar Point
	• Agricultural land was changed to village house and open car parks were observed in Lam Tei. • Yuen Long Road/ New Territories Circular Road was constructed.	So Kwun Wat.	vegetation in Siu Lam.	was observed for the Project Site in comparison with land use from the 1986 aerial photograph.	storage at middle part of Tsing Lung Tau.	observed. • The agricultural land was developed and the sea area to the north of North Lantau Highway was reclaimed.	Mun West Fresh Water Service Reservoir was observed at PLP-MS1.
Year 2008	• Extent of Lam Tei Quarry was reduced at southeast corner, more vegetation was observed at northwest of the Quarry. • Some village houses and an open carpark were replaced by Kong Sham Western Highway in Lam Tei. • An open carpark turned to vacant land or covered by vegetation in Lam Tei.	• Some village houses were observed in So Kwun Wat. • Vacant land was covered by vegetation in So Kwun Wat.	• Some vegetated land was occupied by open storage in Siu Lam.	• No significant change in land use was observed for the Project Site in comparison with land use from the 1999 aerial photograph.	• Additional open storage area was observed at southwest portion of Tsing Lung Tau.	• Reclaimed land remained vacant, no significant change in land use was observed for the Project Site in comparison with land use from the 1999 aerial photograph.	• No significant change in land use was observed for the Project Site in comparison with land use from the 1999 aerial photograph.
Year 2015	• Some vacant land was covered by vegetation surrounding Lam Tei Quarry. Some village houses were replaced by	• No significant change in land use was observed for the Project Site in comparison with land use from the 2008 aerial	• No significant change in land use was observed for the Project Site in comparison with land use from the 2008 aerial	• No significant change in land use was observed for the Project Site in comparison with land use from the 2008 aerial	• No significant change in land use was observed for the Project Site in comparison with land use from the 2008 aerial	• Open storage areas were observed at both NLT-WA1 and NLT-WA2 in North Lantau.	• Open storage was observed at PLP-MS1.

Description	a – Lam Tei	b, c – So Kwun Wat	d - Siu Lam	e - Tai Lam Chung	f - Tsing Lung Tau	g - North Lantau	h – Pillar Point
	vegetation. • A workshop was observed at LTQ-RD1. A small portion of vegetation located at southwest of the workshop was cleared.	photograph, except some more village houses were observed.	photograph, except magazine site was observed at TMN-MS1 and more vegetation was observed at western portion of TMN-WA1.	photograph.	photograph.		
Year 2021	• Some part of Lam Tei Quarry was covered by vegetation. • An open carpark was observed in Lam Tei.	• No significant change in land use was observed for the Project Site in comparison with land use from the 2015 aerial photograph, except some more village houses were observed.	• The magazine site at TMN-MS1 was removed in Siu Lam. • Some open storage areas were covered by vegetation.	• No significant change in land use was observed for the Project Site in comparison with land use from the 2015 aerial photograph, except the vacant land was covered with more vegetation.	• The open storage was removed in Tsing Lung Tau.	• Open storage of sand and rock were observed at both NLT-WA1 and NLT-WA2 in North Lantau.	• The site was left vacant at PLP-MS1.

7.4.2 Site Surveys

7.4.2.1 Site surveys were conducted in March, April, August to October 2022 and April 2023 to verify findings of the desktop review and identify the existing land uses within the Assessment Area which may have land contamination potential. The site survey photos are presented in Appendix C of **Appendix 7.1**. Findings of the site surveys are summarized in **Table 7.5** below.

Table 7.5 Summary of site surveys' findings

Project Site	Location	Observation
Lam Tei	LTQ-RD1	• The site was inaccessible, but peripherical observation can be conducted near its main entrance. • Potential contamination land use of warehouse (previous vehicle maintenance)(Photo A1 in Appendix C of **Appendix 7.1**) was observed from outside. • No maintenance activities were observed.
	LTQ-RD2	• The site was wholly accessible. • Potential contamination land use of open car park with suspected refilling activities, Photos B1 and B2 in Appendix C of **Appendix 7.1**) was observed.
	LTQ-EA1	• The site was inaccessible such that no peripherical observation can be conducted. • Vegetation and vacant land were observed within the Project Site (Photo C1 in Appendix C of **Appendix 7.1**).
	LTQ-EA2, LTQ-EA3, LTQ-MS1	• The sites were partially accessible and peripherical observation can be conducted. • Potential contamination land use of quarry with facilities such as asphalt plant, concrete batching plant and stone crushing plant (Photos D1, E1, E2, F1 and F2 in Appendix C of **Appendix 7.1**) was observed. • Chemical Storage area was observed (Photo E3 in Appendix C). It was noted that secondary containments were provided for the chemical storage tanks to prevent spillage (Photo E4 in Appendix C of **Appendix 7.1**). • No hotspots were identified during the survey.
So Kwun Wat	SKW-EA1	• The site was partially accessible, peripherical observation can be conducted near residential area. • Village houses and vegetation land were observed within the Project Site (Photos G1 to G4 in Appendix C of **Appendix 7.1**). • No potential contamination activities were observed.
	SKW-EA2, SKW-EA3	• The sites were inaccessible such that no peripherical observation can be conducted. • Natural vegetation was observed within the Project Site (Photos H1, H2 and J1 in Appendix C of **Appendix 7.1**).
	SKW-WA1, SKW-WA2	• The sites were inaccessible such that no peripherical observation can be conducted. • Entrance gates were built and blocked access to the Project Sites (Photo U1 and K1 in Appendix C of **Appendix 7.1**).

Project Site	**Location**	Observation
	SKW-EA4, SKW-EA5,	• The sites were inaccessible such that no peripherical observation can be conducted. • Vegetation was observed from Aerial Photo (Year 2021c in Appendix A of **Appendix 7.1**).
	SKW-EA6, SKW-WA3	• The site was mostly inaccessible such that no peripherical observation can be conducted. • Small portion of village houses at southern corner of the site and vegetation for most of the site were observed from Aerial Photo (Year 2021c in Appendix A of **Appendix 7.1**).
Siu Lam	TMN-WA1, TMN-WA5, TMN-MS1	• The site was wholly accessible at TMN-MS1, partially accessible at western portion of TMN-WA1 and TMN-WA5 where peripherical observation can be conducted. • Vegetation and vacant land were observed within the Project Site (Photos M1 to M5 in Appendix C of **Appendix 7.1**). • No oil stain or potential contamination activities were observed. • No hotspots were identified during the survey.
	TMN-WA2	• The site was inaccessible, but peripherical observation can be conducted near its main entrance and along the site edge. • Vegetation and vacant land were observed from outside of the Project Site (Photos N1 and N2 in Appendix C of **Appendix 7.1**).
	TMN-WA3	• The site was wholly accessible. • Vegetation land and vacant land were observed within the Project Site (Photos O1 to O4 in Appendix C of **Appendix 7.1**). • No oil stain or potential contamination activities were observed. • No hotspots were identified during the survey.
	TMN-WA4	• The site was wholly accessible. • Vegetation land and open carpark were observed within the Project Site (Photos V1 and V2 in Appendix C of **Appendix 7.1**). • No oil stain or potential contamination activities were observed. • No hotspots were identified during the survey.
	TMN-EA1, TMN-EA2	• The sites were inaccessible such that no peripherical observation can be conducted. • Vegetation were observed from Aerial Photo (Year 2021d in Appendix A of **Appendix 7.1**).
	TMN-EA3, TMN-EA4	• The sites were mostly inaccessible such that no peripherical observation can be conducted to review overall site condition. • Vegetation and vacant land were observed within the Project Site (Photos P1 and P2 in Appendix C of **Appendix 7.1**). • No potential contamination activities were observed.

Project Site	**Location**	Observation
	TMN-EA5	• The site was inaccessible such that no peripherical observation can be conducted. • Vegetation and vacant land were observed from Aerial Photo (Year 2021e in Appendix A of **Appendix 7.1**).
	TMN-RD1	• The site was mostly inaccessible except small portion of public road, no peripherical observation can be conducted to review overall site condition. • Small portion of public road was observed at southeastern edge of the Project Site (Photos P1 and P2 in Appendix C of **Appendix 7.1**). • Vegetation, vacant land and several village houses were observed from Aerial Photo (Year 2021c & Year 2021d in Appendix A of **Appendix 7.1**).
Tai Lam Chung	TLC-WA1	• The site was inaccessible, but peripherical observation can be conducted at site edge. • Open storage area (including storage of goods and fuel) with loading, unloading activities, equipment transfer and maintenance were observed (Photos W1 to W3 in Appendix C of **Appendix 7.1**).
	TLC-EA1, TLC-RD1	• The sites were inaccessible such that no peripherical observation can be conducted. • Vegetation and vacant land were observed from Aerial Photo (Year 2021e in Appendix A of **Appendix 7.1**).
Tsing Lung Tau	TLT-EA1, TLT-WA1	• The site was partially accessible and peripherical observation can be conducted. • Southwestern portion of the site area next to Tuen Mun Road was wholly accessible. Vegetation land and vacant land were observed within the site area. A temporary office container and a vehicle (Photos R1 to R4 in Appendix C of **Appendix 7.1**) were observed. No maintenance activities and open storage were observed. • Middle part of the site area surrounded by natural slope was inaccessible. The road was blocked with vegetation (Photo R5 in Appendix C of **Appendix 7.1**). • No oil stain or potential contamination activities were observed. • No hotspots were identified during the survey.
	TLT-WA2	• The site was inaccessible such that no peripherical observation can be conducted. • Vegetated land was observed from Aerial Photo (Year 2021f in Appendix A of **Appendix 7.1**).
North Lantau	NLT-WA1	• The site was inaccessible, but peripherical observation can be conducted near main entrance. • Potential contamination land use of open storage (Photo S1 in Appendix C of **Appendix 7.1**) was observed.
	NLT-WA2	• The site was inaccessible such that no peripherical observation can be conducted. • Sand and rock storage were observed from Aerial Photo (Year 2021g in Appendix A of **Appendix 7.1**).

Project Site	Location	Observation
	NLT-WA3	• Western portion of the site lied within To Kau Wan reclaimed land, the reclaimed land area was inaccessible, but peripherical observation can be conducted near main entrance similar to NLT-WA1. Potential contamination land use of open storage (Photo S1 in Appendix C of **Appendix 7.1**) was observed within the reclaimed land area. • Remaining of the site was inaccessible such that no peripherical observation can be conducted. • Most of the site consisted of natural terrain (Year 2021g in Appendix A of **Appendix 7.1**).
	NLT-EA1, NLT-WA4	• The sites were inaccessible such that no peripherical observation can be conducted. • Most of the site consisted of natural terrain (Year 2021g in Appendix A of **Appendix 7.1**).
Pillar Point	PLP-MS1	• The site was wholly accessible. • Storage of construction materials such as barriers, concrete blocks were observed within the Project Site (Photos X1 to X3 in Appendix C of **Appendix 7.1**). • No oil stain or hotspots were identified during the survey.

7.4.3 Information from Relevant Government Departments

7.4.3.1 Information requests have been sent to Fire Services Department (FSD) to enquire:

- Records of Dangerous Goods (DGs) License issued in the assessment area;
- Any past and present information related to the use and/ or storage of DGs in the assessment area; and
- Past and present incident records in the assessment area.

7.4.3.2 Response from FSD is enclosed in Appendix E of **Appendix 7.1**. Based on information provided by FSD, 4 records of Dangerous Goods Licenses were found, total 51 incidents were recorded, and no dangerous goods spillage/leakage were reported in the Project Site. Land contamination impact on the Project due to the relevant incidents is considered unlikely. Further information request from FSD for any latest records within the updated Assessment Area have been sent in August 2022. The response in September 2022 has the same record of Dangerous Goods Licenses as May 2021, total 21 incidents were recorded, and no dangerous goods spillage/leakage were reported in the Project Site. The recorded incidents would not cause land contamination. Further information request from FSD for any latest records within the updated Assessment Area have been sent in October 2022. The response in December 2022 stated no Dangerous Goods Licence was issued in respect of the Project Site. Total 8 incidents were recorded which were not located within works area/ excavation area of the Project, land contamination impact on the Project due to these incidents is therefore considered unlikely.

7.4.3.3 Information requests have been sent to EPD to enquire:

- Past and present chemical spillage/ leakage records in the assessment area; and

- Records of Chemical Waste Producers Registration (CWPR) in the assessment area.

7.4.3.4 Response from EPD is enclosed in Appendix F of **Appendix 7.1**. Based on information provided by EPD, 1 active (valid) and 4 inactive (invalid) registration records were found, and 1 oil spillage case was recorded. As the concerned roads are concrete paved and without cracks, and the spilled oil was cleaned after the accident, the land contamination impact is considered unlikely. Further information request from EPD for any latest records within the updated Assessment Area have been sent in August 2022 and October 2022 respectively. No additional information was received and their stance in the previous reply was still held valid.

7.4.4 Review of Future Land Use

7.4.4.1 The RBRGs have developed four different post-restoration land uses, namely "Urban Residential", "Rural Residential", "Industrial" and "Public Parks", to reflect actual settings which people could be exposed to contaminated soil or groundwater. Definitions of post-restoration land uses are given in EPD's Guidance Manual for Use of Risk-Based Remediation Goals for Contaminated Land Management. Details of future land use of the Project are summarized in Table 2.3 of **Appendix 7.1**.

7.4.5 Summary of Potentially Contaminated Area

7.4.5.1 Identification of potentially contaminated areas within the Project Site has been done based on the criteria stipulated in EPD's Practice Guide for Investigation and Remediation of Contaminated Land. Information collected from desktop review of selected historical aerial photos and from site surveys has also been used to assist the task.

7.4.5.2 Based on the desktop review findings of selected aerial photographs, and the information collected during site surveys and the relevant government departments including EPD and FSD, 15 sites (LTQ-RD1, LTQ-RD2, LTQ-EA2, LTQ-EA3, LTQ-MS1, TMN-MS1, TMN-WA2, TMN-WA3, TLC-WA1, TLT-EA1, TLT-WA1, NLT-WA1, NLT-WA2, NLT-WA3 and PLP-MS1) have been identified with potential contaminated areas as shown in Figure 3.1 (**Figure 3.1a to Figure 3.1h**) and Appendix D of **Appendix 7.1**.

7.4.5.3 Among the 15 sites, 6 (Site LTQ-RD1, TMN-WA2, TLC-WA1, NTL-WA1, NLT-WA2 and NLT-WA3(western potion at To Kau Wan reclaimed land only)) of them were inaccessible during site survey and only peripheral site inspections were undertaken except NLT-WA2. Site inspections were partially conducted in 6 sites (Site LTQ-EA2, LTQ-EA3, LTQ-MS1, TMN-MS1, TLT-EA1 and TLT-WA1) due to limited access and were fully conducted in 3 sites (Site LTQ-RD2, TMN-WA3 and PLP-MS1). According to the findings in Appendix D of **Appendix 7.1**, 9 out of the 15 potential contaminated areas would require SI based on currently available information to determine the types and quantities of contaminants within the sites. Meanwhile, further site re-appraisal is required for the whole project area after land resumption to confirm the contaminated land impacts.

7.5 Site Investigation

7.5.1.1 SI is recommended for the potentially contaminated areas identified based on currently available information. The sampling plan is summarised in **Table 7.6**. A

total of 52 trial pits and 52 boreholes are proposed for soil and groundwater sampling. Since the topsoil of Site LTQ-EA2, LTQ-EA3 and LTQ-MS1(Lam Tei Quarry) are less than 3m thick according to the information provided by the operator and previous SI record, trial pit is proposed for sampling. For LTQ-EA2, LTQ-EA3 and LTQ-MS1, since not the entire site lied within Lam Tei Quarry, sampling points are only proposed at the overlapping area between the works sites (i.e. western portion of Lam Tei Quarry) and area of Lam Tei Quarry with potentially contaminated activities for further investigation. The locations of the proposed sampling points are summarised in Appendix G of **Appendix 7.1**.

Table 7.6 Sampling plan for the potentially contaminated areas in which SI is recommended

Potentially Contaminated Areas	Sampling Location ID	Approach	Sampling Type	
			Soil	Groundwater
LTQ-RD1	LTQ-RD1-BH01 to LTQ-RD1-BH06	Borehole	✓	✓
LTQ-RD2	LTQ-RD2-BH01 to LTQ-RD2-BH09	Borehole	✓	✓
LTQ-EA2, LTQ-EA3	LTQ-EA3-TP01 to LTQ-EA3-TP40	Trial Pit	✓	✓
LTQ-MS1	LTQ-MS1-TP01 to LTQ-MS1-TP12	Trial Pit	✓	✓
TLT-EA1, TLT-WA1	TLT-EA1-BH01 to TLT-EA1-BH33	Borehole	✓	✓
NLT-WA1, NLT-WA3	NLT-WA1-BH01 to NLT-WA1-BH04	Borehole	✓	✓

Notes:
[1] Determination of the number of trial pits and grid size is based on Table 2.1 of the *Practice Guide for Investigation and Remediation of Contaminated Land*.
[2] The recommended sampling strategy are only tentative and subject to be reviewed based on site re-appraisal findings after land resumption.

7.5.1.2 A total of 104 sampling points are proposed at the potentially contaminated areas based on regular grid pattern as summarised in Appendix G of **Appendix 7.1** and **Table 7.7** below.

Table 7.7 Grid size of the identified potentially contaminated areas and number of recommended sampling point

Potentially Contaminated Areas	Approximate Area (m^2)	Grid Size (m) [2]	Number of Recommended Sampling Point [2][3]
LTQ-RD1	740	13	6
LTQ-RD2	1,220	13	9
LTQ-EA2, LTQ-EA3	33,870	32	40
LTQ-MS1	1,560	13	12
TLT-EA1, TLT-WA1	8,203	17	33
NLT-WA1, NLT-WA3	256 ($64m^2$/pier x 4 piers) [1]	9	4
		Total:	**104**

Notes:
[1] The approximate area for Site NLT-WA1 only include the tentative pier areas which have excavation works. In case there is any update in pier areas and building areas, site reappraisal and supplementary CAP would be required before commencement of site investigation works.
[2] Determination of the number of trial pits and grid size is based on Table 2.1 of the *Practice Guide for Investigation and Remediation of Contaminated Land*.
[3] The recommended sampling strategy are only tentative and subject to review based on site re-appraisal findings after land resumption.

7.5.1.3 However, reviewing current site condition, the identified potentially contaminated areas are currently infeasible to carry out site investigation works due to site conditions as illustrated in **Table 7.8** below.

Table 7.8 Site conditions of the identified potentially contaminated areas

Potentially Contaminated Areas	Site Conditions
LTQ-RD1	The land is currently private owned, SI work can only be commenced after land resumption. Therefore, SI work will not be conducted at EIA stage before land resumption.
LTQ-RD2	The land is currently private owned, SI work can only be commenced after land resumption. Therefore, SI work will not be conducted at EIA stage before land resumption.
LTQ-EA2, LTQ-EA3, LTQ-MS1	As the proposed excavation areas for the building areas and earthwork areas are tentative only, site reappraisal and supplementary CAP would be required before commencement of SI work after confirmation on the exact footprint. In addition, as the sites are still in operation, the sites are currently inaccessible for site investigation works. Besides, there can be possible change in land uses or future operational activities with land contamination potential. Therefore, SI work will not be conducted at EIA stage before the site reappraisal, but after supplementary CAP when access is available.
TLT-EA1, TLT-WA1	The land is administered by LandsD and there could be other land use with land contamination potential before construction works. Site reappraisal and supplementary CAP may be required before commencement of SI work when access is available. Therefore, SI work will not be conducted at EIA stage since access is not available.

Potentially Contaminated Areas	Site Conditions
NLT-WA1, NLT-WA3	As pier areas which have excavation works are tentative only, site reappraisal and supplementary CAP would be required before commencement of SI work for any future area update. In addition, the site is still in operation. There is possible change in land uses or continuous activities with land contamination potential. Therefore, SI work will not be conducted at EIA stage before the site reappraisal and supplementary CAP.

7.5.1.4 In view of the above site conditions, the proposed site investigation works will only be conducted when access is available (e.g. after land resumption) prior to construction. Supplementary CAP is recommended to submit for further endorsement before commencement of SI works.

7.6 Mitigation of Adverse Environmental Impacts

7.6.1 Recommended Further Works

7.6.1.1 There are some sites not accessible for visual inspection during site survey, or some sites are not available for site investigation during the EIA stage. Moreover, as the demolition of concerned facilities and construction works at the concerned areas will not commence until 2026 tentatively, there could be changes in the operation or land use within the Project Area which may cause further contamination issues. Detailed land contamination assessment could only be conducted when access is available, which includes site re-appraisal for the whole project area, submission of supplementary CAP, SI and submission of Contamination Assessment Report (CAR) where necessary. Supplementary CAP will be submitted to EPD for endorsement before the commencement of environmental SI. Following the submission of supplementary CAP for EPD's agreement, and completion of SI and laboratory testing works, a CAR would be prepared. The CAR would present the findings of the site investigation and evaluate the level and extent of potential contamination in the Project Site. The CAR would evaluate the potential environmental and human health impacts based on the extent of potential contamination identified. If remediation is required, a Remediation Action Plan (RAP) would be prepared. The objectives of the RAP are:

- To undertake further site investigation where required;
- To evaluate and recommended appropriate remedial measures for the contaminated materials identified in the assessment;
- To recommend good handling practices for the contaminated materials during all stages of the remediation works;
- To recommend approximate handling and disposal measures; and
- To formulate optimal and cost-effective mitigation and remedial measures for EPD's agreement.

7.6.1.2 A Remediation Report (RR) would also be prepared to demonstrate that the clean-up works are adequate. No construction shall be carried out prior to the

endorsement of the aforesaid RR. Any construction / development works at the identified contaminated sites could only commence after approval of the abovementioned submissions.

7.6.2 Possible Remediation Measures

7.6.2.1 The actual remediation methods should be confirmed after completion of the site re-appraisal and the approved CAR and RAP at the later stage of the project before construction. The RAP will provide details of the remedial actions for any identified contaminated soil and groundwater.

7.6.2.2 For soil, there are several technologies commercially available to tackle these contaminants. Technologies that are commonly used in Hong Kong are biopiling and cement solidification/ stabilization. These ex-situ methods have been proven to be effective in treating the target Chemical of Concerns (cement solidification/stabilization on metals and biopiling on hydrocarbons).

7.6.2.3 For groundwater, some examples of remediation techniques of contaminated groundwater (e.g. air sparging, recovery trenches / wells, in-ground containment/capping and permeable reactive barriers) are shown in the Practice Guide from EPD.

7.6.3 Mitigation Measures for Remediation Works

7.6.3.1 Mitigation measures for the remediation works would depend on the nature / extent of contamination and the method of treatment. The mitigation measures will be recommended in the RAP and would typically include the following:

- Excavation profiles must be properly designed and executed with attention to the relevant requirements for environment, health and safety;
- Excavation shall be carried out during dry season as far as possible to minimise contaminated runoff from contaminated soils;
- Supply of suitable clean backfill material (or treated soil) after excavation;
- Stockpiling site(s) should be lined with impermeable sheeting and bunded. Stockpiles should be fully covered by impermeable sheeting to reduce dust emission;
- Vehicles containing any excavated materials should be suitably covered to limit potential dust emissions or contaminated wastewater run-off, and truck bodies and tailgates should be sealed to prevent any discharge during transport or during wet conditions;
- Speed control for the trucks carrying contaminated materials should be enforced;
- Vehicle wheel and body washing facilities at the site's exit points should be established and used; and
- Pollution control measures for air emissions (e.g. from biopile blower and handling of cement), noise emissions (e.g. from blower or earthmoving equipment), and water discharges (e.g. runoff control from treatment facility) shall be implemented and complied with relevant regulations and guidelines.

7.7 Evaluation of Residual Environmental Impacts

7.7.1.1 Recommended further works for the proposed works extent within the Project Site would need to follow EPD's *Guidance Manual*, *Guidance Note and Practice Guide*, and any soil / groundwater contamination would be identified and properly treated prior to the development. Land contamination impacts are therefore considered surmountable if the recommended actions as outlined in **Section 7.6** were followed and contaminated soil and groundwater (if any) were properly treated using appropriate remediation methods according to the RAP to be approved by EPD.

7.8 Conclusion

7.8.1.1 This land contamination assessment examined the potential contaminative land use within the whole Project Site including the proposed elevated or at-grade roads, tunnels, works areas, explosive magazine sites, building areas and earthwork areas. The assessment involved desktop review, site surveys and the proposed environmental SI.

7.8.1.2 15 sites have been identified with potential contaminated areas. Environmental SI was proposed for 9 out of the 15 potentially contaminated areas in the Project Site based on currently available information. However, since all the 9 potentially contaminated areas are currently not available to carry out SI works due to actual site conditions, SI is unlikely to be carried out at this stage. In addition, as some of the sites are still in operation, it is considered not practicable to carry out the SI at this stage as the on-going activities would make the assessment result obsolete.

7.8.1.3 In view of this, further site visits at all potentially contaminated areas are proposed when assess is available in order to identify the need for SI and any additional hot spots as a result of the on-going activities.

7.8.1.4 In addition, re-appraisal would be required for the whole Project Areas to address any change in operation or land use that may give rise to potential land contamination issues.

7.8.1.5 Findings of the re-appraisal will be presented in a supplementary CAP. Upon approval of the supplementary CAP and completion of the SI works, a CAR would be prepared to present findings of the SI works. If contamination has been identified, a RAP would be prepared to recommend specific remediation measures. Upon completion of the remediation works, if any, a RR would also be prepared to demonstrate that the clean-up is adequate. The CAR, RAP and RR would be submitted to EPD for approval prior to commencement of any construction /development works.