

## 9 LAND CONTAMINATION

### 9.1 Environmental Legislation and Guidelines

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

- (1) Annex 19 of the TM-EIA, Guidelines for Assessment of Impact Assessment Process (TM-EIA), Guidelines for Assessment of Impact On Sites of Cultural Heritage and Other Impacts (Section 3 : Potential Contaminated Land Issues), EPD, 1997;
- (2) Guidance Manual for Use of Risk-Based Remediation Goals (RBRGs) for Contaminated Land Management, EPD, 2007.
- (3) Guidance Notes for Contaminated Land Assessment and Remediation EPD, 2007 ; and
- (4) Practice Guide for Investigation and Remediation of Contaminated Land, EPD, 2011.

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

9.1.2 Under Annex 19 of the TM-EIAO, a number of potentially contaminating historical 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.

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

9.1.3 The Guidance Manual introduces the risk based approach in land contamination assessment and present 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 **Tables 9.1** and **9.2** respectively.

**Table 9.1:** Risk-Based Remediation Goals (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 Parks (mg/kg)	
VOCs					
Acetone	9,590	4,260	10,000*	10,000*	***

Chemical	Risk-Based Remediation Goals (RBRGs) for Soil				Soil Saturation Limit (C <sub>sat</sub> ) (mg/kg)
	Urban Residential (mg/kg)	Rural Residential (mg/kg)	Industrial (mg/kg)	Public Parks (mg/kg)	
Benzene	0.704	0.279	9.21	42.2	336
Bromodichloromethane	0.317	0.129	2.85	13.4	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
<b>SVOCs</b>					
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	
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	

Chemical	Risk-Based Remediation Goals (RBRGs) for Soil				Soil Saturation Limit (C <sub>sat</sub> ) (mg/kg)
	Urban Residential (mg/kg)	Rural Residential (mg/kg)	Industrial (mg/kg)	Public Parks (mg/kg)	
<b>Metals</b>					
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*	
<b>Dioxins / PCBs</b>					
Dioxins (I-TEQ)	0.001	0.001	0.005	0.001	
PCBs	0.236	0.226	0.748	0.756	
<b>Petroleum Carbon Ranges</b>					
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
<b>Other Inorganic Compounds</b>					
Cyanide, free	1,480	1,460	10,000*	4,900	
<b>Organometallics</b>					
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. A non risk-based 'ceiling limit' is given as  $10^4$  mg/kg for soil and  $10^4$  mg/L for groundwater for the relatively less toxic inorganic, volatile and semi-volatile contaminants.

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

**Table 9.2:** Risk-Based Remediation Goals (RBRGs) for groundwater and solubility limit

Chemical	Risk-Based Remediation Goals (RBRGs) for Groundwater			Groundwater Solubility Limit (mg/L)
	Urban Residential (mg/L)	Rural Residential (mg/L)	Industrial (mg/L)	
<b>VOCs</b>				
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
<b>SVOCs</b>				
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			Groundwater Solubility Limit (mg/L)
	Urban Residential (mg/L)	Rural Residential (mg/L)	Industrial (mg/L)	
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
<b>Metals</b>				
Antimony				
Arsenic				
Barium				
Cadmium				
Chromium III				
Chromium VI				
Cobalt				
Copper				
Lead				
Manganese				
Mercury	0.486	0.184	6.79	
Molybdenum				
Nickel				
Tin				
Zinc				
<b>PCBs</b>				
Dioxins (I-TEQ)				
PCBs	0.433	0.171	5.11	0.031
<b>Petroleum Carbon Ranges</b>				
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
<b>Other Inorganic Compounds</b>				
Cyanide, free				
<b>Organometallics</b>				
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 > 0.00005 was not met for the inhalation pathway.

- [2] Where 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. A non risk-based 'ceiling limit' is given as  $10^4$  mg/kg for soil and  $10^4$  mg/L for groundwater for the relatively less toxic inorganic, volatile and semi-volatile contaminants.
- [4] \*\*\* indicates that the solubility limit exceeds the 'ceiling limit' therefore the RBRG applies.

### ***Guidance Note for Contamination Land Assessment and Remediation***

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

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

### ***Practice Guide for Investigation and Remediation of Contaminated Land***

**9.1.5** 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.

## **9.2 Assessment Methodology**

**9.2.1** Land contamination assessment has been conducted according to the following procedures:

- (1) Desktop review of site history;
- (2) Site surveys to identify the potentially contaminated areas;
- (3) Prepare Contamination Assessment Plan for EPD's agreement; and
- (4) Propose Environmental Site Investigation for soil and groundwater sampling and testing.

### ***Desktop Review***

**9.2.2** The following information have been collated for the desktop review of site history:

- (1) Hong Kong Geological Survey Map (GSMs); and
- (2) Relevant aerial photos from 1963.

### ***Site Surveys***

**9.2.3** Site surveys were conducted to ground truth the findings of desktop review and to identify any other land uses within the Study Area which may have the potential for causing soil and groundwater contamination. Potentially contaminating activities were identified during the site surveys in accordance with Table 2.3 of EPD's *Practice Guide for Investigation and Remediation of Contamination Land*. The site surveys were conducted on 18 January and 13 June 2013.

### ***Preparation of Contamination Assessment Plan***

**9.2.4** According to the findings of desktop study and site surveys, the Contamination Assessment Plan (CAP) for the Study Area was prepared and submitted to EPD and agreed by EPD in August 2013. The CAP is given in **Appendix 9.1**. Sampling locations for soil and groundwater within the Study Area have been proposed, and the sampling method and testing parameters of soil and groundwater samples have also been specified in the CAP.

### ***Site Investigation and Data Interpretation***

**9.2.5** Upon completion of the environmental SI works at the potentially contaminated areas given in the CAP, the analytical results of the soil and groundwater shall be interpreted using RBRGs. The nature, level and extend of the land contamination in these potentially contaminated sites shall be evaluated.

**9.2.6** However, as the Study Area is managed by private owner and still in operation, therefore undertaking the environmental SI at this EIA stage is not feasible. The proposed environmental SI should be carried out once the operation is terminated and the land is resumed to determine the extent of land contamination.

### ***Preparation of Contamination Assessment Report***

**9.2.7** Following the completion of environmental SI and lab testing works, the Project Proponent would prepare the Contamination Assessment Report (CAR). The CAR would present the findings of the SI and evaluate the level and extent of potential contamination. If land contamination is identified during the proposed environmental SI and remediation is required, a Remediation Action Plan (RAP) will be prepared.

### ***Aerial Photographs and historical Land Use***

**9.2.8** Selected historical aerial photographs between year 1963 and 2011 of the Study Area have been reviewed in order to ascertain any historical land uses with the potential for land contamination. The review findings are summarized in the **Table 9.3**. The historical photographs are shown in Appendix A of the CAP (**Appendix 9.1**).

**Table 9.3:** Description of historical land use of the Study Area

<b>Year</b>	<b>Description</b>
1963	Parts of the area between the southern and western portions were exposed, which are seen that the quarry was operated. The northern and eastern parts were natural terrain. Farm lands could be observed on the most northern area near the site boundary. Anderson Road had been seen.
1973	The area of the quarry activities was extended between the southern and western areas. The area next to the farm lands on the northern portion was also exposed. Several temporary structures could be seen within these exposed areas. The eastern part was still natural terrain.
1982	Most of the areas between the southern and western portions were exposed and quarry-operated. Temporary structures could be seen on the southern, western and northern areas. The layouts of the structures on the northern area were similar to the existing layout. Several conveyor belts could also be seen on the southern and northern areas. Farm lands on the most northern area were replaced by the vegetation. Several village houses were erected on the western area and close to the quarry. The eastern part was still natural terrain.

Year	Description
1993	No significant changes of the land use on the eastern and southern portions as compared with Year 1982. On the northern area, more temporary structures and offices were erected, and suspected as industrial activities or factories. The conveyor belts on the northern area were dismantled. The layouts of these building were similar to the existing layout. The village houses on the western area were dismantled.
2001	No significant changes of the land use on the southern portions as compared with Year 1993. The quarry was further extended to the eastern area. On the southwestern and western areas, more temporary structures were erected and suspected as industrial activities or factories. Several conveyor belts was also be seen on the western area. On the northern area, the structures and office observed in Year 1993 were still existed and no significant changes. In addition, on the most northern part of the site, the area was exposed and a lagoon was formed. Apart from the southern area, the layouts of the structures and office were similar to the existing layout.
2011	No significant changes of the land use as compared with Year 2001 except the southern area, which the temporary structures and conveyor belts were dismantled. On the most northern part, part of the lagoon had been filled and the size was reduced significantly as compared with Year 2001. Along the western and southern boundary, the site formation works at the nearby construction site was commenced and the area was exposed.

## 9.3 Description of the Environment

**9.3.1** The Study Area, as delineated in **Figure 227724/E/0001**, is located on the south-western slopes of the Tai Shueng Tok Hill at the far north-eastern edge of urban East Kowloon, and lies close to the major population centres of Kwun Tong, Lam Tin and Sau Mau Ping. Specifically, the Study Area covers an area of about 86 ha, which includes a platform area of about 40 ha.

**9.3.2** The Study Area is divided into northern (**ARQ-N**) and southern (**ARQ-S**) parts by the Anderson Road. The northern and southern parts are under the management of KWP Quarry Co. Ltd. and China State Construction Ltd. (i.e. main contractor of Contract No. CV/2007/03 Development at Anderson Road), respectively, as shown in Figure 227724/E/5005 of the CAP (**Appendix 9.1**). Approximately 90% of the Study Area falls within the northern part.

### *Southern Part (ARQ-S)*

**9.3.3** The entire southern part (**ARQ-S**) managed by China State Construction Ltd. was exposed and site formation works was in progress. As advised by the Engineer, the land contamination assessment has been carried out in this area under the Agreement No. CE 55/2005 (CE) “Design and Construction of Development at Anderson Road”. The Contamination Assessment Report & Remediation Action Plan (CAR & RAP) had been prepared to present the findings and was endorsed by EPD in November 2006.

**9.3.4** According to the approved CAR & RAP, it was revealed that some area was contaminated with heavy metals (i.e. copper, zinc, lead, arsenic, chromium and nickel) and total petroleum hydrocarbons (TPH). Detail of the approved CAR & RAP is given in Appendix D of the CAP (**Appendix 9.1**).

**9.3.5** In addition, as advised by the Engineer, the remediation exercise according to the approved CAR & RAP has been completed. The organic contaminated soil was disposed of at landfill and the treated soil (i.e. after cement solidification / stabilisation



of heavy metal contaminated soil) was stockpiled at the designated area for on-site backfilling. Once the backfilling works is completed, a Remediation Report (RR) will be prepared and submitted to EPD for approval under the site formation contract.

### ***Northern Part (ARQ-N)***

**9.3.6** The northern part of the Study Area under the management of KWP Quarry Co. Ltd. is still under operation. Existing facilities within the northern part include quarry sites, office buildings, crushing plants, concrete block manufacturing plant, concrete and asphalt plants. As advised by the operator, existing operations are gradually withdrawing from the Study Area.

**9.3.7** In order to facilitate the assessment, the northern part (ARQ-N) is divided into nine sub-sections, namely ARQ-01 to 09. As shown in Figure 227724/E/5017 of the CAP (**Appendix 9.1**), the facilities identified in the northern part are tabulated in **Table 9.4**:

**Table 9.4:** Summary of existing facilities in the northern part

Existing facilities	Site ID
KWP Quarry Co.Ltd.	ARQ-01 & 04
K. Wah Asphalt Plant	ARQ-02
K. Wah Construction Products Ltd.	ARQ-03
K. Wah Concrete Plant	ARQ-05
Anderson Concrete Ltd.	ARQ-06, 07 & 09
Pioneer Asphalt Plant	ARQ-08

**9.3.8** In addition, 7 nos. of electric sub-stations were also identified within the Study Area. Among these 7 electric sub-stations, 3 of which are located within ARQ-01, 03 and 08. The locations and details of findings of each electric sub-station are summarized in **Table 9.5** and shown in Figure 227724/E/5017 of the CAP (**Appendix 9.1**).

**Table 9.5:** Summary of electric sub-stations within the Study Area

Electric sub-station ID	Locations
ESS-01	Within the area ARQ-01
ESS-02	Within the area ARQ-03
ESS-03	Between Anderson Road and the area ARQ-04
ESS-04	Next to Anderson Road and between the area ARQ-07 and ARQ-08
ESS-05	Within the area ARQ-08
ESS-06	Next to Anderson Road and between the area ARQ-08 and ARQ-09
ESS-07	Nearby the area ARQ-09

## **9.4 Future Land Use**

**9.4.1** 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*.

**9.4.2** According to the Recommended Outline Development Plan of the project, the development plan would be consisted of different facilities, such as residential buildings, schools, amenity, commercial, police and fire stations, pumping station, open space and pedestrian walkway etc. Hence, the most relevant RBRGs corresponding to its future land use should be adopted in assessing its land contamination level. Corresponding RBRGs land use of the associated facilities are defined and given in **Table 9.6**.

**Table 9.6:** Post-restoration land use and RBRGs land use

Landuse	Corresponding RBRGs Land Use
Commercial / Residential <ul style="list-style-type: none"> <li>• Urban High Rise</li> <li>• Low Rise in Rural Area</li> </ul>	Urban Residential Rural Residential
Commercial / Business & Office	Urban Residential
School	Rural Residential
Public Park with Indoor Games Hall	Lower of Public Parks or Urban Residential
Warehouse & Storage	Industrial
Government, Institution & Community Facilities	Urban Residential
Road including Pedestrian Walkway	Lower of Industrial or Public Parks
Railway	Industrial
Open Space	Public Parks
Public Utilities	Industrial

## 9.5 Potentially Contaminated Area

### *Identification of Potentially Contaminated Area*

**9.5.1** Based on the desktop review (i.e. historical aerial photos) and the information collected during the site surveys, potentially contaminated areas within the Study Area have been identified. The areas with those activities, posing potential for contamination, have been identified in accordance with the criteria in *EPD's Practice Guide for Investigation and Remediation of Contaminated Land*.

**9.5.2** After reviewing of the aforesaid information, the following areas, as summarized in **Tables 9.7** and **9.8**, are identified as potentially contaminated in the Study Area:

- (1) Total 8 areas (i.e. **ARQ-01** to **08**);
- (2) The area of 7 electric sub-stations (3 electric sub-stations are located in **ARQ-01**, **03** and **08**; the remaining 4 electric sub-stations are located standalone).

### *Environmental Site Investigation*

**9.5.3** As revealed from the geological profile of the Study Area, three of the eight potentially contaminated areas (i.e. **ARQ-01** to **03**) are located on rock layer and penetration of the contaminants through the rock layer is unlikely, therefore the environmental SI of these areas is not required. In addition, apart from the electric sub-station (i.e. ESS-05) located in **ARQ-08**, all other sub-stations are also located on the rock layer, therefore environmental SI for these sub-stations is not required. The locations of the surveyed premises, electric sub-stations and its geology are shown in Figure 227724/E/5017 of the CAP (**Appendix 9.1**).

- 9.5.4** Environmental SI is recommended to be carried out in 5 areas (i.e. **ARQ-04** to **08** including the electric sub-station in **ARQ-08**) where located on the fill materials to determine the types and quantities of contaminants.
- 9.5.5** The environmental SI of potentially contaminated areas is summarized in **Tables 9.9** and **9.10**.

**Table 9.7:** Summary of potential contamination sources of the Study Area

Site ID	Company	Site observations	Potentially Contamination Sources	Potentially Contaminated
ARQ-S	China State Construction Ltd.	<ul style="list-style-type: none"> <li>- Site formation works was in progress in entire area</li> <li>- Remediation exercise was completed</li> <li>- The treated soil was stockpiled at the designated area for on-site backfilling</li> </ul>	<ul style="list-style-type: none"> <li>- Nil</li> </ul>	No
ARQ-01	KWP Quarry Co. Ltd.	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshops</li> <li>- Chemical and chemical waste storage room</li> <li>- Underground diesel tank with fuel station</li> <li>- Electric sub-station (ESS-01)</li> <li>- Site office</li> <li>- Car park</li> </ul>	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshops</li> <li>- Chemical and chemical waste storage room</li> <li>- Underground diesel tank with fuel station</li> <li>- Electric sub-station (ESS-01)</li> </ul>	Yes
ARQ-02	K. Wah Asphalt Plant	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshops</li> <li>- Underground diesel tank with fuel station</li> <li>- Diesel pump</li> <li>- Asphalt production facilities</li> <li>- Chemical and chemical waste storage room</li> <li>- Stockpiling structure</li> </ul>	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshops</li> <li>- Underground diesel tank with fuel station</li> <li>- Diesel pump</li> <li>- Chemical and chemical waste storage room</li> </ul>	Yes
ARQ-03	K. Wah Construction Products Ltd.	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshop</li> <li>- Chemical storage room</li> <li>- Aboveground diesel tank</li> <li>- Electric sub-station (ESS-02)</li> <li>- Brick production plant</li> <li>- Stockpiling area</li> </ul>	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshop</li> <li>- Chemical storage room</li> <li>- Aboveground diesel tank</li> <li>- Electric sub-station (ESS-02)</li> </ul>	Yes

Site ID	Company	Site observations	Potentially Contamination Sources	Potentially Contaminated
ARQ-04	KWP Quarry Co. Ltd.	<ul style="list-style-type: none"> <li>- Maintenance workshop with chemical waste storage area</li> <li>- Temporary structure for stockpiling</li> <li>- Screening plant</li> <li>- Crushing plant</li> </ul>	<ul style="list-style-type: none"> <li>- Maintenance workshop with chemical waste storage area</li> </ul>	Yes
ARQ-05	K. Wah Concrete Plant	<ul style="list-style-type: none"> <li>- Maintenance workshop with chemical waste storage area</li> <li>- Stockpiling area</li> <li>- Concrete production facilities</li> </ul>	<ul style="list-style-type: none"> <li>- Maintenance workshop with chemical waste storage area</li> </ul>	Yes
ARQ-06	Anderson Concrete Ltd.	<ul style="list-style-type: none"> <li>- Chemical storage room</li> <li>- Diesel drum storage room</li> <li>- Concrete production facilities</li> <li>- Temporary structure</li> </ul>	<ul style="list-style-type: none"> <li>- Chemical storage room</li> <li>- Diesel drum storage room</li> </ul>	Yes
ARQ-07	Anderson Concrete Ltd.	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshop with chemical waste storage area</li> <li>- Site office</li> </ul>	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshop with chemical waste storage area</li> </ul>	Yes
ARQ-08	Pioneer Asphalts Plant	<ul style="list-style-type: none"> <li>- Abandoned asphalt production facilities and boiler</li> <li>- Site vehicle repairing and maintenance workshop</li> <li>- Chemical and chemical waste storage room</li> <li>- Aboveground diesel tank</li> <li>- Electric sub-station (ESS-05)</li> <li>- Stockpiling area</li> <li>- Site office</li> </ul>	<ul style="list-style-type: none"> <li>- Abandoned asphalt production facilities and boiler</li> <li>- Site vehicle repairing and maintenance workshop</li> <li>- Chemical and chemical waste storage room</li> <li>- Aboveground diesel tank</li> <li>- Electric sub-station (ESS-05)</li> </ul>	Yes
ARQ-09	Anderson Concrete Ltd.	<ul style="list-style-type: none"> <li>- Open car park</li> </ul>	<ul style="list-style-type: none"> <li>- Nil</li> </ul>	No

**Table 9.8:** Site survey findings of electric sub-stations within the Study Area

Electric sub-station ID	Site observation	Potentially Contaminated
ESS-01	The condition of sub-station could not be identified due to restricted access.	Yes
ESS-02		
ESS-03		
ESS-04		
ESS-05	Transformer was observed in the sub-station.	
ESS-06		
ESS-07	The condition of sub-station could not be identified due to restricted access.	

**Table 9.9:** Summary of environmental SI of potentially contaminated area

Site ID	Company	Potentially Contamination Sources	Geology	Environmental SI
ARQ-01	KWP Quarry Co. Ltd.	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshops</li> <li>- Chemical and chemical waste storage room</li> <li>- Underground diesel tank with fuel station</li> <li>- Electric sub-station (ESS-01)</li> </ul>	Rock	Not required
ARQ-02	K. Wah Asphalt Plant	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshops</li> <li>- Underground diesel tank with fuel station</li> <li>- Diesel pump within the asphalt production facilities</li> <li>- Chemical and chemical waste storage room</li> </ul>	Rock	Not required
ARQ-03	K. Wah Construction Products Ltd.	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshop</li> <li>- Chemical storage room</li> <li>- Aboveground diesel tank</li> <li>- Electric sub-station (ESS-02)</li> </ul>	Rock	Not required
ARQ-04	KWP Quarry Co. Ltd.	<ul style="list-style-type: none"> <li>- Maintenance workshop with chemical waste storage area</li> </ul>	Rock and fill materials	Required
ARQ-05	K. Wah Concrete Plant	<ul style="list-style-type: none"> <li>- Maintenance workshop with chemical waste storage area</li> </ul>	Fill materials	Required
ARQ-06	Anderson Concrete Ltd.	<ul style="list-style-type: none"> <li>- Chemical storage room</li> <li>- Diesel drum storage room</li> </ul>	Fill materials	Required
ARQ-07	Anderson Concrete Ltd.	<ul style="list-style-type: none"> <li>- Site vehicles repairing and maintenance workshop with chemical waste storage area</li> </ul>	Fill materials	Required
ARQ-08	Pioneer Asphalts Plant	<ul style="list-style-type: none"> <li>- Abandoned asphalt production facilities and boiler</li> <li>- Site vehicle repairing and maintenance workshop</li> <li>- Chemical and chemical waste storage room</li> <li>- Aboveground diesel tank</li> <li>- Electric sub-station (ESS-05)</li> </ul>	Fill materials	Required

**Table 9.10:** Summary of environmental SI of potentially contaminated area of electric sub-stations

<b>Electric sub-station ID</b>	<b>Location</b>	<b>Geology</b>	<b>Environmental SI</b>
ESS-01	Within the area ARQ-01	Rock	Not required
ESS-02	Within the area ARQ-03		
ESS-03	Between Anderson Road and the area ARQ-04		
ESS-04	Next to Anderson Road and between the area ARQ-07 and ARQ-08		
ESS-05	Within the area ARQ-08	Fill materials	Required
ESS-06	Next to Anderson Road and between the area ARQ-08 and ARQ-09	Rock	Not required
ESS-07	Nearby the area ARQ-09		



## 9.6 Site Investigation

### *Proposed Site Investigation for Potentially Contaminated Areas*

- 9.6.1** Within the five potentially contaminated areas proposed for environmental SI (i.e. **ARQ-04 to 08**), a total of 29 locations are proposed for soil and groundwater sampling and testing (i.e. **BH-01 to 29**) according to the EPD's *Practice Guide for Investigation and Remediation of Contaminated Land*. The environmental SI works shall be supervised by the on-site Land Contamination Specialist.
- 9.6.2** The collected soil and groundwater samples would be analyzed for the parameters which have been selected with reference to the EPD's *Practice Guide for Investigation and Remediation of Contamination Land* and based on the potentially contaminated sources. All soil and groundwater samples shall be analysed by a HOKLAS accredited laboratory. The details of sampling and testing strategy are given in the CAP (**Appendix 9.1**).
- 9.6.3** As the Study Area is managed by private owner and still in operation, therefore undertaking the environmental SI at this EIA stage is not feasible. The proposed environmental SI should be carried out once the operation is terminated and the land is resumed to determine the extent of land contamination.

### *Submission Requirements of CAR, RAP and RR*

- 9.6.4** As mentioned in **Section 9.4**, the most relevant RBRGs corresponding to the future landuse should be adopted in assessing its land contamination level. Laboratory testing results from site investigation should be compared with correspondent RBRGs for the testing parameters in accordance with the EPD's *Guidance Manual for Use of RBRGs for Contaminated Land Management*.
- 9.6.5** Following the completion of environmental SI and lab testing works, the Project Proponent would prepare the Contamination Assessment Report (CAR). The CAR would present the findings of the SI and evaluate the level and extent of potential contamination. The potential environmental and human health impact based on the extent of potential contamination identified would also be evaluated.
- 9.6.6** If land contamination is identified during the proposed environmental SI and remediation is required, a Remediation Action Plan (RAP) will be prepared. The objectives of RAP are:
- (1) To undertake further site investigation where required;
  - (2) To evaluate and recommend appropriate remedial measures for the contaminated materials identified in the assessment;
  - (3) To recommend good handling practices for the contaminated materials during the remediation works;
  - (4) To recommend approximate handling and disposal measures; and
  - (5) To formulate optimal and cost-effective mitigation and remedial measures for EPD's agreement.
- 9.6.7** A Remediation Report (RR) would also be prepared to demonstrate that the clean-up works are adequate. No construction / development works would be carried out within the potentially contaminated areas in the Study Area prior to the agreement of the RR.

## 9.7 Environmental Acceptability of Schedule 2 Designated Projects

**9.7.1** The engineering feasibility study of the proposed ARQ development is a Schedule 3 Designated Project (DP) under the EIAO, whilst there will be two Schedule 2 DPs; i.e. road improvement works and rock cavern developments under the ARQ project. Details of these two Schedule 2 DPs are provided in **Section 1.4** and shown in **Figure 227724/E/0002**.

### *Road Improvement Works*

**9.7.2** Three road improvement works were proposed at junction of (J/O) Lin Tak Road and Sau Mau Ping Road, at J/O Clear Water Bay Road and Road L1 of Development of Anderson Road (DAR), as well as at the new merging lane at New Clear Water Bay Road near Shun Lee Tsuen Road.

**9.7.3** Selected historical aerial photographs between year 1963 and 2011 of the works areas of 3 road improvement works have been reviewed, and no historical land uses with the potential for land contamination is observed. The review findings are summarized in the **Table 9.11**. The historical photographs are shown in **Appendix 9.2**.

**Table 9.11:** Description of historical land use of the Works Areas of Road Improvement Works

Road Improvement Works	Year	Description
Junction of Lin Tak Road and Sau Mau Ping Road	1963	The whole area was natural terrain and water pond was seen on the northern part.
	1973	Sau Mau Ping Road and Tsuen Kwan O Road were seen. The remained area was still natural terrain and water pond was also seen on the northern part.
	1982	Tsuen Kwan O Tunnel was under construction and part of the natural terrain on the eastern part was exposed. A water pond was also seen on the northern part.
	1993	Tsuen Kwan O Tunnel was in operation. Lin Tak Road was formed and connected to Sau Mau Ping Road.
	2001	No significant changes of the land use as compared with Year 1993.
	2011	No significant changes of the land use as compared with Year 2001.
Junction of Clear Water Bay Road and Road L1 of Development of Anderson Road	1963	The Clear Water Bay Road was seen and the vegetation was along the road side.
	1973	No significant changes of the land use as compared with Year 1963.
	1982	The Clear Water Bay Road was widened and the new junction was seen on the western part. 2 man-made slopes were found at previous vegetation area.
	1993	Tree planting on the man-made slopes was observed.
	2001	No significant changes of the land use as compared with Year 1993.
	2011	No significant changes of the land use as compared with Year 2001.
New Merging Lane at New Water Clear	1963	The area was mainly occupied by the farm lands and few village houses were observed on the western part.

Road Improvement Works	Year	Description
Bay Road near Shun Lee Tsuen Road	1973	All farm lands were removed and the area was exposed. Few village houses were still observed on the western part.
	1982	The New Clear Water Bay Road (include the junction) was formed and in operation.
	1993	No significant changes of the land use as compared with Year 1982.
	2001	No significant changes of the land use as compared with Year 1993.
	2011	Small area of slope formation works beside New Clear Water Bay Road was observed.

**9.7.4** Since there was no contaminative historical land use within the works areas of 3 road improvement works as well as all road improvement works will only be carried out on existing roads and associated rock slopes and nature slopes, therefore land contamination issue is unlikely to be anticipated. Notwithstanding this, detailed land contamination assessment of this Schedule 2 DP will be carried out in a separate EIA under the EIAO.

### ***Rock Cavern Developments***

**9.7.5** The proposed cavern development are located on the hillside of the proposed ARQ Development, where are currently bare rock slope surface, and land contamination issue is therefore not anticipated.

## **9.8 Conclusion**

**9.8.1** This land contamination assessment examined the potential contaminative land use within the Study Area and their potential impacts to future land use. The assessment involved desktop review, site surveys and proposed environmental SI.

**9.8.2** The Study Area is located on top of rock surface and fill materials. According to its geological profile, environmental Site Investigation (SI) (i.e. borehole drilling, soil and groundwater sampling and testing) is recommended to be carried out for the areas located on fill material to determine the types and quantities of contaminants. A total of five potentially contaminated areas within the Study Area were proposed for environmental SI.

**9.8.3** As all areas proposed for environmental SI are privately owned and still in operation, undertaking the environmental SI works at this EIA stage is not feasible. The proposed environmental SI works for these areas should commence once the operation is terminated and the land is resumed.

**9.8.4** Following the completion of the environmental SI works, a CAR will be prepared to present the findings and evaluate the level and extent of potential contamination. If land contamination is identified and remediation is required, a RAP will be prepared to recommend specific remediation measures. Upon completion of the remediation works, if any, a RR that demonstrates the clean-up works are adequate would also be prepared. CAR, RAP and RR would be submitted to EPD for approval prior to commencement of any construction / development works.