Remediation Scheme and Verification Plan
No AE0709/AE1176
[Final]

Proposed Training Facility
Cardiff Docks

January 2018

Geotechnical and environmental services you can rely on.

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1.INTRODUCTION

1.1 Instruction

C.J. Associates Geotechnical Limited (CJA) was instructed by Hydrock, to prepare a Remediation Strategy and Verification Plan to support the construction of a Training facility at the Cardiff Docks. Instructions to proceed are contained in Hydrock's email correspondence, Reference M. Ace dated 27th July 2017.

1.2 Proposed Development

It is proposed to construct a new training facility on site comprising a main building, areas of hardstanding (car parking, parade ground etc) and small areas of soft landscaping.

1.3 Brief and Report Scope

The Remediation Strategy aims to provide a summary of the pollutant pathways, identified by the ground investigation carried out by CJA in August – December 2016, which could affect human users and/or controlled waters in the light of the proposed development. The report also provides an overview of (1) the remedial works that will be implemented in order to address those pathways and ensure they do not present a significant risk to sensitive receptors and (2) the verification procedures to be applied to corroborate the objectives of the remediation scheme have been met.

This document shall provide a platform for discussion with the Regulatory Authorities and once agreed, will constitute the basis on which the site will be remediated.

The strategy presented in this document has been developed in accordance with current guidance; Environment Agency (2004) '*Model Procedures for the Management of Land Contamination*' (CLR11) and Environment Agency (2010) '*Guiding Principles for Land Contamination*'

The remediation strategy and verification plan aims to address the requirements of the following planning conditions as described in The Urbanist '*Pre Construction Planning Conditions and Obligations'* provided by Hydrock:

- Condition 7 – requires the provision of ground gas protection measures to be installed as part of the development, to be submitted for approval by the Local Planning Authority (LPA). If measures are installed, these shall be verified prior to occupation of the development.
- Condition 8 – requires for a detailed remediation scheme and verification plan detailing the measures to be implemented in order to render the site suitable for its intended use.
- Condition 10 – requires details on the protocol to be followed to deal with any unexpected contamination.
- Condition 11 – details of how imported topsoil / subsoil materials will be assessed to ensure these are suitable for use.
- Condition 12- details of how imported aggregates (other than virgin quarry stone) will be assessed to make sure these are suitable for use.
- Condition 13 – details of how site-won materials will be assessed for chemical / potential contaminants to ensure only suitable for use materials are retained.
- Condition 22 – requires a remediation strategy / verification report to be submitted to deal with the potential contamination on site.

1.4 Report References

Information supplied by Hydrock is listed below and includes supporting documentation i.e. Drawings and previous reports that should be read in conjunction with this document:

- Associated British Ports Drawing No. 16-EC-065 'Cardiff Dock Tyneside Road Service Plans General Arrangement' (July 2016).
- Chetwoods Architects Drawing No. 01050 'Proposed Site Plan' 9th May 2015.
- CJA 'Piling Risk Assessment' October 2016.
- CJA 'Site Investigation Factual and Interpretive Report' January 2017.
- Hydrock Drawing No. C161526-HYD-XX-F1-DR-S-1000 'Foundation Layout' 10th July 2017.

- Chetwoods 'Proposed Site Plan' Drawing Ref. 4079-CHT-00-00-DR-A-01060 PL3. 9th May 2016.
- Hydrock Drawing No. HMS-HYD-XX-XX-DR-C-0600 P4 'Drainage Layout' 16th March 2017.
- Western Power Distribution Drawing No. 8837943 'Tyneside Road, Cardiff Bay' 27th July 2016.
- The Urbanist HMS Cambria 'Pre Construction Planning Conditions and Obligations'

1.5 Limitations

The recommendations and opinions expressed in this report are based on the strata observed in the exploratory holes, the results of the site and laboratory tests, and information obtained as part of the desk study, ground investigation carried out to date and other 3rd party information. CJA take no responsibility for conditions that have not been revealed by the exploratory holes, or which occur between them. Whilst every effort has been made to interpret the conditions between investigation locations, such information is only indicative and liability cannot be accepted for its accuracy. Information provided from other sources is taken in good faith and CJA cannot guarantee its accuracy.

The report has been prepared exclusively for Hydrock, for the site area indicated, and for the purpose stated. CJA accepts no responsibility for any site, client or type of development not indicated in this report.

Whilst efforts have been made to ensure the information provided is accurate and current, contractors are ultimately responsible for corroborating the information for the benefit of their site presence and any discrepancies in the data should be reported to CJA.

This document has been prepared specifically for the use of Hydrock as a guide to the remedial works likely to be required to render the site suitable for the proposed scheme. It is by no means a definite list or specification of the works that will be required and may require amendment under the light of further findings.

This report should be reviewed at all stages of construction by someone familiar with the terms and assumptions it contains. It is essential that a suitably qualified and experienced engineer be appointed for the design of the works, and supervise construction.

2.THE SITE

2.1 Site Location & Description

The site is located within Cardiff Docks at National Grid Reference ST 199 745.

The site is irregular in shape and is bounded to the north and east by waterways associated with the docks and to the south and west by Cargo Road and Compass Road. It is occupied by buildings, hardstanding and soft landscaped areas. The northern area of the site appeared to be disused. The remainder of the site is occupied by buildings associated with County Marquees, Fuel Centre and the Maritime Volunteers Centre. There is a 'tank' located in the Maritime Volunteers Centre.

2.2 Geology

According to the British Geological Survey (BGS) the site is underlain by superficial Tidal Flat Deposits (clay, silt and sand) overlying the Mercia Mudstone Group of Triassic Age.

Ground conditions encountered during the intrusive investigation included the presence of variable Made Ground (to depths of 2.1-8.5m below ground level (bgl)) underlain by Tidal Flat Deposits (soft clay / loose sand) (to approx. depths of 12.0-13.9m bgl) over, stiff to very stiff Weathered Mercia Mudstone, below which the Mudstone Bedrock was proven to a depth of 21.0m bgl.

2.3 Hydrogeology

The superficial Tidal Flat deposits have been classed as a Secondary Aquifer – undifferentiated whilst the Mudstone bedrock has been classed as a Secondary Aquifer – B. The soils beneath the site are shown as 'not classified' in terms of leachability.

Groundwater strikes were encountered within the made ground at depths between 1.8-5.4m bgl and within the Tidal Flat deposits at a depth of 12.5m bgl. Groundwater levels recorded during subsequent monitoring visits ranged between 1.50m and 2.54m bgl.

2.4 Hydrology

The nearest surface watercourse is the Cardiff Docks immediately adjacent to the east.

The site is not located within a floodplain.

3. SITE HISTORY

3.1 Historical Maps

The site was originally located within the waters of the Cardiff Flats until the late 1800s when Cardiff Docks were built and the Flats infilled. Since 1901 the site has been occupied by commercial/industrial premises including a fuel works and railway lines.

4. UXO Assessment

The site has been given UXO PROBABILITY ASSESSMENT = 3 rating, indicating a MEDIUM PROBABILITY OF UXO ENCOUNTER.

During WWII the Study Site was situated within Cardiff County Borough, which recorded nine High Explosive (HE) bomb strikes per 100 hectares; a low level of bombing. Luftwaffe aerial reconnaissance photography associated with the Site identified three docks (on-Site, immediately north-west and 10m south) and a grain scale (200m north-north-east) as primary bombing targets. One HE bomb strike was identified within 65m of the Site boundary.

Given that a primary target was located on-Site; it would suggest that further action is warranted to address the potential for UXO encounter. In accordance with CIRIA C681 Chapter 5 on managing UXO risks, it is recommended a detailed UXO threat and risk assessment is commissioned. The site has been assessed to have a Medium Risk Level within it and further action is advisable.

It is recommended a detailed UXO threat and risk assessment be carried out. Should the detailed risk assessment find a similar risk level, it is likely the following will be required for groundworks in all areas:

1. Operational UXO Risk Management Plan; appropriate site management documentation should be held on site to guide and plan for the actions which should be undertaken in the event of a suspected or real UXO discovery.
2. UXO Safety & Awareness Briefings; the briefings are essential when there is a possibility of explosive ordnance encounter and are a vital part of the general

safety requirement. All personnel working on the site should receive a briefing on the identification of a UXB, what actions they should take to keep people and equipment away from such a hazard and to alert Site Management.

3. On Call UXO Engineer; all intrusive works should be supported by an "On Call" UXO Engineer to identify and advise on appropriate action in the event of any suspicious finds.

5. ENVIRONMENTAL ASSESSMENT

5.1 Soils

5.1.1 Risks of soil contamination – during development

In order to assess the risk of soil contamination to construction and ground workers during development, the concentrations of various contaminants of concern have been compared against guideline provided by the HSE (1991) *'Protection of workers and the general public during development of contaminated land'*. The outcome of this assessment is summarised in Table 1 below.

Table 1. *Summary of guideline values for protection of workers and the general public during development of contaminated land*

Contaminant	Typical Values* for:					Test Results	Class
	Uncontaminated Soils	Slight Contamination	Contaminated	Heavy Contamination	Unusually Heavy Contamination		
	Class A	Class B	Class C	Class D	Class E		
pH (alkaline)	7 - 8	8 - 9	9 - 10	10 - 12	12	7.4-9.4	A-C
Arsenic	0 - 30	30 - 50	50 - 100	100 - 500	500	6-35	A-B
Cadmium	0 - 1	1 - 3	3 - 10	10 - 50	50	<1-3	A-B
Chromium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	7-110	A-B
Copper	0 - 100	100 - 200	200 - 500	500 - 2500	2500	21-300	A-B
Lead	0 - 500	500 - 1000	1000 - 2000	2000 – 1%	1.0%	52-2400	A-D
Mercury	0 - 1	1 - 3	3 - 10	10 - 50	50	<1	A
Nickel	0 - 20	20 - 50	50 - 200	200 - 1000	1000	11-56	A-C
Zinc	0 - 250	250 - 500	500 - 1000	1000 - 5000	5000	88-930	A-C
Boron	0 - 2	2 - 5	5 - 50	50 - 250	250	<1	A
Selenium	0 - 1	1 - 3	3 - 10	10 - 50	50	<3	A
Beryllium	0 - 5	5 - 10	10 - 20	20 - 50	50	<2-5	A
Vanadium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	13-78	A
Sulphate	0 - 2000	2000 - 5000	5000 – 1%	1% - 5%	5.05%	600-2000	A
Sulphur	0 - 100	100 - 500	500 - 1000	1000 - 5000	5000	<500	A
Sulphide	0 - 10	10 - 20	20 - 100	100 - 500	500	<10-200	A-D
Cyanide (free)	0 - 1	1 - 5	5 - 50	50 - 100	100	<1	A
Thiocyanate	0 - 10	10 - 50	50 - 100	100 - 500	2500	<10	A
Coal Tar	0-500	500-1000	1000-2000	2000-1.0%	1.0%	960-1800	A-C
Phenol	0 - 2	2 - 5	5 - 50	50 - 250	250	<1	A

Based on the above results, there is a low to moderate potential risk from soil contamination to construction workers, ground workers and members of the public during construction, and appropriate measures, such as PPE, site health plans, dust

suppression and appropriate management of materials and disposal of arisings will be required to mitigate the risks.

5.1.2 Risk of soil contamination – after development

As part of the previous CJA investigation, Lead, Beryllium and Polyaromatic hydrocarbons were found present in concentrations above soil assessment criteria recommended for soft landscaping areas (Residential without Home grown produce/ Residential Public open space) (C4SL[1]/S4UL[2]) and to a lesser degree, concentrations of these contaminants exceeded recommended levels for a commercial end use.

Table 2-3 provide an overview of the contaminants of concern and their respective concentrations, indicating the number of exceedences to their respective criteria protective of human health under the abovementioned scenarios.

Table 2. Soil Results Comparison with DEFRA - C4SL

Determinand	C4SL (mg/kg)*		Min. (mg/kg)	Max. (mg/kg)	No. of Samples with Exceedences
	Residential without home grown produce (1)	Commercial (2)			
Arsenic	40	640	6	35	0
Benzene	3.3	98	<0.010	<0.020	0
Benzo(a)pyrene	5.3	76	12	190	13 for (1) 4 for (2)
Cadmium	149	410	<1	3	0
Chromium VI	21	49	<1	<1	0
Lead	310	2300	52	2400	4 for (1) 1 for (2)
*Minimal risk Health Criteria Values					

In general the samples have shown most contaminants at levels below the recommended C4SLs, with the exception of the following:

- All the samples have elevated levels of **Benzo(a)pyrene** in the range 12mg/kg to 190mg/kg in excess of the recommended C4SL for residential end use without home grown produce (5.3mg/kg).

[1] DEFRA (2014) SP1010-Development of Category 4 Screening Levels for assessment of Land Affected by Contamination. Final Project Report (Revision 2). Appendix H Provisional C4SL.
[2] Nathanail, C.P. et al (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.

- The samples from BH1$^{(0.5m)}$, BH2$^{(1.0m)}$, WS1$^{(1.0m)}$ and HDTP1 also have elevated levels of **Benzo(a)pyrene** in the range (93mg/kg to 190mg/kg) in excess of the recommended C4SL for commercial end use (76mg/kg).
- The samples from BH1$^{(0.5m)}$, BH2$^{(0.5m)}$, BH2$^{(1.0m)}$ and WS1$^{(1.0m)}$ have elevated levels of **Lead** in the range 430mg/kg to 2400mg/kg in excess of the recommended C4SL for residential end use without home grown produce (310mg/kg).
- The sample from BH2$^{(0.5m)}$ also has an elevated level of **Lead** (2400mg/kg) in excess of the recommended C4SL for commercial end use (2300mg/kg).

Table 3. Soil Results Comparison with S4UL

Determinand	Suitable 4 Use Levels (mg/kg)*				No. of Samples	Min. (mg/kg)	Max. (mg/kg)	No. of Exceedences
	Residential without homegrown produce (1)	Commercial (2)	Public Open Space Residential (3)	Public Open Space Parks (4)				
Metals								
Beryllium	1.7	12	2.2	63	13	<2	5	6 for (1), (3)
Boron	11000	240000	21000	46000	13	<1	<1	0
Chromium	910	8600	1500	33000	13	7	110	0
Copper	7100	68000	12000	44000	13	21	300	0
Mercury	1.2	58	16	30	13	<1	<1	0
Nickel	180	980	230	3400	13	11	56	0
Selenium	430	12000	1100	1800	13	<3	<3	0
Vanadium	1200	9000	2000	5000	13	13	88	0
Zinc	4000	730000	81000	170000	13	88	930	0
Petroleum Hydrocarbons								
Toluene	3900	180000	56000	100000	6	<0.010	65	0
Ethylbenzene	440	27000	25000	27000	6	<0.010	21	0
o-xylenes	480	33000	43000	33000	6	<0.010	<0.020	0
m-xylenes	450	31000	43000	32000	6	<0.010	11	0
p-xylenes	430	30000	43000	31000	6	<0.010	11	0
Aliphatic EC 5-6	160	12000	600000	180000	6	<0.10	<0.20	0
Aliphatic EC >6-8	530	40000	620000	320000	6	<0.10	<0.20	0
Aliphatic EC >8-10	150	11000	13000	21000	6	<0.10	<0.20	0
Aliphatic EC >10-12	770	47000	13000	24000	6	<10	12	0
Aliphatic EC >12-16	4400	90000	13000	26000	6	<10	2	0
Aliphatic EC >16-35	110000	1800000	250000	490000	6	14	89	0
Aliphatic EC >35-44	110000	1800000	250000	490000	6	<10	<10	0
Aromatic EC 5-7	1400	86000	56000	920000	6	<0.10	<0.20	0
Aromatic EC >7-8	3900	180000	56000	100000	6	<0.10	<0.20	0
Aromatic EC >8-10	270	17000	5000	9300	6	<0.10	<0.20	0
Aromatic EC >10-12	1200	34000	5000	10000	6	<10	14	0
Aromatic EC>12-16	2500	38000	5000	10000	6	30	60	0
Aromatic EC>16-21	1900	28000	3800	7800	6	270	500	0
Aromatic EC>21-35	1900	28000	3800	7900	6	650	1600	0
Aromatic EC>35-44	1900	28000	3800	7900	6	<10	<10	0
Polycyclic Aromatic Hydrocarbons								
Naphthalene	13	1100	4900	3000	16	1.8	47	2 for (1)
Acenaphthylene	6000	100000	15000	30000	16	<1.0	<10	0
Acenaphthene	6000	100000	15000	30000	16	1.3	28	0
Fluorene	4500	71000	9900	20000	16	<1.0	18	0
Phenanthrene	1500	23000	3100	6300	16	11	300	0
Anthracene	37000	540000	74000	150000	16	3.0	81	0
Fluoranthene	1600	23000	3100	6400	16	19	380	0
Pyrene	3800	54000	7400	15000	16	17	310	0
Benz(a)anthracene	15	180	29	62	16	14	200	13 for (1), 2 for (2), 11 for (3), 6 for (4)
Chrysene	32	350	57	120	16	13	200	11 for (1), 6 for (3), 3 for (4)
Benzo(b)fluoranthene	4.0	45	7.2	16	16	14	250	15 for (1), 3 for (2), 13 for (3), 11 for (4)
Benzo(k)fluoranthene	110	1200	190	440	16	8.6	99	0
Indeno(1,2,3-cd)pyrene	46	510	82	180	16	7.7	110	4 for (1), 2 for (3)

Dibenz(a,h)anthracene	0.32	3.6	0.58	1.4	16	1.9	25	15 for (1), 14 for (2), 13 for (3), 13 for (4)
Benzo(ghi)perylene	360	4000	640	1600	16	8.9	130	0
Phenols								
Phenol	2300	3200	3200	3200	10	<1	<1	0

In general the samples have shown contaminants at levels below the recommended S4ULs, with the exception of the following:

- Samples from BH1$^{(0.5m)}$, BH1$^{(1.0m)}$, BH2$^{(0.5m)}$, BH2$^{(1.0m)}$, WS2 and WS3$^{(1.0m)}$ have elevated levels of **Beryllium** in the range 3mg/kg to 5mg/kg in excess of the recommended S4ULs for residential end use without home grown produce (1.7mg/kg) and public open space, residential (2.2mg/kg).
- Samples from BH1$^{(1.0m)}$ and WS1$^{(1.0m)}$ have elevated levels of **Naphthalene** in the range 17mg/kg to 47mg/kg in excess of the recommended S4UL for residential end use without home grown produce (13mg/kg).
- All the samples, except HDTP3 have elevated levels of **Benz(a)anthracene** in the range 31mg/kg to 200mg/kg in excess of the recommended S4UL for residential end use without home grown produce (15mg/kg).
- Samples from BH1$^{(0.5m)}$ and BH2$^{(1.0m)}$ and TP4$^{(0.6m)}$ have elevated levels of **Benz(a)anthracene** (200mg/kg) in excess of the recommended S4UL for commercial end use (40mg/kg).
- All the samples, except BH2$^{(0.5m)}$, HDTP3, TP5 and TP6 have elevated levels of **Benz(a)anthracene** in the range 31mg/kg to 200mg/kg in excess of the recommended S4UL for public open space, residential (28mg/kg).
- Samples from BH1$^{(0.5m)}$, BH2$^{(1.0m)}$, WS1$^{(0.5m)}$, WS1$^{(1.0m)}$, WS2, HDTP1, and TP4 have elevated levels of **Benz(a)anthracene** in the range 74mg/kg to 200mg/kg in excess of the recommended S4UL for public open space, parks (62mg/kg).
- All the samples, except BH2$^{(0.5m)}$, WS4, TP5, TP6 and HDTP3 have elevated levels of **Chrysene** in the range 35mg/kg to 200mg/kg in excess of the recommended S4UL for public open space, residential (32mg/kg).
- Samples from BH1$^{(0.5m)}$, BH2$^{(1.0m)}$, WS1$^{(0.5m)}$, WS1$^{(1.0m)}$, WS2$^{(0.5m)}$ and HDTP1 have elevated levels of **Chrysene** in the range 59mg/kg to 200mg/kg in excess of the recommended S4UL for public open space, residential (57mg/kg).

- Samples from BH1$^{(0.5m)}$, BH2$^{(1.0m)}$ and HDTP1 have elevated levels of **Chrysene** in the range 140mg/kg to 200mg/kg in excess of the recommended S4UL for public open space, parks (120mg/kg).
- All the samples, except TP6, have elevated levels of **Benzo(b)fluoranthene** in the range 14mg/kg to 250mg/kg in excess of the recommended S4UL for residential end use without home grown produce (4.0mg/kg).
- Samples from BH1$^{(0.5m)}$, BH2$^{(1.0m)}$ and HDTP1 have elevated levels of **Benzo(b)fluoranthene** in the range 170mg/kg to 250mg/kg in excess of the recommended S4UL for commercial end use (45mg/kg).
- All the samples, except TP6, have elevated levels of **Benzo(b)fluoranthene** in the range 14mg/kg to 250mg/kg in excess of the recommended S4UL for public open space, residential (7.2mg/kg).
- All the samples except WS4, TP6 and HDTP3 have elevated levels of **Benzo(b)fluoranthene** in the range 27mg/kg to 250mg/kg in excess of the recommended S4UL for public open space, parks (16mg/kg).
- Samples from BH1$^{(0.5m)}$, BH2$^{(1.0m)}$, WS1$^{(1.0m)}$ and WS4 have elevated levels of **Indeno(1,2,3-cd)pyrene** in the range 61mg/kg to 110mg/kg in excess of the recommended S4UL for residential end use without home grown produce (46mg/kg).
- Samples from BH1$^{(0.5m)}$ and BH2$^{(1.0m)}$ have elevated levels of **Indeno(1,2,3-c,d)pyrene** in the range 94mg/kg to 110mg/kg in excess of the recommended S4UL for public open spaces, residential (82mg/kg).
- All the samples, except TP6, have elevated levels of **Dibenz(a,h)anthracene** in the range 1.9mg/kg to 25mg/kg in excess of the recommended S4ULs for residential end use without home grown produce (0.32mg/kg), public open space, residential (0.58mg/kg) and public open space, parks (1.4mg/kg).
- All the samples, except HDTP3 and TP6, have elevated levels of **Dibenz(a,h)anthracene** in the range 4.1mg/kg to 25mg/kg in excess of the recommended S4UL for commercial end use (3.6mg/kg).

Contaminant exceedences encountered across the site in each of the exploratory holes excavated during the 2016 site investigation (Refer to Figure 2 – Exploratory Hole Location Plan) are summarised in the following table:

Table 4. Summary of Elevated Contaminants Encountered per Exploratory Hole

Location	Depth	Contaminants in excess of guidance values for:			
		Residential end use without home grown produce	Commercial end use	Public Open Spaces (residential)	Public Open Spaces (parks)
BH1	0.5m	Lead Beryllium Benzo(a)pyrene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene	Benzo(a)pyrene Benz(a)anthracene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Beryllium Chrysene Benzo(b)fluoranthene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene	Benz(a)anthracene Chrysene Dibenz(a,h)anthracene
BH1	1.0m	Beryllium Benzo(a)pyrene Naphthalene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	Beryllium Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
BH2	0.5m	Lead Beryllium Benzo(a)pyrene Benz(a)anthracene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Benzo(a)pyrene Dibenz(a,h)anthracene	Beryllium Benz(a)anthracene Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
BH2	1.0m	Lead Beryllium Benzo(a)pyrene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene	Lead Benzo(a)pyrene Benz(a)anthracene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Beryllium Benzo(b)fluoranthene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene	Benz(a)anthracene Chrysene Dibenz(a,h)anthracene
WS1	0.5m	Benzo(a)pyrene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Benz(a)anthracene Dibenz(a,h)anthracene

Continued….

Table 4. Summary of Elevated Contaminants Encountered per Exploratory Hole (continued)

Location	Depth	Contaminants in excess of guidance values for:			
		Residential end use without home grown produce	Commercial end use	Public Open Spaces (residential)	Public Open Spaces (parks)
WS2	0.5m	Beryllium Benzo(a)pyrene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	Beryllium Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Benz(a)anthracene Dibenz(a,h)anthracene
WS3	0.5m	Benzo(a)pyrene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
WS3	1.0m	Beryllium Benzo(a)pyrene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	Beryllium Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
WS4	1.0m	Benzo(a)pyrene Benz(a)anthracene Benzo(b)fluoranthene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
HDTP1	0.6m	Benzo(a)pyrene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Benzo(b)fluoranthene Dibenz(a,h)anthracene	Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Benz(a)anthracene Chrysene Dibenz(a,h)anthracene
HDTP2	0.5m	Benzo(a)pyrene Benz(a)anthracene Chrysene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
HDTP3	0.5m	Benzo(a)pyrene Benzo(b)fluoranthene Dibenz(a,h)anthracene		Benz(a)anthracene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene
TP4	0.6m	Benz(a)anthracene Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene		
TP5	0.6m	Benzo(b)fluoranthene Dibenz(a,h)anthracene	Dibenz(a,h)anthracene		

Results to date indicate the presence of 'site-wide' hydrocarbon contamination, which could have derived from the previous site usage – docks, railway line and fuel works. It is therefore considered the risk posed by soil contamination to future site users is moderate and that remedial measures are required to mitigate such risk.

5.1.3 Risk from Asbestos

Asbestos containing materials (ACM) were not identified on site during the fieldwork, or within the samples subsequently tested at the laboratory. Therefore, the risk of asbestos being present in the ground is considered as low. However, due to the history of the site, the age of the buildings and significant thickness of made ground recorded, the presence of asbestos should not be discounted.

However, due the age of the buildings on site, it is possible ACM may have been used in their construction. As a result, the risk of asbestos present within the existing buildings should be deemed as Moderate, until proven otherwise. It is recommended for an Asbestos Survey to be undertaken prior demolition.

5.2 Groundwater

A direct comparison was made between the groundwater analyses results and the Environmental Quality Standards and UK Drinking Water Standards, with only a few PAH exceedences identified:

- Elevated levels of **benzo(a)pyrene** (0.18µg/l to 0.88µg/l) were encountered in WS1 and WS2 above the recommended EQS value of 0.03µg/l.
- Elevated levels of **fluoranthene** (0.37µg/l to 1.9µg/l) were encountered in WS1 and WS2 above the recommended EQS value of 0.02µg/l.
- Elevated levels of **total PAH** (0.64µg/l to 3.43µg/l) were encountered in WS1 and WS2 above the recommended EQS value of 0.10µg/l.

The results are summarised in Table 5, below:

Table 5. Groundwater Results Comparison

Determinand	(1) EQS value (µg/l unless otherwise stated)	(2) Drinking Water Quality Value (µg/l unless otherwise stated)	No. of Samples	Min. (µg/l)	Max. (µg/l)	No. of Exceedences
Arsenic	50	10	4	<2.0	9.4	0
Cadmium	5.0	5.0	4	<0.20	0.16	0
Chromium	150-250**	50	4	<1	<10	0
Copper	10	2000	4	0.5	<5.0	0
Lead	50-250**	25	4	<0.3	<3.0	0
Mercury	1.0	1.0	4	<0.05	<0.50	0
Selenium	-	10	4	0.5	<5.0	0
Nickel	50-200**	20	4	1	<10	0
Zinc	75-500**	-	4	2	<20	0
Cyanide	-	50	4	<50	<50	0
Phenol	30	-	4	<0.5	<0.5	0
Sulphate	400000	-	4	31000	360000	0
pH	6 – 9	-	4	7.1	7.6	0
Naphthalene	10	-	4	0.05	1.1	0
Benzo(a)pyrene	0.03	-	4	<0.01	0.88	2 for (2)
Fluoranthene	0.02	-	4	<0.01	1.9	3 for (2)
Total PAH*	-	0.10	4	<0.01	3.43	2 for (2)

*total PAH taken as the sum of benzo(b)fluoranthene + benzo(k)fluoranthene + benzo(ghi)perylene+ indeno(123-cd)pyrene.
** dependant on alkalinity

Dissolved contamination presented a similar footprint to that reported in soils (i.e. polyaromatic hydrocarbons), which suggest any impacts to groundwater are likely to be a result of leachate generation. However it is worth noting the contaminants found in the dissolved phase are not highly mobile and were not found in samples retrieved from those wells closest to the docks. Given the concentrations observed and spatial distribution of the contaminant plume, it is anticipated the risk posed by groundwater contamination is moderate. At this stage, no groundwater treatment is considered necessary as (1) low levels of PAH contamination are noted and (2) infiltration and the potential for leachate generation will be significantly reduced / removed by proposed hardstanding surfaces.

It is recommended that precautions are undertaken during piling works in order to avoid mobilising contamination at shallow depths into the underlying aquifer. Further details on the risk and mitigation measures related to piling works are discussed in the CJA (2016) ‘Piling Risk Assessment’.

5.3 Surface Waters

Due to the close proximity of the docks and presence of shallow ground/groundwater, it is possible the site is in hydraulic connection with nearby surface water bodies. Groundwater test results show hydrocarbon contamination was recorded in remote wells (WS1 and WS2), from the dock wall, whilst no evidence of hydrocarbon impact was recorded in test results from samples retrieved from wells located closest to the down wall (BH1 and BH2). This suggests hydrocarbon contamination does not seem to be migrating in groundwater towards the docks. The risk of contamination to the adjacent docks is therefore considered low to moderate.

Whilst no remedial measures are considered necessary (no evident risk/impact to surface waters has been identified) it is recommended that surface water monitoring is undertaken prior, during and post development works in order to identify potential mobilisation of contaminants by construction activities.

5.4 Radon & Ground Gases

According to the British Geological Survey, the site is located in an area where less than 1% of homes are above the radon action level and no radon protection measures are necessary in the construction of new dwellings or extensions.

Ground gas concentrations recorded on site included maximum Methane (CH_4) levels = 0.3% by volume and maximum Carbon Dioxide (CO_2) levels of 12.5% by volume. Oxygen (O_2) levels ranged from 3.1% to 20.7% by volume. Hydrogen Sulphide levels of 0ppm were recorded together with Carbon Monoxide levels in the range 0ppm to 11ppm. Borehole pressures of 0Pa and gas flows of 0l/hr were recorded, however a peak flow rate of 0.2l/h was recorded.

It is likely ground gases are being generated by the Made Ground and organic materials beneath the site.

Based on the maximum carbon dioxide and methane levels encountered in the boreholes on site, and a flow rate of 0.3l/hr assumed to give a worst-case scenario (min level of monitor accuracy), a Gas Screening Value is calculated for each gas as follows:

- Carbon dioxide: GSV = 0.3 x 0.125 = 0.0375l/hr

- Methane: GSV = 0.3 x 0.003 = 0.0009l/hr

The above results suggest the site should be given a Characteristic Situation of (2), i.e. 'Low risk', in accordance with the Modified Wilson and Card Classification (CIRIA C665), due to the measured concentration of carbon dioxide being greater than 5%.

Modified Wilson & Card Classification (CIRIA Report 665)

Characteristic Situation (CIRIA Report 149)	*Risk Classification*	*GSV (CH_4 or CO_2) (l/hr)*	*Additional Factors*	*Typical Source of Generation*
1	Very Low Risk	<0.07	Typically methane ≤1%v/v and/or carbon dioxide ≤5% v/v. Otherwise consider increase to Situation 2.	Natural Soils with low organic content. "Typical" Made Ground.
2	Low Risk	<0.7	Borehole flow rate not to exceed 70l/hr. Otherwise increase to Situation 3.	Natural soil, high peat/organic content. "Typical" Made Ground.
3	Moderate Risk	<3.5		Old landfill, inert waste, mineworking flooded.
4	Moderate to High Risk	<15	Quantitative risk assessment required to evaluate scope of measures required.	Mineworking susceptible to flooding, completed landfill (WMP 26B criteria)
5	High Risk	<70		Mineworking unflooded inactive with shallow workings near surface.
6	Very High Risk	>70		Recent landfill site.

Based on the above, gas protection measures in line with a Characteristic Situation 2 are therefore required for the proposed development.

6.REMEDIATION STRATEGY

6.1 General

The remediation works aim to remove or mitigate the pollutant pathways identified so the site is suitable for its intended use as a Training Facility, within a realistic framework and a suitable timescale for the development.

In general terms, the remediation works shall comprise the following:

- Demolition and site clearance
- Placement of clean cover across landscaping areas
- Installation of ground gas protection measures
- Monitoring of groundwater & surface water quality

6.2 Remediation Objectives

The specific remediation objectives will be:

- To mitigate the risks of soil Pb, Be and PAHs contamination pose to the health of future site users and/or controlled waters.
- To remove historic buildings and infrastructure (i.e. foundations, tanks, interceptors, pipework, drains, etc.) and other structures related to the previous site activities, which could give rise to contamination.
- To monitor the groundwater quality to identify any potential mobilisation resulting from the development works.
- To remove from site any unexpected contamination which may be encountered during redevelopment.
- To prevent the site from being designated as Contaminated Land and/or special site under the Part 2A of the EPA 1990, under the current assessment framework.

6.3 Licenses and Permits

The remedial works shall be undertaken in accordance with the relevant Health and Safety regulations and CDM (2015) regulations.

All remedial works must be overseen by a competent Environmental Consultant operating under a full time watching brief.

If site-won materials are due to be reused on site, this shall be carried out under a Material Management Plan in accordance with the CL:AIRE 'Definition of Waste-Code of Practice'. This document shall be produced prior to the commencement of works on site and maintained throughout the project, with the aim of recording and controlling the movement and adequate use of materials around site in accordance with current waste management legislation and guidance.

Off-site disposal of materials (if required) is also subject to current Waste Management Legislation. For instance, should the total quantity of waste material to be produced at or taken off site is defined as ‘hazardous waste’, and is 500kg or greater in any 12 month period, the developer will need to register the site as a hazardous waste producer.

Appropriately licensed waste carriers and disposers shall be employed for the movement of materials as part of these works.

6.4 Phasing of Remedial works

6.4.1 Phase 1 - Demolition and Site Clearance

The site will require some preparatory work to create a platform for development. The works shall include:

- Removal of any potential Asbestos Containing Materials (ACMs) within the existing buildings
- Demolition of existing buildings and removal of associates structures
- Removal of redundant services/obstructions

- Excavation of service / drainage runs

Asbestos

Due to the age of the buildings on site, there is the possibility Asbestos Containing Materials (ACMs) may have been used in its construction. A pre-demolition survey is recommended to be performed prior demolition. All ACMs must be removed by a licensed asbestos removal contractor prior works commence. Waste consignment notes must be provided following the disposal of these materials to an authorised facility.

Demolition works

Buildings on site shall be demolished and any associated structures (i.e. water tank, sub-station, compactors, containers, etc.) as well as redundant services removed. It is understood all concrete floor slabs and other hard standing surfaces across the site will be broken out, processed and crushed for reuse or disposed off site. In addition, all underground structures / obstructions identified during the site operations will be removed.

Due to the nature of the contamination identified on site, it is anticipated that Made Ground can be left in-situ where located beneath hard cover / hard standing surfaces as this will effectively contain the contamination beneath and break any pollutant linkages by which future site users may become exposed to contamination. If reuse of materials is considered, further testing may be required, as per Section 7.2 and these shall strictly remain beneath hard standing.

Soils excavated from the site which are not due to be reused, should either be taken to a suitable facility. It will be the responsibility of the Main Contractor to ensure materials taken off-site, are characterised in accordance with Technical Guidance WM3[3] and that appropriate haulage contractors are used for the transfer of the materials into licensed waste facilities. Details of the waste carrier, volumes taken off site and final disposal location as well as copies of the waste consignment notes shall be kept and collated on completion of works for their inclusion in the final Verification Report for the scheme.

[3] Environment agency (2015) 'Guidance on the classification and assessment of waste - Technical Guidance WM3' 1st edition.

The Environmental Consultant shall inspect the materials at formation level once all former hard standing and structures have been removed, to identify any potential contamination, which may warrant further assessment and/or remediation.

It is recommended that throughout the construction process, ground workers use adequate PPE and that health and safety plans are put in place by the Main / Ground works Contractor. Dust suppression measures shall be implemented to reduce dust generation and potential exposure to adjacent site users.

Protective pipework

Due to the significant levels of PAH contamination within the made ground materials, it is anticipated non-standard materials are likely to be required for new water pipes. However, this should be corroborated following discussions with the local water company / utility provider.

6.4.2 Phase 2 - Placement of clean cover across landscaping areas

It is recommended that a layer of clean inert material is placed across all soft landscaped areas as a precautionary measure to ensure future users do not come in contact with residual contamination, minimise the release of contaminated dust and limit any potential plant uptake.

The capping layer should be at least 600mm thick, of which at least the top 300mm must comprise topsoil to provide a suitable plant-growing medium. The topsoil should be supplied from a reliable source and certified clean prior to its placement.

The quality of the materials and depth of clean cover will require to be formally validated by the appointed environmental consultant, as per the protocol in Section 7.3.

6.4.3 Phase 3 - Installation of Ground Gas Protection Measures

Ground gas protection measures to be installed beneath the new unit shall comprise a 250mm thick reinforced concrete suspended slab on a gas resistant membrane (2000gauge polythene DPM), with all joints and penetrations sealed.

The membrane shall be installed and verified in accordance with CIRIA C735, on a minimum 300 thick HA Type 1. An independent verification certificate will be provided by the appointed verifier as well as as-built drawings demonstrating the installation of such measures.

6.4.4 Phase 4 - Monitoring of Groundwater & Surface water Quality

It is recommended that as part of the remediation scheme, groundwater and surface water monitoring is carried out to assess if any contamination has been mobilised by the construction activities and to detect if any hydrocarbon contamination is migrating towards the adjacent dock, along the eastern site boundary.

Groundwater and surface water quality shall be monitored prior to commencement of works and on a monthly basis whilst ground works are undertaken. During piling operations, monitoring shall be carried out on a weekly basis. On completion of all works, a final post remediation round shall be performed.

Samples will be retrieved from each of the existing wells along the eastern perimeter of the site (WS1, BH1 and BH2 as shown in CJA Drawing – Exploratory hole location plan) and 2No from the dock itself (upstream and downstream). Samples will be subsequently subjected to a full suite of chemical analysis (Appendix 4) and comparison against Environmental Quality Standards and/or UK Drinking Water Standards (Appendix 2).

It is the Contractor's responsibility to locate and protect the existing wells from damage prior to decommissioning. In the event a well is destroyed, damaged or deemed unserviceable, the well shall be reinstated at the earliest opportunity.

Should migration occur or dissolved phase concentrations rise, the requirement for further action and remedial options shall be discussed with the statutory regulators.

6.5 Unexpected Site Conditions

Due to the nature of the historic activities that took place in the area, unexpected contamination/features may be encountered during the works on site. No current investigation method is capable of identifying all contaminant issues in a given area, hence contamination may not have been fully identified by previous studies due to access constraints, easement restrictions associated with services, or because it was outside the scope of such investigations. Therefore, the potential for unexpected contamination to be encountered across the site should not be discounted.

Unexpected contamination

In the event unexpected contamination and/or Asbestos Containing Materials (ACMs) are found, excavation works should cease. The Main Contractor should cordon-off the area and immediately notify the appointed Environmental Consultant so a preliminary inspection of the materials in question can take place. Sampling and chemical testing of the materials in question may be required in order to characterise the contamination as detailed in Appendix 3 and determine if contaminant levels comply with current assessment criteria for land in commercial use or public open space (the latter for landscaping areas), as shown in Appendix 1. Such assessment will help to determine if materials can be retained on site or need to be excavated and disposed into a licensed facility.

Unexpected Fuel tanks

If fuel tanks or any associated infrastructure is identified during the redevelopment, these structures must be decommissioned by a suitable qualified contractor in accordance with APEA (2011) 'Design Construction, Modification, Maintenance and Decommissioning of Filling Stations' as well as Pollution Prevention Guidelines PPG8 (2004) 'Safe Storage and Disposal of Fuel Oils' and PPG27 'Installation, Decommissioning and Removal of Underground Storage Tanks'.

Health and Safety issues associated with the release of vapours and explosive gases as well as work in confined spaces will be dealt with as part of the Contractor's Health and Safety Plan. The Contractor's Health and Safety Plan will also advise on the requirement and level of personal protective equipment (PPE) necessary throughout the works. The levels of explosive gases shall be monitored continuously by means of the gas detector.

Following their discovery, the area of the underground tanks should be exposed to allow these to be emptied and any associated pipework will need to be flushed. The structures will then be excavated and removed from site.

A watching brief will be maintained by the Environmental Consultant during these works in order to identify any potential gross contamination of soils around the structures which could require remediation.

Where underlying materials exhibit gross contamination, these will be excavated until no visible and/or olfactory evidence of contamination is noted in the area. Materials will be disposed off site to a suitably licensed waste disposal facility or placed onto a visqueen-lined bunded area for sampling to determine its suitability for re-use or disposal. If required, a Photo-ionisation detector shall be used to aid this process.

Once the tanks and contaminated materials (if any) have been removed, the area will be validated by retrieving samples on a 10m x 10m grid, to be applied to validate the base and sides of any excavation. Linear features (i.e. fuel lines) shall be validated by retrieving a sample every 15m.

If free-phase or perched contaminated groundwater is encountered, it shall be removed by a tanker and disposed to an off-site facility.

The discovery of any unexpected contamination or potentially contaminative features will be reported to the Local Planning Authority and statutory regulators.

7.VERIFICATION OF REMEDIAL WORKS

7.1 General

Verification is defined by the Environment Agency as 'confirmation through the provision of objective evidence that specified requirements have been fulfilled'[4]. Hence, in order to demonstrate the remediation objectives have been met, the following verification works will be carried out:

- Verification of site-won materials
- Verification of imported materials
- Verification of clean cover

7.2 Verification of site-won and imported materials

Materials arising from demolition, decommissioning and/or excavation works as well as imported materials must be subject to a verification procedure to demonstrate their suitability for use and/or retention on site. The verification process will consist of:

- Visual inspection of materials
- Sampling of materials at a minimum frequency of 3No. samples per 500m^3 for materials from a single source, with 1No. sample every 250m^3 above this.
- Laboratory chemical analysis of soil samples
- Review of results vs. Soil Assessment Criteria

Site-won materials which are excavated and stockpiled may be suitable for retention on site beneath hard standing surfaces. These materials will be subject to a preliminary visual and/or olfactory inspection by the Environmental Consultant who will determine if the materials have the potential to be retained. Such an inspection shall be supported by sampling and laboratory analysis (as detailed in Appendix 3). Any material which exhibits evidence of gross contamination or deemed not suitable for use, shall be disposed to a licensed facility.

[4] Environment Agency (2010) 'Verification of Remediation of Land Contamination' SC030114/R1.

The quality of any imported materials, which is not virgin quarried aggregate, should be demonstrated ideally prior to their import, with the supplier providing the information to prove the materials are suitable for use. Alternatively, materials can be stockpiled in a designated area and sampled at a rate of 3No. samples for every 500m^3 of material from a single source, and 1No. sample for every 250m^3 over that volume.

Samples obtained will be stored in suitable containers, placed within cool boxes maintained at a temperature of 4°C or below and sent to a UKAS/MCERTs accredited laboratory to be subjected to a full suite of chemical analysis (Appendix 3). The analytical results will be compared against soil assessment criteria for land under a commercial use (if materials will be retained beneath hard standing) or public open space to determine suitability for use across landscaping areas, as enlisted in Appendix 1.

Records of the sources, types, volumes of materials brought to site; their movement and placement areas shall be collated by the Main / Ground works contractor under a Material Management Plan (MMP) in accordance with CL:AIRE Definition of Waste Code of Practice.

7.3 Verification of clean cover

The suitability for use of the materials to be used as part of the clean cover system should be verified, ideally prior to their placement. Three (3No.) samples for every 500m^3 of material from a single source, and 1No. sample for every 250m^3 over that volume should be subjected to a full suite of chemical analysis (at a UKAS/MCERTs accredited laboratory (as per Appendix 3). In addition, topsoil materials should also meet the requirements of BS3882:2015 ‘Specification for topsoil and requirements for use’.

The results of the analysis will be compared against the soil assessment criteria for land used as public open space - park, to ensure the materials are suitable for use (appendix 1).

The thickness of clean cover (600mm) will be confirmed by excavating small pits across the landscaping areas and measure the thickness of the layer.

8.COMPLETION OF WORKS

A final verification report will be produced on completion of the remedial works to provide a detailed account of the remediation and validation works carried out as part of the scheme. The report will include:

- A description of the remedial works performed
- A statement of the remediation objectives
- Photographic record of the remedial works
- Records of consultations with regulators, if required
- Independent verification certificate and as-built plans for the gas protection measures
- Records of material movements and final locations shown in as-built drawings/plans
- Validation chemical tests certificates for the imported materials, as well as their type, volumes, origin and location on site
- Validation chemical tests certificates for the clean cover materials as well as measurements of the thickness of the layer across landscaping areas
- Consignment notes for materials disposed off site (if any)
- A final summary of the environmental status of the site in the context of its intended use

The report will be submitted on completion of works to the Regulatory Authorities for their approval. The remediation and verification works can only be considered completed once written approval is provided by the statutory consultees.

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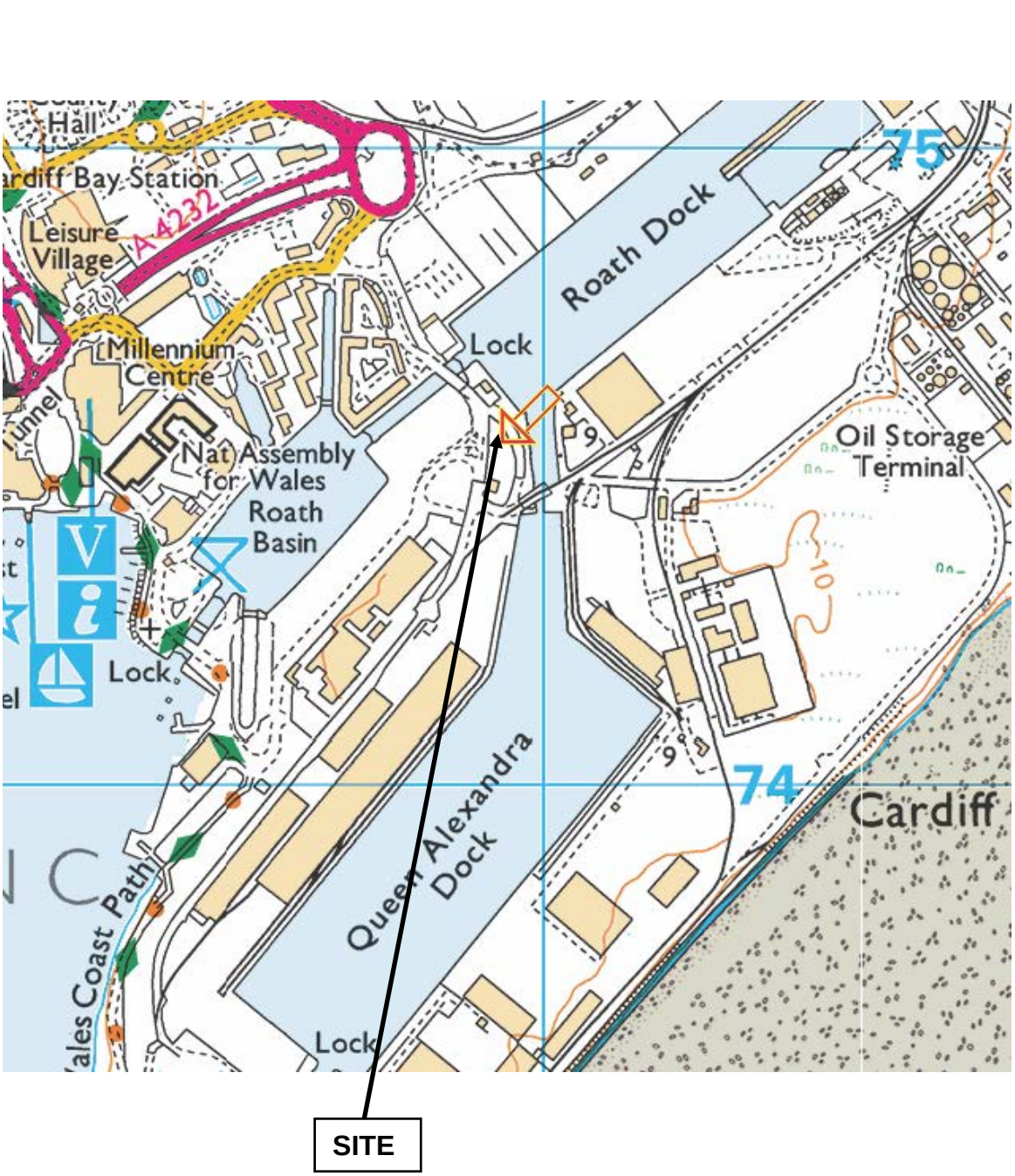
DRAWINGS



Title: **Site Location Plan** – Proposed Training Facility, Cardiff Docks

cjassociates
CJ Associates
Geotechnical Limited

Job no. AE0709	Drawn by: SL	Date: Sept 2016	Scale: NTS

KEY:

- Borehole/Window Sample Location (NTS)
- Hand Dug Sampling Pit (NTS)
- Hand Dug Trial Pit (NTS) December 2016
- TRL Probe Location (NTS) December 2016

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Project	PROPOSED TRAINING FACILITY, CARDIFF
Drawing Title	EXPLORATORY HOLE LOCATION PLAN
Client	Hydrock
Project No.	AE0709

NOTES:
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Contractors must verify all dimensions on site before commencing any work or shop drawings. This drawing is not to be scaled. Use figured dimensions only.
ubject to statutory approvals and survey.
Building areas are liable to adjustment over the course of the design process due to the ongoing construction detailing developments.
Please note the information contained within this drawing is solely for the benefit of the employer and should not be relied upon by third parties.
The CDM hazard management procedures for the Chetwoods aspects of the design of this project are to be found on the "Chetwoods - Hazard Analysis and Design Risk Assessment" and/or drawings. The full project design teams comprehensive set of hazard management procedures are available from the Principle Designer appointed for the project.

0 5m 10m
1:200

North

Site Boundary

3m High CPNI Base Protection Level Welded Mesh (ISF) Fence

Site Area
Red Line Boundary: 1.91a / 0.77ha

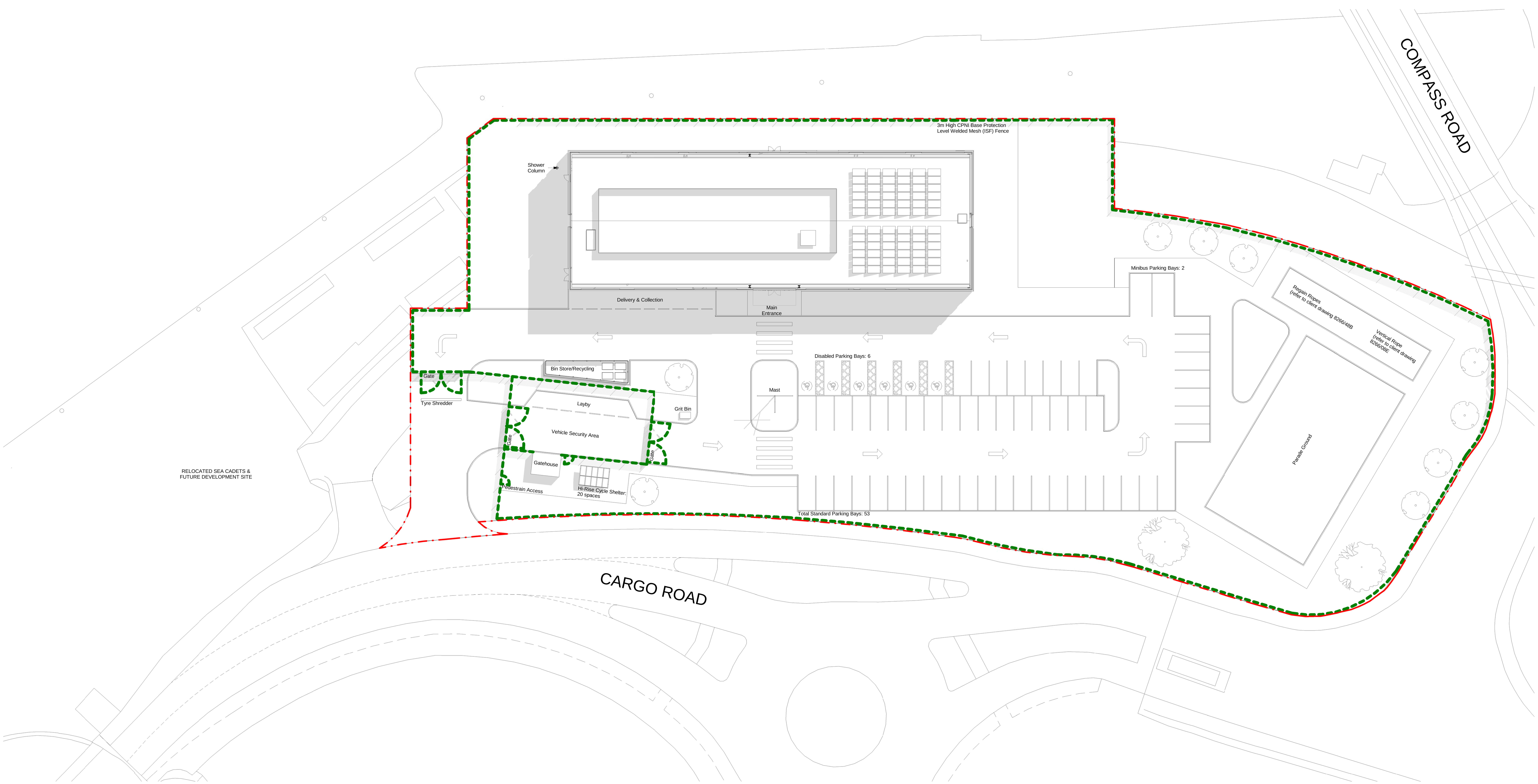
Parking Schedule

Standard Parking Bays:	53
Disabled Parking Bays:	6
Minibus Marking Bays:	2
Cycle Spaces:	20

Accommodation Schedule

Ground Floor:	1025sq.m
First Floor:	972sq.m
Second Floor:	783sq.m
Third Floor:	975sq.m
Total:	3755sq.m

Gatehouse
Area:12sq.m



1 **Proposed Site Plan**
1 : 200

Rev	Revision Description	Date	Author/ Reviewer
PL 3	Boundary line amended	11/01/18	ST
PL 2	Site exit amended to suit sea cadets boundary	28/11/17	ST
PL 1	Revised to relfect VE scheme	24/11/17	ST

PLANNING

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Project
SECURE TRAINING FACILITY

Client
ABP

Drawing Title
PROPOSED SITE PLAN

Scale	Size	Drawn	Checked	Date
1 : 200	A0	ST	TM	09/05/16

Project	Originator	Zone	Level	Type	Role	Number	Rev.
4079	CHT	00	00	DR	A	01060	PL3

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APPENDICES

Appendix 1 - Soil Assessment Criteria

Determinand	C4SL (mg/kg)	
	Commercial (1)	Public Open Space Parks (2)
Arsenic	640	170
Benzene	98	230
Benzo(a)pyrene	76	21
Cadmium	410	880
Chromium VI	49	250
Lead	2300	1300

Determinand	Suitable 4 Use Levels (mg/kg)	
	Commercial (1)	Public Open Space Parks (2)
Metals		
Beryllium	12	63
Boron	240000	46000
Chromium	8600	33000
Copper	68000	44000
Mercury	58	30
Nickel	980	3400
Selenium	12000	1800
Vanadium	9000	5000
Zinc	730000	170000
Petroleum Hydrocarbons		
Toluene	180000	100000
Ethylbenzene	27000	27000
o-xylenes	33000	33000
m-xylenes	31000	32000
p-xylenes	30000	31000
Aliphatic EC 5-6	12000	180000
Aliphatic EC >6-8	40000	320000
Aliphatic EC >8-10	11000	21000
Aliphatic EC >10-12	47000	24000
Aliphatic EC >12-16	90000	26000
Aliphatic EC >16-35	1800000	490000
Aliphatic EC >35-44	1800000	490000
Aromatic EC 5-7	86000	920000
Aromatic EC >7-8	180000	100000
Aromatic EC >8-10	17000	9300
Aromatic EC >10-12	34000	10000
Aromatic EC>12-16	38000	10000
Aromatic EC>16-21	28000	7800
Aromatic EC>21-35	28000	7900
Aromatic EC>35-44	28000	7900
Polycyclic Aromatic Hydrocarbons		
Naphthalene	1100	3000
Acenaphthylene	100000	30000
Acenaphthene	100000	30000
Fluorene	71000	20000
Phenanthrene	23000	6300
Anthracene	540000	150000
Fluoranthene	23000	6400
Pyrene	54000	15000
Benz(a)anthracene	180	62
Chrysene	350	120
Benzo(b)fluoranthene	45	16
Benzo(k)fluoranthene	1200	440
Indeno(1,2,3-cd)pyrene	510	180
Dibenz(a,h)anthracene	3.6	1.4
Benzo(ghi)perylene	4000	1600
Phenols		
Phenol	3200	3200

Appendix 2 - Groundwater assessment criteria

Determinand	(1) EQS value (µg/l)	(2) Drinking Water Quality Value (µg/l)
Arsenic	50	10
Cadmium	5.0	5.0
Chromium	150-250**	50
Copper	10	2000
Lead	50-250**	25
Mercury	1.0	1.0
Selenium	-	10
Nickel	50-200**	20
Zinc	75-500**	-
Cyanide	-	50
Phenol	30	-
Sulphate	400000	-
pH	6 – 9	-
Naphthalene	10	-
Benzo(a)pyrene	0.03	-
Fluoranthene	0.02	-
Total PAH*	-	0.10
Petroleum hydrocarbons	-	10

*Total PAH taken as the sum of benzo(b)fluoranthene + benzo(k)fluoranthene + benzo(ghi)perylene+ indeno(123-cd)pyrene.
** dependant on alkalinity

Appendix 3 - Soil Analysis Suite

Metals	*Polycyclic Aromatic Hydrocarbons*
Arsenic	Naphthalene
Cadmium	Acenaphthylene
Beryllium	Acenaphthene
Boron	Fluorene
Chromium	Phenanthrene
Chromium VI	Anthracene
Copper	Fluoranthene
Lead	Pyrene
Mercury	Benz(a)anthracene
Nickel	Chrysene
Selenium	Benzo(b)fluoranthene
Vanadium	Benzo(k)fluoranthene
Zinc	Indeno(1,2,3-cd)pyrene
Petroleum Hydrocarbons	Dibenz(a,h)anthracene
Aliphatic EC 5-6	Benzo(ghi)perylene
Aliphatic EC >6-8	Benzo(a)pyrene
Aliphatic EC >8-10	
Aliphatic EC >10-12	Phenols
Aliphatic EC >12-16	Total Phenols
Aliphatic EC >16-35	
Aliphatic EC >35-44	BTEX
Aromatic EC 5-7	Benzene
Aromatic EC >7-8	Toluene
Aromatic EC >8-10	Ethylbenzene
Aromatic EC >10-12	o-xylenes
Aromatic EC>12-16	m-xylenes
Aromatic EC>16-21	p-xylenes
Aromatic EC>21-35	
Aromatic EC>35-44	

Appendix 4 - Groundwater analysis suite

Metals	*Polycyclic Aromatic Hydrocarbons*
Arsenic	Naphthalene
Cadmium	Acenaphthylene
Chromium	Acenaphthene
Copper	Fluorene
Lead	Phenanthrene
Mercury	Anthracene
Nickel	Fluoranthene
Selenium	Pyrene
Zinc	Benz(a)anthracene
Inorganics	Chrysene
Cyanide	Benzo(b)fluoranthene
Sulphate	Benzo(k)fluoranthene
pH	Indeno(1,2,3-cd)pyrene
Petroleum Hydrocarbons	Dibenz(a,h)anthracene
Aliphatic EC 5-6	Benzo(ghi)perylene
Aliphatic EC >6-8	Benzo(a)pyrene
Aliphatic EC >8-10	Total PAH
Aliphatic EC >10-12	Phenols
Aliphatic EC >12-16	Total Phenols
Aliphatic EC >16-35	
Aliphatic EC >35-44	
Aromatic EC 5-7	
Aromatic EC >7-8	
Aromatic EC >8-10	
Aromatic EC >10-12	
Aromatic EC>12-16	
Aromatic EC>16-21	
Aromatic EC>21-35	
Aromatic EC>35-44	