



## PHASE I GEO-ENVIRONMENTAL SITE ASSESSMENT

Phase 2  
Monarchs Quay  
Liverpool

Prepared for:

YPG Developments  
Ltd

Report Ref: 11-630-r3  
Date Issued: October 2017





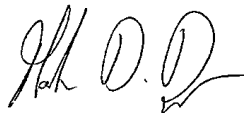
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## EXECUTIVE SUMMARY

<b>Site Address</b>	Phase 2, Land at Monarchs Quay, Liverpool, L3 4FP	
<b>Grid Reference</b>	334492E, 389198N	
<b>Site Area</b>	1.57Ha	
<b>Current Site Use</b>	<p>The subject site is an 'L' shaped parcel of land located within the Liverpool Dock area. The eastern sector of the site is bounded by Queens Dock to the north and Wapping Dock to the south. The western half of the site is bounded by car parks to the north and east with commercial buildings and apartments to the west and south.</p> <p>The western half of the site currently comprises a car park and through road, with the eastern sector comprising Queens Wharf Road and a car park.</p>	
<b>Proposed Development</b>	E3P understands that Knight Frank are preparing a planning application to develop the area for a mixed end use comprising 3 No. of medium rise structures across the site with associated car parking.	
<b>Environmental Setting</b>	<i>Drift Geology</i>	None recorded
	<i>Bedrock Geology</i>	Chester Pebble Beds - Sandstone
	<i>Hydrogeology</i>	Principal Aquifer (Bedrock Geology).
	<i>Hydrology</i>	The site is bounded by Queens Dock to the south east with Wapping Quay 50m north east and the River Mersey circa 50m to the west. The River Mersey flows in a northerly direction.
	<i>Flood Risk</i>	Localised areas adjacent to River Mersey are indicated by the Environment Agency to be in a Flood Zone 2 and 3, however this is circa 25m outside the site.
	<i>Ecology</i>	The River Mersey, Queens Dock and Wapping Quay may provide habitat for wildlife.
	<i>Subsidence Hazards</i>	Data searches indicate that there is a moderate compressible ground risk beneath the site.
<b>Site History</b>	Historical mapping suggests that the site has been utilised as Queens Dock since before the mid 1800s. Since then the northern sector of the site has been infilled and is now used as a car park. The site has had a similar layout to the present since the 1990's	
<b>Utility Locations</b>	A formal utility survey has not been completed, however it is likely all major services are present below the roads traversing the site.	
<b>Landfill Sites &amp; Ground Gases</b>	Although the EA do not note a landfill on-site, the southern sector has been historically infilled and noted as landfill in the Landmark Report. There are also other nearby landfill relating to the infilling of other nearby docks.	
<b>Invasive Plant Species</b>	No invasive plant species were identified during the site walkover however some areas of the site were inaccessible and their presence cannot be ruled out. A full detailed Habitat Survey is likely to be required.	
<b>Radon</b>	Unaffected. No special precaution required.	
<b>Coal Mining</b>	The site is at a low risk from underlying coal workings.	
<b>Unexploded Ordnance (UXO)</b>	The site lies within an area of high risk from UXO and therefore a UXO Assessment is recommended for the site.	

## EXECUTIVE SUMMARY

### Geotechnical Risk

Based on the desk study information, the following geotechnical assessment has been made:

-  Due to the site's locality to the River Mersey it is anticipated that there will be shallow groundwater below the site;
-  Given the heavily developed nature of the site, it is likely there will be deep Made Ground fill deposits and obstructions. Existing buildings will require demolition with all relic foundations removed prior to the construction of the proposed development;
-  The site is defined as being at high risk from unexploded ordnance and therefore a detailed UXO Risk Assessment is recommended and,
-  A historically infilled quay is present within the site boundary which is potential sources of alluvial deposits, silts and possible organic peat deposits in addition to potential depths of Made Ground. Investigation will be required in order to assess these and undertake in-situ geotechnical testing to determine likely foundation solutions.

### Contaminated Land Risk Assessment

#### Human Health

The site has historically been a quay that has subsequently be infilled and developed as a rail siding and most recently a car park. Based on these historical uses, localised areas have been identified as potentially impacted by heavy metals, Semi Volatile Organic Compounds (SVOC), Volatile Organic Compounds (VOC) and hydrocarbon compounds. Additionally, Made Ground may also be a potential source of ground gas.

The risk to the subject site from potential off-site contaminant sources of contamination are likely to be negated due to the presence to the east of Queens Dock and Wapping Quay, therefore limiting the potential for contaminant migration.

Should impacted Made Ground be present then this may pose a risk to construction workers and future commercial and residential end users, particularly if the proposed development includes areas of public open space.

#### Controlled Waters

Significant on-site sources of potentially mobile contaminants are possible, however no historical or current tanks have been identified.

The site is underlain by limited drift deposits which will offer little protection against vertical migration of any mobile contaminants to the underlying Principal aquifer. Additionally, lateral migration of mobile contaminants may pose a risk to the River Mersey to the west and Wapping and Queens Dock to the east.

#### Ground Gas

Former infilled dockland is present below the site which may be potential sources of alluvial / organic deposits which may be a source of carbon dioxide and methane. Carbon dioxide and methane have associated asphyxiation and explosive risks respectively and if present the risks can be appropriately mitigated through the careful design of building structures.

### Recommendations

A detailed Phase II intrusive Geo-Environmental Ground Investigation should be undertaken to confirm the findings of the initial conceptual site model and value engineer a development solution.

## Table of Contents

<b>1. INTRODUCTION.....</b>	<b>5</b>
1.1 Background .....	5
1.2 Proposed Development .....	5
1.3 Objectives.....	5
1.4 Limitations .....	6
1.5 Sources of Information.....	6
1.6 Confidentiality .....	6
<b>2. SITE SETTING.....</b>	<b>7</b>
2.1 Site Details .....	7
2.2 Current Site Use .....	7
2.3 Surrounding Area .....	8
<b>3. SITE HISTORY .....</b>	<b>9</b>
3.1 On-Site Historical Development.....	9
3.2 Off-Site Historical Development.....	12
3.3 Planning History .....	13
<b>4. ENVIRONMENTAL SETTING .....</b>	<b>14</b>
4.1 Geology and Hydrogeology .....	14
4.2 Geotechnical Data .....	14
4.3 Coal Mining .....	15
4.4 Hydrology .....	15
4.5 Radon Risk Potential .....	15
4.6 Industrial Land Uses .....	15
4.7 Sensitive Land Uses .....	15
4.8 Site Sensitivity Assessment .....	15
4.9 Preliminary Geotechnical Assessment.....	16
4.1 Unexploded Ordnance.....	16
.....	<b>Error! Bookmark not defined.</b>
<b>6. CONSULTATIONS.....</b>	<b>17</b>
6.1 Contaminated Land Officer .....	17
6.2 Landfill Sites and Waste Treatment Sites .....	17
6.3 Regulatory Database .....	17
<b>7. INITIAL CONCEPTUAL SITE MODEL .....</b>	<b>19</b>
7.1 Initial CSM .....	19
<b>8. CONCLUSIONS AND RECOMMENDATIONS.....</b>	<b>21</b>

## APPENDICES

**Appendix I** Limitations

**Appendix II** Glossary

**Appendix III** Drawings

*Drawing No 11-630-001* – Site Location Plan

*Drawing No 11-630-002* – Current Site Layout

*Drawing No 11-630-003* – Historical Features Plan

*Drawing No 11-630-004* – Proposed Development Plan

**Appendix IV** Photographs

**Appendix V** Historical Maps



## 1. INTRODUCTION

### 1.1 Background

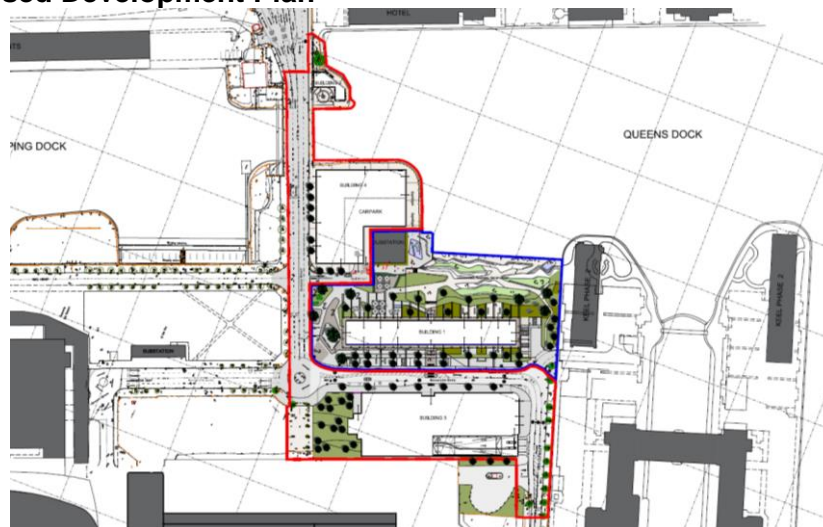
E3P Ltd has been commissioned by Knight Frank on behalf of YPG Developments Ltd to undertake a Phase I Geo-Environmental Site Assessment at land to the west of Wapping Quay and Queens Dock, Liverpool. For avoidance of doubt this report cover the Phase 2 area of the wider proposed development.

This report is required to determine potential contaminated land and geotechnical liabilities associated with a proposed future commercial development.

### 1.2 Proposed Development





E3P understands that Knight Frank are preparing a planning application to develop the area for a mixed end use comprising 3 No. of medium rise structures across the site with associated car parking, as shown in fig 1.1 below and Drawing 11-630-004 within Appendix III.

**Fig 1.1 Proposed Development Plan**



### 1.3 Objectives

The objectives of the Geo-Environmental Investigation are to:









-  Review historical plans, geology, hydrogeology, site sensitivity, flood-plain issues, mining records and any local authority information available in order to complete a Desk Study in line with Environment Agency (EA) document Model Procedures for the Management of Contaminated Land (Contaminated Land Report 11 (CLR11));
-  Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
-  Assess the desk study information and where possible, provide preliminary recommendations in relation to foundations, pavement construction and floor slabs; and,
-  Provide recommendations regarding future works required and undertake a preliminary pre-construction cost appraisal.

## 1.4 Limitations

The limitations of this report are presented in Appendix I.

## 1.5 Sources of Information

Background information was sought from the following sources:

-  Envirocheck Search;
-  Historical mapping dated 1849 to 2015. A selection of historical maps are reproduced in Appendix V;
-  On-line planning records held by Liverpool City Council;
-  Consultations with representatives of the Liverpool City Council;
-  Environment Agency Groundwater Vulnerability Map ([www.environment-agency.gov.uk/wiyby](http://www.environment-agency.gov.uk/wiyby));
-  Radon: Guidance on protective measures for new buildings (BRE Document BR 211, 2007);
-  British Geological Survey Map; and,
-  Zetica UXO Map – Merseyside.

## 1.6 Confidentiality

E3P has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.



## 2. SITE SETTING

### 2.1 Site Details

<b>Site Address</b>	Phase 2, Area, Monarchs Quay, Liverpool, L3 4FP
<b>National Grid Reference</b>	334492, 389198
<b>Site Area</b>	1.57Ha

All acronyms used within this report are defined in the Glossary presented in Appendix II.

A site location map is presented in Appendix III as Drawing 11-630-001.

### 2.2 Current Site Use

E3P has undertaken a site walkover of the entire site and a description of the key findings is summarised in Table 2.1.

**Table 2.1 Site Description**

<b>Occupancy/use</b>	<p>The subject site is an 'L' shaped parcel of land located within the Liverpool Dock area. The eastern sector of the site is bounded by Queens Dock to the north and Wapping Dock to the south. The western half of the site is bounded by car parks to the north and east with commercial buildings and apartments to the west and south.</p> <p>The western half of the site currently comprises a car park and through road, with the eastern sector comprising Queens Wharf Road and a car park.</p>	
<b>Structures</b>	There are currently no structures on-site.	
<b>Access</b>	The site is currently an active car park and road therefore it is accessible via roads that traverses across the site.	
<b>Slope</b>	The site is relatively level, however retaining walls are present along the dock wall on the eastern boundary.	
<b>Retaining structures</b>	Retaining structure are present on all land that bounds open water to the east and west of the site.	
<b>Surface Cover (%)</b>	Buildings:	0%
	Hardstand:	85%
	Soft cover:	15%
<b>Vegetation/Ecology</b>	Areas of maintained grassland are present in the north and west of the site with a small number of semi-mature trees planted along the road line adjacent to the site.	
<b>Hazardous Material Storage</b>	No Above Ground Storage Tanks (AST) or Underground Storage Tanks (UST) were observed at the site during the preliminary site walkover.	
<b>Asbestos Containing Material (ACM)</b>	No evidence of ACM was noted across the site during the site walkover.	

<b>Polychlorinated Biphenyls (PCBs)</b>	There is no equipment identified which may contain PCBs within the site boundary as the electricity sub station was constructed in the past decade.
<b>Waste Storage</b>	Potentially hazardous waste streams are unlikely to be generated at the site and none were observed during the preliminary site inspection.
<b>Drainage</b>	A formal drainage survey has not been completed, however it is likely that all major services are present below the roads traversing site.

## 2.3 Surrounding Area

The surrounding area land uses are summarised in Table 2.2.

**Table 2.2 Surrounding Land Uses**

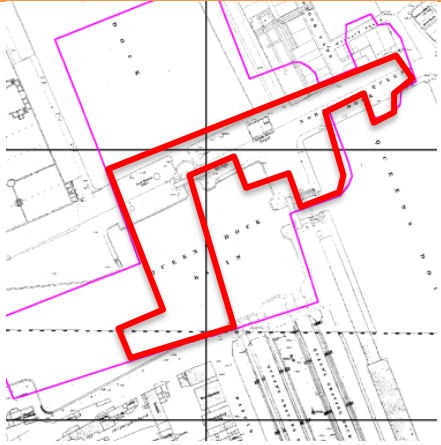
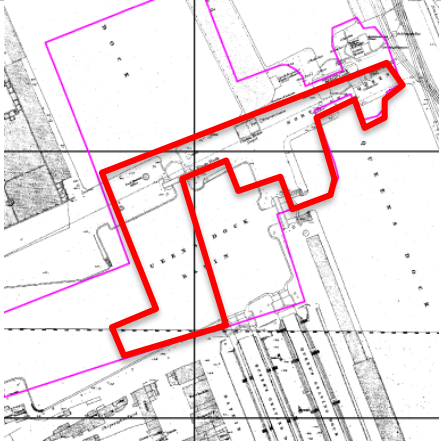
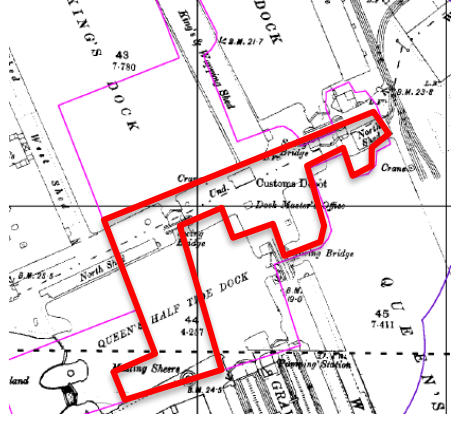
<b>DIRECTION</b>	<b>LAND USE</b>
<b>North</b>	Commercial Units
<b>East</b>	Commercial units, Wapping Quay and Queens Dock
<b>South</b>	Commercial Units and Queens Dock
<b>West</b>	Electricity Substation, Commercial Units and the River Mersey

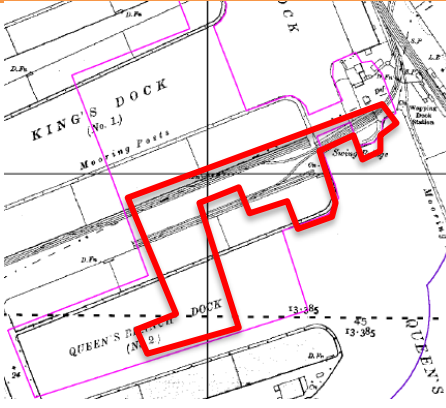
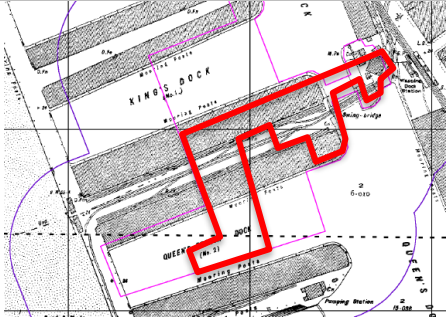
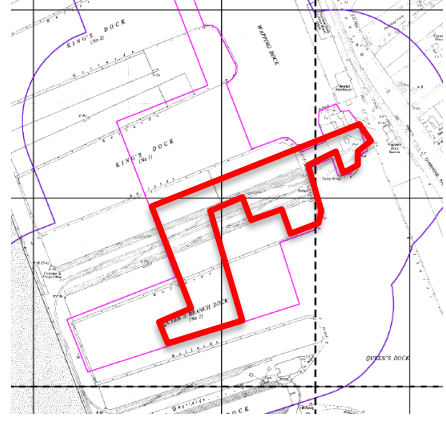
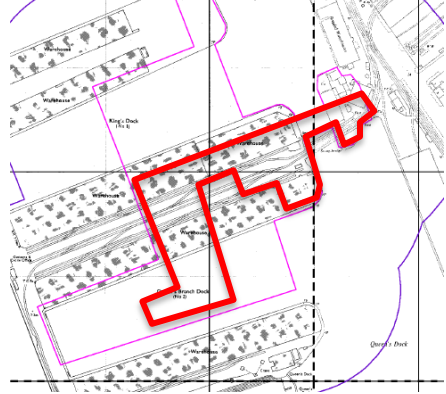
### 3. SITE HISTORY

#### 3.1 On-Site Historical Development

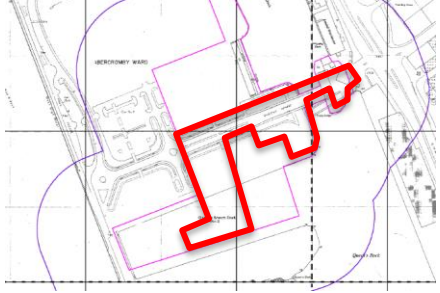
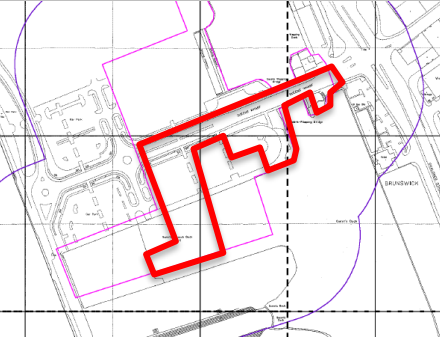
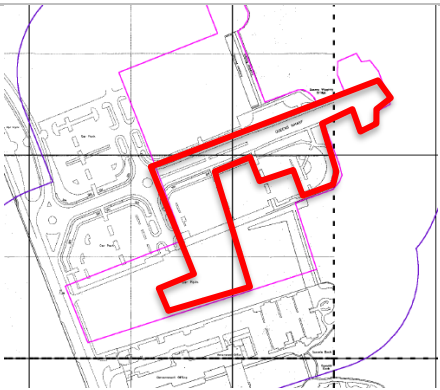

A review of historical mapping pertinent to the site is summarised in Table 3.1 below. In addition, historical site features are presented on Drawing No 11-630-003 in Appendix III.


**Table 3.1 Site Historical Development**

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1849 1:1,056	The majority of the site comprises Queens Dock Basin. The northern sector of the site is formed by roads and unlabelled structures.	
1864 1:1,056	There are no significant changes to the site.	
1890-1893 1:2,500	There are no significant changes to the site.	

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
<p><b>1908</b>  <b>1:2,500</b></p>	<p>The northern half of the site has been infilled and now has a railway crossing east west. The southern sector is now named Queen's Branch Dock. Furthermore unnamed structures in the north west of the site have been removed.</p>	
<p><b>1927</b>  <b>1:2,500</b></p>	<p>A large structure has been constructed in the north of the site related to the railway and therefore likely used for storage</p>	
<p><b>1953-1955</b>  <b>1:2,500</b></p>	<p>No significant changes have occurred</p>	
<p><b>1959-1971</b>  <b>1:1,250</b></p>	<p>No significant changes have occurred.</p>	



MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1984-1989 1:1,250	The railway in the north and associated buildings have now been removed. A road and roundabout have been built on the north sector of the site.	
1993 1:1,250	The land in the central eastern sector is now a designated car park	
1994 1: 2,500	No significant changes have occurred.	
1999 1: 10,000	Queens Branch Dock has now been infilled and developed into a car park	

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
2016 1: 10,000	No significant changes have occurred.	

### 3.2 Off-Site Historical Development

A review of potentially contaminative uses identified on historical Ordnance Survey maps within a 200m radius of the site is summarised below in Table 3.2.

**Table 3.2 Surrounding Potentially Contaminative Land Uses.**

SURROUNDING FEATURE	DISTANCE	DATES	DIRECTION
Kings Dock <i>Infilled</i>	0m	Pre 1890 Pre 1965	North West
Wapping Dock	0m	Pre 1890-	North
Railway <i>Removed</i>	0m	Pre 1890 Pre 1984	East
West Shed <i>Demolished</i>	50m	Pre 1890 Pre 1908	South
Queen's Pier Head Works (Shipbuilding Yard) <i>Demolished</i>	50m	Pre 1890 Pre 1908	South
Kings Dock Tobacco Warehouse <i>Demolished and now forms part of the dock</i>	50m	Pre 1890 Pre 1908	West
Pumping Station <i>Demolished</i>	50m	Pre 1908 Pre 1984	South
Mill <i>Demolished</i>	110m	Pre 1969 Pre 1984	East
Warehouses <i>Demolished</i>	110m	Pre 1908 Pre 1993	East
Polish Factory <i>Demolished</i>	110m	Pre 1953 Pre 1984	East
Engineering Works	110m	Pre 1927	East
Queens Soap Works <i>No longer labelled</i>	120m	Pre 1890 Pre 1927	East
Goods Depot <i>No Longer shown</i>	130m	Pre 1927 Pre 1993	East
Scrap Metal yard	150m	Pre 1969 to Present	East
Lead Works <i>Demolished</i>	160m	Pre 1953 Pre 1984	East
Custom Water Guard Depot <i>Demolished</i>	170m	Pre 1890 Pre 1984	West

SURROUNDING FEATURE	DISTANCE	DATES	DIRECTION
Spice Mills <i>Demolished</i>	190m	Pre 1953 <i>Pre 1969</i>	East
Drill Shed <i>Demolished</i>	220m	Pre 1890 <i>Pre 1908</i>	West

### 3.3 Planning History

E3P has undertaken a detailed search of on-line planning records held by Liverpool City Council which has identified that there are multiple applications relating to the development of sectors of the site.



## 4. ENVIRONMENTAL SETTING

### 4.1 Geology and Hydrogeology

The British Geological Survey (BGS) map for the site, (1:50,000, Solid & Drift edition) and online records indicates the site is underlain by the geological sequence presented in Table 4.1.

**Table 4.1** *Summary of Underlying Geology*

GEOLOGICAL UNIT	CLASSIFICATION	DESCRIPTION	AQUIFER CLASSIFICATION
Drift	None Recorded	-	-
Solid	Chester Pebble Beds	Sandstone	Secondary A Aquifer

The BGS boreholes nearby to the site generally encountered circa 4.00m Made Ground which is subsequently underlain by Sand. Bedrock is then encountered at circa 6.00m bgl. However, the strata underlying the very western sectors appears to comprises organic silts containing peat to circa 13.00m bgl where bedrock is encountered.

The Envirocheck Report indicates that the site is not located within a Groundwater Source Protection Zone. Furthermore, there are two groundwater / potable abstractions within 1km of the site, the closest of which is Brewery Limited located 575m east of the site where the water is used for drinking, coking, sanitary, watering and processing. The other abstraction is located 645m south east of the site relating to Robert Cain & Co Ltd where the water is utilised for drinking, cooking, sanitary and general cooling.

Based on the site location groundwater will likely flow north west towards the River Mersey located immediately west of the site. Groundwater may be subject to tidal influence.

### 4.2 Geotechnical Data

Geotechnical Data presented within a commercially available environmental database is summarised within Table 4.2.

**Table 4.2** *Summary of Geotechnical Data*

HAZARD	DESIGNATION
Shrink-Swell Clay	Very Low Risk
Landslides	Very Low to Low Risk
Ground Dissolution	No Hazard
Compressible Ground	Moderate Risk
Collapsible Deposits	Very Low Risk
Running Sand	Very Low Risk



### 4.3 Coal Mining

The Envirocheck Report states the site is not in an area which may be affected by coal mining.

### 4.4 Hydrology

The site is bounded by Queens Dock and Wapping Dock in the east and the River Mersey circa 50m to the west. The River Mersey flows in a northerly direction.

Circa 100m west of the site there are localised areas adjacent to River Mersey that are indicated by the Environment Agency to be in a Flood Zone 2 and 3. This type of flooding is defined as *'an area that has a chance of flooding of greater than 1 in 30 (3.3%), although this type of flooding can be difficult to predict, much more so than river or sea flooding as it is hard to forecast exactly where or how much rain will fall in any storm.'*

### 4.5 Radon Risk Potential

The Envirocheck Report indicates the site is situated in an area where less than 1% of homes are above the Action Level and that the BGS reports that full radon protective measures are not necessary in the construction of new dwellings or extensions.

### 4.6 Industrial Land Uses

The site is located within a predominantly commercial and industrial area, therefore there are 8 No. entries within the trade directory for industrial land use within 250m of the subject site. The closest trade directory is for a car painters & sprayers located 63m west of the site the other industries include a screen process painters, freight forwarders, food manufacturers and photocopyers.

### 4.7 Sensitive Land Uses

There are no obvious residential dwellings within 250m of the site, however it is likely that there are multiple buildings containing apartments within the area.

The site is located within a registered World Heritage Site.

### 4.8 Site Sensitivity Assessment

The site is assessed to be located within a **moderate** sensitivity setting as discussed within Table 4.5.

**Table 4.5 Site Sensitivity Assessment**

SENSITIVITY PROFILE	DISCUSSION	RATING
Sensitive land uses within close proximity (e.g. residential, school, nursery, local nature reserves etc.)	The site is within a World Heritage Area	Moderate
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	None	Low

SENSITIVITY PROFILE	DISCUSSION	RATING
Distance to the closest groundwater abstraction point.	524m east of the site.	Moderate
Aquifer Classification in Superficial Drift Deposits.	None	Low
Aquifer classification in Bedrock.	Secondary A	Moderate
Is the site underlain by low permeability Drift to depths in excess of 10.0m?	No – for the majority of the site BGS records show bedrock encountered at circa 6.00mbgl for the majority of the site.	High
Is the site located within 50m of a surface watercourse?	Yes Queens Dock and Wapping quay are located to the east of the site.	High
Overall Site Environmental Sensitivity		Moderate

## 4.9 Preliminary Geotechnical Assessment

Based on the desk study information, the following geotechnical assessment has been made:

- Due to the site's locality to the River Mersey it is anticipated that there will be shallow groundwater below the site;
- Given the heavily developed nature of the site, it is likely there will be deep Made Ground fill deposits and obstructions. Existing buildings will require demolition with all relic foundations removed prior to the construction of the proposed development;
- The site is defined as being at high risk from unexploded ordnance and therefore a detailed UXO Risk Assessment is recommended and,
- A historically infilled quay is present within the site boundary which is potential sources of alluvial deposits, silts and possible organic peat deposits in addition to potential depths of Made Ground. Investigation will be required in order to assess these and undertake in-situ geotechnical testing to determine likely foundation solutions.

## 4.1 Unexploded Ordnance

The regional unexploded bomb risk map from Zetica indicates that the site is in an area at high risk from possible Unexploded Ordnance (UXO) resulting from the Second World War. (Zetica, 2014).

Additionally, E3P has undertaken additional research which has identified that Wapping, Kings, Queens, Coburg and Brunswick Docks were heavily bombed during the blitz with many warehouses alongside them destroyed.

Based on the above, any future site investigation and ground works are likely to require specialist supervision by qualified/trained UXO specialists.

## 5. CONSULTATIONS

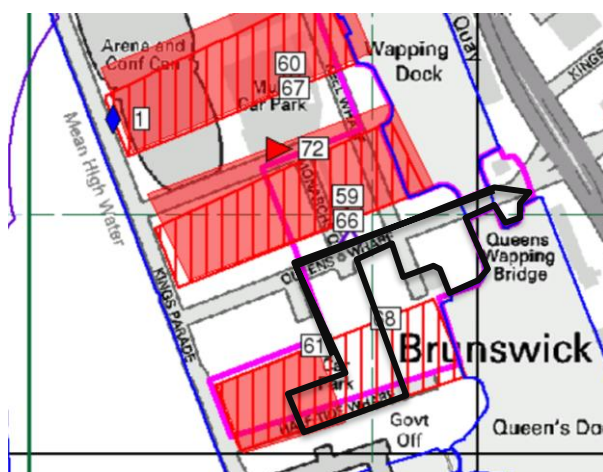
### 5.1 Contaminated Land Officer

E3P contacted the Environmental Health Department at Liverpool City Council who have responded stating that there is unlikely to be any information that we do not already have within our report.

### 5.2 Landfill Sites and Waste Treatment Sites

The Environment Agency do not note a landfill on-site however, there is historical infilling on-site and the Envirocheck report shows an area of landfill within the southern sector. Furthermore there is the other nearby landfills relating to the infilling of other nearby docks.

**Fig 5.1 Site Sensitivity Map from Envirocheck Report**



### 5.3 Regulatory Database

The information summarised in Table 5.1 has been obtained from a commercially available environmental database. The summary table only includes records from within 250m of the subject site and not otherwise detailed in the report.

**Table 5.1 Summary of Environmental Data**

RECORD	ENTRIES WITHIN 250m	DETAILS
Contaminated Land Register Entries and Notices	0	None Identified (N/A).
Authorised industrial processes (IPC/IPPC/LAPPC).	3	86m North – Mobile Screening and Crushing Processes 113m North East – Manufacture of timber and wood-based products 181m North West – Local Authority Air Pollution Control
Fuel Stations Entries	0	N/A
Licensed radioactive substances	0	N/A

RECORD	ENTRIES WITHIN 250m	DETAILS
Enforcements, prohibitions or prosecutions	0	N/A
Discharge Consents	3	151m north west – Effluent discharge between 2005 and 2007. 203m south east – Public sewage and storm overflow 241m north west – Sewage discharge
Pollution Incidents	1	185m south - Category 3 incident in June 1995 – miscellaneous incident affecting the River Mersey
Consents issued under the Planning (Hazardous Substances) Act 1990	0	N/A
Control of Major Accident Hazard (COMAH) sites	0	N/A

## 6. INITIAL CONCEPTUAL SITE MODEL

### 6.1 Initial CSM

In accordance with Environment Agency, CLR 11 (2004) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), E3P Ltd has developed an initial CSM to identify potential contamination sources, migration pathways and receptors within the study area. This is summarised within Table 7.1.

**Table 7.1 Initial Conceptual Site Model**

SOURCE	EXPOSURE	POTENTIAL PATHWAY
<b>Human Health</b>		
<b>Heavy metals / polycyclic aromatic hydrocarbons (PAH) associated within Made Ground and historical site use as a dockland with associated railway</b>	Dermal Contact and Ingestion	Construction Workers Commercial End Users
<p><b>Discussion:</b></p> <p>The presence of a former railway and likely extensive Made Ground associated with historic construction and demolition activities may give rise to heavy metals and non-volatile PAHs impact which may pose a short term risk to construction workers who may come into contact with impacted soils during earthworks. All construction works must be undertaken using the appropriate Personal Protective Equipment (PPE) to remove this potential risk.</p> <p>Future residential users may come into contact with impacted soils within any landscaped areas. If impacted soils are identified, then an appropriate cover system will be required.</p>		
<b>Volatile hydrocarbon compounds associated with the former use as a dockland with associated railway</b>	Volatilisation / Accumulation, Vapour Inhalation	Construction Workers, Commercial End Users
<p><b>Discussion:</b></p> <p>The site has previously been utilised as a dockland area with associated railway sidings. In addition, the area immediately surrounding the site in all directions was heavily industrialised throughout the 20<sup>th</sup> century occupied by a wide range of industrial works and processes (see Section 3.2) which are potential sources of volatile hydrocarbons and may pose a risk to constructions workers and/or future site users via vapour inhalation and accumulation within confined spaces.</p>		
<b>Asbestos Containing Materials (ACM) within Made Ground</b>	Fibre / Dust Inhalation	Construction Workers Commercial End Users Third Party Property
<p><b>Discussion:</b></p> <p>Dust associated with any Made Ground underlying the site may potentially contain ACMs which could be released during future earthworks and then subsequently inhaled by construction workers and possibly third party property.</p> <p>However, with the appropriate construction phase health and safety controls, asbestos containing material is likely to represent a low risk. Furthermore, the development is likely to comprise predominantly hardstanding that will prevent exposure to end users. If identified landscaped areas are likely to require a cover system.</p>		

SOURCE	EXPOSURE	POTENTIAL PATHWAY
<b>Hazardous Ground Gases</b>		
<b>Methane and Carbon Dioxide associated with possible on-site fill material</b>	Inhalation Accumulation	Construction Workers Commercial End Users
<p><b>Discussion:</b> Made Ground underlying the site, in particular the areas of infilled quay may be a source of hazardous ground gases which can accumulate within deep excavations and pose a potential risk to construction workers.</p> <p>Ground gas can also migrate through permeable strata, foundation structures and/or service ducting and accumulate within confined spaces where they may pose a risk to residential end users. Based on the information currently available there is considered to be a low risk to future site users.</p>		
<b>Controlled Waters</b>		
<b>Hydrocarbon compounds associated within railway lines and former dockland operations</b>	Vertical / Lateral Migration	Principal Aquifer River Mersey Wapping Dock Queens Dock
<p><b>Discussion:</b> Significant on-site sources of potentially mobile contaminants are possible, however no historical or current tanks have been identified.</p> <p>The site is underlain by limited drift deposits which will offer little protection from vertical migration of any mobile contaminants. The presence of the River Mersey to the west of the site, in addition to Wapping and Queens Dock to the east, it is considered that there is a moderate to high risk to controlled waters and a detailed controlled waters risk assessment will be required to satisfy the Environment Agency.</p>		
<b>Buildings and Infrastructure</b>		
<b>pH &amp; Sulphate</b>	Corrosion of Concrete	Foundations / Concrete
<p><b>Discussion</b> Presence of pH and sulphate within Made Ground deposits may result in corrosion of buried concrete within the proposed development. Assessment must be undertaken to confirm the levels of pH and sulphate within Made Ground deposits and thus determine the concrete classification.</p>		
<b>Ecology</b>		
<b>None Identified</b>	Lateral Migration	River Mersey
<p><b>Discussion</b> The River Mersey is considered to be the only viable ecological receptor, the sensitivity of this watercourses is likely reduced by the presence of dock wall structures that will restrict lateral migration from the site.</p>		

## 7. CONCLUSIONS AND RECOMMENDATIONS

### Site Summary

The site has historically been utilised as a dock land area with railway sidings and quays which have been infilled. More recently the site has utilised as a car park, highway and an area of POS.

The former uses are considered to have the potential to be sources of heavy metal, polycyclic aromatic hydrocarbon (PAH), petroleum hydrocarbon, asbestos and ground gas impact to the sub-surface.




The site was heavily bombed during the Second World War and therefore a UXO Assessment is recommended prior to any groundworks.

### Contamination Issues

Human Health	<p>The site has historically been a quay that has subsequently be infilled and developed as a rail siding and most recently a car park and electricity sub-station. Based on these historical uses, localised areas have been identified as potentially impacted by heavy metals, Semi Volatile Organic Compounds (SVOC), Volatile Organic Compounds (VOC) and hydrocarbon compounds. Additionally, Made Ground may also be a potential source of ground gas.</p> <p>The risk to the subject site from potential off-site contaminant sources of contamination are likely to be negated due to the presence to the east of Queens Dock and Wapping Quay, therefore limiting the potential for contaminant migration.</p> <p>Should impacted Made Ground be present then this may pose a risk to construction workers and future commercial and residential end users, particularly if the proposed development includes areas of public open space</p>
Controlled Waters	<p>Significant on-site sources of potentially mobile contaminants are possible, however no historical or current tanks have been identified.</p> <p>The site is underlain by limited drift deposits which will offer little protection against vertical migration of any mobile contaminants to the underlying Principal aquifer. Additionally, lateral migration of mobile contaminants may pose a risk to the River Mersey to the west and Wapping and Queens Dock to the east.</p>
Ground Gas	<p>Former infilled dockland is present below the site which may be potential sources of alluvial / organic deposits which may be a source of carbon dioxide and methane. Carbon dioxide and methane have associated asphyxiation and explosive risks respectively and if present the risks can be appropriately mitigated through the careful design of building structures.</p>
Potable Waters	<p>Following detailed Remediation and Enabling Works it is considered the site will be suitable for PE water supply pipework.</p>

### Geotechnical Issues

Based on the desk study information, the following geotechnical assessment has been made:

-  Due to the site's locality to the River Mersey it is anticipated that there will be shallow groundwater below the site;
-  Given the heavily developed nature of the site, it is likely there will be deep Made Ground fill deposits and obstructions. Existing buildings will require demolition with all relic foundations removed prior to the construction of the proposed development;
-  The site is defined as being at high risk from unexploded ordnance and therefore a detailed UXO Risk Assessment is recommended and,



A historically infilled quay is present within the site boundary which is potential sources of alluvial deposits, silts and possible organic peat deposits in addition to potential depths of Made Ground. Investigation will be required in order to assess these and undertake in-situ geotechnical testing to determine likely foundation solutions.

## END OF REPORT





## APPENDIX I LIMITATIONS



1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the Client as indicated in Section 1.2.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.
10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.



## APPENDIX II GLOSSARY

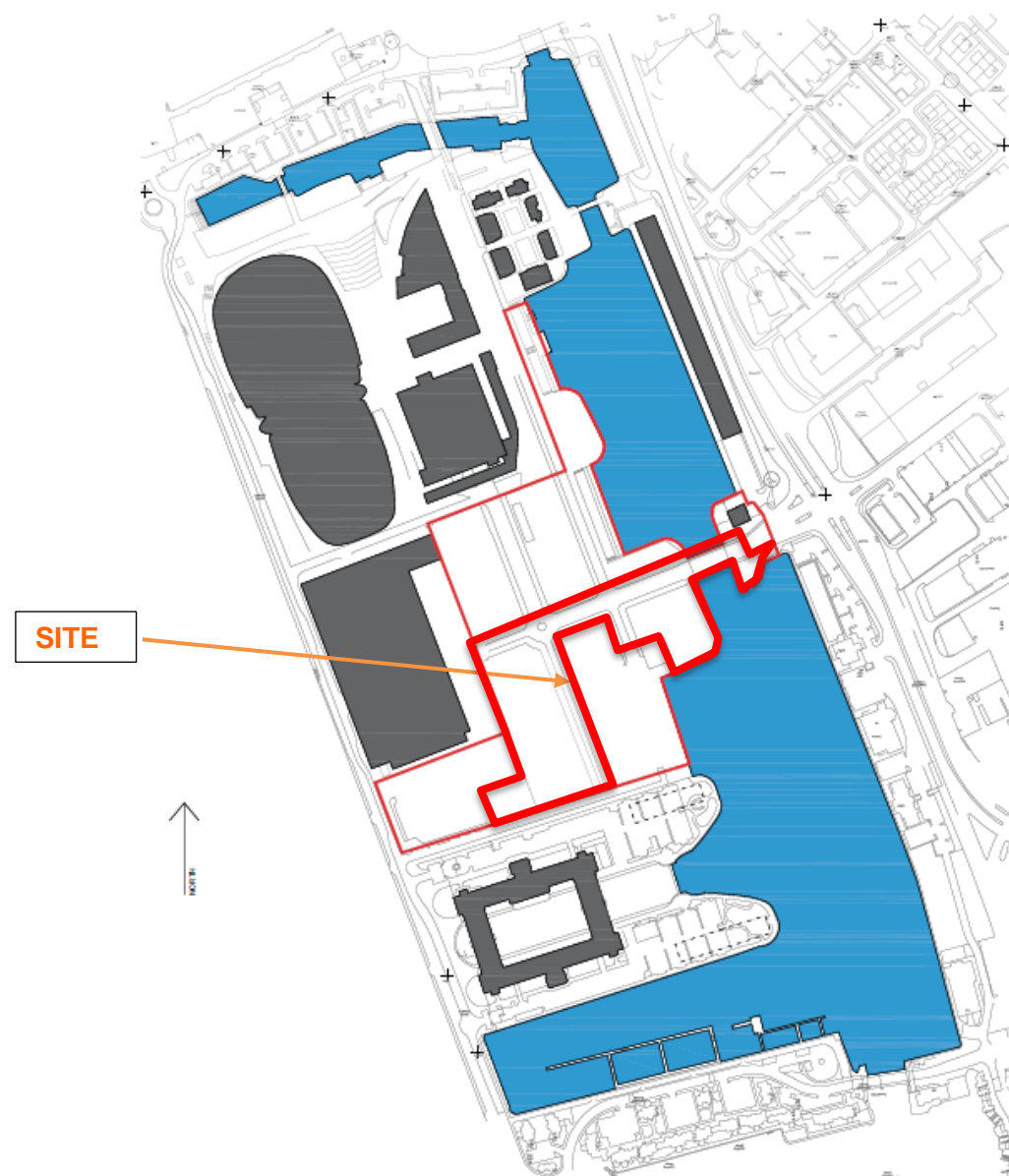


## TERMS

<b>AST</b>	Above Ground Storage Tank	<b>SGV</b>	Soil Guideline Value
<b>BGS</b>	British Geological Survey	<b>SPH</b>	Separate Phase Hydrocarbon
<b>BSI</b>	British Standards Institute	<b>TPH CWG</b>	Total Petroleum Hydrocarbon (Criteria Working Group)
<b>BTEX</b>	Benzene, Toluene, Ethylbenzene, Xylenes	<b>SPT</b>	Standard Penetration Test
<b>CIEH</b>	Chartered Institute of Environmental Health	<b>SVOC</b>	Semi Volatile Organic Compound
<b>CIRIA</b>	Construction Industry Research Association	<b>UST</b>	Underground Storage Tank
<b>CLEA</b>	Contaminated Land Exposure Assessment	<b>VCCs</b>	Vibro Concrete Columns
<b>CSM</b>	Conceptual Site Model	<b>VOC</b>	Volatile Organic Compound
<b>DNAPL</b>	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)	<b>WTE</b>	Water Table Elevation
<b>DWS</b>	Drinking Water Standard	<b>m</b>	Metres
<b>EA</b>	Environment Agency	<b>km</b>	Kilometres
<b>EQS</b>	Environmental Quality Standard	<b>%</b>	Percent
<b>GAC</b>	General Assessment Criteria	<b>%v/v</b>	Percent volume in air
<b>GL</b>	Ground Level	<b>mb</b>	Milli Bars (atmospheric pressure)
<b>GSV</b>	Gas Screening Value	<b>l/hr</b>	Litres per hour
<b>HCV</b>	Health Criteria Value	<b>µg/l</b>	Micrograms per Litre (parts per billion)
<b>ICSM</b>	Initial Conceptual Site Model	<b>ppb</b>	Parts Per Billion
<b>LNAPL</b>	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)	<b>mg/kg</b>	Milligrams per kilogram (parts per million)
<b>ND</b>	Not Detected	<b>ppm</b>	Parts Per Million
<b>LMRL</b>	Lower Method Reporting Limit	<b>mg/m<sup>3</sup></b>	Milligram per metre cubed
<b>NR</b>	Not Recorded	<b>m bgl</b>	Metres Below Ground Level
<b>PAH</b>	Polycyclic Aromatic Hydrocarbon	<b>m bcl</b>	Metre Below Cover Level
<b>PCB</b>	Poly-Chlorinated Biphenyl	<b>mAOD</b>	Metres Above Ordnance Datum (sea level)
<b>PID</b>	Photo Ionisation Detector	<b>kN/m<sup>2</sup></b>	Kilo Newtons per metre squared
<b>QA</b>	Quality Assurance	<b>µm</b>	Micro metre
<b>SGV</b>	Soil Guideline Value		

## APPENDIX III DRAWINGS

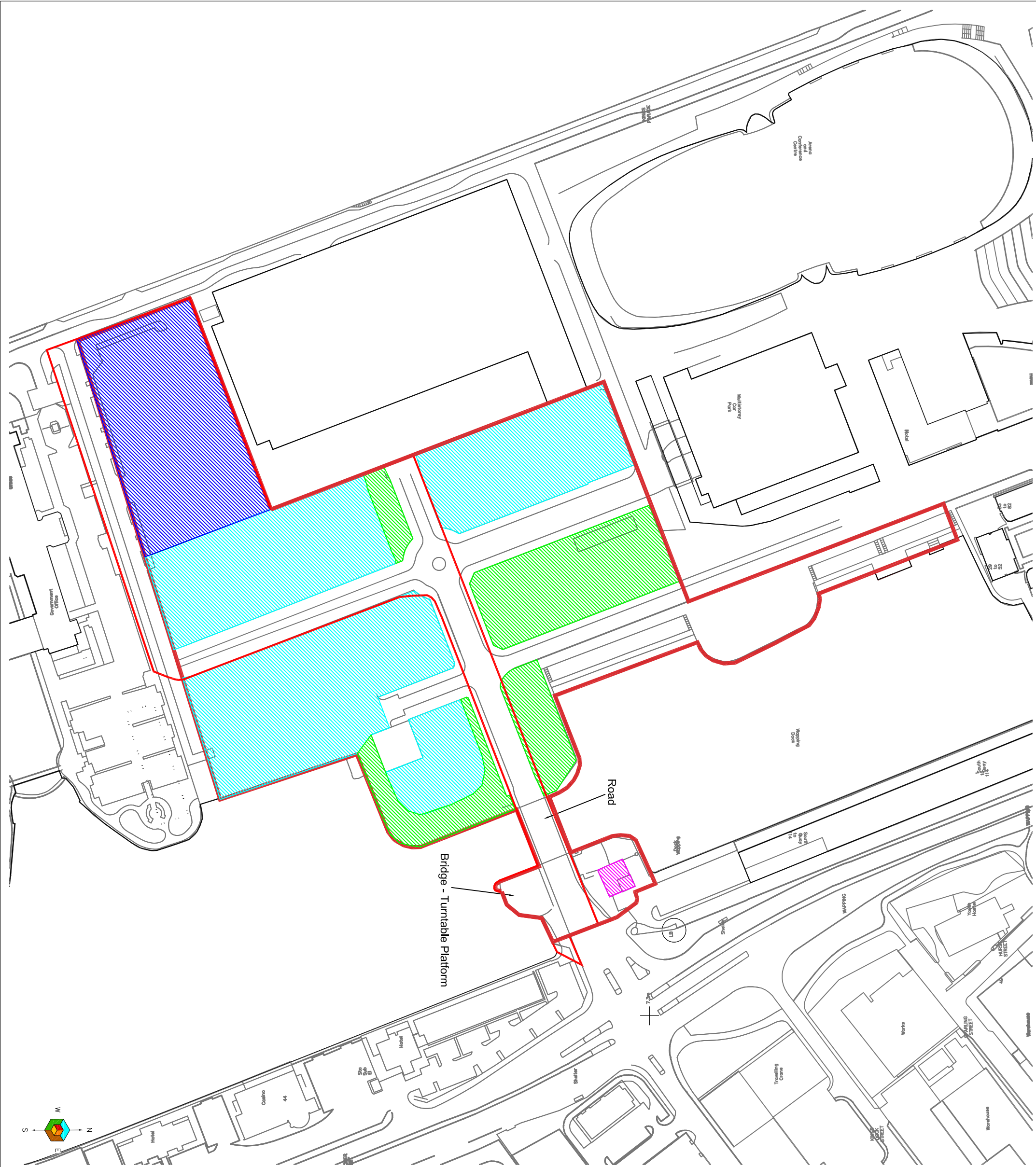








*Drawing 11-630-001  
Site Location Plan*







- Key:**
-  Historic Viewing Tower
  -  Soft Landscape Areas/Public Open Space
  -  Car Park
  -  Current Construction Site

Notes:

P1		-	17.10.2017	DRAFT	AL	MD
Phase		Revision	Date	Issue	Drawn	Authorised
Client:		Knight Frank		Job No:	11-630	Date: 17.10.2017
				Drawing No:	002	Scale: NTS @ A3
Job Title:		Monarchs Quay, Liverpool		Drawing Title:		
				Phase 2 Current Site Features Plan		



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- Historical Features**
- Pre 1890 (North Shed, Queens Half Tide Dock, Mastling Sheers, Swing Bridge, Customs Depot, Kings and Wapping Shed)
  - Pre 1908 (Queens Branch Dock, Railway Sidings)
  - Pre 1927 (Railway Sidings, Wapping Dock Station)
  - Pre 1984 (Queens Wharf)

Notes:					

Notes:					

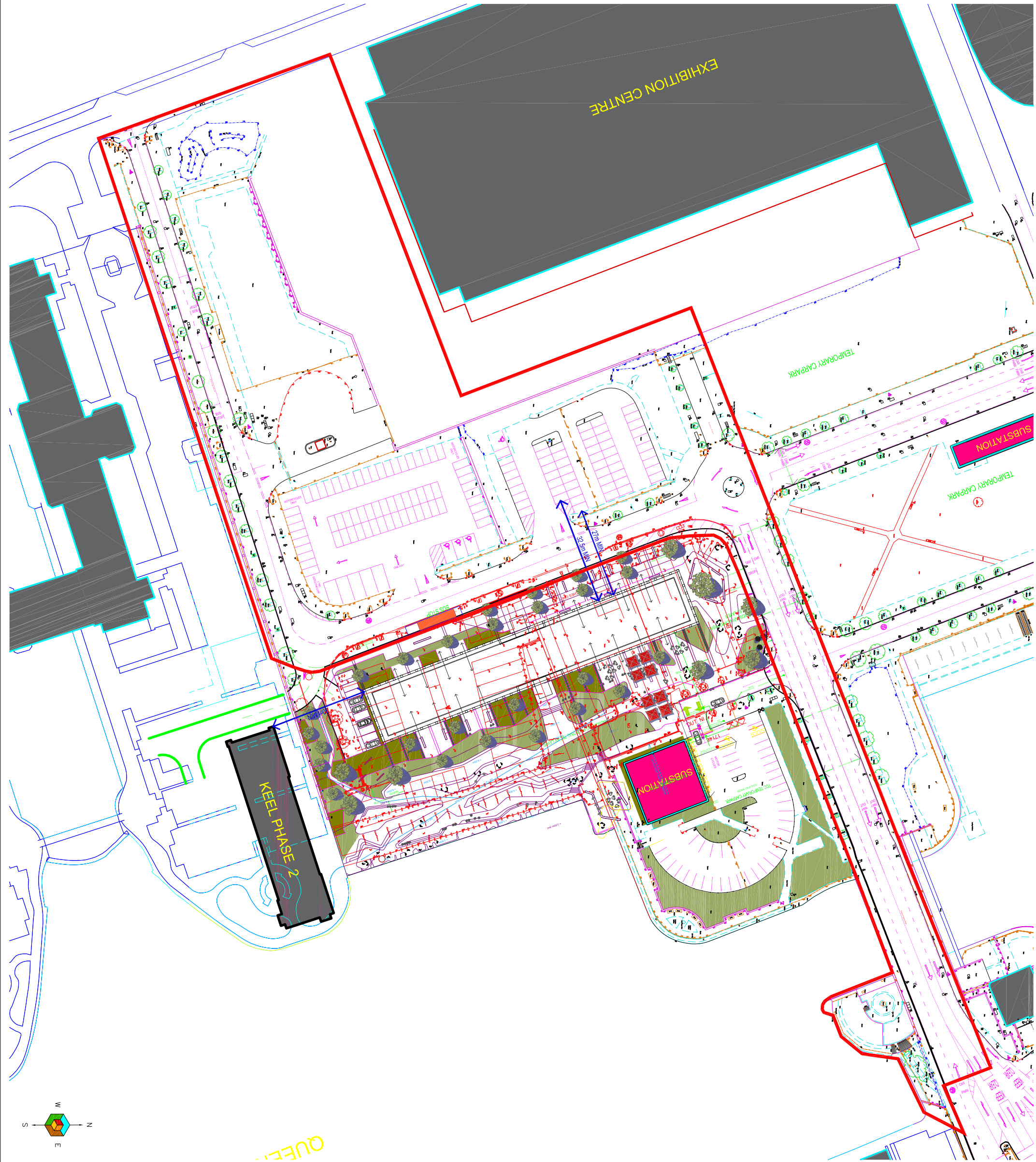
Job Title:	Drawing Title:
Monarchs Quay, Liverpool	Phase 2 Historical Features Plan



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QUEEN'S

Key:

Notes:

P1	-	17.10.2017	DRAFT	AL	MD
Phase	Revision	Date	Issue	Drawn	Authorised
Knight Frank		Job No:	11-630	Date:	17.10.2017
		Drawing No:	004	Scale:	NTS @ A3
		Job Title:	Monarchs Quay, Liverpool		
		Drawing Title:	Phase 2 Proposed Development Plan		



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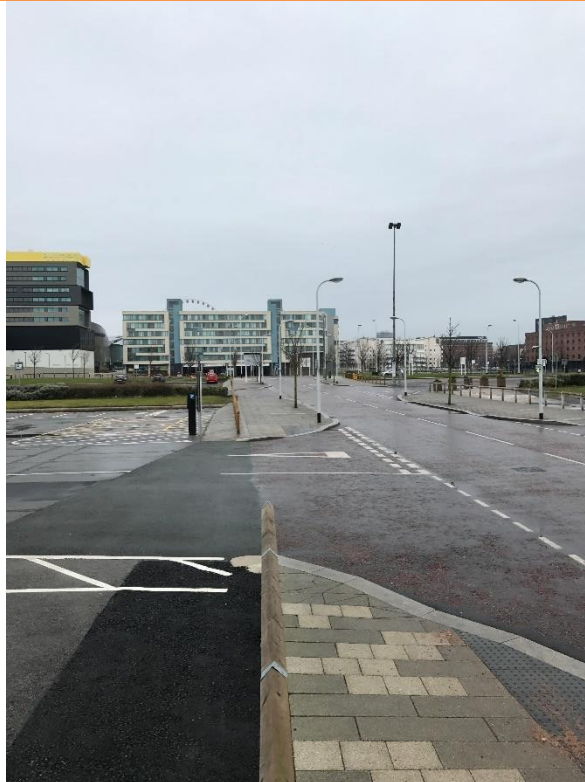
## APPENDIX IV PHOTOGRAPHS







**PLATE 1 – LOOKING EAST FROM BEYOND THE WEST OF THE SITE**



**PLATE 2 – LOOKING NORTH ACROSS THE SITE**



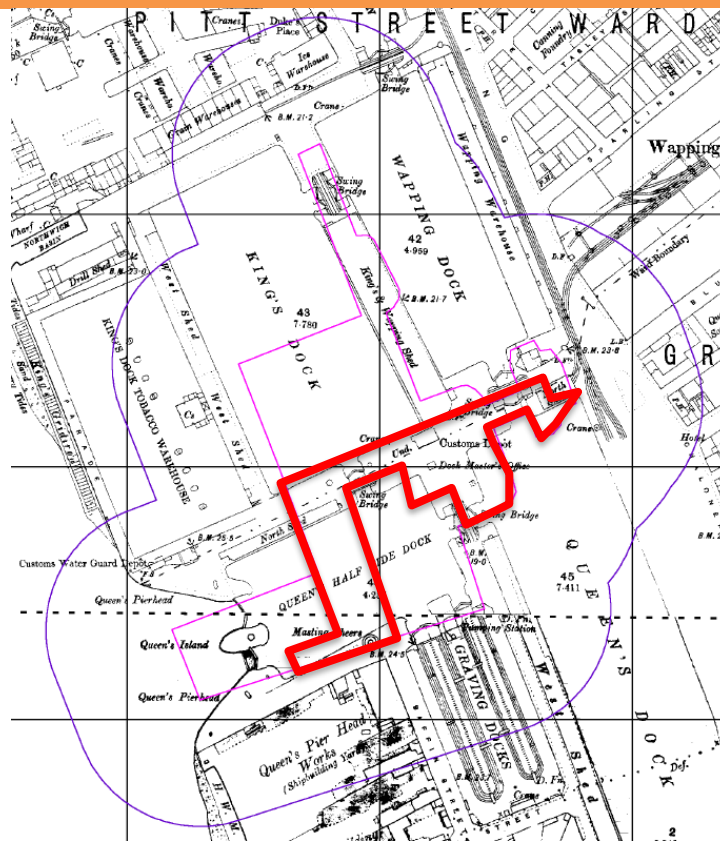


**PLATE 3 – A VIEW OF WHERE THE PROPOSED BUILDING 2 IS LOCATED**



## APPENDIX V HISTORICAL MAPS





### Historical Map

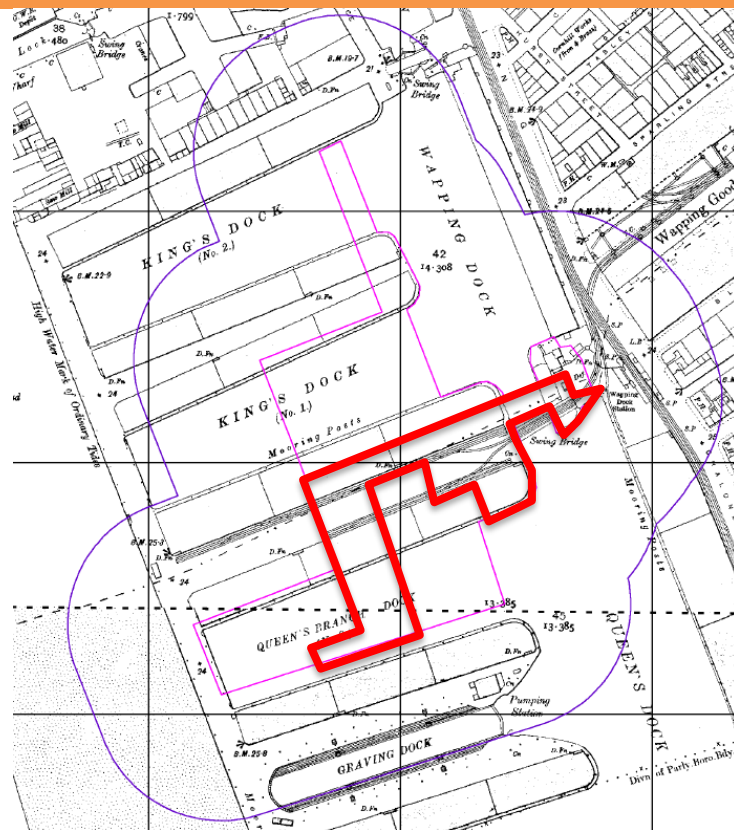
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Original Scale: 1:2,500



North





### Historical Map

Dated: 1908

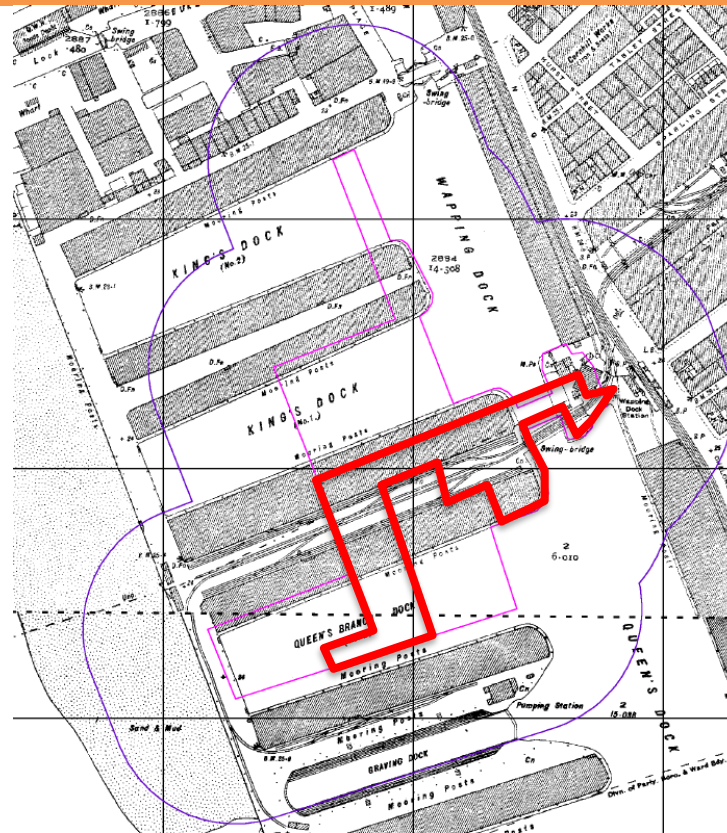
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North







### Historical Map

Dated: 1927

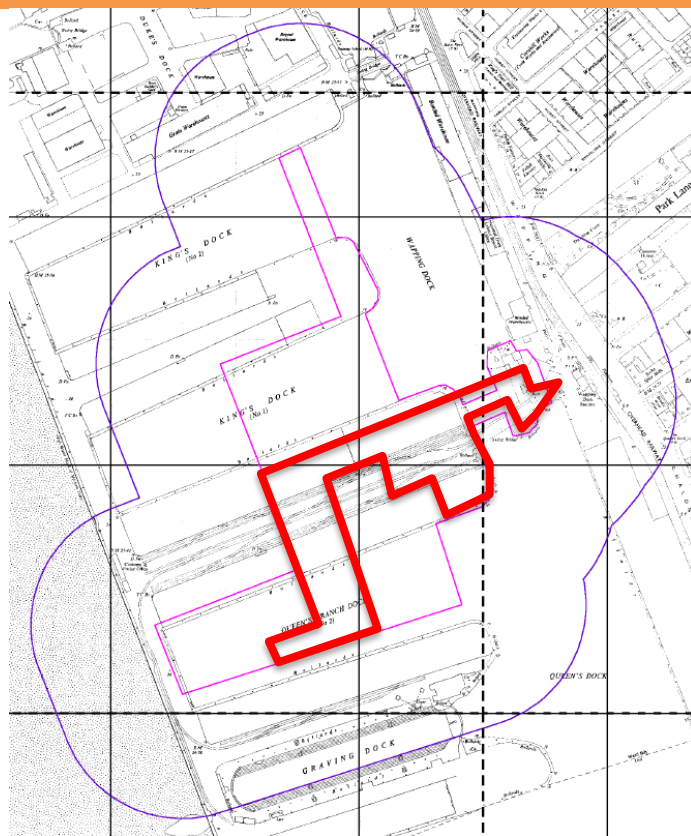
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North







### Historical Map

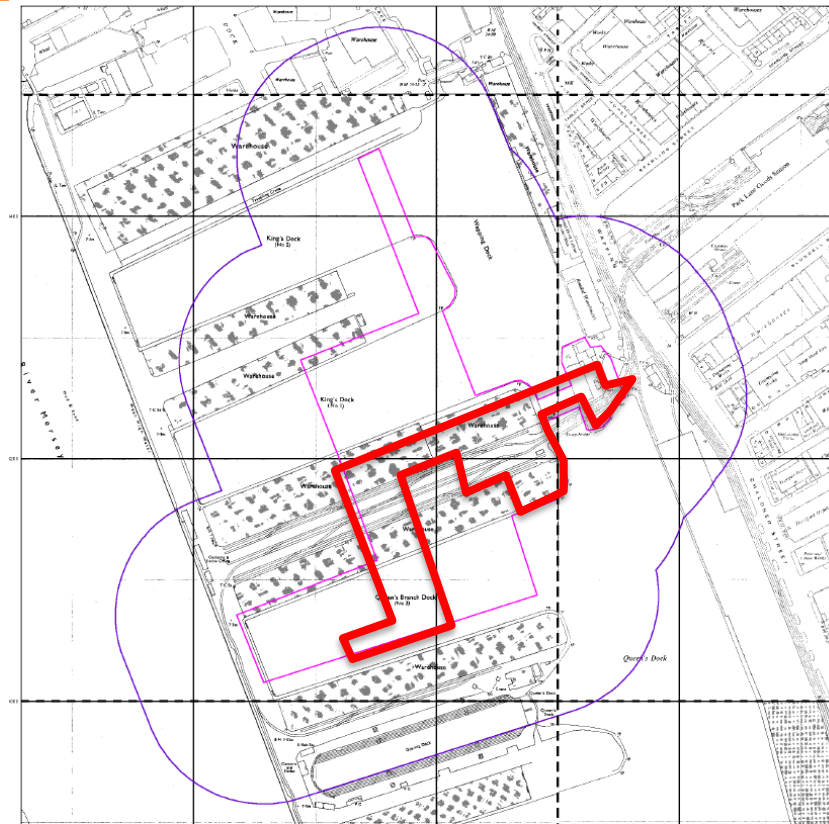
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North





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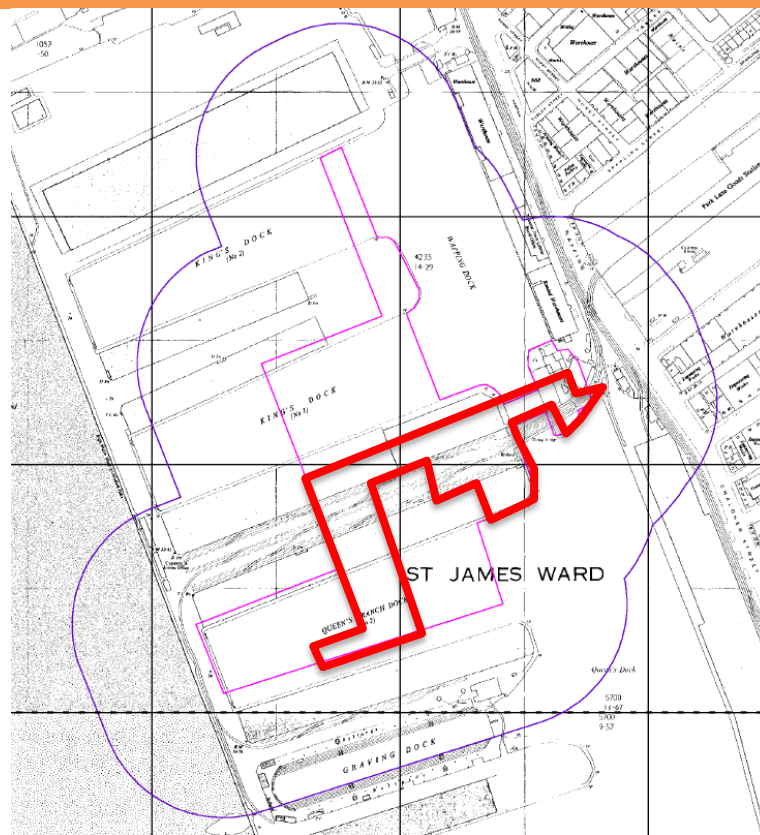
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North





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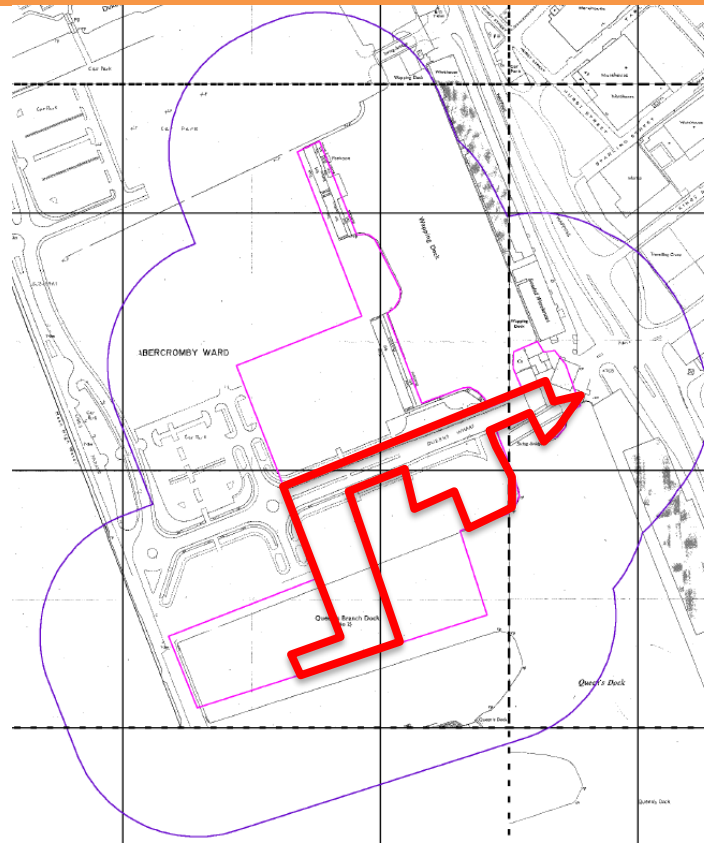
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North





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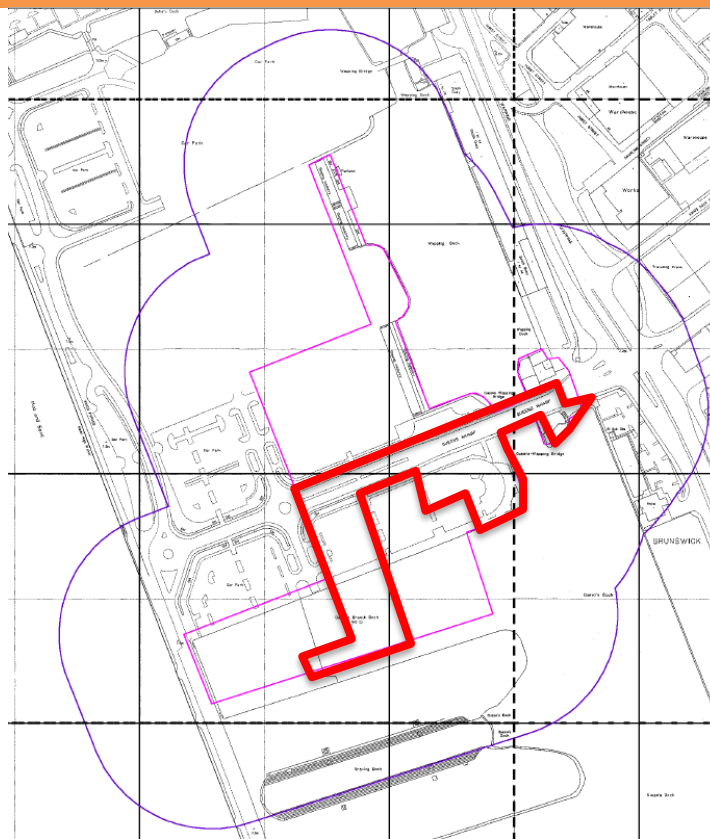
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North





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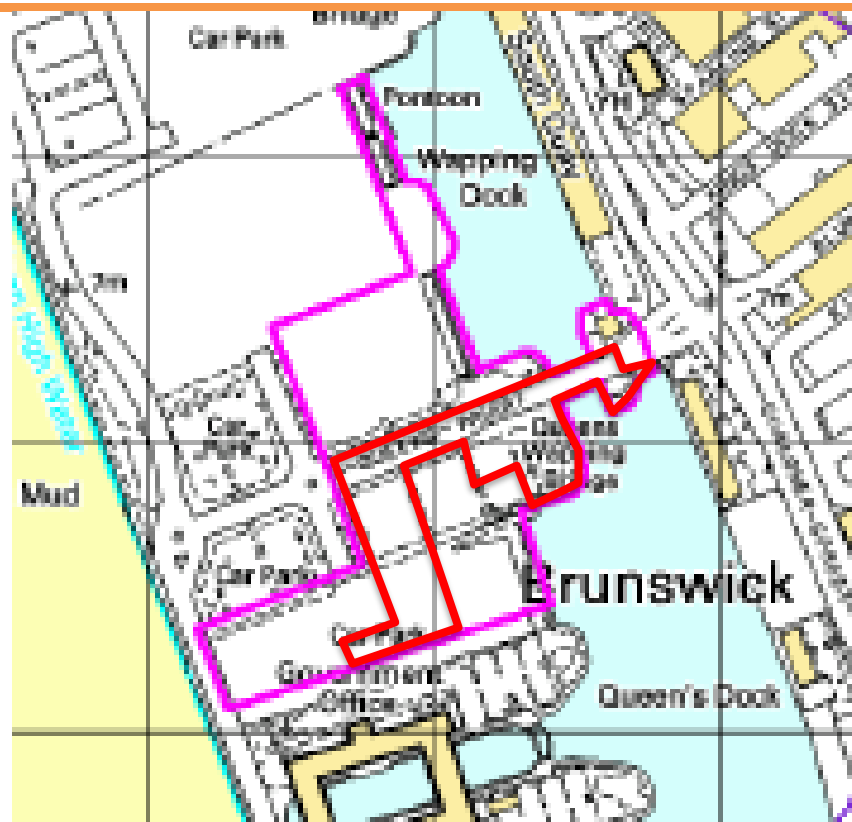
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Original Scale: 1:2,500



North





#### Historical Map

Dated: 1999

Original Scale: 1:10,000







#### Historical Map

Dated: 2016

Original Scale: 1:10,000



North



