

Jehu Group

JACK'S PILL LAND, USK WAY, NEWPORT

Site Investigation Report

12923/JJ/21/SI

CLIENT: Jehu Group

PROJECT: Jack's Pill Land, Usk Way, Newport

TITLE: Site Investigation Report

JOB NO: 12923

DOCUMENT REF: 12923/JJ/21/SI

Revision	Purpose Description	Originated	Reviewed	Authorised	Date
0	Issue	LW/JJ	RB	HP	Nov '21

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1.0 INTRODUCTION

1.1 GENERAL

Jehu Group are proposing to redevelop a site known as 'Jacks Pill', located off Usk Way in Newport, for residential end-use. The location of the site is shown in Figure 1.

Intégral Géotechnique (Wales) Limited have been appointed as the Geotechnical Engineers to undertake an intrusive site investigation to enable a geotechnical and geoenvironmental appraisal of the site and provide a basis for design.

This report presents the findings of the intrusive site investigation and gives recommendations for the design of foundations, floor slabs and other geotechnical and geoenvironmental aspects of the project.

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1.2 PROPOSED DEVELOPMENT

The proposed development will comprise the construction of a number of residential apartment blocks (up to 5 storeys high) and a number of low-rise terraced residential properties. The development will include associated infrastructure such as access roads, car parking areas, private driveways, areas of landscaping, and private gardens. An indicative development layout is presented in Figure 2.

1.3 SCOPE OF WORKS

The work instructed included a desk study of available information, site reconnaissance and intrusive site investigation. This was followed by laboratory testing, on site monitoring and geotechnical and geoenvironmental reporting.

The desk study comprised a review of:

- An Envirocheck Report obtained for the site

1.3 SCOPE OF WORKS (CONTINUED)

- Old Ordnance Survey maps covering the site, included within the Envirocheck Report
- A Radon GeoReport obtained from the British Geological Survey (BGS)
- Geological maps of the area provided by the BGS
- The Natural Resources Wales (NRW) groundwater vulnerability map and aquifer database for the area
- Existing site investigation and reclamation data.

The desk study information was used to make an initial assessment of the site and to design an intrusive site investigation to be carried out by Intégral Géotechnique (Wales) Limited. The intrusive site investigation was designed in accordance with BS 5930:2015+A1:2020, the Code of Practice for Site Investigations, BS10175:2011+A2:2017, the Code of Practice for Investigation of Potentially Contaminated Sites, and 'Development of Land Affected by Contamination: A Guide for Developers' prepared by Welsh Local Government Association (WLGA)/Natural Resources Wales (NRW) Land Contamination Working Group, 2017.

The intrusive site investigation comprised:

- 12 No. machine excavated trial pits, 2 No. machine excavated trial trenches, and 4 No. shell and auger boreholes carried out during October 2021
- Soakaway testing carried out in 4 No. trial pits
- Sampling of soil for laboratory chemical testing
- Sampling of soil for laboratory geotechnical testing
- Sampling of groundwater for laboratory chemical testing
- Monitoring for concentrations of methane, carbon dioxide, oxygen, and gas flow
- Monitoring of groundwater levels.

1.4 LIMITATIONS

This document is intended to be a working document for further development in discussion with all concerned including the Local Planning Authority, Natural Resources Wales, and the NHBC as appropriate.

1.4 LIMITATIONS (CONTINUED)

“Contamination” is taken throughout the report to mean the “presence of one or more potentially harmful substances as a result of human activity”. The use of the term in this way does not imply that harm is being or might be caused by the contamination. It should be noted that “contamination” can have different meanings under different regulatory regimes, for example, planning, building control and Part IIA of the Environmental Protection Act 1990.

Naturally elevated concentrations of potentially harmful substances may also be of concern and the significance of any that have been found is also evaluated in this report.

It is important to recognise that there may be areas of contamination that have not been found, or that contaminants are present at concentrations above those that have been found. It is also important to recognise that contamination may be localised and that no investigation, however comprehensive, is capable of finding such occurrences other than by chance.

It should also be noted that vertical and lateral changes in ground conditions may be present between exploratory hole locations.

It was not possible to gain access to the southern corner of the site at the time of the site works. This area was fenced off and occupied by homeless people at the time of the fieldworks.

2.0 THE SITE

2.1 SITE LOCATION AND DESCRIPTION

The site is located off Usk Way, approximately 1.0km south east of Newport city centre, at a National Grid Reference of 331850, 187530, see Figure 1.

The site is roughly rectangular in shape and occupies an area of approximately 1.1 hectares. The boundaries of the site are defined by a pedestrian walkway along the River Usk to the east and south, Usk Way to the west, and 'Newport Student Village' to the north.

The majority of the site comprises a disused former pay-and-display car park (formerly known as 'Usk Way Car Park'). The ground surface generally comprises gravel and areas of scrub vegetation.

An area in the southern corner of the site is fenced off and laid to hardstanding (comprising a combination of tarmac and concrete). This area was inaccessible at the time of the fieldworks due to the presence of a homeless person's campsite.

A site plan is presented in Figure 3.

The site is generally flat and situated on relatively low-lying ground at an approximate elevation of 9m AOD.

2.2 SITE OPERATIONS

The site is currently vacant with no on-going operations.

2.3 SURROUNDING LAND USE

The surrounding areas are generally developed for commercial use.

2.4 AVAILABLE SITE INVESTIGATION & RECLAMATION DATA

The following previous reports covering the site have been made available for review:

- Geotechnical Report by Intégral Géotechnique (Wales) Limited, Ref. 8418/RB/04, dated September 2004. On behalf of Newport City Council.
- Validation Report for Site Remediation by Intégral Géotechnique (Wales) Limited, Ref. 9059/TD/06, dated August 2006. On behalf of Newport City Council.

2.4 AVAILABLE SITE INVESTIGATION DATA (CONTINUED)

Intégral Géotechnique (Wales) Limited have previously undertaken a site investigation within the site and the land parcel directly to the north in 2004. The site investigation works consisted of the drilling of cable percussion and windowless sample boreholes and the excavation of trial pits.

During the intrusive works, the encountered ground conditions typically consisted of a variable thickness of made ground, overlying superficial deposits consisting of alluvial clays, over gravels, over mudstone bedrock of the Mercia Mudstone Formation.

The made ground was proven to depths of between approximately 1.8m and 7.3m below existing ground level, with an average thickness of 3.0m. The made ground consisted of loose, loose to medium dense and medium dense clayey ashy sand, gravels and cobbles or locally clay.

The made ground was underlain by alluvial deposits consisting of soft, soft to firm occasional sandy silty clay and sandy silt. The deposits were encountered to depths of between 12.7m and 16.8m below existing ground level. The cohesive deposits were further underlain by granular deposits consisting of medium dense sand, gravel and cobbles. The granular deposits were encountered to a maximum depth of 20m below existing ground level.

The superficial deposits were further underlain by mudstone bedrock strata of the Mercia Mudstone Formation.

Perched groundwater was encountered within the made ground deposits at a depth of typically 1.5m to 1.8m below existing ground level. The perched groundwater was often oily with a hydrocarbon odour.

Deeper groundwater was encountered within the granular superficial deposits at depths of between 12.8m and 16.5m below existing ground level. Due to the proximity of the site to the River Usk, the deeper groundwater is tidally influenced.

During the site investigation works, samples of the made ground were sent for laboratory chemical testing and the results were screened against appropriate residential thresholds. The results indicated exceedance of arsenic, cadmium, lead, copper and zinc and locally PAHs, petroleum hydrocarbons, SVOCs and VOCs. The results of the laboratory leachate testing indicated exceedances of copper, zinc and cyanide.

2.4 AVAILABLE SITE INVESTIGATION DATA (CONTINUED)

Monitoring wells were installed within cable percussion boreholes to monitor and sample the deeper groundwater. The results of the laboratory groundwater testing indicated exceedances of magnesium, copper, zinc, petroleum hydrocarbons and naphthalene.

Shallow ground gas monitoring wells were also installed within the boreholes. The results of the ground gas monitoring programme indicated a mean maximum methane concentration of 10.3% and a mean maximum carbon dioxide concentration of 7.1%. Depleted oxygen concentrations were encountered within the boreholes.

The reports recommended that proposed buildings should be founded upon piled foundations set at an appropriate depth within the granular deposits or the underlying Mercia Mudstone Formation.

Following the site investigation works, a reclamation and remediation strategy was produced by Intégral Géotechnique (Wales) Limited. The main features of the works consisted of removal of hardstanding, structures and buried obstructions to a depth of 1.5m, removal of any areas of loose/soft made ground, reprocess made ground for re-use with the removal and treatment of any encountered contamination hotspots within the made ground and perched groundwater, and engineered placement of structural clean fill to create a development plateau. A minimum 600mm thick clean capping layer was advised in areas of soft landscaping and gardens following development.

The reclamation works were undertaken in 2005 by Alun Griffiths (Contractors) Limited, and monitored by Intégral Géotechnique, who prepared a validation report for the works. The validation report states that an acceptable reclaimed plateau was achieved by removing the existing made ground to a depth of 1.5m, including the removal to 1.5m depth of any hardstanding and buried obstructions and placing of acceptable reprocessed materials in an engineered manner to form a development surface.

It should be noted that during the reclamation works a 7m easement was established along the River Usk to the east and Jack's Pill to the south. A further 3m easement was established around a commercial building located in the south-western corner of the site, as the premises remained occupied for the duration of the works. No reclamation or remediation works were undertaken within the easement zones.

During the monitoring works, samples were taken at regular intervals for chemical and physical testing. Suspected hotspots were removed and subject to additional chemical testing. Materials found to be acceptable were re-used on site. Perched groundwater, locally encountered to contain free phase hydrocarbon products was pumped into an oil/water separator before being returned to the site via a second discharge sump.

2.4 AVAILABLE SITE INVESTIGATION DATA (CONTINUED)

Following completion of the works, 40 validation samples were taken from across the site at approximate 20m centres. The results of the laboratory chemical testing indicated that the contaminant concentrations were below the appropriate threshold with exception to lead. No asbestos fibres were identified within the made ground samples.

To determine the presence of potential buried obstructions below the 1.5m reduced dig a geophysical survey was undertaken. No significant anomalies were identified.

Additional groundwater monitoring wells were installed on site to obtain groundwater samples from both the perched groundwater and the deeper groundwater. The results of the laboratory groundwater testing indicated that the contaminant concentrations within the deeper groundwater were below the appropriate EQS thresholds for estuarine waters. Elevated concentrations of mercury were detected within the perched groundwater. However, it was concluded that the past site usage and the made ground present does not impact adversely on groundwater.

2.5 CONSULTATIONS WITH REGULATORS

The Local Authority have not been consulted at this stage.

3.0 SITE HISTORY

The recent history of the site has been traced with the aid of an Envirocheck Report, a copy of which is included in Appendix A. The Envirocheck Report includes the following scaled historical maps:

Map Scale	Dates
1:500	1883-1884
1:2,500	1883-1884, 1901-1902, 1937, 1956, 1970
1:1,250	1956, 1965-1968, 1974, 1986-1991, 1989, 1991, 1992, 1993, 1993-1994, 1995, 1996
1:10,560	1886-1187, 1902, 1922, 1938, 1947, 1954
1:10,000	1965, 1973, 1981, 1983, 1987, 1999, 2006, 2021

The earliest edition of the map, dated 1883-1884, indicated that the site was known as Victoria Wharf and a number of buildings were located in the northern and western area of the site. A tank was located in the northern to central area of the site. Railway lines/tram lines were located across the remaining site area extending from the north western corner towards the River Usk immediately east of the site and Jack's Pill located immediately south of the site. The high-water mark of the River Usk was located along the eastern and southern site boundary.

River Wharf was located immediately north of the site, which was occupied by a number of buildings and tram lines. Further railway lines/tram lines were located directly west of the site. Numerous wharfs continued along the River Usk to the north and south of the site. A goods depot was located approximately 145m west of the site. Residential areas were located some 60m north west of the site and some 155m south west of the site. A cattle market was located approximately 230m south west of the site.

By 1901-1902, no significant changes had occurred on site, with the exception to reconfiguration and/or addition of buildings and railway lines/tram lines. The wharf to the north was now known as Gloucester Wharf and Mary Dry Dock was located approximately 65m south of the site. A number of buildings were located some 20m south of the site. Further railway lines/tram lines were located immediately east of the site.

3.0 SITE HISTORY (CONTINUED)

A map dated 1937, indicated that the tank was no longer located on site. The number of railway lines/tram lines crossing the site had decreased, along with a slight reduction in the number of buildings in the northern area of the site. Within Gloucester Wharf, the buildings had been removed. Along the banks of the River Usk, the number of wharfs had decreased, and a number of docks had been infilled.

A map dated 1956, indicated that the buildings located on site had been reconfigured and were labelled as Ebbw Vale House and a warehouse. The number of railway lines/tram lines had further decreased, however a number of cranes associated with the lines were located on site. On Gloucester Wharf located directly north of the site, new buildings had been constructed. Mary Dry Dock located 65m south of the site had been infilled and the buildings located some 20m south of the site were noted as ruins.

A map dated 1965-1978, showed significant changes had occurred on site, with Victoria Wharf noted as disused. Ebbw Vale House and the Warehouse remained in the north of the site; however, the buildings had been reconfigured with the addition of some further buildings. In the central area of the site a Wagon Works was located, and a Welding and Engineering Works was located in the south western area of the site. Gloucester Wharf to the north was also noted as disused. Additional buildings were located on the site and noted as a Scrap Yard. The former area of Mary Dry Dock was now noted as Jack's Wharf with the construction of a large building on the former dock. The number of railway lines directly west of the site had significantly decreased. A number of breweries and some residential properties were located some 150m east and south east of the site. A new road network had been constructed in the immediate area, with the construction of George Street Bridge crossing the River Usk approximately 75m north of the site and Dock Street and East Dock Road located approximately 106m west and 115m south of the site.

By 1973-1987, the Wagon Works were no longer shown, and the Welding and Engineering Works were extended across the site. Additional buildings were located in the Scrap Yard located directly north of the site. The goods depot had been removed and replaced with a Coal Distribution Centre which contained hoppers, conveyors, cranes etc.

By 1993, no significant changes had occurred on site with the exception to the reconfiguration of the buildings. Jacks Pill Industrial Estate was located south of Jack's Pill. All railway lines had now been removed to the west of the site and replaced by the A4042. The Coal Distribution Centre had been removed. The brewery buildings located some 150m to the west of the site were no longer present.

3.0 SITE HISTORY (CONTINUED)

An aerial image dated 2000, indicated that the industrial works remained on site and consisted of a number of buildings and storage areas. The scrap yard remained to the north and the former Coal Distribution Depot remained cleared and vacant.

Subsequent Google Earth Images indicated that the Jacks Pill Industrial Estate and remaining brewery buildings were demolished and cleared circa early 2000s. By 2004, demolition works were ongoing in the northern area of the site and the storage areas had been cleared. The Scrap Yard to the north had been cleared and the buildings partially demolished.

A Google Earth Image dated 2006, indicated that the majority of the buildings located on site had been demolished with one building remaining in the southern corner. The site, along with the former Scrap Yard to the north was used as a site compound with stockpiles, storage areas, site cabins etc located on site. The former Jacks Pill Industrial Estate remained vacant, and construction of buildings had commenced on the site of the former Coal Distribution Centre.

A Google Earth Image dated 2009 indicated that the site was vacant with the exception of a building remaining in the southern area. Newport Student Village was located directly north of the site and construction of buildings was ongoing on the former Jacks Pill Industrial Estate. Further construction had taken place on the former Coal Distribution Centre including commercial/office buildings, HM Passport Office and Newport Magistrates' Court. An Asda Supermarket had been constructed on the site of the former Cattle Market and brewery buildings. By 2013, the remaining building on site had been removed and the site consisted of a car park.

No significant changes had occurred on site in the subsequent map editions and Google Earth Images with the site remaining a car park until present day.

4.0 SITE ENVIRONMENTAL SETTING

4.1 PHYSICAL SETTING

The site is located on the banks of the River Usk at an approximate elevation of 9m AOD.

4.2 GEOLOGY

The 1:50,000 scale geological map of the area indicates the site to be underlain by bedrock strata of the St Maughans Formation of the Devonian period. These rocks typically comprise interbedded purple, brown and green sandstones and red mudstones with intraformational conglomerates containing calcrete clasts.

Superficial Tidal Flat Deposits of the Quaternary period are indicated to overlie the solid strata. These deposits typically comprise a normally consolidated soft silty clay, with layers of sand, gravel and peat.

A variable thickness of made ground and engineered fill is anticipated above the superficial deposits across the site.

A summary of the anticipated geological succession is given below in Table 1.

Table 1: Summary of Anticipated Site Geology		
Geological unit	Horizon	Description
Recent	Made ground	Various materials
Quaternary	Tidal Flat Deposits	Sands and gravels with varying matrix
Devonian	St Maughans Formation	Interbedded purple, brown and green sandstones and red mudstones with intraformational conglomerates containing calcrete clasts

4.3 RADON

Information with regard to Radon Protective Measures is provided within the Envirocheck Report (see Appendix A) and the BGS Radon GeoReport (see Appendix B). The reports state that the site is within an intermediate probability area, as 1% to 3% of properties are above action level, and that no radon protective measures would be necessary in the construction of new buildings within the site.

4.4 MINING

The site is not located within an area that would be affected by past, present or future underground mining.

4.5 HYDROLOGY, HYDROGEOLOGY AND FLOOD RISK

The nearest surface water feature consists of the River Usk located directly east and south of the site.

The Natural Resources Wales groundwater vulnerability map and aquifer database classifies the bedrock beneath the site as a Secondary 'A' Aquifer. Secondary 'A' Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The Natural Resources Wales groundwater vulnerability map and aquifer database classifies the superficial deposits beneath the site as Unproductive Strata. Unproductive strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

A perched water body is anticipated in the made ground due to the impermeable nature of the underlying tidal flat deposits.

It is considered possible that any existing site drainage could act as a pathway for potential surface contaminants.

The Envirocheck Report indicates that there are 15 discharge consents recorded within 250m of the site boundary. The nearest is located 17m south of the site and operated by Dwr Cymru for the discharge of sewage from a pumping station into the River Usk Estuary. A further eight discharge consents operated by Dwr Cymru for the discharge of sewage from a pumping station or storm overflow into the River Usk are located within 21m and 23m of the site. The next nearest discharge consent is located 108m south east of the site at Old Town Dock for the unspecified discharge into the River Usk. The consent has expired.

The Envirocheck Report states that there are two groundwater abstractions within 1.0km of the site. Both are located at Pirelli Cables located 801m and 804m north east of the site where groundwater was abstracted for general industrial purposes. No further information is available.

4.5 HYDROLOGY, HYDROGEOLOGY AND FLOOD RISK (CONTINUED)

Tables 2 and 3 present a summary of the hydrological features and key hydrogeological nature of the site.

Table 2: Summary of Site Hydrology					
Feature	Distance from site	Flow	Classification	Abstraction	Discharge
River Usk	Immediately east and south of the site	Southerly	Tidal River	No	Bristol Channel
Surface run-off	On site	Flows into site drainage or infiltrates into the ground	N/A	No	Not known
Site Drainage	On site	Not known	N/A	No	Not known

Table 3: Summary of Site Hydrogeology				
Geological Unit	Aquifer Classification	Aquifer Characteristics	Source Protection Zone	Groundwater Abstractions
Made ground	Not classified	Highly variable permeability and porosity. Perched water may be present with variable flow directions.	No	None
Tidal Flat Deposits	Unproductive Strata	Variable moderate permeability and porosity with intergranular flow possible. High clay content likely to restrict flow.	No	None
St Maughans Formation	Secondary 'A' Aquifer	Variable moderate permeability sandstones, mudstones and conglomerates	No	None

The Groundwater Vulnerability map of the area indicates the secondary bedrock aquifer to have a high vulnerability. The pollutant speed is high with well-connected fractures.

The Natural Resources Wales Flood Risk Map as presented within the Envirocheck Report indicates that the majority of the site (with exception to the most western area) is at risk from extreme flooding from rivers or sea without defences (zone 2). The far north eastern boundary is at risk from flooding from rivers and sea without defences (zone 3).

4.5 HYDROLOGY, HYDROGEOLOGY AND FLOOD RISK (CONTINUED)

The Natural Resources Wales Surface Water Flood Risk map as presented within the Envirocheck Report indicates that the site is not at risk to surface water flooding.

The BGS Groundwater Flooding Susceptibility Map indicates that the site is not at risk from groundwater flooding.

4.6 LANDFILL SITES

The Envirocheck Report indicates that there is one registered landfill site recorded within 250m of the site and two historical landfill sites recorded within 500m of the site boundary.

The registered landfill site is located 49m north west of the site at Riverbank, Mariners Wharf and consisted of on-site produced waste comprising hardcore and rubble. The license has either lapsed, been cancelled or surrendered.

The nearest historical landfill is located 295m east of the site on the opposite side of the River Usk at Maindee, Lilleshall Street. No further details are provided.

The Envirocheck Report indicates that there are two areas of potentially infilled land (water) located within 250m of the site boundary. Both are located 225m north of the site and were mapped in 1886 and consisted of an unknown filled ground feature such as pond, marsh river, dock etc. These areas are located on the opposite side of the River Usk.

4.7 POTENTIAL CONTAMINATION

4.7.1 Previous Uses

The various activities in the vicinity of the site which may have resulted in ground or water resource contamination on this site are listed below in Tables 4 and 5. Reference to Department of the Environment Industry Profiles has been made and a summary of the potential contaminants can be found in the tables.

4.7 POTENTIAL CONTAMINATION (CONTINUED)

Table 4: Potential Contaminants		
Land Use: Victoria Wharf until 1960's		
Material/Process	Contamination/Hazard	Evidence
Imported made ground/earthworks	Metals, semi metals, non-metals, PAH, asbestos	Historical Maps
Wharf with numerous buildings and railway/tram lines and unknown industrial processes within buildings	Metals, semi metals, non-metals, PAH, petroleum hydrocarbons, SVOCs/VOCs, PCBs, asbestos	Historical Maps
Above ground storage tanks	Petroleum hydrocarbons – fuel/oils	Historical Maps
Land Use: Numerous works from 1960's until mid-2000s		
Material/Process	Contamination/Hazard	Evidence
Imported made ground/earthworks	Metals, semi metals, non-metals, PAH, asbestos	Historical Maps
Processes within the building including within the Wagon Works and Welding and Engineering Works. Known processes include vehicle repairs and industrial door manufacturing works	Metals, semi metals, non-metals, PAH, petroleum hydrocarbons, SVOCs/VOCs, PCBs, asbestos	Historical Maps
Possible storage tanks	Petroleum hydrocarbons – fuel/oils	Historical Maps
Land Use: Demolition works/reclamation works and site compound mid 2000's to mid-2010s		
Material/Process	Contamination/Hazard	Evidence
Asbestos within building fabric	Asbestos	Historical Maps/Anecdotal information
Minor imported made ground	Metals, semi metals, non-metals, PAH, asbestos	Anecdotal information

4.7 POTENTIAL CONTAMINATION (CONTINUED)

Table 4: Potential Contaminants (CONTINUED)		
Land Use: Car Park from mid 2010s to present day		
Material/Process	Contamination/Hazard	Evidence
Localised spillages from vehicles	Petroleum hydrocarbons – fuel/oils	Current Site Use
Possible imported made ground	Metals, semi metals, non-metals, PAH, asbestos	Current Site Use

4.7.2 Existing Uses

The site is currently unoccupied with no potentially contaminative uses.

4.7.3 Adjacent Site Uses

Table 5: Potential Contaminants: Adjacent Site Uses		
Potential Contamination Source	Boundary	Associated Contaminants and Hazards
River Usk	Eastern and Southern	No Potential Contaminants
Road – Usk Way	Western	No Potential Contaminants
Student Village	Northern	No Potential Contaminants

4.8 OTHER ENVIRONMENTAL ISSUES

The River Usk, which is located immediately east and south of the site, is classified as a Site of Special Scientific Interest (SSI) and a Special Area of Conservation (SAC).

The Envirocheck Report indicates that there is one Local Authority Pollution Prevention and Control in place within 500m of the site boundary. The permit is for the manufacture of timber and wood-based products located 310m south west of the site.

4.8 OTHER ENVIRONMENTAL ISSUES (CONTINUED)

The Envirocheck Report indicates that there have been four pollution incidents to controlled waters recorded within 250m of the site. The nearest was located 45m north east of the site at George Street bridge, where in 1995, a category 3 – minor incident occurred involving chemicals – listed as 'other organic'. The next nearest incidence was located 50m north of the site at Shaftsbury and George, where in 1995 a category 3 – minor incident occurred involving crude sewage.

The Envirocheck Report indicates that there have been no substantiated pollution incidents, or prosecutions relating to controlled waters and prosecutions relating to authorised processes within 1.0km of the site.

The Contemporary Trade Directory Entries indicate that the site was formerly occupied by a car body repairs and garage services and an industrial door manufacturing business.

Areas of dense scrub vegetation are present in the northern and southern parts of the site. The presence of invasive plant species such as Japanese Knotweed cannot be ruled out. A full vegetation survey of the site is recommended. Any identified invasive plant species will require eradication prior to development.

5.0 PRELIMINARY CONCEPTUAL SITE MODEL

5.1 RISK ASSESSMENT FRAMEWORK

In order to be consistent with current UK government policies and legislation, it is necessary to identify, assess, estimate, evaluate, and take appropriate action to deal with land contamination, in accordance with the procedures specified in the Environment Agency guidance Land Contamination Risk Management (LCRM) published in October 2020. This replaces the now withdrawn 'Model Procedures for the Management of Land Contamination CLR-11' (Environment Agency 2004).

The risk assessment process is designed to provide a reasoned, structured and pragmatic mechanism for the identification of any potential human health and controlled waters risks associated with land contamination and where necessary to develop a robust remediation strategy to ensure protection of the sensitive receptors (human health of future residents, controlled waters, etc).

In accordance with LCRM, the term 'land contamination' is defined as:

- All land affected by contamination – land that might have contamination present which may, or may or may not, meet the statutory definition of contaminated land,
- Land determined as contaminated land under Part 2A of the Environmental Protection Act 1990.

LCRM provides a tiered approach to risk assessment, comprising a preliminary risk assessment (including the development of an initial conceptual site model), a generic quantitative risk assessment and a detailed quantitative risk assessment. For each tier of risk assessment, the following steps must be followed:

1. Identify the hazard - establish contaminant sources,
2. Assess the hazard – use a source-pathway-receptor linkage approach to determine if there is potential for unacceptable risk,
3. Estimate the risk – predict what degree of harm or pollution may result and how likely it is to occur, and
4. Evaluate the risk – decide whether a risk is unacceptable.

LCRM also provides definitions of the following terms:

- Hazard – a property or situation that in particular circumstances could lead to harm or pollution,

5.1 RISK ASSESSMENT FRAMEWORK (CONTINUED)

- Risk – a combination of the probability, or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence,
- Risk assessment – the formal process of identifying, assessing and evaluating the health and environmental risks that may be associated with a hazard,
- Risk management – the formal process to identify, assess and determine the risks, and to select and take action to mitigate them.

The three essential elements to any risk are defined by LCRM as follows:

- A contaminant, or pollutant, that is in, on, or under the land and that has the potential to cause harm, or pollution (Source)
- A route by which a receptor is, or could be affected by a contaminant (Pathway)
- A receptor, i.e., something that could be adversely affected by a contaminant, for example a person, controlled waters, an organism, an ecosystem, or Part 2A receptors such as buildings, crops or animals (Receptor).

In order for there to be a potential risk, all three of the above elements must be present. If there is a source of contamination and a receptor (for example a resident or site user), then there is only a potential risk if there is a pathway linking the two. Such an active pathway is known as a relevant pollutant linkage. It is possible for the same contaminant to be linked to a receptor via a number of pathways, and hence it is important that all relevant pollutant linkages, to both human health and controlled waters, are separately identified on a site in order that a comprehensive conceptual model can be formed and ultimately a robust remediation strategy designed.

Current practice during Generic Quantitative Risk Assessment of land affected by contamination is to use generic soil screening values based on the appropriate proposed end use. These usually comprise risk-based Soil Guideline values (SGVs) or Generic Assessment Criteria (GACs) derived by the Environment Agency's Contaminated Land Exposure Assessment Model (CLEA). The SGVs and the supporting technical guidance were developed in order to assist in the assessment of long-term risk to human health from the exposure to contaminated soils.

Revised Statutory Guidance, published in 2012, to support Part 2A of the Environmental Protection Act 1990, introduced a new four category system for classifying land under Part 2A. Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is considered to be acceptably low. Under Part 2A, land would be determined as contaminated if it falls within Categories 1 or 2.

5.1 RISK ASSESSMENT FRAMEWORK (CONTINUED)

The revised Part 2A Statutory Guidance was accompanied by an Impact Assessment that identified a role for new 'Category 4 Screening Levels' (C4SLs) that would provide a simple test for determining when land is suitable for use and definitely not contaminated land. A Policy Companion Document including the C4SLs was published in March 2014 (England) and May 2014 (Wales).

The C4SLs have been based on the CLEA methodology and derived using the CLEA model, with modified toxicological and exposure parameters. To date, C4SLs have been released for six substances (arsenic, cadmium, chromium (VI), lead, benzo(a)pyrene and benzene).

The C4SLs have been derived on the assumption that where they exist, they will be used as generic screening criteria within generic quantitative risk assessment.

Following publication of the C4SLs, Land Quality Management (LQM), in conjunction with the Chartered Institute for Environmental Health (CIEH) released Suitable 4 Use Levels (S4ULs) in January 2015.

The S4ULs have been derived in accordance with UK legislation and using a modified version of the Environment Agency's CLEA software. As such, the S4ULs are based on the concept of minimal or tolerable risk as described in Human Health Toxicological Assessment of Contaminants in Soil (Science Report SR2, Environment Agency 2009a).

S4ULs have been derived for a wider number of substances.

In addition to the existing SGVs, C4SLs and S4ULs, Atkins ATRISK^{soil} also provide a set of Soil Screening Values. These are currently intended to be used in conjunction with SGVs, although they intend to update these values in line with the C4SLs in due course.

With respect to PCBs, the screening value published by RIVM (2014) has been adopted for the sum of seven indicator species derived using Arochlor-1254.

We have reviewed all sets of values and intend to use the most appropriate assessment criteria as Tier 1 screening values in the first instance. Where a published S4UL is available, and considered appropriate, this will be used in the first instance.

5.2 CONCEPTUAL MODEL FRAMEWORK

The preliminary stage of the risk assessment process is to develop and define a conceptual site model, based on the desk study and any existing site investigation data. This is used to establish any potential contaminant sources, identify existing and future receptors and assess if there are any potentially active pathways by which a potential risk may be present.

The preliminary conceptual site model will be developed and refined as site specific data is gathered, such as actual ground conditions and chemical data, resulting in a more robust conceptual understanding of the site.

5.3 CRITICAL SENSITIVE RECEPTOR – HUMAN HEALTH

The proposed redevelopment of the site is for a residential end use. Therefore, the critical sensitive receptor from a human health perspective is an onsite residential receptor.

In accordance with S4UL/C4SL and CLEA guidance for a standard residential with homegrown produce scenario, the critical sensitive receptor for a residential end use risk assessment is a female child, with exposure from 0 to 6 years.

The standard residential with homegrown produce end use conceptual model defined by S4UL/C4SL and CLEA is assumed to be suitable for the purposes of this assessment.

5.4 CRITICAL SENSITIVE RECEPTOR – CONTROLLED WATERS

Based on the proposed redevelopment of the site for a residential end use, and the findings of the desk study, the critical sensitive receptor from a controlled water perspective is groundwater within the Secondary 'A' Aquifer of the St Maughans Formation.

By considering groundwater as the critical sensitive receptor for controlled waters, the groundwater/hydrogeological risk assessment will also be protective of the River Usk located immediately east and south of the site.

5.5 POTENTIAL CONTAMINANT SOURCES

As identified in the desk study, the extensive historical land uses at the site since the late 1800s has resulted in potential contaminative uses that include railway/tramway land, a wharf, vehicle repairs, welding works, door manufacturing and a construction of a site compound and the present-day car park.

The potential types of contaminants of concern are listed below:

- Metals, semi-metals, and inorganics within the made ground and groundwater
- Polyaromatic hydrocarbons (PAHs) within the made ground and groundwater
- Petroleum Hydrocarbons (VPH/EPH) within the made ground and groundwater
- Volatile and Semi Volatile Organic Compounds (VOCs/SVOCs) within the made ground and groundwater
- Polychlorinated Biphenyls (PCBs) within the made ground and groundwater
- Asbestos within the made ground.

5.6 POTENTIAL EXPOSURE PATHWAYS

Potential exposure pathways for the critical receptors (both human health and controlled waters) are listed below:

- Dermal contact with soil and/or soil derived dust
- Ingestion of soil and/or soil attached to home-grown produce
- Ingestion of home-grown produce
- Inhalation of soil derived dust
- Inhalation of vapours – indoor and outdoor air
- Leaching of contaminants from made ground to groundwater
- Transportation of contaminants within groundwater.

In addition, the following exposure pathways have also been considered:

- Ground gas generation and migration
- Building materials durability.

5.7 SUMMARY OF CONCEPTUAL EXPOSURE MODEL

A preliminary conceptual exposure model has been developed for the site. This is based on the findings of the desk study, historical review and a site walk over, and includes all potential sources, pathways and receptors that may be present on site. Those that have been identified as being potentially active require further investigation in the form of sampling and testing of soils and groundwater, followed by appropriate risk assessment.

The preliminary conceptual exposure model will be reviewed and refined following the completion of the site works and laboratory testing.

The preliminary conceptual exposure model is presented below in Table 6.

Table 6: Preliminary Conceptual Exposure Model				
Source		Receptor	Pathway	Potentially Active Pathway?
Origin	Contaminant			
Made Ground of unknown origin and historical land uses	Metals, semi-metals, non-metals, PAH, petroleum hydrocarbons, VOCs/SVOCs, PCBs, asbestos	Resident – human health	Dermal Contact with made ground/dust	✓
			Ingestion of soil and/or soil attached to home-grown produce	✓
			Ingestion of home-grown produce	✓
			Inhalation of dust	✓
			Inhalation of vapours – indoor/outdoor	✓
	Metals, semi-metals, inorganics, PAH, petroleum hydrocarbons, VOCs/SVOCs	Groundwater quality	Leaching from made ground	✓
		Surface water quality	Transportation within groundwater	✓
Made Ground of unknown origin and natural ground	pH and water-soluble sulphate	Building Materials Durability	Direct contact	✓
Ground Gas – organic, gas producing materials	Methane, carbon dioxide	Human health	Accumulation of gases in confined spaces, and/or migration off site, leading to asphyxiation, or risk of explosion	✓

6.0 THE SITE INVESTIGATION

6.1 FIELDWORKS

An intrusive site investigation was designed in accordance with BS 5930:2015+A1:2020, the Code of Practice for Site Investigations, BS10175:2011+A2:2017, the Code of Practice for Investigation of Potentially Contaminated Sites, and 'Development of Land Affected by Contamination: A Guide for Developers' prepared by Welsh Local Government Association (WLGA)/Natural Resources Wales (NRW) Land Contamination Working Group, 2017.

The intrusive site investigation was also designed to provide information to support and refine the preliminary conceptual site model/conceptual exposure model.

The intrusive site investigation comprised:

- 12 No. machine excavated trial pits, 2 No. machine excavated trial trenches, and 4 No. shell and auger boreholes carried out during October 2021
- Soakaway testing carried out in 4 No. trial pits
- Sampling of soil for laboratory chemical testing
- Sampling of soil for laboratory geotechnical testing
- Sampling of groundwater for laboratory chemical testing
- Monitoring for concentrations of methane, carbon dioxide, oxygen, hydrocarbon vapours and gas flow
- Monitoring of groundwater levels.

The machine excavated trial pits (referenced TP1 to TP12) were undertaken using a JCB 3CX mechanical excavator down to a maximum depth of 3.6m bgl. The purpose of the trial pits was to examine the shallow ground conditions and to obtain soil samples for laboratory chemical and geotechnical analysis.

Soakaway testing was carried out at 4 No. trial pits in order to assess the likely infiltration potential of the natural strata.

The machine excavated trial trenches (referenced Trench 1 and Trench 2) were undertaken using a JCB 3CX mechanical excavator down to a maximum depth of 4.0m bgl. The purpose of the trial trenches was to investigate for the presence of any remnant dock/wharf walls in the eastern extents of the site.

6.1 FIELDWORKS (CONTINUED)

The shell and auger boreholes (referenced BH1 to BH4) were drilled to maximum depth of 22.3m bgl using a Dando 2000 drilling rig. In-situ strength testing (SPTs) was carried out in the boreholes. Shallow and deep ground gas and groundwater monitoring standpipes were installed within BH1 to BH4.

Following the installation of the standpipes, groundwater was sampled for laboratory chemical testing, and a programme of gas monitoring was commenced.

The fieldworks were supervised by a qualified Geotechnical Engineer from Intégral Géotechnique (Wales) Limited who also logged the trial pits and boreholes and prepared their detailed engineering logs in accordance with the requirements of BS5930:2015+A1:2020. The engineering logs provide descriptions of the materials encountered in accordance with BSEN ISO 14688-1 (2002) and 14689-1 (2003) for soils and rocks respectively.

The approximate locations of the trial pits, trenches and boreholes are shown in Figure 3. The trial pit logs are presented in Appendix C. The trial trench cross-sections are presented in Appendix D. The shell and auger borehole logs are presented in Appendix E. The soakaway testing results are presented in Appendix F.

6.2 FIELD OBSERVATIONS

Made ground deposits were encountered at all trial pit and borehole locations.

A mild hydrocarbon odour was noted within the made ground at TP2 (between 2.0m and 2.7m depth), and TP3 (between 1.1m and 2.0m depth).

A buried masonry structure, considered to represent a cut down former dock/wharf wall was encountered at Trench 1, at a depth of approximately 2.1m bgl. This structure was recorded to be between approximately 0.8m and 2.0m wide.

A buried timber obstruction, possibly associated with an old dock/wharf wall was encountered at Trench 2, at a depth of approximately 3.0m bgl. This structure was recorded to be approximately 0.5 wide.

6.3 LABORATORY CHEMICAL TESTING

Representative soil samples were taken from the trial pits and boreholes across the site, stored at the appropriate temperature and dispatched to the UKAS and MCERTS accredited laboratories of i2 Analytical for laboratory chemical testing within 24 hours.

The samples were tested for a range of contaminants that reflects the historical use of the site, the findings of the desk study and the preliminary conceptual site model/conceptual exposure model. A list of the soil testing carried out is given below:

Beryllium	Cadmium
Total Chromium	Hexavalent Chromium (VI)
Copper	Lead
Mercury	Nickel
Vanadium	Zinc
Arsenic	Boron
Selenium	Elemental Sulphur
Total Cyanide	Total Sulphate
Sulphide	Water Soluble Sulphate
pH	Monohydric Phenol
Polycyclic Aromatic Hydrocarbons (PAH)	Petroleum Hydrocarbons (VPH/EPH)
Asbestos Screening	VOCs / SVOCs
PCBs	

The potential for leachate generation and migration to groundwater was identified as being active in the preliminary conceptual site model. Therefore, selected samples were also tested for their leachability characteristics for the same suite of contaminants as the soils.

Upon completion of the drilling works, a programme of groundwater sampling and testing was commenced. Groundwater was sampled from each of the standpipe installations at BH1 to BH4. The samples were dispatched to the laboratories of i2 Analytical and tested for the same elements/compounds as the soils (with the exception of asbestos).

The results of all the soil, leachate and groundwater testing are presented in Appendices G, H and I respectively.

6.4 LABORATORY GEOTECHNICAL TESTING

Representative soil samples were dispatched to the UKAS accredited laboratories of Apex Testing Solutions (ATS) and scheduled for moisture content, Atterberg Limits, and Particle Size Distribution (PSD) testing.

The results of the laboratory geotechnical testing are presented in Appendix J.

6.5 IN-SITU GAS AND GROUNDWATER LEVEL MONITORING

Gas and groundwater monitoring standpipes were installed in each of the shell and auger boreholes (BH1, BH2, BH3 and BH4). Two standpipes were installed in each borehole (i.e., a shallow standpipe, and a deep standpipe).

A summary of the standpipe installations is provided below in Table 7.

Table 7: Summary of Standpipe Installations		
Standpipe Reference	Base Depth (m)	Response Zone (m)
BH1 (shallow)	3.0	1.0 to 3.0
BH1 (deep)	21.0	15.5 to 21.0
BH2 (shallow)	4.0	1.0 to 4.0
BH2 (deep)	20.0	14.0 to 20.0
BH3 (shallow)	4.0	1.0 to 4.0
BH3 (deep)	19.0	12.0 to 19.0
BH4 (shallow)	4.0	1.0 to 4.0
BH4 (deep)	17.0	12.0 to 17.0

A programme of ground gas and groundwater level monitoring was commenced on 08 November 2021. At the time of writing, the monitoring programme was on-going. Two out of a proposed six rounds of monitoring have been completed to date. Upon completion of the monitoring programme, a revision to this report will be issued.

During each monitoring visit, the groundwater levels were dipped and the concentration levels of methane, carbon dioxide and oxygen were measured in the standpipes using a GA5000 Landfill Gas Analyser. In addition, gas flow rate and the atmospheric pressure at the time of the field measurements were also recorded.

6.5 IN-SITU GAS AND GROUNDWATER LEVEL MONITORING (CONTINUED)

Gas monitoring will be carried out over a range of atmospheric pressures to include at least one reading in low and/or falling pressure, in accordance with the recommendations made in CIRIA Report C665.

The results of the monitoring to date (comprising two rounds) are presented in Appendix K.

7.0 GROUND CONDITIONS

A summary of the typical ground conditions encountered across the site is presented below in Table 8.

Table 8: Summary of Ground Conditions		
Depth (m)		Stratum
From	To	
0.00	0.10/0.20	MADE GROUND: (Loose) grey and red brown sandy fine to coarse GRAVEL of angular limestone [Aggregate].
0.10/0.20	0.30/0.40	MADE GROUND: (Very Dense) grey sandy fine to coarse GRAVEL with high cobble content. Gravel and cobbles are angular of slag and clinker.
0.10/0.40	0.70/1.90	MADE GROUND: (Dense) grey and brown sandy fine to coarse GRAVEL of angular brick, concrete, slag and clinker [Compacted fill].
0.70/1.90	1.60/3.60	MADE GROUND: Variable granular and cohesive deposits. Typically, dark grey and black. Containing anthropogenic constituents such as ash, brick, concrete, lime, timber and plastic.
1.60/3.60	16.0/17.0	Soft, locally very soft, grey CLAY with occasional organic matter [Tidal Flat Deposits – Alluvial Clay].
16.0/17.0	20.0/20.8	Medium dense brown sandy fine to coarse GRAVEL with medium cobble content. Gravel and cobbles are rounded of sandstone [Tidal Flat Deposits – Basal Gravels].
20.0/20.8	21.5/21.9	Stiff becoming very stiff red brown gravelly CLAY. Gravel is fine to coarse angular of mudstone [Completely Weathered Bedrock].
21.5/21.9	>21.9/22.3	Extremely weak red brown mottled green grey highly weathered MUDSTONE.

7.1 SURFACE AGGREGATE

The site surface predominantly comprises a layer of limestone aggregate, between approximately 0.1m and 0.2m thick.

7.2 COMPACTED / RE-ENGINEERED FILL

As discussed in Section 2.4, the site was reclaimed by Alun Griffiths in 2005 on behalf of Newport City Council. The reclamation works comprised the excavation, processing and re-compaction of made ground to a depth of 1.5m below original ground level.

A variable thickness of engineered fill was encountered within all trial pits and boreholes.

The encountered engineered fill is predominantly granular, comprising a thin layer of very dense grey sandy fine to coarse gravel and cobbles of angular slag and clinker (approximate 0.2m thick), over dense grey and brown sandy fine to coarse gravel of angular brick, concrete, slag and clinker.

A number of bulk samples of the re-engineered fill were taken and sent for Particle Size Distribution (PSD) testing. The results indicate the material comprises a silty sandy gravel.

The base of the encountered engineered fill was recorded at depths ranging between approximately 0.7m (at TP1) to 1.9m (at TP10).

7.3 MADE GROUND

A variable thickness of uncompacted made ground (i.e., not re-engineered) underlies the re-engineered fill. These deposits comprise variable dark grey and black granular and cohesive soils containing anthropogenic constituents such as ash, brick, concrete, lime, timber and plastic. The base of the made ground was proven at depths ranging between approximately 1.6m (at TP9) and 3.6m (at TP12).

7.4 TIDAL FLAT DEPOSITS – ALLUVIAL CLAY

The made ground deposits were recorded to be underlain by natural strata comprising firm or soft to firm, rapidly becoming soft and very soft, grey organic clay. These soils are considered to represent superficial Tidal Flat Deposits / Alluvial Clay.

Typically, at depths shallower than approximately 3.0m/4.0m bgl, these cohesive deposits were observed to have a consistency of firm or soft to firm. At depths greater than approximately 3.0m/4.0m bgl, these cohesive deposits were observed to become notably softer.

The base of the Tidal Flat Deposits / Alluvial Clay was recorded at depths of between approximately 16.0m and 17.0m within the boreholes drilled across the site.

7.4 TIDAL FLAT DEPOSITS – ALLUVIAL CLAY (CONTINUED)

Variable SPT 'N' values ranging between 1 and 8 were recorded. A plot of SPT 'N' value with depth is presented in Figure 4.

Laboratory plasticity testing undertaken on samples of the clay soils recorded plasticity indices in the range of 29% to 37%. The calculated modified plasticity indices range between 26% to 36%, indicating the soils to have a medium volume change potential.

7.5 TIDAL FLAT DEPOSITS – BASAL GRAVELS

The Tidal Flat Deposits / Alluvial Clays were recorded to be underlain by a layer of typically medium dense brown sandy fine to coarse gravel with medium cobble content. The gravel and cobbles were recorded to comprise rounded and sub-rounded sandstone.

The base of the gravel deposits was recorded at depths of between approximately 20.0m and 20.8m bgl.

SPT 'N' values ranging between 9 and 65 were recorded. A plot of SPT 'N' value with depth is presented in Figure 4.

7.6 WEATHERED MUDSTONE BEDROCK

Stiff becoming very stiff red brown gravelly clay, considered to represent completely weathered bedrock of the St Maughans Formation, was encountered below the basal gravels at depths ranging between approximately 20.0m and 20.8m bgl.

SPT 'N' values of between 36 and 81 were recorded within the completely weathered bedrock strata.

The completely weathered bedrock was recorded to be underlain by solid mudstone bedrock strata, typically comprising extremely weak red brown mottled green grey highly weathered mudstone, encountered from depths of between approximately 21.5m and 21.9m bgl.

SPT 'N' values ranging between 50 (for 75mm) and 80 (for 150mm) were recorded within the solid mudstone bedrock strata. A plot of SPT 'N' value with depth is presented in Figure 4.

7.7 BURIED OBSTRUCTIONS

A buried masonry structure, considered to represent a cut down former dock/wharf wall was encountered at Trench 1, at a depth of approximately 2.1m bgl. This structure was recorded to be between approximately 0.8m and 2.0m wide.

A buried timber obstruction, possibly associated with an old dock/wharf wall was encountered at Trench 2, at a depth of approximately 3.0m bgl. This structure was recorded to be approximately 0.5 wide.

7.8 GROUNDWATER

A summary of the groundwater conditions encountered during the excavation of the trial pits is as follows:

- TP1 – Fast inflow of perched groundwater at 2.3m depth.
- TP2 – Fast inflow of perched groundwater at 2.0m depth.
- TP3 – Fast inflow of perched groundwater at 2.0m depth.
- TP4 – Seepage of perched groundwater at 1.6m depth.
- TP5 – No groundwater encountered.
- TP6 – No groundwater encountered.
- TP7 – Fast inflow of perched groundwater at 1.9m depth.
- TP8 – Fast inflow of perched groundwater at 2.4m depth.
- TP9 – Seepage of perched groundwater at 1.6m depth.
- TP10 – Fast inflow of perched groundwater at 1.9m depth.
- TP11 – Seepage of perched groundwater at 2.0m depth.
- TP12 – Seepage of perched groundwater at 3.5m depth.

A summary of the groundwater conditions encountered during the drilling of the boreholes is as follows. Note that the boreholes typically encountered two separate water bodies (i.e., a shallow perched groundwater table in the made ground, and a deep natural groundwater table within the basal gravels underlying the alluvial clays):

- BH1 – Perched at 3.0m depth / Deep at 16.0m depth.
- BH2 – Perched at 2.8m depth / Deep at 16.6m depth.
- BH3 – Perched at 3.6m depth / Deep at 17.0m depth
- BH4 – Perched at 3.0m depth / Deep at 16.2m depth

7.8 GROUNDWATER (CONTINUED)

The groundwater conditions are based on observations made at the time of the fieldwork. It should be noted that groundwater levels may vary due to seasonal, tidal and other effects.

A summary of the groundwater levels measured within the boreholes during a return visit to site is provided below in Table 9. Note that at the time of writing, one out of a planned six rounds of water level monitoring has been completed.

Table 9: Summary of Groundwater Levels						
Borehole Ref:	Depth (m bgl)					
	Round 1 08/11/21	Round 2 16/11/21	Round 3 TBC	Round 4 TBC	Round 5 TBC	Round 6 TBC
BH1 (shallow)	1.42	1.52				
BH1 (deep)	8.18	9.48				
BH2 (shallow)	1.48	2.13				
BH2 (deep)	7.79	8.52				
BH3 (shallow)	2.33	2.24				
BH3 (deep)	8.62	9.81				
BH4 (shallow)	2.68	2.62				
BH4 (deep)	8.84	8.28				

7.9 SOAKAWAY TESTS

Soakaway testing was undertaken at 4 No. trial pit locations (TP3, TP4, TP6 and TP9).

No infiltration was recorded at any of the test locations. The soakaway test calculation sheets are presented in Appendix F.

Note that the soakaway test results are specific to the locations and depths of the tests undertaken.

8.0 CONTAMINATION

8.1 AVERAGING AREAS

In order to assess the laboratory test results reliably and in context, the data have been grouped into an averaging area. An averaging area (or area of interest) is that area of soil to which a receptor is exposed, or which otherwise contributes to the creation of hazardous conditions. This may be an area of historical industrial usage, a soil type, or a specific proposed end use.

In the case of this analysis, a site wide averaging area has been determined according to the proposed residential end use.

8.2 SOIL CONTAMINATION

The Suitable 4 Use Levels (S4ULs) published by LQM have been adopted as critical concentrations against which soil contaminant concentrations can be compared. In the absence of additional published S4ULs, the Category 4 Screening Levels (C4SLs) derived by DEFRA and Soil Screening Values (SSVs) derived by Atkins ATRISK^{soil} for a residential with homegrown produce end use have been adopted, where considered appropriate. With respect to PCBs, the screening value published by RIVM (2014) has been adopted for the sum of seven indicator species derived using Arochlor-1254.

The soil test results for the samples of made ground and natural ground have been summarised separately and are shown in Appendices E and F respectively. A discussion of the results is provided below.

8.2.1 Re-engineered Fill

Seven samples of the re-engineered fill were tested for contamination.

The re-engineered fill test results have been summarised and are presented in Appendix L.

The results indicate TOC values in the range of 0.9% to 2.4% and equivalent SOM values in the range of 1.55% to 4.13%. As such, the results have been compared to the respective guidelines (for a proposed residential with homegrown produce end use), for 2.5% soil organic matter content (SOM).

The contamination testing results are discussed below:

8.2 SOIL CONTAMINATION (CONTINUED)

- Exceedances of lead were recorded in all tested samples of the re-engineered fill.
- A single exceedance of cadmium was recorded in a tested sample of the re-engineered fill from TP4 (0.4m).
- A single exceedance of zinc was recorded in a tested sample of the re-engineered fill from TP8 (0.5m).
- Exceedances of the polycyclic aromatic hydrocarbons (PAHs) were recorded in tested samples of the re-engineered fill from TP4 (0.4m) and TP5 (0.5m).
- Loose fibres of chrysotile asbestos in soil were recorded in tested samples of the re-engineered fill from TP4 (0.4m) and Trench 1 (0.5m).
- No elevated petroleum hydrocarbon concentrations were recorded within the tested soil samples.
- No elevated volatile organic compound (VOC) concentrations were recorded. All VOC concentrations were recorded below detectable limits.

A summary of the contaminants recorded at concentrations which exceed the applied residential screening criteria is provided below in Table 10.

Table 10: Re-engineered Fill Exceedances					
Contaminant	Screening criteria (mg/kg)	No. of samples tested	No. samples exceeding screening criteria	Min concentration (mg/kg)	Max concentration (mg/kg)
Lead	200	5	5	220	670
Cadmium	11	5	1	1.4	45
Zinc	3700	5	1	280	4000
Dibenzo(ah)anthracene	0.28	5	2	<0.05	0.94
Benzo(a)pyrene	2.7	5	1	0.64	3.9
Benzo(b)fluoranthene	3.3	5	1	0.69	5.2
Asbestos (chrysotile – loose fibres)	N/A	7	2	Non-detect	0.001%*

* denotes %

The contamination recorded within the re-engineered fill has been considered further in Section 10.3 below.

8.2 SOIL CONTAMINATION (CONTINUED)

8.2.2 *Made Ground*

Eight samples of the made ground were tested for contamination. Note that the made ground deposits underlie the layer of compacted / re-engineered fill.

The made ground test results have been summarised and are presented in Appendix M.

The results indicate TOC values in the range of 1.6% to 5.1% and equivalent SOM values in the range of 2.75% to 8.77%. As such, the results have been compared to the respective guidelines (for a proposed residential with homegrown produce end use), for 2.5% soil organic matter content (SOM).

The contamination testing results are discussed below:

- Exceedances of lead were recorded in all tested samples of the made ground.
- Exceedances of arsenic were recorded in tested samples of the made ground from TP1 (0.8m), TP7 (1.0m), and TP9 (1.0m).
- Exceedances of mercury were recorded in tested samples of the made ground from TP3 (1.3m) and TP7 (1.0m).
- Exceedances of the polycyclic aromatic hydrocarbons (PAHs) were recorded in tested samples of the made ground from TP7 (1.0m), TP8 (2.0m), TP9 (1.0m), Trench 1 (2.0m) and Trench 2 (1.1m).
- Loose fibres of chrysotile asbestos in soil were recorded in a tested sample of the made ground from TP8 (2.0m).
- Loose fibrous debris of chrysotile asbestos in soil was recorded in a tested sample of the made ground from Trench 1 (2.0m).
- Loose fibres of crocidolite asbestos in soil were recorded in a tested sample of the made ground from Trench 2 (1.1m).
- Chrysotile asbestos cement type material was recorded in a tested sample of the made ground from TP3 (1.3m).
- No elevated petroleum hydrocarbon concentrations were recorded within the tested soil samples.
- No elevated volatile organic compound (VOC) concentrations were recorded. All VOC concentrations were recorded below detectable limits.
- No elevated PCB concentrations were recorded within the tested soil samples.

A summary of the contaminants recorded at concentrations which exceed the applied residential screening criteria is provided below in Table 11.

8.2 SOIL CONTAMINATION (CONTINUED)

Table 11: Made Ground Exceedances					
Contaminant	Screening criteria (mg/kg)	No. of samples tested	No. samples exceeding screening criteria	Min concentration (mg/kg)	Max concentration (mg/kg)
Lead	200	7	7	280	1100
Arsenic	37	7	3	32	100
Mercury	1.2	7	2	<0.3	2.7
Dibenzo(ah)anthracene	0.28	7	5	<0.05	6.7
Benzo(a)pyrene	2.7	7	2	0.83	33
Benzo(b)fluoranthene	3.3	7	2	1.2	42
Benzo(a)anthracene	11	7	1	1.5	76
Chrysene	22	7	1	1.3	49
Naphthalene	5.6	7	1	<0.05	9.4
Asbestos (chrysotile – loose fibres or loose fibrous debris)	N/A	7	2	Non-detect	0.008%*
Asbestos (crocidolite – loose fibres)	N/A	7	1	Non-detect	<0.001%*
Asbestos (chrysotile – hard/cement type material)	N/A	7	1	Non-detect	0.336%*

* denotes %

The contamination recorded within the made ground has been considered further in Section 10.3 below.

8.2.3 Natural Ground

Two samples of natural ground were tested for petroleum hydrocarbon contamination.

The natural ground test results have been summarised and are presented in Appendix N.

All petroleum hydrocarbon concentrations were recorded below detectable limits.

8.3 SOIL LEACHATE

Samples of the made ground from TP1 (0.8m) and TP8 (2.0m) were tested for their leachable concentrations for the same suite of contaminants as the soils (with the exception of asbestos).

As part of a 'Tier 1' screening exercise, the results of the leachate analyses have been compared against the Annual Average Environmental Quality Standards (AA-EQS) for estuaries and coastal waters in the first instance. Where no AA-EQS values are available, the results have been compared against the available Maximum Allowable Concentration Environmental Quality Standards (MAC-EQS) for estuaries and coastal waters. Where no EQS values are available, the results have been compared against UK and WHO drinking water standards, in hierarchical order.

A summary of the results and comparison against the screening criteria are presented in Appendix O.

Most of the results were below the laboratory detection limits, or the relevant published guidelines. However, exceedances of lead and zinc have been recorded.

A summary of the exceedances recorded within the soil leachate samples is provided below.

- Lead was recorded above the adopted AA-EQS (1.3ug/l) in both samples from TP1 (0.8m) and TP8 at (2.0m bgl). The exceeding concentrations were 3.7ug/l and 4.6ug/l respectively. It should be noted that both concentrations are significantly below the published MAC EQS of 14ug/l, and the UKDWS of 10ug/l.
- Zinc was recorded above the adopted AA-EQS (6.8ug/l) in both samples from TP1 (0.8m) and TP8 at (2.0m bgl). The exceeding concentrations were 15ug/l and 19ug/l respectively. It should be noted that both concentrations are significantly below the published UKDWS of 5000ug/l.

No further exceedances were recorded within the analysed soil leachate samples.

8.4 GROUNDWATER CONTAMINATION

Groundwater samples were taken from BH2 (deep), BH3 (deep), BH4 (deep), and BH3 (shallow) and analysed at the UKAS and MCERTS accredited laboratories of i2 Analytical for the same suite of elements and compounds as the soils (with the exception of asbestos).

As part of a 'Tier 1' screening exercise, the results of the groundwater analyses have been compared against the Annual Average Environmental Quality Standards (AA-EQS) for estuaries and coastal waters in the first instance. Where no AA-EQS values are available, the results have been compared against the available Maximum Allowable Concentration Environmental Quality Standards (MAC-EQS) for estuaries and coastal waters. Where no EQS values are available, the results have been compared against UK and WHO drinking water standards, in hierarchical order.

A summary of the groundwater test results and comparison with the screening values is presented in Appendix P.

Most of the results were below the laboratory detection limits, or the relevant published guidelines. However, localised exceedances of arsenic, copper, mercury and zinc have been recorded.

A summary of the exceedances recorded within the groundwater samples is provided below.

- Arsenic was recorded above the adopted AA-EQS (25ug/l) in samples of groundwater from BH3 (deep), and BH4 (deep). The exceeding concentrations at these locations were 44.9ug/l at BH3, and 22.7ug/l at BH4.
- Copper was recorded above the adopted AA-EQS (17.25ug/l) in samples of groundwater from BH3 (shallow), and BH4 (deep). The exceeding concentrations at these locations were 22ug/l at BH3, and 23ug/l at BH4. It should be noted that both concentrations are significantly below the UKDWS of 2000ug/l.
- Mercury was recorded above the adopted MAC-EQS (0.07ug/l) in samples of groundwater from BH2 (deep), and BH3 (shallow). The exceeding concentrations at these locations were 0.52ug/l at BH2, and 0.60ug/l at BH3. It should be noted that both concentrations are below the UKDWS of 1ug/l.

8.4 GROUNDWATER CONTAMINATION (CONTINUED)

- Zinc was recorded above the adopted AA-EQS (6.8ug/l) in samples of groundwater from BH2 (deep), BH3 (deep), and BH4 (deep). The exceeding concentrations at these locations were 7.7ug/l at BH2, 17ug/l at BH3, and 8.3ug/l at BH4. It should be noted that both concentrations are significantly below the UKDWS of 5000ug/l.

No further exceedances were recorded within the analysed groundwater samples.

It should be noted that the above results are for the first round of water sampling and testing only. Two further rounds of sampling and testing will be carried out and this report updated once the results are available.

8.5 GROUND GASES

The results of the gas monitoring programme to date are included in Appendix K. A summary of the results obtained to date is given in Table 11.

Table 11: Summary of Ground Gas Results				
Borehole	Maximum Methane Concentration (%)	Maximum Carbon Dioxide Concentration (%)	Minimum Oxygen Concentration (%)	Gas Flow Rate (l/hr)
BH1 (shallow)	0.20	1.60	16.20	0.80
BH2 (shallow)	19.30	1.10	10.60	<0.30
BH3 (shallow)	0.10	0.40	17.80	<0.30
BH4 (shallow)	2.40	1.90	4.50	<0.30

Note: Results based on two rounds of monitoring completed to date.

The results show a maximum methane concentration of 19.3% and a maximum carbon dioxide concentration of 1.90%. A minimum oxygen concentration of 4.50% was recorded. A maximum gas flow rate of 0.80l/hr was measured during the gas monitoring programme completed to date.

It should be noted that the above results are for the first two rounds of gas monitoring only. Four further rounds of monitoring will be carried out and this report will be updated once the results are available.

9.0 REVISED CONCEPTUAL EXPOSURE MODEL

The preliminary conceptual exposure model has been reviewed and revised to reflect the findings of the intrusive site investigation and the results of the laboratory testing of soils, soil leachate, groundwater and gas monitoring. Pathways identified as a relevant pollutant linkage require appropriate risk assessment or mitigation measures (see Section 10).

Table 12: Revised Conceptual Exposure Model

Source		Receptor	Pathway	Preliminary Active Pathway? (see Sect. 5.8)	Relevant Pollutant Linkage	Justification/ Mitigation
Origin	Contaminant					
Made Ground of unknown origin and historical land uses	Metals, semi-metals, inorganics, PAH, petroleum hydrocarbons, VOC/SVOC, PCBs, asbestos	Resident – human health	Dermal Contact with made ground/dust	✓	✓	Elevated concentrations of metals, PAHs and asbestos identified within the made ground – risk assess.
			Ingestion of soil and/or soil attached to home-grown produce	✓	✓	
			Ingestion of home-grown produce	✓	✓	
			Inhalation of dust	✓	✓	
			Inhalation of vapours – indoor/outdoor	✓	X	No sufficiently volatile contaminants identified.
	Metals, semi-metals, inorganics, PAH, petroleum hydrocarbons, VOC/SVOC, PCBs	Groundwater quality	Leaching from made ground	✓	✓	Elevated concentrations of metals recorded in groundwater – risk assess.
		Surface water quality	Transportation within groundwater	✓	✓	

9.0 REVISED CONCEPTUAL EXPOSURE MODEL (CONTINUED)

Source		Receptor	Pathway	Preliminary Active Pathway?	Relevant Pollutant Linkage	Justification/ Mitigation
Origin	Contaminant					
Made Ground of unknown origin and natural ground	pH and water-soluble sulphate	Building Materials Durability	Direct contact	✓	✓	Building materials will be in contact with made ground and natural ground– risk assess
Ground Gas – organic, gas producing materials	Methane, carbon dioxide	Human health	Accumulation of gases in confined spaces, and/or migration off site, leading to asphyxiation, or risk of explosion	✓	✓	Gas monitoring results indicate elevated methane and depleted oxygen – risk assess.

10.0 RISK ASSESSMENT

10.1 METHODOLOGY

The risk of pollution, health effects or environmental harm occurring as a result of ground contamination is dependent upon three principal factors:

- The scale of the contamination sources
- The presence of sensitive “receptors”, e.g., Humans: health of the general public, site occupiers, redevelopment workers. Environment: flora, fauna, etc.
- The existence of migration pathways by which contaminants can reach the sensitive receptors.

This section assesses each of these factors in order to evaluate the overall level of risk and potential harm to receptors. The receptor may be human, a water resource, an eco-system or construction materials. Pathways connecting a perceived hazard to a receptor are referred to as exposure pathways.

The sources of contamination and the links connecting the hazards to the sensitive receptors will represent the basis for the risk assessment.

10.2 SOURCE-PATHWAY-RECEPTOR MODEL

The preliminary conceptual site model was based on the findings of the desk study. This was later reviewed and refined according to the findings of the site investigation, allowing for the ground conditions encountered and the results of laboratory testing of soil and groundwater. Any pathways considered to be inactive were removed from the model and all remaining potentially active pathways require risk assessment.

The pathways shown as potentially active in the Revised Conceptual Site Model in Section 9.0 above have been assessed below.

10.3 HUMAN HEALTH RISK ASSESSMENT

10.3.1 *Site in its Present Condition*

The site does not pose any risks to casual visitors or trespassers.

10.3 HUMAN HEALTH RISK ASSESSMENT (CONTINUED)

10.3.2 Future Site Users

The contamination test results have recorded elevated concentration levels in the re-engineered fill and underlying made ground of several metals and polycyclic aromatic hydrocarbon (PAH) compounds. Asbestos was also recorded in several samples of the re-engineered fill and made ground.

Given the elevated contaminant concentrations within the re-engineered fill and made ground, it is considered that a potential risk to human health may exist via the following relevant pollutant linkages:

- Dermal contact
- Ingestion of soil or soil derived dust
- Ingestion of soil attached to homegrown produce
- Ingestion of homegrown produce
- Inhalation of soil bourn dust.

The inhalation of vapours pathways (indoor and outdoor air) are not considered to be active since the contaminants of concern identified are not sufficiently volatile.

It is necessary to protect future site end users from the identified contamination within the shallow re-engineered fill and underlying made ground. This can be achieved by breaking the above listed relevant pollutant linkages thereby removing the potential risk.

In order to protect future site end users, it is considered the following preliminary remedial measures will be required:

- Following site strip, all exposed formations should be visually inspected and handpicked of any identified ACM. Additionally, any excavated made ground, any encountered buried foundations, service runs/ducts, pipework etc should also be visually inspected and handpicked of any identified ACM. These works should be carried out by a suitably licenced contractor in accordance with an appropriate risk assessment and managed in accordance with the requirements of the Control of Asbestos Regulations (2012). Any handpicked ACM should be disposed off-site at a suitable licensed facility as hazardous waste. Daily records and waste transfer notes should be kept in order to document the identification and subsequent removal of any ACM. These records and waste transfer notes should be made available for review as they will be required for potential remediation verification.

10.3 HUMAN HEALTH RISK ASSESSMENT (CONTINUED)

- A capping layer, of a minimum 600mm thickness, of clean inert imported subsoil and topsoil will be required in all gardens and areas of soft landscaping that are underlain by made ground. A geotextile separation/alert membrane (such as Terram T1000 orange) should be placed at the base of the capping soils to maintain the integrity of the capping layer and to prevent the upwards migration of contamination.

Note that the above preliminary remediation recommendation should be reviewed upon completion of the recommended supplemental soil sampling and contamination assessment across the currently inaccessible southern corner of the site. A detailed remediation strategy report should be prepared and submitted to the regulators for approval upon completion of these recommended further works.

10.3.3 Construction Workers

Following site strip and during site construction works when the existing made ground materials are exposed, there could be a potential risk to construction workers.

During site preparation and construction works, any exposed made ground soils should be dampened down to minimise the potential for soils to dust and the subsequent release of any asbestos fibres.

During exposure and excavation of soils, the exposed formations, and excavated materials should be inspected by asbestos awareness trained contractors. These works should be carried out under an appropriate risk assessment and managed in accordance with the Control of Asbestos Regulations 2012 (CAR 2012).

With future site development works involving the excavation and removal of made ground, there would be a risk to workers from contaminants (including asbestos) in the soils. Appropriate measures are therefore recommended for works involving the made ground materials which are known to be present beneath the site.

The following practical measures are required while excavating/re-using made ground:

- Excavations will need to be regularly dampened down to prevent any dust that may contain asbestos becoming airborne
- Any excavated materials should be regularly dampened down to prevent any dust may contain asbestos becoming airborne
- Appropriate PPE/RPE to be worn by all workers, as appropriate
- Asbestos/dust/air monitoring may be required during early site establishment.

10.3 HUMAN HEALTH RISK ASSESSMENT (CONTINUED)

Site preparation and operational constraints will be covered in the contractor's method statements. These should include the contractor's proposals for controls and monitoring of dust, noise, vibrations and odour.

All site operatives are to be suitably asbestos awareness trained. Routine visual checks should be made for the presence of any asbestos containing materials (ACM). Any handpicked ACM should be disposed off-site at a suitable licensed facility as hazardous waste.

All excavations should be regularly checked for safe atmospheres, including oxygen levels and guidance sought should depleted oxygen levels be identified in excavations/ confined spaces.

During excavation, in order to prevent cross contamination of materials, the made ground arisings should be segregated from any underlying natural soils.

Additionally, a system should be established by which any 'unusual' materials that may be encountered are reported rapidly to the site management, so that the appropriate action may be taken, following specialist advice if necessary. An unusual material may be identified on site by colour, odour or physical nature.

Daily records and waste transfer notes should be kept in order to document the identification and subsequent removal of any asbestos containing materials (ACM).

These records and waste transfer notes should be made available for review as they will be required for potential remediation verification.

Reference should be made to the Health and Safety Executive document "Protection of Workers and the General Public during the development of contaminated land" for detailed guidance on these matters.

10.4 RISKS TO VEGETATION

The concentrations of contaminants in the made ground, indicate the potential for adverse effects to vegetation. Similarly, the physical nature of the existing made ground does not provide a suitable growing medium for vegetation. To ensure viable landscape areas by preventing upward migration of contaminants into the overlying soils, and in order to promote plant growth, any landscaped areas will require the provision of a minimum 600mm thick capping layer of clean, inert subsoil and topsoil materials.

10.4 RISKS TO VEGETATION (CONTINUED)

A geotextile separation/alert membrane (such as Terram T1000 orange) should be placed at the base of the capping soils to maintain the integrity of the capping layer and to prevent the upwards migration of contamination.

10.5 CONTROLLED WATERS RISK ASSESSMENT

The groundwater regime beneath the site comprises two separate groundwater bodies as follows: (1) a shallow/perched inconsistent groundwater body in the made ground, separated from (2) a deep groundwater body, present in the basal gravel layer below the low permeability alluvial clays.

The results of the 'Tier 1' screening exercise (as detailed in Section 8.4) indicate minimal groundwater contamination at the site. Most of the results were below the laboratory detection limits, or the relevant published guideline values. However, localised exceedances of arsenic, copper, mercury and zinc have been recorded.

10.5.1 Perched Groundwater

The site was reclaimed in 2005 by Alun Griffiths (Contractors) Limited. The works undertaken included a shallow turn-and-recompact earthworks exercise. As noted in Validation Report of Site Remediation (ref: 9059/TD/06, dated August 2006), during the reclamation earthworks, perched groundwater was encountered and was locally observed to contain free phase hydrocarbon product. When encountered, the contaminated perched groundwater was remediated by being pumped through oil/water separators before being returned to the site via a second discharge sump.

Pockets of perched groundwater were encountered at varying depths below existing ground level within the made ground during the recent 2021 site investigation works. However, it should be noted that no free phase hydrocarbon product was observed. The perched groundwater body sits within the made ground, on top of the underlying low permeability alluvial clay deposits. The perched water was found to be inconsistent and is considered to 'pond' in natural depressions on top of the natural clay soils.

The results of the groundwater testing have recorded very minimal contamination within the perched groundwater body. In a sample obtained from BH3 (shallow) the only contaminants to exceed the adopted EQS screening values were copper and mercury. All organic contaminants (PAHs and petroleum hydrocarbons), VOCs and PCBs were recorded at concentrations below laboratory detectable limits.

10.5 CONTROLLED WATERS RISK ASSESSMENT (CONTINUED)

It is considered that any migration of contaminants from the shallow/perched groundwater body into the deep groundwater body is significantly hindered by the presence of the underlying low permeability alluvial clay deposits. This is demonstrated by the results of the groundwater testing completed to date, which do not indicate any correlation between contaminants in the shallow and deep groundwater bodies at BH3.

Based on the minimal contamination recorded and the previous remediation undertaken during 2005, it is considered that the shallow/perched groundwater body does not present a risk to environmental receptors such as the River Usk.

It should be noted that this assessment is based on one round of groundwater sampling and testing at this stage. Further rounds of groundwater sampling and testing are planned, and this risk assessment will be further reviewed and may be subject to change, depending on the results.

10.5.2 Deep Groundwater

Minimal contamination has been recorded within the deep groundwater body beneath the site. The only contaminants to exceed the adopted screening values are arsenic, copper, mercury, and zinc.

All organic contaminants (PAHs and petroleum hydrocarbons), VOCs and PCBs were recorded at concentrations below laboratory detectable limits.

The recorded metal concentrations are not considered significant and are likely to be representative of normal background levels for this formerly industrialised area of Newport.

Based on the contamination data obtained to date, the risks to environmental receptors such as the Secondary 'A' Aquifer in the bedrock strata, and the River Usk, from site sourced contamination is considered to be low.

It should be noted that this assessment is based on one round of groundwater sampling and testing at this stage. Further rounds of groundwater sampling and testing are planned, and this risk assessment will be further reviewed and may be subject to change, depending on the results.

10.6 GROUND GAS RISK ASSESSMENT

The results of the monitoring to date (two rounds) show a maximum methane concentration of 19.3% and a maximum carbon dioxide concentration of 1.90%. A minimum oxygen concentration of 4.50% was recorded. A maximum gas flow rate of 0.80l/hr was measured during the gas monitoring programme completed to date. In accordance with CIRIA Report C665 a worst-case Gas Screening Value (GSV) of 0.1544l/hr has been calculated.

In accordance with CIRIA C665 guidance, due to elevated methane, the site has been assessed as 'Characteristic Situation 2' (CS2). For high rise buildings, in accordance with BS8485:2015+A1:2019, the proposed development will need to incorporate appropriate gas protection measures relating to a CS2 site classification and the proposed 'building type'.

It is noted that the development proposals also include some low-rise residential buildings. For low rise residential buildings (comparable to a 'typical house'), in accordance with NHBC guidance the proposed development will need to incorporate appropriate gas protection measures relating to an Amber 2 classification.

For both CS2 and Amber 2 classifications, gas protection mitigation measures are likely to require the installation of an appropriate gas resistant membrane (installation to be verified by a third party) and passive sub floor ventilation.

It should be noted that this classification is based on two rounds of gas monitoring completed to date and may therefore be subject to change. A revision to this report will be issued upon completion of the gas monitoring programme, which may include a revised classification.

All excavations should be regularly checked for safe atmospheres, including oxygen levels, and guidance sought should low oxygen levels be identified in any excavations or confined spaces.

No radon protective measures are required for the site.

10.7 RISKS TO BUILDINGS AND MATERIALS DURABILITY

10.7.1 Concrete Classification

A summary of the laboratory chemical test results for the chemicals water soluble sulphate and pH, which may adversely affect the durability of building materials is presented in Appendix G.

Evidence to date does not indicate any specifically aggressive conditions, but it would be reasonable to expect a degree of sulphate and acidic aggressiveness from the made ground.

In accordance with BRE Digest SD1:2005 and adopting the assessment procedure specified therein for brownfield sites, the laboratory chemical test results indicate a characteristic value for water soluble sulphate of 2,500mg/l in the made ground, and 760mg/l in the natural soils (taking the highest test results).

Using Table C2 of BRE Digest SD1:2005, these characteristic values correspond to Design Sulphate Class DS-3 for the made ground, and DS-1 for the natural ground.

The groundwater regime of the site has been assessed as 'mobile' and characteristic pH values of 8.0 and 7.7 in the made ground and natural ground respectively (taking the lowest test results).

The Design Sulphate Class has been modified to give a site ACEC class of AC-3 for concrete structures constructed within the made ground, and AC-2 for concrete structures constructed within the natural ground.

10.7.2 Water Services

Water supply pipes will need to be protected from any contamination present within the ground. In particular, the presence of organic contaminants (such as PAH and TPH) should be addressed when selecting pipe materials.

Measures to protect the pipes should include clean backfill to trenches and alternative material selection. Reference should be made to UKWIR Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, document No. 10/WM/03/21.

The final design and selection of the pipe and associated backfill should be agreed with the appropriate Regulator prior to installation.

10.8 WASTE DISPOSAL

Excavated materials generated by the development may be considered as waste and subject to waste controls. Any re-use of excavated materials on-site should be undertaken in accordance with current waste and environmental legislation and which may require the production of an approved Materials Management Plan (MMP) prepared in accordance with the CL:AIRE Code of Practice.

It is recommended that a sustainable development strategy is adopted which reduces to a practicable minimum the generation of waste materials and the need for disposal to a licensed tip. Emphasis should be on recovery and re-use rather than disposal.

However, any waste or surplus materials that are generated will need to be classified in accordance with current EC regulations and NRW guidance prior to disposal. It is the responsibility of the waste producer to classify the waste.

Based on the data obtained from the site investigation data, any waste materials comprising of the existing made ground are likely to be classified as hazardous waste.

Based on the data obtained from the site investigation data, any waste materials comprising of the existing natural soils are likely to be classified as non-hazardous waste.

Any asbestos containing materials (ACMs) will be classified as hazardous waste.

This classification is provisional, and indicative of the likely waste classification based on the data obtained to date (including chemical composition, moisture content, etc.). It also assumes that the materials tested will be representative of future generated waste.

In order to minimise disposal, the materials generated should be segregated and examined, with appropriate testing as necessary, to enable the materials to be sorted or treated into lower classifications, with the resultant benefit of potentially generating re-use rather than disposal.

Once final waste sources and volumes are known, the waste stockpile to be disposed off-site will need to be classified in accordance with Environment Agency/Natural Resources Wales Waste Classification – Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (2015). This is likely to require additional sampling and testing of the generated waste materials to provide an up-to-date current basis for classification.

Depending on the waste classification, waste acceptance criteria (WAC) testing may be required, in order to determine which class of landfill site the waste can be sent to.

10.8 WASTE DISPOSAL (CONTINUED)

It is recommended that the results of the waste classification and any WAC test results are sent to the intended licensed waste operator prior to disposal in order to confirm their classification and acceptance.

10.9 UNCERTAINTIES

It is important to recognise that there may be areas of contamination within the site that have not been found or that contaminants may be present at concentrations above those that have been found. It is also important to recognise that contamination may be localised and that no investigation, however comprehensive, is capable of finding such occurrences, other than by chance.

The near-surface drainage patterns have not been fully established.

11.0 ENGINEERING CONSIDERATIONS AND RECOMMENDATIONS

11.1 DETAILS OF PROPOSED DEVELOPMENT

The proposed development will comprise the construction of a number of residential apartment blocks (up to 5 storeys) and a number of low-rise terraced residential properties. The development will include associated infrastructure such as access roads, car parking areas and private driveways, areas of landscaping, and private gardens. An indicative development layout is presented in Figure 2.

11.2 SITE PREPARATION

Prior to works commencing on site, any services within the proposed development areas should be identified and either diverted or protected. Any diversion works should be carried out under the supervision of, and to the specification of appropriate Statutory Authorities. The resulting excavation should be backfilled with suitable granular fill material laid and compacted to Department of Transport (DTp) Specification for Earthworks.

A system should be established for identification and dealing with any unforeseen contamination encountered during the site works (including identification of any potential asbestos containing materials). Any contamination, or suspected contamination, should be reported to the site manager, so that appropriate action may be taken, following specialist advice if necessary.

Any existing tarmac and surface concrete (e.g., such as that present in the inaccessible southern corner of the site) should be planed off/broken out and the materials set aside for appropriate re-use.

All materials to be disposed of offsite should be sent to a suitably licensed facility. Licenced tips may require additional waste classification and Waste Acceptance Criteria testing of materials to ensure compliance with their current licence agreements.

Allowances should be made for appropriate pollution prevention measures to be in place during the construction phase. Pollution prevention measures should be included within the appointed contractor's method statements and agreed with the appropriate regulator prior to commencement. The required pollution prevention measures should include, but not be limited to, the following:

11.2 SITE PREPARATION (CONTINUED)

- Protection/diversion of any active surface water drains that cross the site
- Segregation of arising's from piling operations and/or excavation works
- Stockpiled materials are to be sealed from the weather, placed on a suitable impermeable surface and bunded to prevent run-off
- Exposed formations are to be regularly damped down to prevent fugitive dust emissions
- Appropriate boundary air and dust monitoring.

Exposed formations should be protected from site traffic and inclement weather in order to preserve their integrity. Any soft spots/areas should be removed and replaced with well compacted site won or imported granular fill material.

11.3 FOUNDATIONS AND FLOOR SLABS

Due to the presence of highly compressible Tidal Flat Deposits / Alluvial Clay at shallow depths beneath the site, and the anticipated loading associated with the proposed buildings, the use of conventional shallow foundations is not considered feasible due to the potential for unacceptable total and differential settlements.

It is recommended that piled foundations are used for the proposed buildings.

Subject to vibration and noise issues, pre-cast concrete or steel tube driven piles, driven to an appropriate set within the weathered mudstone bedrock deposits encountered from depths of between approximately 21.5m and 21.9m bgl, should be feasible, subject to advice from a specialist Piling Contractor.

Based on the results of the intrusive site investigation, pile lengths are anticipated at approximately 23m to 25m, although variation should be expected.

Variations in pile lengths should be limited to avoid over-stressing adjacent piles of different lengths.

Piles will need to be designed to ignore load contribution from the made ground and soft and very soft underlying clay strata.

Any piles that are driven to a premature set should be investigated and allowances made for re-driving, digging out any encountered shallow obstructions, or pile replacement. Subject to the advice of a specialist piling contractor, the use of alternative piling techniques may be required.

11.3 FOUNDATIONS AND FLOOR SLABS (CONTINUED)

Allowances should be made for encountering potential buried obstructions such as the old suspected cut down wharf/dock walls observed during the excavations of Trench 1 and Trench 2.

Note that the adopted piling system will need to consider any potential vibration and noise issues in relation of the adjacent buildings/structures. If noise and/or vibration issues preclude the use of driven piles then a bored or drilled piling system deriving load capacity in the form of a suitably designed and constructed socket within competent mudstone bedrock, could be considered.

If an augured piling system is adopted, it will be necessary to segregate the made ground arisings from the natural soil arisings for appropriate off-site disposal.

It is recommended that the advice of a specialist piling contractor is sought in order to confirm the most appropriate piling technique and for the detailed pile design.

It should be noted that subject to the detailed pile design and the requirements of the NHBC, rotary cored boreholes beyond the depths of the shell and auger boreholes and/or anticipated toe of the piles may be required.

Due to the proximity of the site with the River Usk, a piling risk assessment is likely to be required.

Floor slabs should be designed and constructed as suspended, incorporating gas protective measures (as per the requirements for the classifications detailed in Section 10.6).

11.4 EXCAVATIONS AND FORMATIONS

Excavations should be possible with normal soil excavating machinery. Allowances should be made for using larger plant or the use of a pneumatic breaker attachment, or similar tools, should any remnant buried obstructions be encountered in the made ground (such as those encountered at Trench 1 and Trench 2).

The sides of excavations deeper than 1.0m should be supported by trench boxes.

Shallow excavations within the made ground will encounter variable and sometimes significant groundwater inflows. However, any groundwater seepages/inflows or rainfall infiltrations should be dealt with by conventional pumping techniques.

11.4 EXCAVATIONS AND FORMATIONS (CONTINUED)

Exposed formations within the in-situ materials will be susceptible to damage, softening and deterioration by wet weather and site traffic. They should therefore be protected by blinding concrete or a 200mm thick layer of hardcore immediately after exposure.

Any soft spots/areas should be removed and replaced with compacted imported granular material.

11.5 ACCESS ROADS AND CAR PARKING AREAS

The site was reclaimed in 2005 via a shallow turn-and-recompact earthworks exercise undertaken by Alun Griffiths (Contractors) Limited on behalf of Newport City Council.

Plate load tests undertaken as part of the previous earthworks validation works (see Validation Report for Site Remediation, ref: 9059/TD/06, dated August 2006) indicate equivalent CBR values within the re-engineered fill between 8% and 38%.

After proof rolling the formations, all the 'soft spots/areas' should be removed and replaced with well compacted imported granular materials. Such materials should be to the approval of the local highway authority and should be compacted in layers, in accordance with the DTp Specification for Highway Works.

Field CBR tests should be carried out to confirm the above plate load testing results from 2006.

11.6 DRAINAGE AND SERVICES

Soakaway testing was undertaken at 4 No. trial pit locations (TP3, TP4, TP6 and TP9). Due to the impermeable nature of the tested strata, no infiltration/decrease in water level was recorded at any test location over the monitoring period, and therefore soil infiltration rates could not be determined.

Subject to the proposed development levels, drainage runs may pass through very soft and soft organic clay deposits or loose made ground. It is therefore recommended that drainage runs be designed using flexible joints with steep gradients, in order to prevent any backfalls occurring as a result of future settlements.

Special care should be taken at the entry detail of external services into the proposed buildings, in order to deal with potential differential movements. At these locations, flexible joints should again be used.

11.7 RECOMMENDED FURTHER WORKS

At the time of the fieldworks, it was not possible to gain access to the southern corner of the site. This area was fenced off and occupied by homeless people. Once access is available, it is recommended that further soil sampling and contamination testing is undertaken across this area. Following assessment of the results, the risk assessment and preliminary remedial recommendations detailed in Section 10.3 should be reviewed.