ARUP

VolkerFitzpatrick Limited

# MetroWest Phase 1B

## GRIP 5 Geo-Environmental Desk Study (BCC)

Reference: 140569-VLF-WST-POD-REP-EGE-000002

A01 | 07 July 2023


This report takes into account the particular instructions and requirements of our client.

Job number 293556

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# Executive Summary

## Site Descriptions

**Temporary/ Satellite Sites**

Ch195800m - Ch195600m - Clanage Road: Predominantly undeveloped land with the disused railway line trending north to south along the western edge of the site. Additionally, the A369 trends north to south on the eastern boundary of the site.

Ch195100m – Ch194840m – Ashton Gate: The site encompasses three roadways and the disused railway trending southeast to northwest, including the A3029, the Ashton Gate Underpass and an unnamed road along an overpass. The site also includes the Ashton Vale Road intersection.

## Proposed Development

Clanage Road: Site 13 will comprise a temporary construction compound providing access from the A369 Clanage Road roadway to the railway line (to be converted into a permanent vehicular access point for future railway and highway maintenance, as well as flood mitigation works).

Ashton Gate: Site 14 will comprise a temporary construction compound to support the development of the Ashton Gate Underpass improvement works, which involves an additional lane on the southern side of the intersection for left-hand turns.

## Ground Conditions

Ch195800m - Ch195600m - Clanage Road: The site is underlain by Head Deposits in the southeastern half, and TFD in the northwestern half, followed by Mercia Mudstone as bedrock geology. Made Ground of at least 1m thick concrete is revealed from the trial pit records on site. The groundwater table is anticipated to be deeper than 1mBGL.

Ch195100m – Ch194840m – Ashton Gate: The site is anticipated to be overlain by 2m to 3.5m thick of variable Made Ground comprising clay with gravels and occasional boulders, and ash, brick and rubble. Underlying the Made Ground is Alluvium of firm to soft organic clay with peat, to a depth of circa 10mBGL overlying stiff red mudstone. The groundwater table is anticipated to be circa 8mBGL.

## Key Geo-Environmental Risks

- Construction and maintenance workers are at greater risk during the development, predominantly from dermal contact, ingestion and inhalation of soils and dust derived from potentially contaminated Made Ground and groundwater.
- Potential contamination sources include contaminants associated with historic railway infrastructure and ash ballast.
- Risk to end site users (albeit low considering that only some of the sites will have a permanent use and these will be used infrequently by rail workers), will be mitigated by hardstanding and limited access.
- Service trenches and soil/structure interfaces may create a preferential pathway for leachates related to the historic railway infrastructure to migrate to the River Terrace Deposits and Mercia Mudstone (conglomerate) beneath the sites which are designated Secondary A and Principal aquifers respectively.
- Contaminants within the Made Ground present a risk to materials and structures included in the proposed scheme, causing corrosion.

## Recommendations / Further work

In order to further investigate the key geo-environmental risks identified from the preliminary risk assessments, an intrusive ground investigation has been scoped up, and it is summarised below (currently underway):

- A combination of boreholes and trial pits to understand the extent and nature of Made Ground and the underlying superficial deposits.
- Geo-environmental sampling and contamination testing (suite of testing to be informed by the potential contamination sources presented in this desk study) to allow assessment of risks to human health and the environment, and WAC (Waste Acceptance Criteria) testing to inform off-site disposal options should excavated materials be unsuitable for re-use.
- pH and Sulphate testing to allow assessment of aggressivity of ground to buried concrete.
- Laboratory testing of soil samples to allow characterising and classifying of the materials for re-use.
- Obtaining groundwater information (quality and levels) to inform contamination risk assessments through installations within boreholes in selected locations for groundwater sampling and monitoring.
- Groundwater monitoring at any existing boreholes from previous GI (subject to their condition).

# 1. Introduction

## 1.1 This Document

This document has been produced by Arup on behalf of Network Rail to discharge Requirement 17 of the Portishead Branch Line (MetroWest Phase 1) Order 2022 (the Development Consent Order which will be referred to as "DCO" in this document).

Requirement 17 of the DCO states that:

(1) Any stage of the authorised development must not commence until a written scheme applicable to that stage to deal with the contamination of any land, including groundwater, within the Order limits which is likely to cause significant harm to persons or pollution of controlled waters or the environment has, after consultation with the relevant planning authority and the Environment Agency, been submitted to and approved by the relevant planning authority.

(2) The scheme must include an investigation and assessment report (including a desk based study), prepared by a specialist consultant approved by the relevant planning authority, to identify the extent of any contamination and remedial measures to be taken with respect to any contaminants on the site."

This document is submitted to Bristol City Council for approval to discharge Requirement 17 for the detailed design (GRIP 5) of MetroWest Phase 1.

## 1.2 Overview of the project

The MetroWest Phase 1 project aims to reconnect Bristol and Portishead by rail, providing the capability to introduce an hourly or hourly plus passenger service from Bristol Temple Meads to Pill and Portishead. The project consists of the following key components:

- The re-opening of a passenger service between a new Portishead station and Bristol Temple Meads, including reopening a freight line to passenger traffic and 4.68km of new railway to be constructed on the disused line between Pill and Portishead.
- New Stations at Pill and Portishead and twin tracking through the Pill area.
- Improvement works to the existing freight line between Portbury Junction and Parson Street Junction.
- Highway works in the Portishead and Winterstoke Road, Bristol areas.
- Access improvements, new highway accesses, new or altered bridleways, and new or altered pedestrian and cycle routes.
- Construction of permanent rail maintenance compounds and Road/Rail Access Points (RRAP).

Temporary works are also proposed in the form of construction compounds and creation of haul roads.

Development Consent was granted for the above works by the Department for Transport on 14/11/2022 following consideration by the Secretary of State for Transport and the Planning Inspectorate. The commission includes the discharge of Requirements related to the implementation of the DCO.

The 'made' version of the DCO includes a total of 37 Requirements that those parties implementing the DCO must comply with. Of these Requirements, 31 require the submission and approval of information to the relevant planning authority and/or statutory consultees. As already mentioned, this document seeks to 'discharge' Sub parts 1 and 2 of Requirement 17 for the detailed design (GRIP 5) of MetroWest Phase 1.

## 1.3 Project Scope and Context

Ove Arup & Partners Ltd (Arup) have been commissioned by VolkerFitzpatrick to provide multi-disciplinary support for the detailed design (GRIP 5 -8) of MetroWest Phase 1. The development is covered by the DCO boundary as presented in Drawing 1. The site broadly consists of the following areas:

- The existing freight line from Bristol (Parson Street Junction) to Portbury Docks
- The former line from Portbury Junction (after Pill) to Portishead which was decommissioned in the 1960s as part of the Beeching's Cuts and is classified as non-operational railway land;
- A number of temporary and permanent "satellite sites" which are located outside the operational rail corridor and are required to deliver the project.

The purpose of this report is to support the discharge of sub parts 1 and 2 of Requirement 17 the DCO conditions set out in the Secretary of States Decision Letter [2] as described in section 1.1. It should be noted that Requirement 17, sub part 6 limits Requirement 17 to only the non-operational railway parts of the proposed scheme. This has been interpreted to comprise the rail infrastructure including Portishead Station to Portbury Junction, and the "satellite sites". It should be noted that this report only refers to the temporary/satellite sites which are relevant to the Bristol City Council (BCC). These sites are shown in Drawing 1.

This report aims to identify the extent of any potential contamination and assess the potential risk posed to identified receptors through a desk based review of readily available information and completion of a preliminary risk assessment (PRA).

The study area has been defined in line with the Environmental Impact Assessment. It is considered that a 500m boundary from the railway will capture the risk of horizontal contamination beyond the construction footprint and potential impacts on abstraction sources. Further to this the study area for source protection zones (SPZ) was extended to 2km in keeping with the EIA [3].

## 1.4 Assumptions and Limitations

This report has been prepared for VolkerFitzpatrick (the Client) and takes into consideration their particular instructions and requirements.

The interpretation of the ground conditions is based on the information obtained as part of this desk-based assessment, newly acquired third party information and available ground investigation information. All reasonable skill, care and diligence has been exercised in carrying out this report, within the timescales available.

# 2. Development proposals

The Scheme covered by the DCO boundary encompasses approximately nine miles of the Bristol and Portishead Railway Line between Portishead and Parson Street in Bristol (which will henceforth be referred to as "the railway"). This comprises three miles of disused railway from the site of the proposed Portishead Station to Portbury Junction and six miles of currently operational railway (freight only) from Portbury Junction to Parson Street Station in Bedminster, Bristol.

The development proposals comprise the upgrading of the rail connection from Bristol Parson Street Station to Portishead for a new passenger rail connection between the two stations. The development involves upgrading the existing rail between Parson Street station and Portbury Junction and the new rail along the former rail line between Portbury Junction and Portishead. The Scheme involves the upgrade of the former (now disused) Pill Station along the currently operational freight railway line and the development of a new station in Portishead.

In addition to the works along the rail corridor, ancillary works are required to the highways at Portishead and Ashton in Bristol. Also, a number of temporary sites will be established along the route for compounds and haul roads, some of these will later become permanent railway access points. A number of these sites were identified by North Somerset Council (NSC) and WECA as requiring further investigation to establish the following:

- Structure of the soil to inform the design of temporary haul roads and compounds and permanent compounds, paths and highways,
- To inform on the understanding of settlement periods for new works based on the stability of the ground,
- and to identify contaminants in the soil which may affect how the soil is managed and disposed of [4].

These NSC and WECA sites have not been assessed within this report, except for Temporary sites 13 and 14 which are within BCC's authority and as such are included in this report. Temporary sites 17 and 18 were identified early in the design stage as no longer being required for the proposed works (areas of haul roads where no further works are proposed). On this basis these sites are not included in this desk study.

The temporary/Satellite Sites which are the subject of this report, are as follows:

- Ch195800m - Ch195600m (Clanage Road) - site 13.
- Ch195100m – Ch194840m – (Ashton Gate) – site 14.

## 2.1 Temporary/Satellite Sites

In line with the conditions outlined in the DCO, we have reviewed and assessed all relevant sites to BCC not included within the boundaries of operational railway land. This section reviews information for both temporary sites, reserved for construction compounds, and permanent works within proximity to the railway (deemed 'Satellite Sites').

The scheme from Portishead to Portbury Junction principally comprise the disused railway (currently owned by North Somerset Council) together with adjacent agricultural land required temporarily for construction haul roads and compounds, permanent railway access points, and ecological mitigation areas.

### 2.1.1 Clanage Road

Site 13 will comprise a temporary construction compound providing access from the A369 Clanage Road to the railway. Following completion of the development, the northern half of the temporary site will be converted into a RRAP for future railway maintenance, as well as flood mitigation works. Additionally, the southern tip of the site will also become a permanent vehicular access point to the adjoining land.

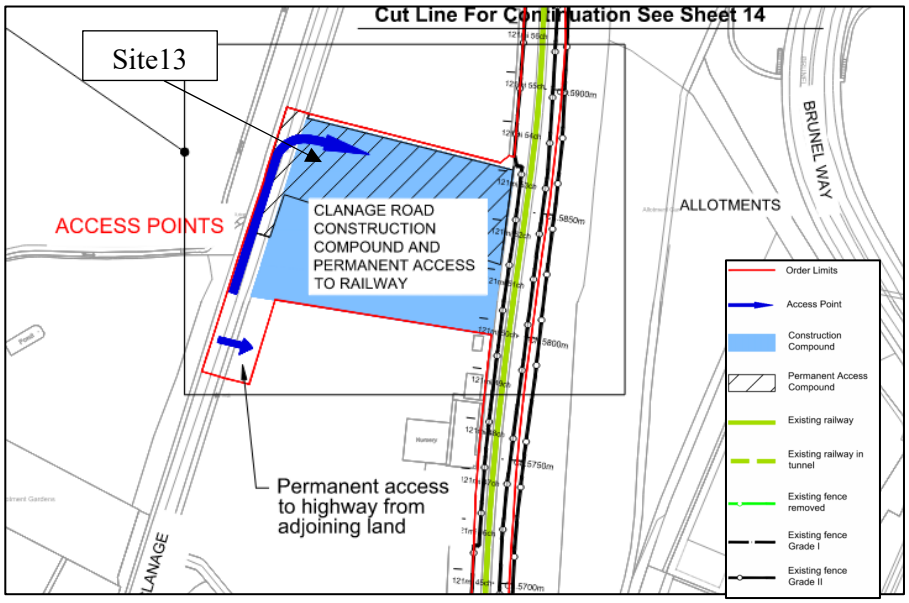



**Figure 2-1: Proposed works for Clanage Road site [4].**

### 2.1.2 Ashton Gate

Site 14 will comprise a temporary construction compound to support the development of the Ashton Gate Underpass improvement works, as well as the Ashton Vale Road intersection where the permanent works are to take place. The works involve the development of an additional lane on the southern side of the intersection for left-hand turns.

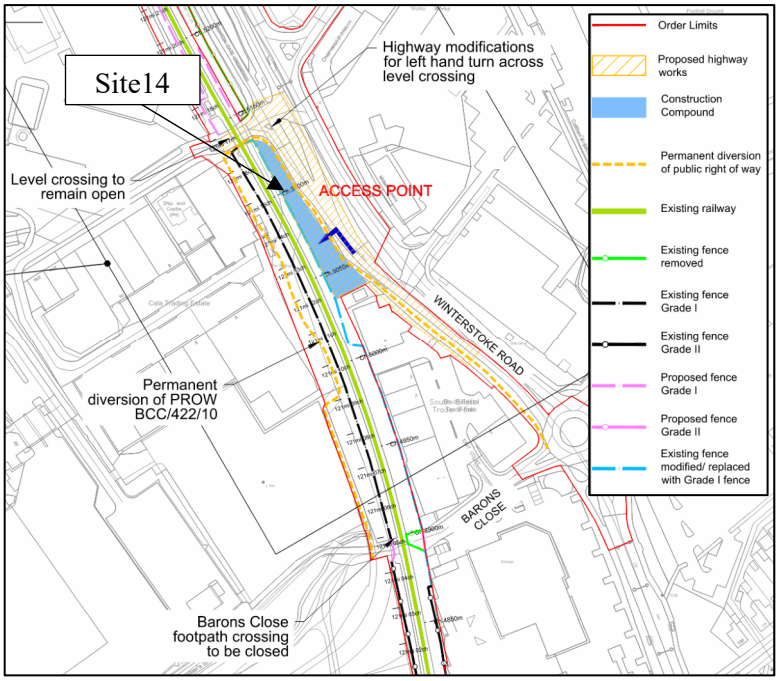



**Figure 2-2: Proposed works for Ashton Gate site [4].**

# 3. Desk Study

## 3.1 Data Sources

The following data sources have been used to provide information to inform the desk study and identify potentially contaminated sites:

- Groundsure Enviro + Geo Insights information (Appendix A) which was purchased as part of this commission. This includes 1:1,250, 1:2,500, 1:10,000, and 1:10,560 scale Ordnance Survey (OS) maps from 1881 to the present-day. Appendix A also includes environmental sensitivity and permitting information, as well as geological sensitivity information (from Groundsure).
- Travelwest website accessed for information on MetroWest project [1].
- The Portishead Branch Line (MetroWest Phase 1) Order 2022 No. 1194 (came into force on 5th December 2022) [2].
- CH2M Environmental Statement for Portishead Branch Line (MetroWest Phase 1), Volume 2, Chapter 10 Geology, Hydrogeology, Ground Conditions and Contaminated Land (2019) [3].
- MetroWest Phase 1 website. Accessed to review DCO documents as made November 14th, 2022 [4].
- Womble Bond Dickinson (UK) LLP Statement of Reasons for Portishead Branch Line (MetroWest Phase 1 (2019) [5].
- British Geological Survey (BGS), Sheet 264: Geological map of Bristol, Solid and Drift (1:50,000) - 2004. Reviewed for site geological information [6].
- British Geological Survey (BGS), GeoIndex Onshore online database. Reviewed for geological mapping, and digital historical borehole records for the regional area [7].
- Flood Map for Planning website. Accessed for indication of flood risk [8].
- Google Earth Pro historical aerial photography.
- Historic England online Aerial Photo Explorer. Reviewed to understand whether there was any historical aerial imagery of interest [9].
- Department for Environment, Food & Rural Affairs (DEFRA), MAGIC online database. Accessed for aquifer designations, and general environmental sensitivity information [10].
- Zetica UXO risk maps. Reviewed for indication of UXO risk on site [11].
- Fellows Detailed UXO Risk Assessment for Sheets 1 and 2a - Portishead Station & Trinity Footbridge and Sheets 2 to 5a - Works Plan Version 4 (2021) [12].
- Gordano Civic Society website. Reviewed for information on the history of Portishead's Power Stations [13].
- Department of the Environment Industry Profile, Railway Land (1995) [14].
- Existing Ground Investigation Works Factual Reports. Reviewed for geology and hydrogeology.
    - Factual Report on Ground Investigation at Metrowest, 2016, by Structural Soils Ltd [15].
    - Portishead Car Park, Factual Geotechnical Report, 2017, by ACS Testing Ltd [16].
    - Site Investigation No. AG0254 Factual Report, Portishead, 2018, by C.J. Associates Geotechnical Limited (CJA) [17].
    - Site Investigation No. AG0255 Factual Report, Sheepway, 2018, by CJA [18].

- Site Investigation No. AG0442 Factual Report, Elm Tree Farm Sheepway, 2018, by CJA [19].
- Site Investigation No. AG0502 Factual Report, Change Road, 2018, by CJA [20].
- Site Investigation No. AG0660 Factual Report, Portbury Hundred, Sheepway, 2018, by CJA [21].
- MetroWest Phase 1 Trial Holes, Factual Report on Ground Investigation, 2021, SOCOTEC UK Ltd [22].
- MetroWest Phase 1B Package 3 Ground Investigations Various Locations, 2021, by Keltbray [23].

- CH2M Master Construction Environmental Management Plan for Portishead Branch Line (MetroWest Phase 1) (2021) [24].
- Department of the Environment Industry Profile, Waste recycling, treatment and disposal sites, landfill and other waste treatment or waste disposal sites (1996) [25].
- Coal Authority. Online Interactive Map [26]. Reviewed for potential former or active coal workings for the site areas.

## 3.2 Temporary/Satellite Sites Study

A total of 18 temporary and/or satellite sites have been identified as part of the DCO and their function summarised in Table 1 below.

**Table 1: Summary of temporary/satellite sites**

| Site No. | Work element | Proposed works |
|---|---|---|
| **Clanage Road** | | |
| **13** | Clanage Road highway accesses + permanent compound (DCO Stage 7 – Work Nos. 26, 26A and 26B) | To be used as a temporary construction compound and then used as a permanent rail access compound |
| **Ashton Gate** | | |
| **14** | Highway improvement (DCO Stage 9 – Work No. 28) | A temporary site compound to support the permanent works to add additional lane to highway junction |

A full preliminary study of the sites listed above is provided in Table 2 below.

**Table 2: Preliminary study of temporary satellite sites**

| Temporary/Satellite Sites Summary |
|---|

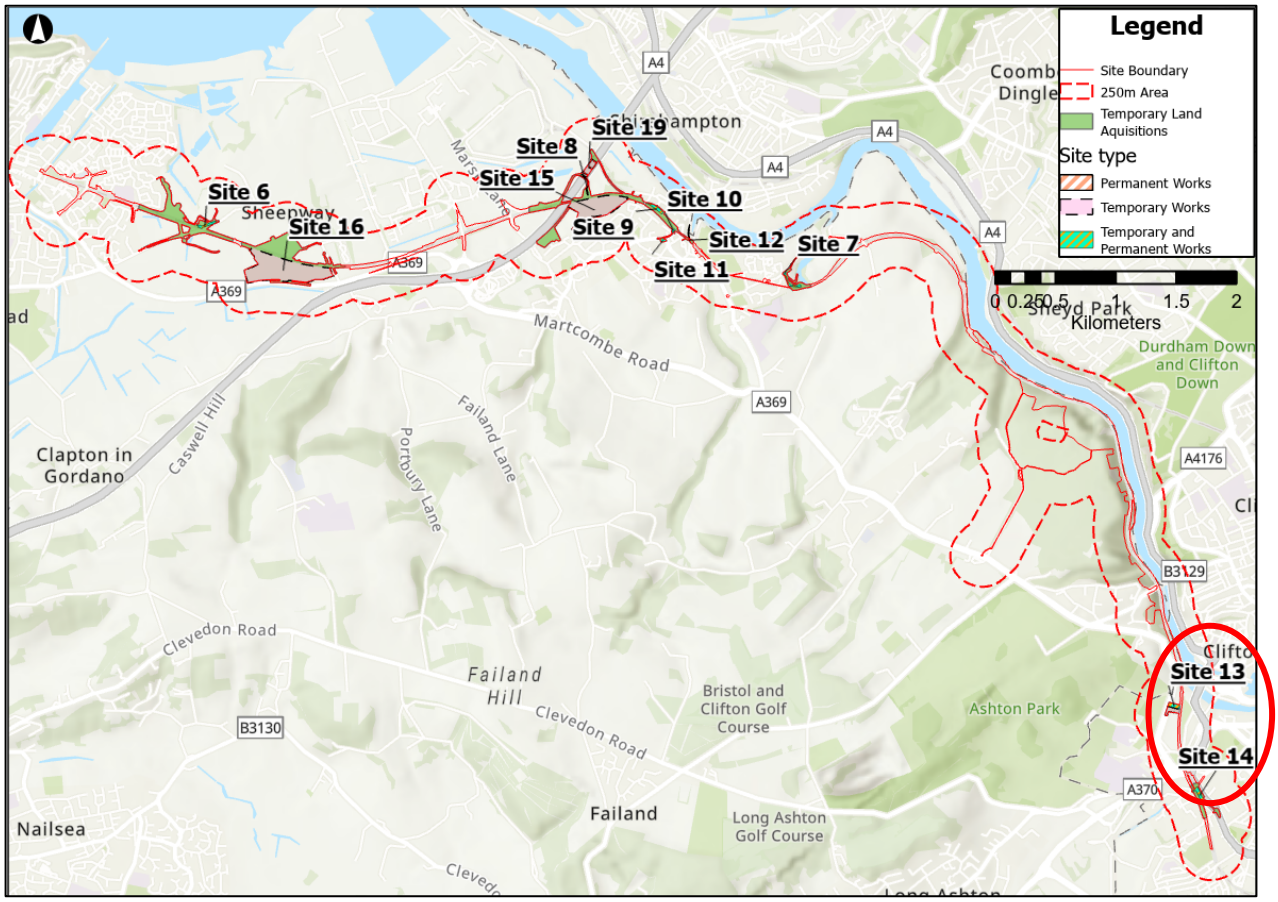



**Figure 3-1 Plan of temporary/satellite sites, based on the Metrowest Phase 1 Ground Investigation [22] (the sites which are the subject of this study are included in the red circle)**

| Current Land Use |
|---|

**Ch195800m - Ch195600m - Clanage Road (Site 13)**

Predominantly undeveloped land with the disused railway trending north to south along the western edge of the site. Additionally, the A369 trends north to south on the eastern boundary of the site.

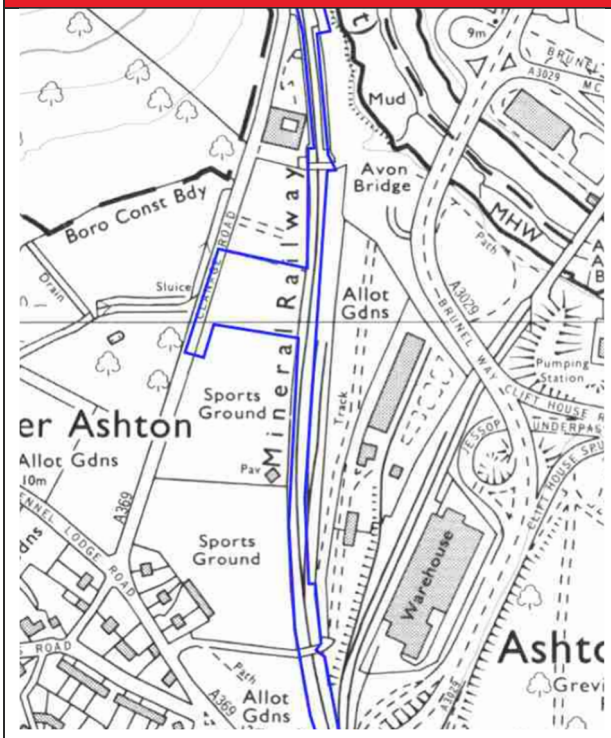
The site is bounded to the west by agricultural fields, the east by allotment gardens, and to the south by sports grounds and commercial buildings. To the north of the site is a large complex which looks dilapidated and disused on aerial images. The purpose of this complex is not specified.

**Ch195100m – Ch194840m – Ashton Gate (Site 14)**

The site encompasses three roadways trending southeast to northwest, including the A3029, the Ashton Gate Underpass and an unnamed roadway which runs along an overpass on the western side of the site. The Ashton Gate Underpass intersects with Ashton Vale Road at the site centre, which trends southwest to the northeast. Additionally, the railway line runs southeast to the northwest along the western boundary of the site, with a railway crossing present across Ashton Vale Road.

The site is bounded to the west by the Cala Trade Estate and south by the South Bristol Trade Park which both comprise primarily of industrial and commercial businesses including vehicular repair works, recycling centres and a timber works. The South Bristol Retail Park bounds the site to the southeast, comprising oof commercial warehouses and Ashton Gate Stadium. Residential builds and Greville Smyth Park are situated to the west of the site and the A370 overpass bounds the site to the north, followed by residential flats and allotments gardens.

| Historical Land Use (based on Groundsure report included in Appendix A) | |
|---|---|
| **Ch195800m - Ch195600m - Clanage Road**<br>1973 Ordnance Survey 1:10,560 | **1883**<br>**Onsite;** |




The site consists of undeveloped land with the railway line trending north to south adjacent to the eastern site boundary and Clanage Road trending north to south on the western site boundary.

**Offsite:**

The surrounding region predominantly consists of undeveloped land east of the site, as this is subject to tidal flooding, and agricultural fields west of the site. Clifton Bridge Railway Station is present 210m north of north of the site. A tramway related to the operation of Frayne's Colliery to the south is present 60m east of the site boundary trending northeast to southwest.

**1902**

A large compound is present 140m southwest of the site comprising several large buildings. The purpose of this compound is not specified.

**1913**

The tramway east of the site has now been replaced by the Bristol lines Railway as well as several extra railway sidings.

**1973**

The A3029 (also referred to as Brunel Way) is now present 120m east of the site trending north to south. Adjacent to the major roadway is a large unspecified warehouse approximately 250m southeast of the site as well as some industrial buildings at a closer distance of 150m southeast. The compound to the southwest of the site is no longer present.

**2010**

The warehouse and railway infrastructure to the southeast of the site have now been demolished.

**Ch195100m – Ch194840m – Ashton Gate**

1930 Ordnance Survey 1:10,560

**1883**

**Onsite:**

The site comprises predominantly the railway line trending southeast to northwest. Railway sidings trend northwest to southeast across the site centre, related to Frayne's Colliery to the west.

**Offsite:**

The surroundings include residential builds to the northeast and undeveloped land to the east and north. The Ashton Rolling Iron Mills are present adjacent to the southeast site boundary. Agricultural fields bound the site to the south and southwest. Buildings and infrastructure related to the disused Frayne's Colliery are present adjacent to the site's western boundary, including railway sidings, tramways and circular structures (potential fuel tanks). This is followed by the Ashton Vale Iron Works 150m to the west.

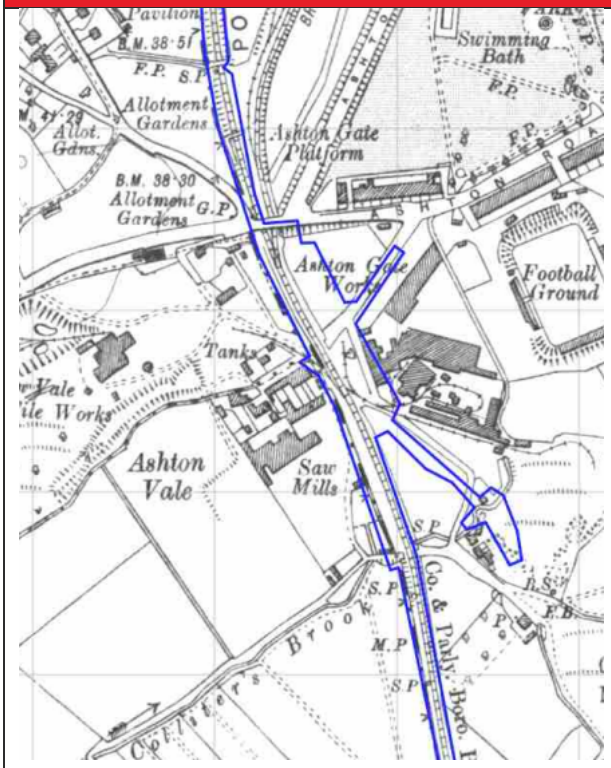
**1902**

The map denotes a malleable nail works adjacent to the east boundary of the site and the residential builds to the northeast have been replaced by a smithy.

**1930**

The railway infrastructure to the north has been expanded to include the Ashton Gate Platform and the Bristol Railway Lines. The map denotes large industrial buildings present on the eastern boundary of the site, referred to as Ashton Gate Works. The Iron

## Temporary/Satellite Sites Summary




Works to the southeast have now been demolished and cleared. The infrastructure of Frayne's Colliery has been demolished and replaced with a Saw Mill. This is accompanied by several tanks approximately 50m to the west. Ashton Vale Iron Works are no longer present. Finally, the Ashton Vale Brick and Tile Works is situated 220m to the west, adjacent to an excavation pit with railway sidings.

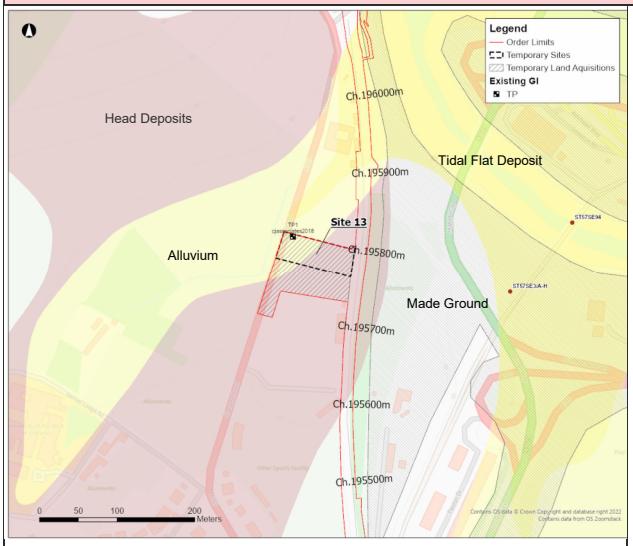
**1973**

The A3029 is now present trending northwest to southeast across site. A number of unspecified industrial sites are present adjacent to the site boundary, including the warehouse to the south followed by a factory at 150m. Works are present to the east and another warehouse 250m to the north. Finally, an industrial park has been developed to the west, including 2 large warehouses and several unspecified works. Finally, the A370 overpass is present to the north with allotment gardens at a further 180m.

**2001**

The Ashton Gate Underpass has now been developed adjacent to the A3029. The large warehouses in the western industrial park and the southeast has now been demolished and removed.

## BGS Geology

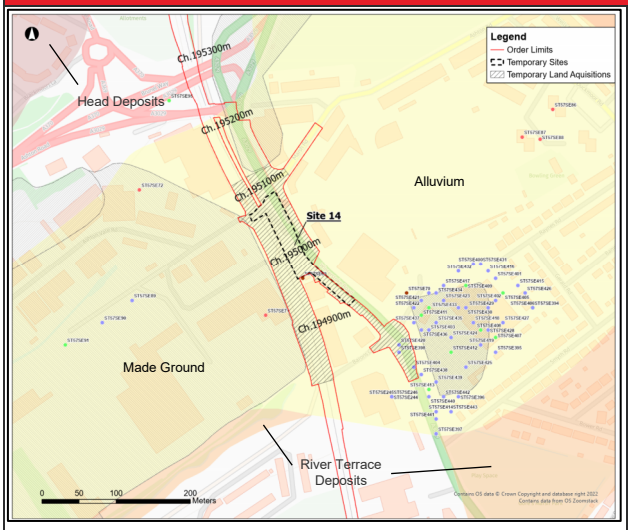



**Ch195800m - Ch195600m - Clanage Road**

Based on the BGS geological map, there is no Made Ground recorded onsite, but 30m east of the site. The site is underlain by Head Deposits in the southeastern half and Alluvium in the northwestern half. Tidal Flat Deposit is present to the north of the site. There is no BGS borehole records within or in close proximity of the site. A BGS borehole record (ref. ST57SW3/A-H) 200m to the east of the site reveals clay materials, which is probably Tidal Flat Deposit, to a depth of circa 5-8mBGL above sandstone.

There was a shallow trial pit conducted next to the Clanage Road indicates CJ Associates Geotechnical Ltd. in 2018 [18]. The trial pit indicates at least 1m thick of concrete at the north-western end of the site. The groundwater table was not encountered in the trial pit so is anticipated to be deeper than 1mBGL.

## Temporary/Satellite Sites Summary



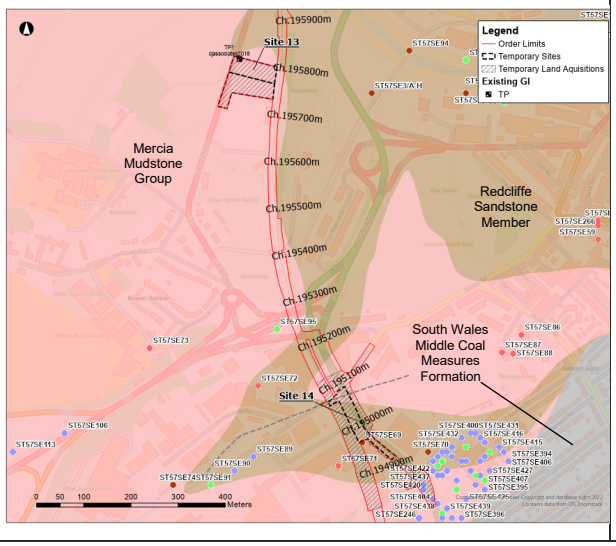

### Ch195100m – Ch194840m – Ashton Gate

Based on the BGS maps, there is almost no Made Ground onsite although it is anticipated to be present based on the historic development of the site. An area of artificial deposit is present on the northern boundary and north of the site, underlying the former railway infrastructure. An artificial deposit is present adjacent to the western boundary of the site, underlying the Cala Trade Estate and South Bristol Trade Park. The BGS maps also denote a void approximately 280m west of the site, related to the former Brick and Tile Works. Finally, an area of infilled ground is present to the immediate southeast of the site, related to the former Ashton Rolling Iron Works.

The BGS maps denote alluvium deposits underlying the entire site. Head deposits and River Terrace Deposits are present circa 300m to the northwest and circa 150m to the south of the site.

The nearby BGS borehole records indicate Made Ground of 2m to 3.5m thickness surrounding the site (Ref. ST57SE411 and ST57SE89 at circa 90m southwest and 200m west of the site respectively). The Made Ground is variable comprising clay with gravels and occasional boulders, and ash, brick and rubble. Underlying the Made Ground is Alluvium of firm to soft organic clay with peat, to a depth of circa 10mBGL overlying stiff red mudstone.

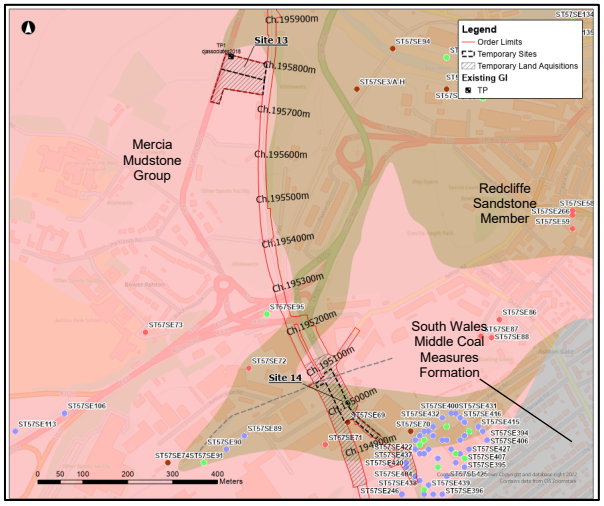
Based on the closet available BGS borehole records (Ref. ST57SE411), groundwater was encountered at a depth of 8.2mBGL.




### Ch195800m - Ch195600m - Clanage Road

Based on the BGS geological map, Site 13 is predominantly underlain by Mercia Mudstone (Halite and Mudstone), with Redcliffe Sandstone Member recorded on the eastern and northern boundaries. There is no BGS borehole or existing GI available within the site. A BGS borehole record (ref. ST57SW3/A-H) 200m to the east of the site reveals sandstone at circa 5-8mBGL.

## Temporary/Satellite Sites Summary




**Ch195100m – Ch194840m – Ashton Gate**

The site is predominantly underlain by Redcliffe Sandstone Member with Mercia Mudstone, comprising halite and mudstone, on the northern and southern site boundaries. A BGS borehole record (Ref. ST57SE71) at circa 60m southwest of the site reveals red mudstone at circa 10mBGL. Additionally, an unspecified coal seam is inferred across the centre of the site, trending west to east.

### Hydrogeology

| | |
|---|---|
| Superficial Deposits | River Terrace Deposits (Secondary A)<br>Head Deposits (Secondary undifferentiated) |
| Bedrock | Mercia Mudstone – Halite and Mudstone (Secondary B)<br>Mercia Mudstone – Conglomerate (Principal)<br>Redcliffe Sandstone (Secondary A) |
| Source protection zones | None |
| Groundwater vulnerability | High – areas that can easily transmit pollutants to groundwater, Mercia Mudstone (Conglomerate) and Redcliffe Sandstone Member.<br>Low – areas that offer groundwater protection, associated with the Mercia Mudstone (Halite and Mudstone) and the peat deposits.<br>Soluble rock risk associated with the bedrock |

### Hydrology

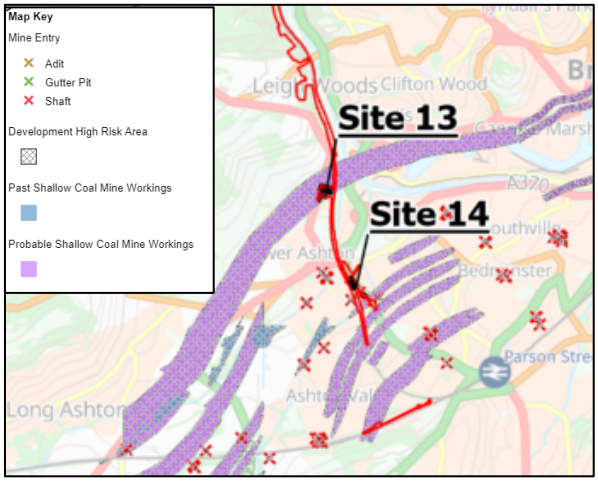
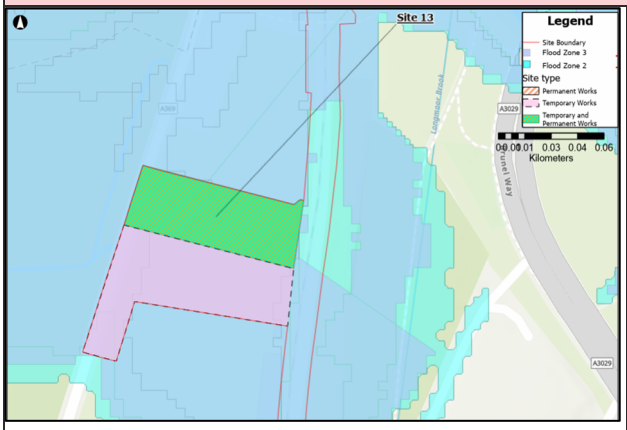
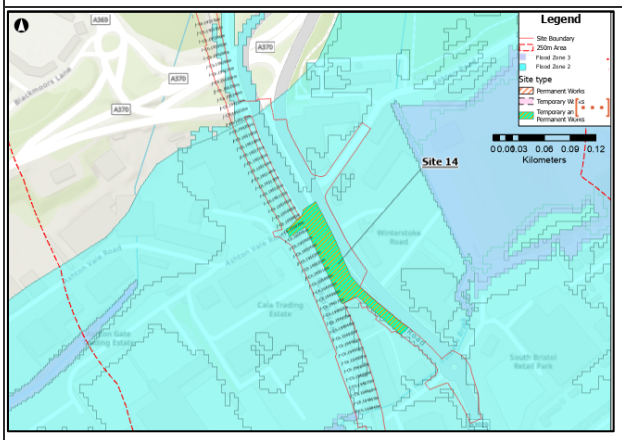
**Ch195800m - Ch195600m - Clanage Road**

No hydrogeological features are present onsite. However, an unnamed and culverted stream is present on the opposing side of Clanage Road, approximately 30m east of the site, flowing north. Additionally, Longmoor Brook is present 50m to the east and flows from south to north.

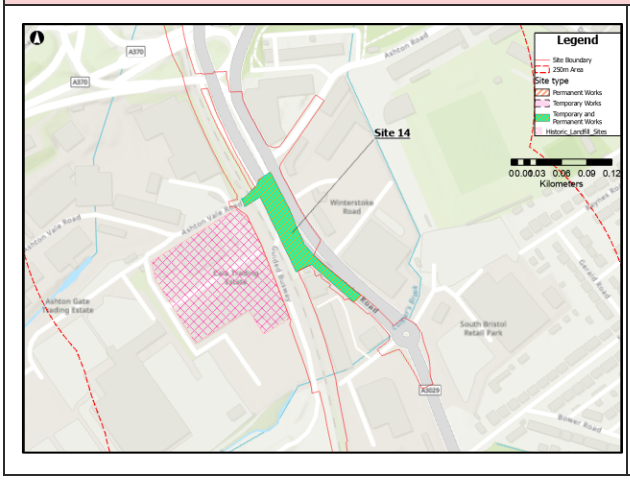
**Ch195100m – Ch194840m – Ashton Gate**

The site is bisected by two separate watercourses; the Longmoor Brook which transects the northern end of the site, and Colliter's Brook which flows across the southern end of the site. Both brooks flow from southwest to northeast across site before being redirected to the north and converging immediately northeast of the site.

### The Coal Authority

| Temporary/Satellite Sites Summary | |
|---|---|
|  | **Ch195100m – Ch194840m – Ashton Gate**<br>Reviewing the Coal Authority Interactive Map [26], Site 14 is located beyond the Development High Risk Area. Within 100m to the south of the site, there are two records of mine entries that are likely associated with the former coal working, Frayne's Colliery. |
| Flooding | |
|  | **Ch195800m - Ch195600m - Clanage Road**<br>The entire site is situated in a Flood Zone 3. |
|  | **Ch195100m – Ch194840m – Ashton Gate**<br>The entire site is situated within a Flood Zone 2. |
| Active abstractions (within 1km) | |
| Surface Water | |
| None | |
| Groundwater | |
| None | |
| Active licensed discharge consents (within 500m) | |

| Temporary/Satellite Sites Summary |
|---|
| Surface Water |
| None |
| Groundwater |
| None |
| Registered waste exemptions |
| **Ch195800m - Ch195600m - Clanage Road**<br>Several waste exceptions are registered for the secure storage of non-agricultural waste including unspecified sites at 330m to the northeast, 421m west and 440m east.<br>The University of West England 250m to the southwest is registered for the use of waste in construction.<br>Another waste exception at 265m is registered for use of mulch and waste plant matter at an unspecified site. |
| Authorised Landfills |
| None |
| Historical landfills |




**Ch195100m – Ch194840m – Ashton Gate**

The Cala Trade Estate adjacent to the western boundary of the site is underlain by a historical landfill. Unfortunately, there is very limited information available regarding the waste type and operational duration.

# 4. Conceptual Site Model

## 4.1 Methodology

A preliminary conceptual site model (CSM) has been developed for the DCO sites identified on the basis of the screening process, within the framework of Land Contamination Risk Management (LCRM). The conceptual site model is a representation of the relationships between the contamination potential of the sites of concern, proposed works, and receptors, to support the identification and assessment of potential contaminant linkages (PCLs) and an assessment of known contaminant linkages, where identified, from existing information. The CSM considers risks during construction and subsequent operation of the scheme.

The model comprises identification of:

- The principal pollutant hazards associated with the site (the sources).
- The principal receptors at risk from the identified hazards.
- The existence, or absence, of plausible pathways which may exist between the identified hazards and receptors.

For risks to be present at the site, all three elements (source-pathway-receptor) of a potential contaminant linkage must be present.

Where identified a Preliminary Risk Assessment (PRA) is carried out in accordance with CIRIA C552 [27] and in the context of LCRM guidance [28]. The purpose of the PRA is to assess the likelihood that each potential issue exists and determine whether these pose potentially unacceptable risks to identified receptors and require further investigation and assessment and/or remediation. The potential risk class of each PCL has been based on consideration of:

- **The likelihood of an event (probability)** – takes into account both the presence of the hazard and receptor, and the integrity of the pathways; and
- **The severity of the potential consequence** – takes into account both the potential severity of the hazard and the sensitivity of the receptor.

The risk assessment process is underpinned by an initial conceptual site model created based on a desk study review of available information pertinent to the site.

## 4.2 Temporary/Satellite Sites

As part of the proposed Scheme, ancillary works are required to the highways at Portishead. Also, a number of temporary sites will be established along the route for compounds and haul roads, some of these will later become permanent railway access points.

### 4.2.1 Potential contaminants and sources

A summary of the potential contamination sources and likely contaminants for the temporary and satellite sites are presented in Table 3.

**Table 3: Potential contamination sources – Temporary/satellite sites**

| Potential source | Location | Associated Contamination |
|---|---|---|
| **Onsite** | | |
| Made ground | Temporary sites encompass infrastructure related to the railway and A369. | Asbestos, metals, sulphate, TPH and PAH, VOCs and SVOCs, and phenol. |

| Potential source | Location | Associated Contamination |
|---|---|---|
| Railway land | Sites encompass and provide access to railway line. | Hydrocarbons (including diesel, lubricating oils, paraffin), PCBs, PAHs, solvents, metals (ferrous residues, metal fines), ash and fill (possibly containing metals, phenols, sulphates and PAHs). Possible historic herbicides used to control growth on tracks and sidings [14]. |
| **Offsite** | | |
| Electrical Substations (dating back to 1948) | | Polychlorinated biphenyls (PCBs). |
| Historical landfills | Cala Trade Estate adjacent to Site 14. | Landfills have historically accepted inert (adjacent to Site 14).<br>Potential for leachate contaminants (metals, asbestos, inorganic and/or organic contaminants). |
| Historical Railway Infrastructure | Railway sidings related to Frayne's Colliery 60m east of Clanage Road. | Hydrocarbons (including petroleum hydrocarbons and polycyclic aromatic hydrocarbons), fuel oils, lubricating oils, greases, solvents, paints, heavy metals, asbestos, phenols, and creosote.<br>Possible historic herbicides used to control growth on tracks and sidings. |

### 4.2.2 Ground gas

There is potential for ground gas (albeit low considering the very low gas generation rates) related to the underlying Tidal Deposits [29]. The assessment for ground gas is included in Appendix B.1.

### 4.2.3 Pathways

For a risk to exist the (potential) sources and receptors must be connected by a viable pathway. Potential pathways by which human and environmental receptors may be impacted upon are as identified below:

- **Ingestion of contaminated soils and dust**: During construction of the proposed development, site workers who are dealing closely with excavated soils may come into contact with contaminants through ingestion of soils and dust. Workers, or users of the neighbouring residential or commercial areas may be impacted by the ingestion dust created during development.

  Post completion of the development, maintenance workers involved in excavations may be impacted by the ingestion of soils and dust related to contaminated Made Ground.

- **Dermal contact with soils, dust, leachate, and perched groundwater**: During site development, site workers who are engaged in ground works and handling of excavated soils may come into skin contact with impacted material and groundwater.

  Post completion of the development, maintenance workers involved in excavations may be impacted by dermal contact with contaminated Made Ground, leachate and groundwater.

- **Inhalation of soil derived dust, organic vapours**: Generation of dust through earthworks to facilitate the proposed development, may impact construction workers and site neighbours.

  Post development it is considered unlikely that dust generation will occur, mainly due to the development largely comprising platform footprint and hard surfacing. However, if soft landscaped areas are proposed then there is a potential that dust could be generated from these areas should contaminated soils be present at or near the surface.

  Volatile contaminants may be present in the subsurface, these may impact construction workers during earthworks.

- **Leachate generation and migration**: There is potential for the generation and migration of leachate from impacted soils which may enter and migrate within the underlying groundwater bodies. However, the likelihood is low based on the hardstanding surface cover on most of the site and existing drainage, as well as the fact that the underlying ground conditions predominantly comprise low permeability soils (Mercia Mudstone bedrock comprising halite and mudstone).
- **Lateral and vertical migration of contaminants**: Contaminants released to the ground through spillage or leaks may migrate vertically or laterally through the underlying strata. It is considered that the low permeability surface of the underlying bedrock will largely inhibit vertical migration unless preferential pathways are created. Laterally it is feasible that perched groundwater might be present on the bedrock and that this may be impacted allowing lateral migration of contaminated groundwater.
- **Surface water run-off**: May occur onto nearby land and surface water receptors during construction. However, this will be managed as part of the CEMP [24]. Post development the site include drainage to manage surface water run-off.
- **Direct contact with structure materials – corrosion**: There is potential for chemical attack of concrete and pipe materials (of services) as a result of aggressive ground conditions (pH and sulphates) encountered.

### 4.2.4 Receptors

The receptors considered relevant to any existing contamination within the subsurface associated with the proposed development are identified as follows:

<u>During Construction:</u>

- Construction workers involved in the development works.
- Off-site receptors – residents of Ashton Gate.
- Surface waters – tributaries of River Avon including Markham Brook, Longmoor Brook and Colliter's Brook
- Principal aquifer – Mercia Mudstone (Conglomerate)
- Secondary A aquifer – River Terrace Deposits

<u>During Operation:</u>

- On-site maintenance workers involved in railway maintenance.
- Developed infrastructure (concrete, plastic pipes).
- Surface waters – tributaries of River Avon including Longmoor Brook and Colliter's Brook
- Principal aquifer – Mercia Mudstone (Conglomerate)
- Secondary A aquifer – River Terrace Deposits.

## 4.3 Preliminary Risk Assessment

A preliminary CSM has been developed for the proposed end uses set out in section 4. The risk magnitude of the PCLs has been assessed through a qualitative risk assessment process as described in section 4.1. The CSM has been developed based on the design elements of the scheme which intersect with the area/site of potentially contaminative land use. The PRA developed is presented in Appendix B. A summary of the moderate to high-risk PCLs are presented in this section.

### 4.3.1 Temporary/Satellite Sites PCLs

The following Potential Contaminant Linkages (PCL) were identified:
During construction:

- PCL1: Contaminated Made Ground across the satellite sites related to current and former railway infrastructure and ash ballast > Dermal contact, ingestion and inhalation of soils and dust > Site construction workers.

- PCL2: Contaminated groundwater > Dermal contact with groundwater, ingestion and inhalation of soils and dust > Site construction workers.

- PCL3: Contaminated surface water > Dermal contact with surface water, ingestion and inhalation of soils and dust > Site construction workers.

- PCL4: Contamination from sources associated with the historical Cala Trade Estate Landfill > Dermal contact, ingestion and inhalation of soils and dust > Site construction workers.

- PCL5: Contaminated Made Ground across the site > preferential pathway for lateral migration along higher permeability horizons and leachate migration of temporarily stockpiled and exposed excavated soils > Groundwater body beneath the site (River Terrace Deposits and Mercia Mudstone).

During operation:

- PCL6: Contaminated Made Ground across the site related to current and former land use including asbestos containing soils > Dermal contact with soils, ingestion and inhalation of soils and dust > Maintenance workers involved in future excavations.

- PCL7: Contaminated Made Ground across the site > preferential pathway for lateral migration along higher permeability horizons and lateral and vertical migration along soil/structure interfaces > Groundwater body beneath the site (River Terrace Deposits and Mercia Mudstone).

- PCL8: Contamination from sources associated with the historical Cala Trade Estate Landfill > preferential pathway for lateral and vertical migration of leachates created through service trenches and along soil/structure interfaces > Groundwater body beneath the site (River Terrace Deposits and Mercia Mudstone).

# 5. Conclusions

### 5.1.1 Key geo-environmental risks

A geo-environmental assessment of the desk based information has been undertaken to identify SPR linkages sites that require consideration as part of the proposed scheme. The identified SPR linkages have been assessed as part of the Preliminary Risk Assessment and the following section presents the conclusions of these assessments.

Moderate risk PCLs have been identified as summarised in Appendix B. Recommendations for further investigating and quantifying risk is presented in Section 6.

The development of temporary construction compounds and access services present the following potential contaminant linkages:

- Construction and maintenance workers are at greater risk during the development, predominantly from dermal contact, ingestion and inhalation of soils and dust derived from potentially contaminated Made Ground and groundwater.
- Potential contamination sources include Cala Trade Estate Landfill and contaminants associated with historic railway infrastructure and ash ballast.
- Risk to end site users (albeit low considering that only some of the sites will have a permanent use and these will be used infrequently by rail workers), will be mitigated by hardstanding and limited access.
- Service trenches and soil/structure interfaces may create a preferential pathway for leachates related to Cala Trade Estate Landfill and the historic railway infrastructure to migrate to the River Terrace Deposits and Mercia Mudstone (conglomerate) beneath the sites which are designated Secondary A and Principal aquifers respectively.
- Contaminants within the Made Ground present a risk to materials and structures included in the proposed scheme, causing corrosion.

# 6. Recommendations / Further work

In order to further investigate the key geo-environmental risks identified from the preliminary risk assessments, an intrusive ground investigation has been scoped and is currently underway.

The scope of the investigation has been developed to provide information on the ground conditions across the scheme. This information will feed into the geotechnical design of the proposed scheme but will also allow contaminative status of the subsurface along the length of the development to be better understood.

The desk study has identified plausible pollution linkages during construction and operation of the proposed development areas. However, the proposed end use is of low sensitivity and the form of development means there are likely to be limited pathways for exposure to end users. It is generally considered that further understanding of the contaminative nature of the subsurface is required both to confirm this understanding and determine the risk to other identified receptors such as construction workers and controlled waters during construction. In addition, there are requirements to undertake preliminary chemical analysis to inform materials management and potential off-site waste disposal options.

## 6.1 Scope for Ground Investigation

The scope of ground investigation is summarised below:

- The exact scope of GI  may be subject to change based on access constraints.
- 2no. machine excavated trial pits to a maximum depth of 3.5m bgl to confirm ground conditions for the permanent vehicular access, ramp, flood mitigation works and railway maintenance compound in Site 13 and to identify potential contamination from historical land uses (agricultural use/car boot field) as identified in this report.
- 3no. hand dug pits to a maximum depth of 1.2m bgl to confirm ground conditions for the Ashton Vale Road intersection in Site 14, and to identify potential contamination from historical land uses (former colliery, landfill, mills and other industrial uses) as identified in this report.
- 2no. window sampling holes to a maximum depth of 6m bgl to confirm ground conditions for the proposed retaining walls designed to bridge the foul sewer beneath a ramp (Site 13) and to identify potential contamination from historical land use as identified in this report.
- Geo-environmental laboratory testing of soil samples will be obtained from exploratory holes (suite of testing to be informed by the potential contamination sources presented in this report) to allow assessment of risks to human health and the environment, inform materials management and WAC (Waste Acceptance Criteria) testing to inform preliminary off-site disposal options should excavated materials be unsuitable for re-use.
- pH and Sulphate testing to allow assessment of aggressivity of ground to buried concrete.
- Geotechnical laboratory analysis of soil and rock samples to inform the design of the proposed scheme.

Following the scoping of these investigations it was confirmed that North Somerset Council would be undertaking these works, it is expected that the results of these investigations will be provided to Arup for incorporation into any subsequent assessments.

## 6.2 UXO

Based on the detailed UXO Risk Assessment carried out by Fellows in 2021 [12], the assessment indicated the following for any piling, drilling, deep excavations, or ground investigation and this should be taken into account: "*If planned within the client scope of works, risk mitigation process, including Cone Penetration Testing will be required where practical in virgin ground. For deep excavations or Ground Investigations works (deeper than 2m below existing ground level) a UXO Engineer should be retained on-site to oversee the works*".

# 7. References


[1] "Travelwest info projects metrowest," Travelwest, [Online]. Available: https://travelwest.info/projects/metrowest/. [Accessed May 2023].

[2] "The Portishead Branch Line (MetroWest Phase 1) Order 2022 No. 1194 (came into force on 5th December 2022)," 2022.

[3] CH2M, "Portishead Branch Line (MetroWest Phase 1) Environmental Statement, Volume 2, Chapter 10 Geology, Hydrogeology, Ground Conditions and Contaminated Land (Ref: TR040011)," 2019.

[4] "MetroWest Phase 1 website," [Online]. Available: https://metrowestphase1.org/. [Accessed 20 06 2023].

[5] Womble Bond Dickinson (UK) LLP, "Portishead Branch Line (MetroWest Phase 1) Statement of Reasons (Ref: TR040011)," 2019.

[6] British Geological Survey, "BGS Map Sheet 264: Geological Map of Bristol, Solid and Drift (1:50,000 Scale)," 2004.

[7] British Geological Survey, "BGS GeoIndex Database. [Accessed June 2022] GeoIndex Database," [Online]. Available: https://mapapps2.bgs.ac.uk/geoindex/home.html?_ga=2.18211068.450239448.1687442307-981559678.1687442307. [Accessed 20 06 2023].

[8] Environment Agency, "Flood Map for Planning website," [Online]. Available: https://flood-map-for-planning.service.gov.uk/. [Accessed 12 06 2023].

[9] Historic England , "Historic England Aerial Photo Explorer," [Online]. Available: https://historicengland.org.uk/images-books/archive/collections/aerial-photos/. [Accessed 21 06 2023].

[10] Department for Environment, Food & Rural Affairs, "DEFRA MAGIC Database," [Online]. Available: https://magic.defra.gov.uk/magicmap.aspx. [Accessed 12 06 2023].

[11] Zetica, "UXO Risk Maps," [Online]. Available: https://zeticauxo.com/downloads-and-resources/risk-maps/. [Accessed 22 06 2023].

[12] Fellows, "Detailed UXO Risk Assessment Sheets 1 and 2a - Portishead Station & Trinity Footbridge and Sheets 2 to 5a - Works Plan Version 4 (Ref: 2992R)," 2021.

[13] Gordano Civic Society , "Details of Portishead's two Power Stations now demolished.," [Online]. Available: https://www.gordanosociety.org.uk/powerstations.html. [Accessed 21 06 2023].

[14] Department of the Environment, "Industry Profile, Railway Land," 1995.

[15] Structural Soils Ltd., "Factual Report on Ground Investigation at Metrowest," 2016.

[16] ACS Testing Ltd., "Portishead Car Park, Factual Geotechnical Report," 2017.

[17] C.J. Associates Geotechnical Ltd., "Site Investigation No. AG0254 Factual Report, Portishead," 2018.

[18] C.J. Associates Geotechnical Ltd., "Site Investigation No. AG0255, Factual Report, Sheepway," 2018.

[19] CJ Associates Geotechnical Ltd., “Site Investigation No. AG0442 Factual Report, Elm Tree Farm, Sheepway”.

[20] CJ Associates Geotechnical Ltd., “Site Investigation No. AG0502 Factual Report, Change Road,” 2018.

[21] CJ Associates Geotechnical Ltd. , “Site Investigation No. AG0660, Factual Report, Portbury Hundred, Sheepway,” 2018.

[22] SOCOTEC UK Ltd., “MetroWest Phase 1 Trial Holes, Factual Report on Ground Investigation,” 2021.

[23] Keltbray, “MetroWest Phase 1B Package 3 Ground Investigations Various Location,” 2021.

[24] CH2M, “Master Construction Environmental Management Plan for Portishead Branch Line (MetroWest Phase 1) (Ref: TR040011),” 2021.

[25] Department of the Environment Industry Profile, “Waste recycling, treatment and disposal sites, landfill and other waste treatment or waste disposal sites,” 1996.

[26] The Coal Authority, “The Coal Authority Interactive Map,” [Online]. Available: https://mapapps2.bgs.ac.uk/coalauthority/home.html. [Accessed 2023].

[27] CIRIA, “Contaminated land risk assessment. A guide to good practice (C552),” Construction Industry Research and Information Association, London, 2001.

[28] E. Agency., “ Land Contamination Risk Management,” 2020. [Online]. Available: https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks. [Accessed 20 June 2023].

[29] CL:AIRE, “Research Bulletin 17: A Pragmatic Approach to Ground Gas Risk Assessment,” 2012.

[30] AECOM, “MetroWest Parson Street to Pill Factual TBI Report,” 2015.

[31] NHBC Foundation , “NF94, Hazardous ground gas - an essential guide for housebuilders,” 2023.

[32] Bristol City Council, “West of England Know Your Place,” 2023. [Online]. Available: https://maps.bristol.gov.uk/kyp/?edition=&ma. [Accessed 6 July 2023].

# Drawings (provided as a separate document)

## Drawing 1 - Site boundary - DCO boundary (focus of study) + highways sites, station locations (chainage lengths)

# Appendix A (provided as a separate document)

## Groundsure Report

# Appendix B

## Preliminary Risk Assessments

# B.1 Temporary/Satellite Sites

| Potential Sources | Potential Receptor | Possible Pathway | Likelihood | Severity | Risk | Comment |
|---|---|---|---|---|---|---|
| <u>Onsite:</u><br>- Made ground<br>- Contamination related to historical Cala Trade Estate Landfill<br>- Railway infrastructure<br><u>Offsite:</u><br>- Electrical Substations<br>- Contamination related to historical landfills<br>- Historical railway infrastructure related to Frayne's Colliery | Site End Users (rail employees) | Direct dermal | Unlikely | Medium | **Low** | Overall, the risk posed to site end users by contaminated Made Ground is low, considering that the majority of the temporary and permanent developments will consist of hardstanding which acts as a barrier to site soils (hard surfacing, reinstatement of surface cover in areas of service and access road diversions as part of the enabling works). |
| | | Direct dermal | Unlikely | Medium | **Low** | There is a moderate risk should areas soft landscaping are proposed as part of the development. Mitigation measures such as source removal/suitable capping may be required in these areas. There would also be a requirement to confirm risks posed to site end users should any materials be re-used at surface in areas of the development (although this is considered unlikely) |
| | | Inhalation of vapours | Unlikely | Medium | **Low** | There is a risk of vapours generated from volatile hydrocarbons in soils from the railway ash ballast. However, the risk is considered negligible for permanent access routes and new infrastructure given the reinstatement of site surfacing and lack of plausible exposure pathways for end site users.<br>Overall site end users are considered to be at low risk. This is based on the low sensitivity of the sites and that hardstanding, clean capping in soft landscaping (if proposed) and reinstatement of existing surfacing in areas of service upgrades providing pathway breaks between potential contamination sources and site end users. |
| | | Contact with contaminated water | Unlikely | Medium | **Low** | The underlying strata present across the satellite sites includes high vulnerability deposits (i.e., river terrace deposits and conglomerate-dominated Mercia Mudstone) that are capable of transferring pollutants to groundwater. The longevity and extent of the railway infrastructure and nearby historical industries presents the risk of contaminants leaching into the groundwater below. As |

| Potential Sources | Potential Receptor | Possible Pathway | Likelihood | Severity | Risk | Comment |
|---|---|---|---|---|---|---|
| | | | | | | such, investigation of the groundwater on site will be required to establish if there has been an impact on the groundwater. However, contact with the groundwater from site end users is not plausible. Nevertheless, the investigations will be required to establish risk to controlled waters or potential vapour pathways. |
| | Construction & maintenance Workers | Direct dermal | Likely | Medium | **Moderate** | Constructions workers are likely to be exposed to potentially contaminated soils as part of development works, during earthworks and enabling works. However, exposure duration will be short term only. Use of PPE and good hygiene practice throughout earthworks and construction phase is considered sufficient to mitigate risks presented.<br>There is an overall moderate risk to construction and maintenance workers involved in the site works. It is considered that investigations undertaken for the proposed developments will provide sufficient information on potential contamination so that adequate PPE can be provided. |
| | | Ingestion | Likely | Medium | **Moderate** | |
| | | Inhalation of vapours | Likely | Medium | **Moderate** | |
| | | Contact with contaminated groundwater | Low Likelihood | Medium | **Low/ Moderate** | There is a minor risk that groundwater may be encountered as part of the works although it is considered unlikely given the sites comprising predominantly shallow works. Appropriate PPE and health and safety measures will be required during works to mitigate any impact on construction and maintenance workers. |
| | Off-site surface water receptors (tributaries for River Avon) | Surface water run-off<br>Leachate migration of temporarily stockpiled and exposed excavated soils | Low Likelihood | Medium | **Low/ Moderate** | The risk from surface water run-off during construction will be mitigated by application of mitigation measures as referenced in the Master CEMP [24] prior to any work undertaken on site.<br>Post development most of the site will comprise hardstanding at surface level, proposed and existing surface water drainage systems will manage surface water run-off. |
| | Groundwater (River Terrace | Leaching into groundwater and | Unlikely | Medium | **Low** | The leaching of contaminants from the adjacent current and historical industries could present a risk to groundwater aquifers beneath the sites, although this risk is likely |

| Potential Sources | Potential Receptor | Possible Pathway | Likelihood | Severity | Risk | Comment |
|---|---|---|---|---|---|---|
| | Deposits and Mercia Mudstone) | subsequent flow beneath site | | | | reduced by the widespread Made Ground and hardstanding across the site associated with the railway, residential districts, and Royal Portbury Docks.<br>While the risk to groundwater is low, a GI is proposed to be carried out for other moderate risks identified on site, the low risk to groundwater could also be confirmed as part of the GI. |
| | | Migration of contamination along preferential pathways or soil/structure interfaces | Unlikely | Medium | **Low** | The proposed development is unlikely to create preferential pathways for vertical migration through soil/structure interfaces given that the development predominantly comprises shallow workings and foundations. However, new and existing service trenches may provide preferential routes for lateral contaminant migration. Given the shallow depth of these working, the potential wider impact is considered low. |
| | Building materials (including services) | Direct contact with building materials | Low Likelihood | Medium | **Low/ Moderate** | Possible chemical attack of concrete and pipe materials (of services) will require assessment to ensure appropriate, resistant materials are used. |
| | Off-site residents and workers | Ingestion and inhalation of airborne dust | Low likelihood | Mild | **Low** | It is considered that dust suppression measures will be adopted during construction works which will mitigate risks. Following site development, it is not anticipated that site soils will be exposed at the site surface mitigating this risk. |
| <u>Onsite:</u><br>- Ground gas from Tidal Flat Deposits | Site End Users (rail employees) | Ground gas migration into confined spaces and inhalation | Unlikely | High | **Low** | The gas generation potential of the underlying Tidal Deposits is low [31]. In addition, there will be no confined spaces as part of the proposed development. The risk to end users form ground gas is low. |
| | Construction & maintenance Workers | Ground gas migration into confined spaces and inhalation | Unlikely | High | **Low** | Any ground gas risk posed to construction workers is low, as the works will be undertaken in open air and health & safety measures during the works will mitigate the risk if works are required in confined spaces/trenches etc. |