Mill Street, Quakers Yard

Remediation Implementation and Verification Report

Wales & West Utilities
R1871/23/5302 - Rev 1

March 2024

ENGLOBE

Wales & West Utilities
R1871/23/5302 - Rev 1

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Property and Confidentiality

This report has been prepared for Wales & West Utilities Ltd. and their advisors as part of the Remediation Framework Agreement for the provision of Land Remediation Contracting Services (Design and Build) and subsequent extensions in accordance with the terms and conditions set out therein.

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1 Introduction and Objectives

Englobe Regeneration UK Ltd (Englobe) has been commissioned as a Design and Build Contractor by Wales & West Utilities (W&WU), under NEC3 contract, to implement environmental improvement works at the Former Quakers Yard Gasworks site, Mill Street, Quakers Yard, CF46 5AG (NGR. ST09820, 96670). The Site is owned by W&WU and was inherited by their predecessors. The Site's location, layout and surrounding land use is illustrated on Drawing D1871/23/5302/A1, Appendix A.

Englobe will fulfil the Principal Contractor status as well as Principal Designer obligations under the Construction Design and Management Regulations 2015 (CDM Regulations) with W&WU being the Client. The principal project contacts can be found within Table 1.

Supplementary investigation and Detailed Quantitative Risk Assessment undertaken by Englobe, together with previous investigative works undertaken at the site has assisted the development of the contemporary assessment presented within this report, relating to the degree and extent of contamination and conceptual understanding in terms of its environmental setting.

The remediation works are considered necessary to mitigate potential statutory risks associated with contamination from its historical industrial use and render the site suitable for its continued use as public open space. In addition to the continued current use, the outcome of the works is that the site will not be considered contaminated land under Part IIA, Environmental Protection Act 1990 and can achieve the following W&WU objectives:

— The works should provide a durable solution that takes into account any reasonably foreseeable events and / or longer-term trends of climate change.

— There will be no reasonably foreseeable liability for W&WU as a result of the presence of contamination in, on, at or under the site following completion of the works.

— There will be no reasonably foreseeable liability for W&WU as a result of substances in the waters in, on or under the site.

— There will be no reasonably foreseeable liability for W&WU as a result of migration of contamination from the site or waters following completion of the works.

— There will be no reasonably foreseeable liability for W&WU as a result of creation of any new source-pathway-receptor linkages following completion of the works.

— There will be no risk of significant migration from the site from any of the contaminants presently located in/on/at or under the site.

— There will be no reasonably foreseeable risk of any significant pollution or contamination of Waters by or as a result of the condition of the site following completion of the works.

— The site will comply with and fulfil any and all health and safety legislation relating to investigation and remediation and contaminated land and use of the site arising from the works.

The objectives of this report are therefore to present the current conceptualisation of the site's environmental understanding; summarise the detailed quantitative risk assessment (DQRA) in line with latest guidance for sensitive receptors including human health and wider environmental receptors (including controlled waters as defined by Section 104 of the Water Resources Act 1991). The report will also provide an appraisal of viable remediation options (available within the UK's legislative framework) and present performance criteria for the chosen techniques.

Contact points for the various project organisations are included within Table 1 and the relevant regulatory and consultee contacts are provided within Table 2.

Table 1 - Contact Points

Role	Organisation Information	Contact
Client Land Management Officer / Estates Manager / Network Services Plant Protection / Community Relations	Wales & West Utilities, Wales & West House, Spooner Close, Celtic Springs, Newport, NP10 8FZ	Alan Smith Land Management Officer alan.smith@wwutilities.co.uk Mobile: 07890 051835 Mike Ellis Embedded from Worley Consulting Mike.Ellis@wwutilities.co.uk Mobile: 07771339519 Tenecia Inniss Communications Assistant Tenecia.Inniss@wwutilities.co.uk Mobile: 07977 059946
Project Management Principal Contractor / Principal Designer	Englobe Regeneration UK Ltd, Columbus House, Village Way, Cardiff, CF15 7NE	Rhys Davies Rhys.davies@englobecorp.com 07500 091677 Stephen Kidley Stephen.kidley@englobecorp.com
Client's CDM-Advisor	WSP, WSP House, Yale Business Village, Wrexham Technology Park, Wrexham, LL13 7YL	Richard Delaney Richard.delaney@wsp.com Mobile: 07811408127
Ecologist	Head Office, The Old Barn, Park Farm Buildings, Beverston, Tetbury, Gloucestershire GL8 8TT	Tas Adcock Tas.Adcock@keyenv.co.uk Mobile: 07702241568
Riverbank Specialist Subcontractor	CBEC, Octagon Point, 5 Cheapside, London. EC2V 6AA	Sam McArthur S.McArthur@cbecoeng.co.uk

Table 2 - Regulatory and Consultee Contact Details

Role	Organisation Information	Contact
Local Regulatory Authority	Merthyr Tydfil County Borough Council, Civic Centre, Castle Street, Merthyr Tydfil, CF47 8AN Tel.: 01685 725000	Garin Eldred Environmental Health Officer Garin.Eldred@merthyr.gov.uk Matthew Davies Ecology Officer

Role	Organisation Information	Contact
		Matthew.davies3@merthyr.gov.uk Craig Watkins Planning Services Manager, Development Control Craig.watkins@merthyr.gov.uk Beth Jones Rights of Way Officer Beth.jones@merthyr.gov.uk
Environmental Regulator	Cyfoeth Naturiol Cymru / Natural Resources Wales, Cambria House, 29 Newport Rd, Cardiff, CF24 0TP. Tel.: 03000 653000	Sarah Poulton Lead Specialist Advisor (Hydrogeology) sarah.poulton@cyfoethnaturiolcymru.gov.uk Hannah Biggs Specialist Advisor (Geoscience) Hannah.c.biggs@cyfoethnaturiolcymru.gov.uk Sarah Lund Advisor, Development Planning southeastplanning@cyfoethnaturiolcymru.gov.uk Rhiannon Smith Permitting Officer, Permitting Service rhiannon.smith@cyfoethnaturiolcymru.gov.uk Rebecca Loder Development & Flood Risk rebecca.Loder@cyfoethnaturiolcymru.gov.uk James Nixon Water Framework Officer james.nixon@cyfoethnaturiolcymru.gov.uk Sion Evans Environmental Management sion.r.evans@cyfoethnaturiolcymru.gov.uk
Sustrans Cymru	Sustrans Cymru, Cardiff and Vale College Business Centre, 1 Canal Parade, Cardiff, CF10 5BF	Emily Sinclair Network Development Manager, South Wales Emily.Sinclair@sustrans.org.uk Ben Darrah-Morgan Network Development Manager, South Wales Ben.Darrah-Morgan@sustrans.org.uk
Merthyr Tydfil County Borough Council	Merthyr Tydfil County Borough Council, Civic Centre, Castle Street, Merthyr Tydfil, CF47 8AN	Gareth Richards Local Councillor Gareth.richards1@merthyr.gov.uk

1.1 Information Sources

The site, its former uses, ground conditions and ground contamination are described in detail within the previous Advisian site investigation reports including:

- Environmental Assessment Factual Site Investigation Report: (Final). Advisian. Document Number 305001-00009 51810-01. January 2016.
- Environmental Assessment Site Investigation Factual Report (FINAL). Advisian. Document Number 305001-00009 51810-02. January 2017.

— Ad Hoc Riverbank Stability Assessment. Advisian. Ref 305001-00009_00106_Final. December 2021.

The information contained within these reports has been summarised within this section of the report. For more detailed information, please refer to the specific reports contained in Appendix D.

A summary of the previous site investigation locations is provided in Drawings D1871/23/5302/A5, Appendix A.

1.1.1 Supplementary Site Investigation Works

Englobe undertook further site investigation works in October 2022 to supplement and gain contemporary data. The findings are summarised in a factual report (Englobe report reference R1871/22/5270 dated May 2023) a copy of which is provided in Appendix D. The objective of the works was to improve upon the existing dataset and to inform conceptualisation and modelling of ground and groundwater conditions prior to finalising the remediation strategy.

A summary of the Englobe 2022 site investigation locations is provided in Drawing D1871/23/5302/A4, Appendix A.

In addition to the site investigation works, an additional cycle way condition survey and series of ecological surveys were undertaken followed by a targeted vegetation clearance and service clearance survey. Bulk samples of grossly contaminated material were also collected and submitted to Englobe's Engineering Department for bench-trial stabilisation assessment (further discussed in Section 5.2.3).

2 Site Summary

2.1 Site Details

The Site is roughly rectangular in shape, covering an area of approximately 0.55 hectares and comprises a vacant and unsecured area of woodland with a public cycle path running through the northeast of the Site. The Site is located at the bottom of a steep river valley although the Site itself is gently sloping, with ground elevations ranging from 105 m above Ordnance Datum (m AOD) in the north of the Site to 98 m AOD in the south of the Site. The site's location, together with surrounding land use is illustrated on Drawing D1871/23/5302/A1, Appendix A.

The unfenced site mainly consists of a flat area sloping from east to west bounded by dense woodland and a steep slope to the north and the Afon (river) Taff Bargoed to the south. There is currently no existing vehicle access to the site with access only possible via the cycle path route from the top of the hill leading to the Perrott Street carpark or the base of the valley via Mill Street.

From the top of the hill where the town of Treharris is located, access can be gained through the east of the site via a macadam cycle path (Route 47 of the National Cycle Network) that begins in the south-eastern corner of Perrott Street Public Car Park. The cycle path runs down a steep banking in a zig zag formation towards the east of the site where it traverses a comparably flat section of the site that runs perpendicular to the hillside. The path exits the south of the site at the Taff Bargoed river over a metal cycle/footpath bridge onto Mill Street.

There is no above ground operational plant at the vacant site and other than some stone columns and walls, the only appreciable structure is an abandoned river level monitoring station near the footbridge that is surrounded by some aging palisade fencing.

Other than public open space, the combined cycle route(this is part of the national cycleways system and provides an offshoot to the nearby Taff Trail), footpath and bridleway that runs through the site, there is no other use on the site. There are live W&WU gas mains that cross the river and into the south-western half of the site.

The heavily wooded site is not fenced, but unhindered site access to the site at the bottom of the valley from anything other than the cycle path is not easy with natural barriers of steep topography and woodland to the north, river to the south and dense woodland to the east and west.

2.2 Adjoining Land Uses

Adjacent land use surrounding the site comprises the following:

— North-western – The area directly northwest of the Site is woodland. However, a housing estate lies north of this, with houses on Thornwood Place located from approximately 70 m from the Site boundary. There is a significant elevation rise with the residential properties being some 20 m higher than the Site.

— North-eastern – The area northeast of the Site comprises woodland with a cycle path and bridleway running through it.

— South-eastern – The Taff Bargoed river marks the south-eastern boundary of the Site with Mill Street running parallel to the river on its opposite bank. The land on the far side of Mill Street is occupied by woodland opposite the north of the Site and occupied by barn/ stable buildings, sheds and animal enclosures opposite the south of the Site. Towards the Site's south-western end, Mill Street diverges from the riverbank. The triangular piece of land that lies between the two is also occupied by a series of stables and animal enclosures. A small metal cycle/footpath bridge connects Mill Street to the Site.

— South-western – The site is bordered by woodland.

The site layout and surrounding land uses can be seen on drawings D1871/23/5302/A1 and D1871/23/5302/A2, Appendix A.

2.3 Historical Development

Historical development at the site and surrounds has been provided in detail in the various previous site assessment reports listed in Section 1.1. In addition, Englobe has reviewed the 'History of Gas Production in Wales' publication and internet-based data to ascertain any additional information and a summary of this is provided here:

1868 to 1875 Published on the 1884 six-inch map, no development is recorded at the site. A notation of C.R. (Continuous Revision – usually as development within 6 months expected) in the southeast of the site is on the map suggesting that the site was earmarked for development and was to be reviewed on the next mapping exercise.

1878 - The Quakers Yard Gas and Water Company was created on 20 September 1878 and to help finance the development of the yard they sold 122 shares at £10 each. It may be reasonable to assume the gasworks would be constructed and operational with a few years of the share issue.

1898 Survey Published in 1901 The site is identified as a 'Gas Works' occupying the north-eastern half of the current site extent. Gasholders No. 1 & 2 are shown to be present in the north-east of the site along with numerous buildings/ancillary structures. Access to the site is via a bridge across the river opposite the newly formed quarry that may have provided the building stone.

1914 to 1915 Published in 1919 Gasholder No. 3 is shown in the south-west of the site. Additional buildings/structures appear on site.

1938 No significant change.

1930s/40s An undated site plan believed to be circa 1930s/40s shows that Gasholder No. 1 has been converted to a tar well. Plan shows retort house as disused and replaced by a Tully Gas plant.

1948 Described in the publication 'The History of Gas production in Wales', gas production is known to have ceased due to gas supply switching to Rhymney and Aber coke works.

1949 Described in the publication 'The History of Gas production in Wales' Quakers Yard Gas and Water Company dissolved on 1 May 1949 with ownership transferred to British Gas Wales as part of the nationalisation of the gas industry.

1951 to 1952 It appears that Gasholder No. 1 has been removed which also ties in with an aerial photo thought to be taken some time in the late 1940s that shows a circular area of dark staining where it used to stand.

1958 The site is no longer recognisable as a gasworks with several of the building having been demolished. An additional building has been constructed in the centre of the site. Spring identified on northern boundary.

1960s Gasholder No. 3 remains with other site infrastructure including governor, boiler house and a dwelling.

1974 – 1975 No significant changes.

1976 Gasholder No. 3 has now been removed from the site.

1979 to 1990 No significant changes.

2006 Only 2 small buildings are shown to remain at the site with the present-day cycle path.

Noted in the Advisian reports is the lack of a suspected 'original' tar well on the site prior to the smallest of the three gasholders being converted. Englobe agree with this statement that an historical well may be present; however, based on our experience of other South Wales gasworks, a tar well was not always initially constructed (if ever) and the tar and liquors were, in some cases simply discharged directly to drains and rivers or into a hole if ground and groundwater conditions allowed.

A summary of the historical site layout and features is provided in Drawing D1871/23/5302/A5, Appendix A.

2.4 Geology, Hydrogeology and Hydrology

2.4.1 Geology

Based on the information provided in the tender information, the identified geology at the site is as follows:

Hardstanding - macadam (cycle path) up to 0.15 m thick traversing the site.

Soft Standing (inc. Made Ground) – Surface layers beneath the vegetation have been noted as either a brown sandy topsoil with rootlets or brown sandy gravels of limestone/sandstone with some clinker and brick fragments. Topsoil like material has been identified in several places but is generally thinner although more prevalent in the west of the site.

Made Ground (outside gasholders/tanks) – Made ground has been identified throughout the site and is typically of sandy clayey gravels with concrete and slag with a high content of demolition rubble in places. Other typical gasworks and demolition material has been noted within the made ground especially above underlying layers of tarmac or concrete that were part of the original gasworks processing areas/buildings in the east of the site, and above the base of the former above ground gasholder in the west.

The thickness of made ground is quite variable throughout the site, outside of deeper structures, varying from 0.8 m in MW16-12 and up to 2.6 m in MW16-06.

Made Ground – Within Former Gasholder No. 1/Converted Tar Tank

Initially a gasholder until later used as a Tar Well, various lithologies of made ground typical of gasworks has been identified to 3.8 m bgl although a layer of sandstone/limestone gravel has been recorded from 3.4 to 3.8 m bgl.

Made Ground – Within Gasholder No. 2

Made ground of differing lithologies typical of gasworks has been identified to at least 5.1 m bgl in Former Gasholder No. 2 in MW16-13 with suspected in-situ concrete thought to be representing the base from 4.9 – 5.1 m bgl.

It is noted that a suspected base was also recorded in MW16-05 at 3.8 m bgl although logs were not conclusive.

Superficial Deposits (Alluvium)

BGS maps suggested that superficial deposits are a combination of alluvial deposits of clay, sands and gravels in the west and central areas of the site with Glacial Till in the north-eastern area. Investigations across the site confirmed superficial deposits of orange, brown sandy gravels, grey, brown cobbles in the south and west of the site and with soft sandy clays overlying sands to 4 m bgl in MW16-4 in the north-eastern corner. To date MW16-12 has been advanced the furthest at the site (10 m bgl), with grey and occasionally brown, orange sandstone cobbles recorded over sandstone at 8.5 m bgl.

Solid Geology (Bedrock) Hughes Member

Bedrock of heavily fractured grey/brown sandstone has been confirmed at 8.5 m bgl in MW16-12. Part of the Hughes Member sandstone, the BGS describes these interbedded 'Pennant' sandstones as being between 45 m and 270 m thick with mudstones/siltstones and seatearth and thin bands of coals.

Below the sandstone lies the South Wales Upper Coal Measures Formation.

2.4.2 Hydrogeology

Natural Resources Wales (NRW) classify the underlying bedrock of the South-east Valleys Carboniferous Coal Measures and superficial Alluvium deposits each as a Secondary A aquifer with 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. The overall Water Framework Directive Cycle 3 (2021) overall status of the aquifer was 'Poor', the chemical status was 'Poor' and the Quantitative status as 'Good'. The NRW classify the Glacial Till described as 'Undifferentiated Strata'. The Environmental database report procured by Advisian does not identify any groundwater abstractions and that the site is not located within a groundwater source protection zone.

Giving consideration to the location of the site, the surrounding topography at the base of a steep valley, and the adjacent Afon Taff Bargoed on the southern boundary, the identified shallow groundwater in the alluvial deposits would be anticipated to flow in a south-to-south westerly direction providing base flow to the river.

2.4.3 Hydrology

The Afon Taff Bargoed which forms the site's southern boundary is the nearest surface watercourse and flows past the site in a north-east to south-west direction. The NRW state that the River Waterbodies Cycle 3 and Catchments Cycle 3 (2021) data classified as being Moderate. The Environmental database report procured by Advisian does not identify any surface water abstractions within 1 km of the site.

2.4.3.1 Off Site Hydrology

The river originally ran through farms and villages in the Taff Bargoed valley before it became part of the industrial coal mining landscape running underground in a culvert past the Trelewis Drift Mine, the Taff Merthyr Colliery and the Deep Navigation mine.

As part of the Taff Bargoed Catchment Restoration Scheme, recent land reclamation and regeneration following the closure of the mines has brought the river back to the surface 1 mile upstream of the site and created lakes in Parc Taff Bargoed. The creation of these lakes now benefits the downstream flood control of the site by delaying rainwater from entering the rivers at peak flow reducing the risk of flash flooding.

The average annual rainfall of the area is likely to be subject to the effects of climate change and rainfall has been significantly increasing over the past 4 average monitoring regimes that have

been recorded at the Tredegar weather station 8 miles north-west of the site (NRW online data). The following average rainfall periods shown below highlight the increasing rainfall trends in the area.

- 1961 – 1990 – 1,548 mm rainfall
- 1971 – 2000 – 1,611 mm rainfall
- 1981 – 2010 – 1,674 mm rainfall
- 1991 – 2020 – 1,715 mm rainfall

The data shows that the rainfall has increased nearly 11% over the 4 data sets.

Also of note, there was a flooding event that effected the south-west corner of the site in February 2020. A blockage of a downstream box culvert section that feeds into the River Taff approximately 200 m downstream blocked and caused the river to back up the valley to flood Quakers Yard. Anecdotal evidence from local contractors said the river backed up the valley and flooded Mill Street. Closer inspection of the south-western corner of the site also shows that material has been historically deposited from a flood event.

2.4.3.2 On Site Hydrology

During previous investigations, four springs were observed across the site within the north-eastern area. To aid the advancement of the 2016 site investigation works some of the springs were channelised to reduce the general water flow across the site. The flow from the springs is culverted beneath the public cycle path/footpath and then flows over the indicated location of former Gasholder No. 1/tar well. The springs are then discharged immediately south of Gasholder No. 1 to the river.

The ongoing effectiveness of the French drain is unknown with site observations showing wet areas of ground in the west of the site. It is likely that these springs are adding to water flow through the contaminated strata under the site and therefore potentially increasing the risk of contamination migration to groundwater and adjacent Afon Taff Bargoed.

Previous investigation shows that groundwater strikes, and resting levels are quite variable across the site. However, in general, the groundwater water was identified below the made ground in the upper alluvial deposits and is not impacted by historical structures.

Historical photos shows that 2-3 springs used to flow across the yard in between the exhauster house and the purifier sheds with an historical plan suggesting flow to the south of former Gasholder No. 2.

Springs have not been recorded in the west of the site, but it was noted during the site walkover undertaken in June 2022 that the ground in the area of Gasholder No. 3 was saturated despite a period of dry weather. In addition, an historical plan shows a trench was in place to the west of Gasholder No. 3 that discharged directly into the river.

2.5 Structures

2.5.1 Former River Monitoring Station

An abandoned river monitoring station surrounded by palisade fencing is located in the south of the site, to the west of the Mill Street foot bridge. NRW has indicated that it can be removed and disposed of during the remediation works.

It is noted that river monitoring station has occasionally been shown on some OS Base Plan Maps (e.g. 1:1,250 maps from 1979; 1993 and 1994) and some previous Advisian reports as a sub-station. Englobe have reviewed the historical OS Maps and compared against the available site plans and consider that the river monitoring station was mistakenly recorded as a small sub-station.

2.5.2 Former Gasholder No. 1/ Tar Well

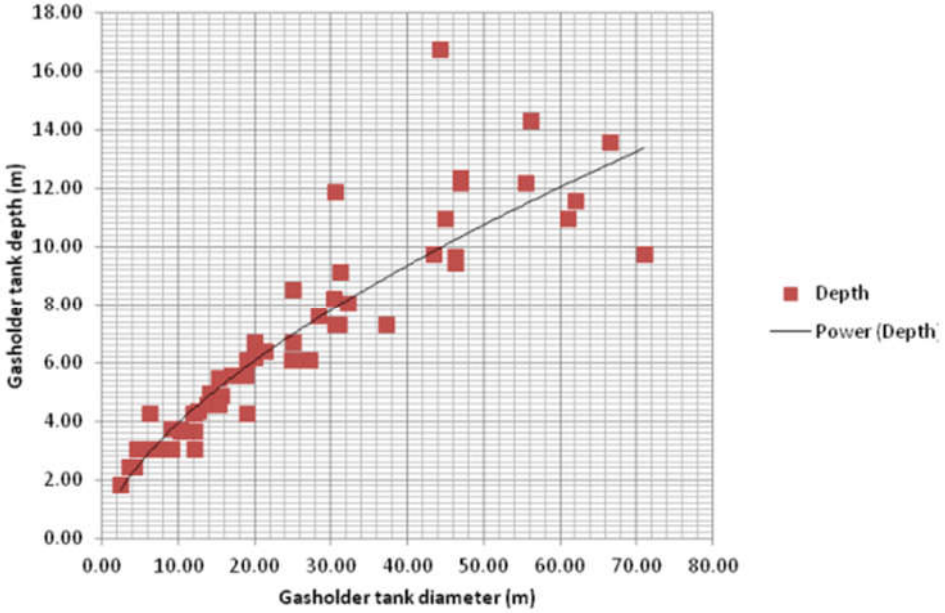
Located in the centre of the eastern half of the site, previous reports expected the tar well to be between 3-4 m deep with a diameter of ~10 m. TP16-08 was advance to 3.2 m bgl and although abandoned due to the ingress of groundwater, the excavator operator reported a potential firm structure at 3.2 m bgl. MW 16-09 was advanced to 3.8 m bgl, and potential base reported at 3.4 m bgl where sandstone and limestone gravels were recovered.

Given consideration that the ground level is elevated approximately 1.2 m above what would have been the historical working level of the site, these observations would put the base of the gasholder at 2.0 to 2.2 m of original site levels.

Based on Englobe's experience of gasworks site and also utilising the research of Dr Russell Thomas in the CL:AIRE publication 'Gasworks Profile B: Gasholders and their tanks' it would be expected that the gasholder base would be at least 3 m deep and possibly up to 4 m deep. Figure 1 below taken from this publication presents the expected diameter to depth relationship based on observations.

A dumpling would be unexpected in any below ground gasholder less than 16 m in diameter that required water proofing unless built in rock or stiff clay.

Figure 1 – Gasholder Depth to Diameter Comparisons. (CL:AIRE 2014)



Based on the above information, and not discounting the onsite observations it is assumed that the former flat-bottomed gasholder/tar well to be 10 m wide and 3.5 m deep (below original site levels) providing an approximate volume of 275 m^3.

2.5.3 Former Gasholder No. 2

Initially estimated to be between 4-5 m deep with a diameter of 15 m, there have been several exploratory locations in the northern area of the gasholder.

Without the identification of the gasholders walls, it is not clear as to the exact location of the gasholder. Concrete has been encountered from 4.9 to 5.1 m bgl in MW16-13 and with 'original' tarmac levels encountered in nearby locations at circa 1 m below existing site levels. This would put the original gasholder base at approximately 4 m. Based on Englobe's knowledge of gasworks and typical gasholder depths presented in Figure 1, a 4 m gasholder base would be unusual for a 15 m wide gasholder and that a 4.5 m deep gasholder would be more plausible.

It is assumed that the gasholder would be flat bottomed, 15 m wide and 4.5 m deep giving a volume of approximately 795 m^3.

2.5.4 Former gasholder No. 3

Located in the south-west of the site the former above ground gasholder concrete base is located approximately 0.9 to 1 m below existing site levels and is overlain by a mix of vegetation, soil and demolition rubble. Identified as circa 400 mm thick, the 17 m diameter gasholder base comprises approximately 90 m^3 of in-situ concrete. 10no. exploratory locations, both trial pits and boreholes were advanced in this area and their findings is summarised in Table 3-1 of the DQRA report in Appendix B. The above ground gasholder can be clearly identified in historical aerial photography for the site and available within the previous Advisian reports. Site investigation positions

2.5.5 Other Structures and Bases

Existing site investigation data suggests that the base and foundations of much of the gasworks' infrastructure was left in place following demolition. Concrete bases, brick walls and other structures are commonly encountered between 0.9 m and 1.8 m which was the likely former site level having since been covered with demolition rubble, soil, and vegetation.

Some dilapidated walls in both the north and south of the site, including the northern wall of the retort house are still evident and provide limited retaining capacity for the rising land to the west. A stone buttress is also located in the riverbank to the south-east of former Gasholder No. 2, it was thought that this formed a supporting buttress for the gasholder frame, however, a stone buttress would be unusual with concrete normally favoured. Recent inspection during the site walkover suggests that this may an independent structure, but heavy vegetation made it difficult to confirm.

2.5.6 Tarmac Cycle Path

Route 47 of the National Cycle Network, an offshoot to the Taff Trail, enters the site from the east running from the eastern corner of Perrott Street Public Car Park and exits across a small steel cycle bridge over the Taff Bargoed to the south, and on to Mill Street. The cycle route is a macadam path, approximately 2.5 m wide, steep in areas, and zig zags down the side of the river valley. This is used regularly by cyclists and pedestrians and is maintained by Sustrans and the Local Authority.

2.6 Visual and Olfactory Evidence of Contamination

2.6.1 Areas of Notable Contamination

The site investigations are conclusive in identifying legacy gasworks contamination at the site which in some areas is significant.

The reports note that the central area of the site to the east of the former gasworks house throughout the former production areas up to Gasholder No. 2 is heavily impacted with hydrocarbon-based contamination throughout both the deeper made ground, above and below the former site hardstand level and into the underlying Alluvial Deposits.

Very strong hydrocarbon, tar and phenolic odours were recorded throughout the central area with Non-Aqueous Phase Liquids (NAPL) positively identified on perched waters within or near former building structures. Black staining in both made ground and natural sands/gravels with tar seepages and tar globules are recorded in many investigative locations throughout the central zone, both within and outside of historic structures.

Both the former underground gasholders in the east of the site are impacted with contamination, with very strong tar odours, NAPL and tar-stained clinker identified at depth in former gasholder No. 1/tar well where strong coal tar/phenolic/hydrocarbon odours from 1.1 m bgl and black staining at depth were recorded.

The far west of the site, around and beyond former Gasholder No 3, appears to be less impacted with contamination.

Tar has also been noted seeping through exposed stonework in the riverbank and a strong hydrocarbon odour is noted from exposed broken pipework and surrounding materials particularly south of Former Gasholder No. 1. In addition, exposed deposits of spent oxide have been noted in parts of the bank where river erosion is strongly advancing.

To the east of the site, behind the former gasworks house, the ground conditions are considerably less impacted and more confined to deeper stratum. A hydrocarbon sheen and moderate hydrocarbon odours noted in drift deposits from 1.65 – 2.05 m bgl in MW16.03 and 'petrol' odours noted in groundwater and on the cored cobbles of MW16-11 towards the south-west corner of the site.

Groundwater in this part of the site recorded the highest concentrations of dissolved phase hydrocarbons in MW16-01 and MW16-12 with the highest concentrations identified in MW16-01 installed within tar-stained gravels. Lower concentrations of dissolved phase hydrocarbons were recorded in groundwater recovered from MW16-08.

Asbestos has been identified in sporadic areas of the site and identified in 11no. samples out of a total of 53 collected soil samples. There has been no visual evidence of asbestos containing material in all but two of the exploratory locations. Asbestos insulating board (AIB) debris (chrysotile fibre bundles) was recorded in TP16-12 close to where the former gasworks house was located, and trace asbestos found at the surface of TP16-01 in the area of the former Gasholder No. 3.

2.7 Ecology Survey

2.7.1 Initial Ecological Appraisal

An ecological appraisal was undertaken by Keystone in 2015 and at the time noted invasive species with multiple stands of Japanese Knotweed and Himalayan Balsam being recorded at the site. Tree cover at and around the site mainly consists of lowland mixed deciduous woodland such as Ash, Beech, Oak, Hazel, Hawthorne, Sycamore and Holly.

The woodland was also noted to have full dense undergrowth primarily bramble with several other species making the area a Wales Biodiversity Partnership (WBP) and Local Biodiversity Action Plan (LBAP) habitat of national value. The woodland surrounding the site are also subject to Tree Preservation Orders (TPOs).

The Taff Bargoed at the south of the site has also been identified as a WBP (and LBAP) habitat considered of national value.

2.7.2 Updated and Detailed Ecological Assessments

Since the initial ecological appraisal was undertaken in 2015, Englobe have commissioned Keystone to progress with several further specific ecological assessments. Some have been specific to enable site investigation works to proceed whilst others have been part of the site assessment required to put together an Ecological Management Plan for the wider site remediation works. The further assessments are further described in Section 4.2.3 and copies of all the associated reports included in Appendix I.

3 Geo-Environmental Risk Assessments

3.1 Data Sources

Several phases of ground investigations have targeted the Site to date, two in 2015 and 2016 by Advisian, and most recently further supplementary investigations undertaken in 2022 by Englobe. Advisian collected groundwater and surface water samples between March 2017 and 2022; Englobe undertook groundwater and surface water sampling in December 2023 and January 2023 followed by a round of groundwater level and river monitoring during September 2023.

A detailed summary of the data collected, and work undertaken in each of these phases is provided in the YellowSub Geo-environmental Detailed Quantitative Risk Assessment report ref. P23545_R1 Rev04 provided within Appendix B.

3.2 Qualitative Risk Assessment and Pre-Works Assessment and Confirmation of Unacceptable Risks

The preliminary conceptual site model considers the primary plausible pathways (relevant pollutant linkages, RPLs) through which contaminants could impact upon sensitive human health and controlled waters. These RPLs are summarised within Table 3. This is to be assessed via a pollutant linkage assessment that considers the following components:

Receptors	The identification of sensitive human health and controlled waters receptors.
Sources	The identification of potential contamination sources. These may be individual contaminants (e.g., in site soils, soil vapour, perched water or groundwater), contamination within structures or in specific areas of the site.
Pathways	The presence of migration or exposure pathways linking identified contamination sources to receptors.

Table 3 – Summary of Relevant Pollutant Linkages

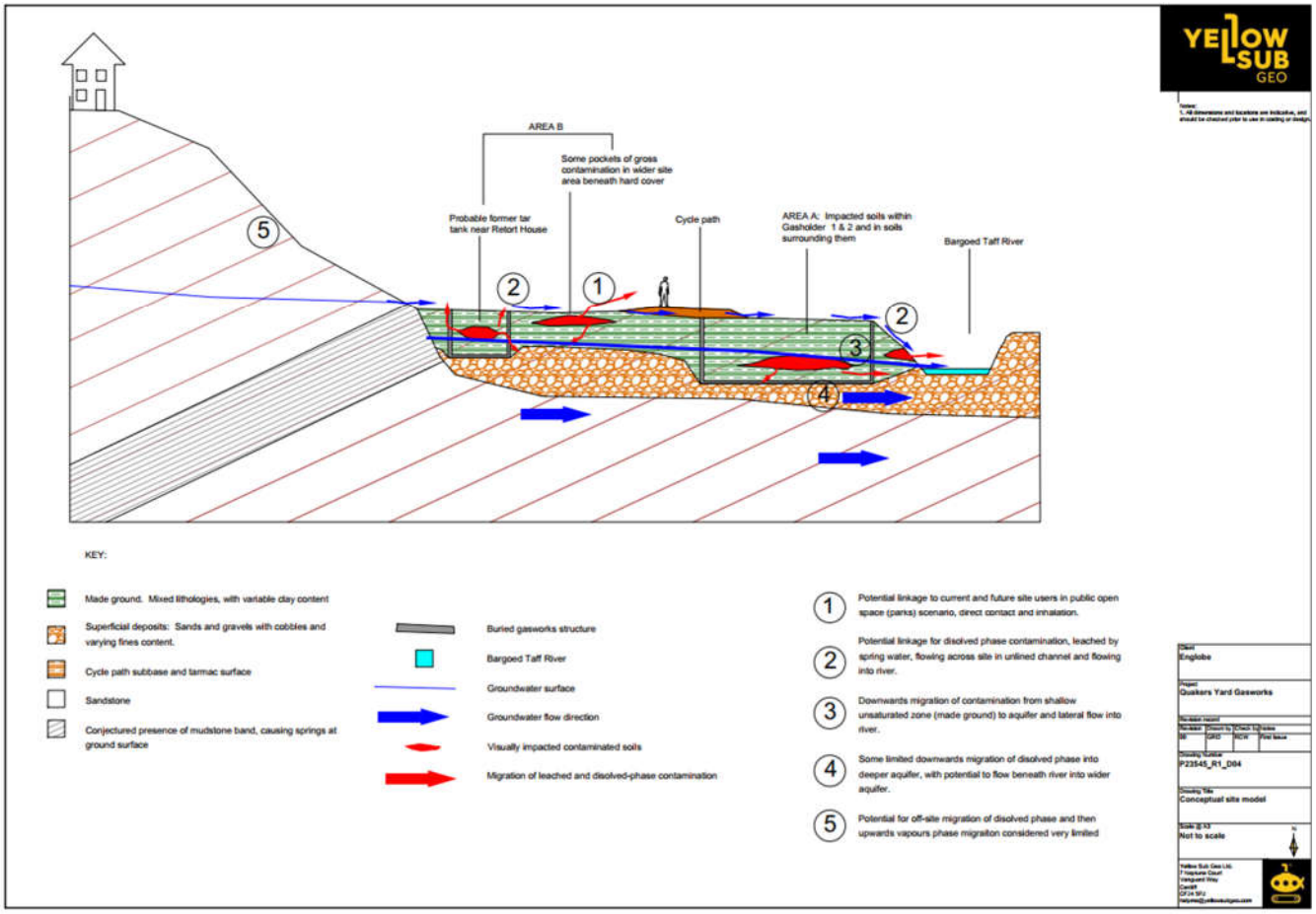
Sources	Pathways	Receptors
Visual and olfactorily impacted soils and groundwater beneath the Site **Contents of below ground holders and tanks**	Direct (dermal/ ingestion) exposure, inhalation of dust and vapours.	Current and future users of the Site (users of the cycle path and informal recreation). Residents of nearby residential properties.
	Leaching into dissolved phase. Lateral migration/dispersion in dissolved phase in shallow aquifer towards Taff Bargoed. Direct riverbank and made ground erosion. Dissolved contaminant migration within spring flow towards Taff Bargoed.	Taff Bargoed river.
	Vertical migration and lateral migration in the dissolved phase in deeper aquifer.	River Taff. Secondary (A) Aquifer.

3.3 Conceptual Site Model

In-line with best practice (e.g., LCRM, EA 2017, EA 2016, CL:AIRE 2017, BS EN ISO21365), a conceptual model has been derived to assess potential interaction between the ground and groundwater conditions beneath the site with either human health or the wider environment (groundwater within aquifers and local surface watercourses and the ecosystems they support).

The CSM represents the site characteristics and indicates potential contaminant sources, sensitive receptors and a pathway linking the two (i.e., a source-pathway-receptor linkage). A pictorial CSM, as provided within the DQRA (provided in Appendix B), is illustrated in Figure 2 below.

Figure 2 – Conceptual Site Model



3.3.1 Unacceptable Risks at the Site

Based on our review and assessment of the site, the potential unacceptable risks are as follow:

- Direct NAPL migration from areas of unsaturated made ground.
- Direct NAPL migration from within and adjacent to underground structures or overlying original site levels.
- Dissolved phase contamination migration from made ground in unsaturated zone (and smear zone) to shallow groundwater and surface waters.
- Dissolved phase contamination migration from made ground within structures to shallow groundwater, surface waters.
- Asbestos exposure from asbestos fibres in soft surface coverings where there is insufficient ‘clean’ coverage.

It should also be noted that there is a current risk of direct impact to the river due to ongoing erosion of the riverbank exposing former gasworks structures, pipework, made ground (including spent oxide) and the associated contamination and potential collapse into the river. There is evidence noted at times of low flow where some contamination has been identified seeping into the river.

Englobe has reviewed the Advisian ‘Ad-hoc Riverbank Stability Assessment’ report (December 2021) included in Appendix D and compared against evidence from more recent visits at various river heights. It is noticeable how much the riverbank has changed due to the ongoing erosion, particularly over the past 24 months. It is considered that swift intervention is urgently required to mitigate this ongoing risk and prevent any catastrophic collapse of the riverbank or a below ground structure into the river.

3.4 Proposed Remedial Areas

In order to address the identified potentially unacceptable risks, remedial works are considered to be required in the following defined source areas as outlined in Drawing D1871/23/5302/A6, Appendix A:

- **Source Area A**. The hydrocarbon impacted area of the site from approximately the Gasholder house eastwards up to and including former Gasholder No 2. This is from the northern boundary to the southern riverbank.
- **Source Area B**. Significant areas of Spent Oxide in made ground.
- **Source Area C**. Hotspots of shallow asbestos impacted soils.

3.5 Detailed Quantitative Risk Assessment

A detailed quantitative risk assessment (DQRA) has been undertaken by YellowSub Geo to consider the identified residual soil and groundwater contamination at the site. The standalone DQRA report, provided within Appendix B provides a technical assessment of all available soil, groundwater, surface water and vapour chemistry data with respect to potential risks to human health and the wider environment.

The DQRA was produced in accordance with the UK Government's Land Contamination Risk Management guidance (LCRM) (EA 2020), focussing on the assessment of potential statutory risk under Part 2A of the Environmental Protection Act 1990 as enacted by the Environment Act 1995 (Part 2A). LCRM defines possible receptors under Part 2A to include human health, controlled waters, organisms and ecosystems. The report uses the term "wider environment" to encapsulate those potential receptors not associated with human health.

The purpose of the DQRA is to provide supporting technical evidence to assist with remedial design and aspirational performance criteria for the reuse of site-won materials and remedial validation/verification works. The risk assessment approach considers a continued public open space for the site in line with its current configuration, existing site levels and unsecured boundaries.

The DQRA provides a description of the data collection and assessments used and presents a more detailed risk assessment of source-pathway-receptor linkages, generic quantitative risk assessment, a conceptual site model together with detailed pollutant linkage assessments.

The assessments and modelling outputs have been used as the technical basis for deriving potential and aspirational Remedial Target Values (RTVs). These detailed assessments are presented within the DQRA report, with a summary of the findings presented within the following sub-sections.

It should be noted that such assessments, despite best intentions and following best practice sometimes provide simplistic and overly conservative outputs that need to be carefully reviewed and considered alongside the site setting and overall objectives for the site. At Quakers Yard, given the close proximity of the river, such modelling will inevitably generate very low and unachievable remediation targets. The focus therefore must remain on the key overall objective, regardless of always meeting performance criteria targets which is site betterment. These elements have been discussed in detail with the NRW with several additional aspects and parameters incorporated into the DQRA to agree a methodology. The discussion also recognised that the generated RTVs would be low, not always achievable and would need to be carefully considered alongside the cost benefit and overall site betterment objectives.

3.6 GQRA & DQRA Modelling

The risk assessment considered the following potential risks:

— The risk that soils pose an unacceptable risk to human health of current or future Site users in a public open space scenario;

— The risk that dissolved-phase concentrations or NAPL in the saturated zone pose a risk to human health, either on-Site in a public open space scenario, or off-Site following off-Site migration under a residential scenario;

— The risk that soils/ dissolved phase/ NAPL on-Site poses an unacceptable risk to the Taff Bargoed River as representative of the wider environment; and,

— The risk that soils/ dissolved phase/ NAPL on-Site poses an unacceptable risk to the Secondary A Aquifers.

The data from each phase of investigation has been combined to compile a single soils dataset for the Site. This includes contaminants typical of gasworks, including BTEX, cyanides, PAHs, phenols, TPH and asbestos. An assessment of the data with respect to potential risks to human health and the wider environment has then been made.

A number of organisations have published screening criteria, or Generic Acceptance Criteria (GACs) representative of low risk in a range of land-use scenarios. This assessment utilises a public open space (parks) land use scenario as an initial generic comparison initially. The statistical methodologies are described, and results presented across all phases of contamination.

A process of computer modelling has then been undertaken using the Environment Agency P20 Worksheets Version 3.2 (EA 2013) and the calculation sheets are provided within Appendix D of the DQRA report, which is included within Appendix B of this report.

3.7 Results of the DQRA Modelling Process

As highlighted in the DQRA report and the associated sensitivity analysis, the RTVs have to be carefully developed to ensure they are both protective of environmental receptors but also to enable the works to be delivered from a technical and sustainable point of view without excessive impact on the environment and local communities, e.g. the requirement to excavate and landfill significant volumes of material.

It is noted however that some of the RTVs are very low and unlikely to be achievable (i.e. they are likely to be overly conservative and beyond the realistic site betterment objectives).

The RTVs have been generated based on some key factors as outlined in Section 7.2 of the DQRA report and are summarised below. These are considered crucial in the cost-benefit considerations of the remediation scheme, it's scope and how the works will be validated.

— There is a clear and current risk of direct impact to the river due to the ongoing erosion of the site soils (and structures) by the river. Some direct impact to the river can be seen at times of low flow. Intervention is therefore required with a degree of urgency.

— The Site is extremely constrained with respect to access, and this severely restricts the type of plant and remedial methods and techniques. **Holistic sustainability** is therefore a key consideration when determining the degree to which the Site should be remediated.

— The **achievable remediation criteria** will be limited by the technical limitations of available techniques (i.e. which cannot achieve some of the base case RTVs).

— The proposed remediation works are being undertaken by W&WU on a **voluntary basis**, in accordance with their **environmental and sustainability commitments**. The available budget is limited and not supplemented by any land sale or development driven objectives.

— The works will include the excavation and turn-over of the vast majority of the Site to remediate the primary and secondary source terms. A proportion of Area C will also be excavated to gain suitably clean material to help form the 1 m wide new engineered riverbank.

— There is some evidence to suggest aerobic aquifer conditions do exist. It is considered reasonable to assume that biodegradation will occur following remediation of the primary and secondary source terms.

The works will attempt to adopt the following **aspirational RTVs** of which some are acknowledged to be considered very low and potentially unachievable. The review of the validation data collected during the works will be considered alongside the targets as discussed in Section 3.8.

The following RTVs presented in Table 4 have been derived from the sensitivity analysis with biodegradation occurring in both the dissolved and sorbed phases.

Table 4 – Summary of DQRA Modelling

Contaminant	SOILS		GROUNDWATER	Soil max concentration (mg/kg)	Groundwater max concentration (mg/l)
	For use in riverbank works Level 2 RTV after dilution (mg/kg)	For zone >5 m from river Level 3 after dilution (mg/kg)	For use site-wide Nominal 1 m pathway. Level 3 RTV after dilution (mg/l)		
Free cyanide	**2.07**	**61.03**	0.12	330	0.07
Total cyanide	**2.07**	**61.03**	**0.12**	25,529	3.43
Ammoniacal Nitrogen NH_4 #	**67.91**	**7.05**	**2.60**	129	73.28
Dissolved Chromium III	4,641	4,641	0.20	202	0.07
Phenol	**4.94**	10,272	4.86	22	1.91
Anthracene	**4.14**	**2,389**	0.04	5,379	0.01
Fluoranthene #	**0.84**	**1,560**	0.004	47,660	0.02
Benzo(a)pyrene	**0.16**	7.82×10^{16}	713	2,090	0.003
Naphthalene	**9.54**	**328**	**0.26**	23,107	12.03
Benzene	**5.33**	**6.53**	**0.45**	89.4	2.20
Toluene	**113**	114,755	34.68	207	1.29
O-Xylene	94.99	610	2.19	90.20	0.68
m/p-xylene	**108**	881	2.36	237	1.90
Aliphatic EC6-EC8	66.62	9.50×10^{9}	962	36.6	0.80
Aliphatic EC8-EC10	2,363	4.22×10^{76}	2.70×10^{35}	123	0.86
Aromatic EC5-EC7	**5.33**	**6.53**	**0.45**	76.3	2.20
Aromatic EC7-EC8	**113**	114,755	34.68	173	1.29
Aromatic EC8-EC10	**109**	881	**2.19**	303	2.96
Aromatic EC10-EC12	**9.54**	**328**	**0.26**	8,381	28.41
Aromatic EC12-EC16	**367**	2.98×10^{9}	250	8,908	2.12
Asbestos	ID non detect or <= 0.001 % w/w by gravimetric test	<0.01 % w/w by gravimetric test *	N/A	0.032 %	N/A

Notes: Bold text denotes that the RTV is exceeded by the maximum concentrations recorded on site.

Ammoniacal nitrogen and fluoranthene RTVs are multiplied by 10% to take account of uncertainty that other sources may impact the Taff Bargoed river (see Sections 7.1.2.4 and 7.1.6.5 of the YelloSub DQRQ report in Appendix B).
*Note that material >5m from the river will be below hardstanding or capping layer. Best practicable efforts will be undertaken to remove all visible asbestos fragments. However rare asbestos containing material (ACM) fragments may remain within, consisting of smaller than palm sized fragments.

As a result of the modelling, some contaminants can be disregarded as potential CoCs with respect to the potential risks to the wider environment and need not be considered further (i.e., the calculated RTV values are greater than the maximum recorded concentrations on Site).

For soils to be used in riverbank works, remaining potential CoCs include: Free cyanide, total cyanide, ammoniacal nitrogen NH_4, phenol, anthracene, fluoranthene, benzo(a)pyrene, naphthalene, benzene, toluene, m/pXylene, aromatic EC5-EC7, aromatic EC7-EC8, aromatic EC8-EC10, aromatic EC10-EC12 and aromatic EC12-EC16.

For the wider Site soils (i.e. >5 m from the river edge) the remaining potential CoCs include free cyanide, total cyanide, ammoniacal Nitrogen NH_4, anthracene, fluoranthene, naphthalene, benzene, aromatic EC5-EC7 and aromatic EC10-EC12.

3.8 Use and Application of RTVs

As mentioned, the works will attempt to adopt the proposed aspirational RTVs of which some are acknowledged to be very low and potentially unachievable. It is also acknowledged that the DQRA does factor-in an inherent level of additional conservatism which is reflected in these low values.

Validation sample results will be carefully reviewed and considered alongside the wider site setting and overall objectives for the site. The focus will remain on the key overall objective, regardless of always meeting performance criteria targets and will be considered alongside the overall cost benefit and site betterment objectives.

The RTVs will be considered and used carefully when comparing directly against site data and their use should appropriately take into account adopted sampling strategies, background concentrations and wider results.

An RTV exceedance will not immediately imply that a substance is not ‘compliant’ with the criteria or that a substance poses an unacceptable risk; rather an exceedance means that some form of further consideration is warranted, and a wider judgement is required to consider the exceedance and wider setting and overall site objectives (this could for example include no further action).

Where an RTV represents a very low concentration (e.g. near to or less than method detection limit), due consideration will also be given to the method detection limit and/or other practical/pragmatic criteria as well as the RTV.

Where a number of exceedances are identified, further sampling; statistical consideration (e.g. using CL:AIRE 2008 & 2020) may be useful in further assessing whether average/representative concentrations are in excess of an adopted criteria; a review and consideration of the actual RTV (how it was derived, it’s conservatism and overall site objectives), and/or quantitative risk assessment may be warranted. For example, results will be deemed acceptable if the UCL Mean concentration of the results for each source area meet or are lower than the relevant remedial targets.

In addition, some of the RTVs are based on modelling outputs that are above saturation/solubility limits as such these must be applied with care/caution as the targets may overestimate the risks posed to the controlled waters environment and/or human health. Care should also be taken to ensure the laboratory results are representative of ‘dissolved phase’.

3.9 Distribution of contaminants in excess of RTVs

The DQRA report has screened the available data (from historical site investigations) against the proposed RTVs and this is summarised in the following tables.

3.9.1 Re-use of soils

Table 5 – Proposed RTVs for the Re-Use of Soils in Riverbank

Contaminant	Soil Level 2 Remedial target after dilution (mg/kg)	Soil Max. concentration (mg/kg)	Area A: No. of exceedances	Area B: No. of exceedances	Area C: No. of exceedances
Free Cyanide	2.07	330	19	12	None
Total Cyanide	2.07	25,529.9	34	28	12
Ammoniacal Nitrogen as N	6.79	128.5	8	14	None
Phenol	4.94	22	2	1	None
Anthracene	4.14	5,379	23	22	9
Fluoranthene	0.084	47,660	45	58	34
Benzo(a)pyrene	0.16	2,090	44	49	31
Naphthalene	9.54	23,107	12	11	None
Benzene	5.33	89.4	2	None	None
Toluene	113	207	1	None	None
O-Xylene	94.99	237	None	None	None
m/p-Xylene	109	90.2	2	None	None
Aromatic EC5-EC7	5.33	76.3	2	None	None
Aromatic EC7-EC8	113	173	1	None	None
Aromatic EC8-EC10	109	303	1	None	None
Aromatic EC10-EC12 (naphthalene)	9.5	8,381	12	12	1
Aromatic EC12-EC16	367	8,908	10	7	1
Asbestos	ID non detect or <= 0.001 % w/w by gravimetric test	0.032 %	2	5	4

As outlined in the DQRA report, it is noted that the only exploratory positions within 5 m of the river edge are RB16-01, RB16-02, RB16-03 and RB16-04 for which RTV exceedances for anthracene, fluoranthene, naphthalene, benzo(a)pyrene, aromatic EC10-EC12, aromatic EC12-EC16, free cyanide and total cyanide have been recorded.

However, with the continued erosion of the riverbank, soil associated with source Area A, which showed widespread RTV failures is likely to be already exposed to the river edge in some locations.

The remediation works will include a re-engineered riverbank (described further in Section 5.16). A 5.0m wide section of site-won soils used to create this riverbank will meet the relevant RTV presented in Table 4.

The data indicates that soils from Area C are most suitable (fewer failures, many of which are marginal). It is also noted that exceeding samples are all mostly within the upper 1 m and all within the upper 2 m.

Soils analysed from depths in excess of 2 mbgl recorded no exceedances of the RTVs presented in Table 5 and are therefore considered potentially suitable for excavation and re-use within the 5 m wide section along the riverbank edge.

Table 6 – Adopted RTVs for the Re-Use of Soils >5 m from the River

Contaminant	Soil Level 3 RTV after dilution (mg/kg)	Max. concentration (mg/kg)	Area A: No. of exceedances	Area B: No. of exceedances	Area C: No. of exceedances
Free cyanide	61	330	1	1	None
Total cyanide	61	25,530	17	12	None
Ammoniacal Nitrogen NH_4	7.05	129	8	14	None
Anthracene	2,390	5,380	2	None	None
Fluoranthene	1,560	47,660	7	2	None
Naphthalene	328	23,107	5	2	None
Benzene	6.5	89.4	2	1	None
Aromatic EC5-EC7	6.5	76.3	2	None	None
Aromatic EC10-EC12	328	8,381	4	1	None
Asbestos	ID non detect or <= 0.001 % w/w by gravimetric test	0.032 %	2	5	4

It is noted that in Table 6 none of the Area C soils exceed the RTVs outside the zone within 5 m of the river (i.e. no remediation required in Area C for soils to be retained provided they are in excess of 5 m from the river's edge).

Remediation of soils will be required in Areas A and B to ensure that soils are suitable for retention without posing potential unacceptable risk to the river.

3.9.2 Groundwater RTVs

Table 7 – Proposed Groundwater RTVs

Contaminant	Groundwater Level 3 RTV after dilution (mg/l)	Max Concentration (mg/l)	Area A: Number of exceedances	Area B: No. of exceedances	Area C: No. of exceedances
Total Cyanide	0.12	3.43	43	13	None
Ammoniacal Nitrogen as N	2.6	73.28	16	31	2
Naphthalene	0.26	12.03	14	15	None
Fluranthene	0.004	0.02	25	4	None
Benzene	0.45	2.2	14	2	None
Aromatic EC5-EC7 (Benzene)	0.45	2.2	13	2	None
Aromatic EC8-EC10 (Xylenes)	2.19	2.96	7	1	None
Aromatic EC10-EC12 (naphthalene)	0.26	28.4	12	18	None

Groundwater in Areas A and B record RTV failures for total cyanide, ammoniacal Nitrogen as NH_4, naphthalene, benzene and aromatic EC5-EC7, EC8-EC10 and EC10-EC12. There are only two RTV exceedances in Area C, both ammoniacal Nitrogen as NH_4.

3.10 Proposed Capping RTVs

It is proposed that site-won crushed hard materials such as brick and concrete will be used as site backfill and capping material.

The surface capping layer (within 0.5 m of finished ground level) where hard cover is not in place will meet the human health Generic Acceptance Criteria (GACs) for public open space (parks) and use scenario as used in Section 5.3.2 of the DQRA report included in Appendix B.

As mentioned in the DQRA report, this is considered a conservative approach as the site (woodland and cycle/foot path) represents a lower risk exposure risk than a formal park i.e. it lacks amenities such as seated areas, play areas etc. and therefore it would be expected that an individual would spend less time at the site.

In order of priority, the following sources have been used to provide Capping RTVs:

— Category 4 screening levels (C4SL) (Defra, 2014) [1].

— Suitable for use levels (S4ULs) (LQM/ CIEH, 2015)[2]

— Regional screening limits (RSLs), (USEPA, May 2021)[3]. RSLs have been used for cyanide and various VOCs in the absence of UK sources. There are no reports of cyanide being a carcinogen. Therefore, under guidance set out in EA (2009), the use of USEPA values can be considered appropriate (as the derivation of Reference Doses (RfDs) and Reference Concentrations (RfCs) by USEPA largely follows the same principles as those used in the UK to derive tolerable daily intakes (TDIs)).

We note that for some contaminants (e.g. free and complex cyanide, dissolved chromium III, some PAHs and TPH Bands) the capping layer C4SL values are higher than the zone >5m from the river RTVs. As such, for these contaminants the lower RTV will be used.

Analytical results are to be analysed and compared to the remedial targets in line with the discussions presented in Section 3.8. Results will be deemed acceptable if the UCL Mean concentration of the results for each source area meet or are lower than the relevant remedial targets.

[1] CLAIRE/Defra 2014. CL:AIRE/ Defra 2014. SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Defra.

[2] Nathanail et al. 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.

[3] USEPA 2021. Regional Screening Level (RSL) Summary Table (TR=1E-06, HQ=1). May 2021

Table 8 - Adopted RTVs for Capping Layer (0 – 0.5 m depth)

Contaminant	Remedial Targets Protective of Human Health (0 - 0.5 m depth) mg/kg	
Asbestos	ID non detect or <= 0.001 % w/w by gravimetric test	
	GACs Public Open Space - Parks (C4SL POSpark)	Source
Inorganics		
Arsenic (inorganic)	170	C4SL POS_{park}
Cadmium	880	C4SL POS_{park}
Chromium III	4,641	RTV for zone >5m from river taken from Table 4
Nickel	804	C4SL POS_{park}
Zinc	201,000	C4SL POS_{park}
Lead	1,300	C4SL POS_{park}
Mercury	30	LQM
Complex Cyanide	61.03	RTV for zone >5m from river taken from Table 4
Free Cyanide	61.03	RTV for zone >5m from river taken from Table 4
PAHs		
Naphthalene	328	RTV for zone >5m from river taken from Table 4
Phenanthrene	6,300	LQM
Fluoranthene	1,560	RTV for zone >5m from river taken from Table 4
Benzo(a)anthracene	62	LQM
Chrysene	120	LQM
Benzo(b)fluoranthene	16	LQM
Benzo(k)fluoranthene	440	LQM
Benzo(a)pyrene	21	C4SL POS_{park}
Indeno(123cd)pyrene	180	LQM
Dibenzo(ah)anthracene	1.4	LQM
TPH (aliphatic)		
>C5 - C6	340,000	C4SL POS_{park}
>C6 - C8	9.5×10^{9}	RTV for zone >5m from river taken from Table 4
>C8 - C10	4.22×10^{76}	RTV for zone >5m from river taken from Table 4
>C10 - C12	27,800	C4SL POS_{park}
>C12 - C16	30,000	C4SL POS_{park}
>C16 - C35	864,000	C4SL POS_{park}
TPH (aromatic) & VOCs		
>C5 - C7 (benzene)	6.53	RTV for zone >5m from river taken from Table 4
>C7 - C8 (toluene)	114,755	RTV for zone >5m from river taken from Table 4
>C8 - C10	881	RTV for zone >5m from river taken from Table 4
>C10 - C12	328	RTV for zone >5m from river taken from Table 4
>C12 - C16	2.98×10^{9}	RTV for zone >5m from river taken from Table 4
>C16 - C21	7,800	LQM
>C21 - C35	7,900	LQM

3.10.1 Estimated Volume of Materials

It is the intention to treat as much of the contamination impacted material on site as practicable.

In addition, Englobe do not intend to import additional aggregate with the exception of any required to replace the existing cycle path. It is anticipated that parts of the path will have to be removed and replaced to enable the remediation works and suitable and crushed site-won materials will be validated for use. The approach will minimise the number of lorry movements in and out of the site,

reducing impacts on the local road network and community, in addition to reducing transport related emissions.

Based on the proposed remedial areas and anticipated depths of excavation, the volumes expected to be excavated, treated, re-used, imported and disposed off-site are presented within Table 9. These volumes will be subject to on-site survey and measurement during the remediation works and final volumes will be included within the verification report.

Table 9 – Estimated Volumes of Materials Requiring Excavation and Treatment

Source	Estimated Volume (m^3)
Site-wide excavation and turnover	Between 3,500 - 4,000 m^3 (excluding gasholder volumes).
Gasholder No. 1 and No. 2 structures	1,000 - 1,200 m^3 of which 500-600 m^3 grossly contaminated material to be treated within the gasholder structure. Remaining 500-600 m^3 expected to be oversize hard material (discussed below).
Gross Contamination encountered during site-wide turnover works (including suspect tar tank area)	400 - 600 m^3 expected to be encountered during site-wide excavation works and to be treated in the gasholder structures.
Hard materials (brick, concrete etc.) foundations, walls, below ground structures	800 - 1,000 m^3 expected to be encountered during general site-wide turnover works and (as mentioned above) 500-600m^3 from the gasholder structures. Total Hard materials 1,300 - 1,600 m^3 to be broken out, crushed for re-use onsite
Disposal off-site	Non-hazardous <50 m^3 (vegetation, wood etc.) Hazardous <20 m^3 (NAPL, gross spent oxide, ACMs)

4 Options Appraisal & Proposed Technologies

4.1 General Approach

Englobe have undertaken an extensive assessment of the site's historical usage, its present condition, constraints and the pollutant linkages identified within the DQRA. This section of the report will consider a range of remedial options, which have been selected based on Englobe's environmental improvement experience and the constraints and objectives specific to this site. The considered techniques are viable within the UK market and regulatory framework.

An assessment of the feasibility of the various techniques and consideration of the waste hierarchy will determine the Best Practicable Technique (BPT) for the environmental improvement works at the Former Quakers Yard Gasworks to render the site suitable for a continued public open space use.

Englobe's general approach for the site is broadly to ensure:

— Made ground above saturated zone or within structures containing significant tar or phase separated NAPL are removed or remediated appropriately.

— Soils containing contaminant concentrations that represent a risk to human health are dealt with appropriately.

— NAPLs representing a risk to human health, shallow surface waters and deeper groundwater are dealt with appropriately.

— That uncertainty with respect to extents of contamination and undiscovered sources are reduced.

— That the risk from ongoing riverbank erosion and potential collapse that could lead to contamination entering the river directly is reduced.

Englobe are clear on the desire of W&WU to provide a remediation that reduces environmental liabilities at the site in a sustainable manner with minimal impact on the environment, the wider community, whilst minimising the carbon footprint of the works.

4.2 Constraints

As previously described in Section 2, the site contains a number of significant constraints that require careful consideration and mitigation to enable the works to proceed.

4.2.1 Site Access

There is no vehicular access to site, its location is in a steep sided valley and potential access from the south limited by the Taff Bargoed river and being over a small footbridge with unknown weight restrictions. The only usable access is down via the steep footpath from Perrott Street car park.

Englobe has agreed temporary footpath closure orders with the Local Authority and Sustrans respectively to enable safe and secure access from the Perrot Street car park to the site.

The cycle path that runs through the site has been measured at 2.5 m wide which will allow for the access of mid-size plant with rubber tracks such as 13 to 16 tonne excavators. Any potential damage caused to the footpath by the works will be repaired in-line with Sustrans specifications.

Temporary works design will be required to ensure that the gas mains that underly the southern end of the site (Area C) are not subject to overloading or overstressing by works access. Temporary works design will be undertaken to ascertain the risk and if this is so, the mains are appropriately protected with road plates or other appropriate protection. This will be done in consultation with W&WU Gas Engineers.

4.2.2 Remediation Working Hours/Vehicle Movements

Based on the works information, the proposed works have been programmed based on plant working hours from 08.00 to 18.00 Monday to Friday with the site opening at 07.00 for daily briefings and other health and safety requirements and closing at 18.30 to allow site closure and daily site inspections.

In the unlikely event that Saturday working is required, this will be restricted to 08:00 – 13:00 hrs. No works will be undertaken on Sundays or Public Holidays. If required for the purposes of essential maintenance or site safety, works may be required outside of these times and W&WU, and the Local Authority will be informed of such events.

During the operational period, consideration for traffic movement has been accounted for and shall be planned where possible to avoid school nursery times and high traffic periods in the early morning and afternoon.

4.2.3 Ecological Constraints

There are several ecological constraints identified associated with the heavily wooded and vegetated site and Taff Bargoed river. These include flora and fauna such as trees, vegetation including invasive species, nesting birds, reptiles including toads, bats, hedgehogs, dormice, otters, crayfish, salmon and trout.

Following extensive ecological surveys and in consultation with the county ecologist, the vast majority of the site was cleared during December 2023. It is expected that some additional tree and undergrowth clearance works may be required prior to the start of works. Any site clearance works will be undertaken outside bird nesting season to minimise ecological risk and if not possible an appropriately trained ecologist must be in attendance no more than 24 hours prior to the clearance.

Japanese Knotweed and Balsam have been noted in several areas of the site with ongoing treatment of the knotweed since 2016. These areas will be controlled during the works to avoid cross contamination. Although there are no TPOs, Englobe will ensure that overall, the works do not negatively impact on Flora and Fauna and upon completion the works will, as a minimum, have a net neutral impact on biodiversity and will look to exceed this. Englobe have assessed the potential biodiversity impact of the works using the Defra/NRW biodiversity metric.

Copies of all the ecological assessments undertaken by Keystone Ecology are included in Appendix I.

4.2.3.1 Contemporary Preliminary Ecological Appraisal (PEA)

The PEA was undertaken in August 2022 and helps identify any constraints and other surveys that will be required for the Ecological Impact Assessment. This also helps to inform design changes and provide opportunities for the development of ecological and habitat advancement.

It is noted that the original PEA was undertaken in 2015 and as such the updated assessment is considered to provide a thorough understanding of the ecological status of the site.

The PEA identified the following sites, habitat and species as potential constraints to the proposed works and also provides relevant mitigation measures and/or additional surveys required (some of which are detailed in following sections):

— Afon Taff Bargoed SINC/Lower Taf and Edwardsville Woods SINC/HPI Rivers/SPI Brown Trout.

— Berthlewd SINC/HPI Woodland (on and offsite).

— Bats – roosting.

— Dormice.

— Otter.

— Nesting Birds (including SPI and Schedule 1 species).

— Reptiles.

— White-clawed Crayfish.

— SPI Hedgehog/HPI Common Toad.

— SPI Invertebrates.

— Himalayan Balsam.

— Japanese Knotweed.

— Harlequin Ladybird.

4.2.3.2 Otter Survey

Otters are widespread in the downstream River Taff and in consideration of the proposed works on the riverbank, an otter survey was undertaken in August 2022. Although no field signs of otters were identified during the survey, a later site visit by Matthew Davies, ecologist for Merthyr County Borough Council, on 20th June 2023 identified some potential otter spraints on the riverbank directly opposite the site. These were later confirmed by Keystone, but the location is considered unlikely to be a regular place of rest.

A ‘wildcam’ was deployed between 19th August and 23rd September (5 weeks) to further survey otter activity in the area from August 2023 onwards with no further record of otter activity. The camera remained in-situ as a precaution and ongoing monitoring until the start of the site clearance works undertaken in December 2023. It is considered that an EPS licence is not required.

4.2.3.3 Bat Roost Inspection Survey (BRIS)

A Bat Roost Inspection Survey was undertaken initially on 15th August 2022, but also further survey works were undertaken during July and August 2023 including an endoscope survey of potential roosting trees. The survey results confirmed the site has low bat roosting potential and therefore no mitigation measures are required.

4.2.3.4 Dormouse Survey

A dormouse survey was undertaken at the site on 15th August 2022 with nest tubes distributed at 10 metre intervals. Subsequent site inspection visits were undertaken by a dormouse Licenced ecologist on 31st October 2022; 20th November 2022 and 31st May 2023. Some nesting tubes were lost during the Local Authority ash dieback tree clearance work but were replaced in March 2023. No dormice or signs of dormice were identified during the survey visits inferring the probable absence of dormice on the site.

4.2.3.5 White Clawed Crayfish eDNA

An eDNA survey of water sample was collected from the Taff Bargoed to determine the presence of crayfish in the river. Water samples were collected from 20 locations along the watercourse on 15th August 2022. The results confirm the absence of White-clawed Crayfish in this surveyed section of the Taff Bargoed.

4.2.3.6 National Vegetation Classification (NVC) Survey

To enable the complete understanding of existing flora within this wooded area, all vegetation has been mapped which will aid in matching and recovering existing biodiversity following the remediation works.

4.2.3.7 Arboricultural Impact Assessment

An Arboricultural Impact Assessment and Method Statement has been produced following a tree survey on the 9th September 2022. The survey was undertaken in accordance with BS5837:2012 *'Trees in relation to design, demolition and construction – Recommendations.'*

During the site walkover it was noted that some trees at the site are suffering from ash die back and others within and just outside of the site are in poor condition and at risk of falling. Merthyr County Borough Council removed the affected trees in February 2023 as part of a wider safety and path maintenance programme.

Where any trees are felled in order to facilitate the works, the Englobe will record the number of trees felled and report the number of trees fells to the W&WU representative. For the purposes of recording the number of trees felled, a tree is considered to be defined as having a minimum diameter of 50 mm at 1.5 m above ground level.

The report provides details on the impact assessment, tree protection plan and also an arboricultural method statement. Upon completion of the land remediation works, a new tree planting plan will be implemented in-line with W&WU policy.

4.2.3.8 Reptile Survey

A reptile survey was undertaken at the site on 15th August 2022 using roofing felt refugia with 50 placed at suitable locations onsite. These were placed for two weeks prior to the first checks and then checked non-consecutively on 7 days. No reptiles were found during any of the 7 survey visits.

4.2.4 Excavation Near Services and Service Structures

There are known live services at the site but also an expectation that there may be others that are historical and/or currently unknown.

With some services known to be near the breakout and remediation areas, precautionary measures will be agreed prior with various plant protection teams based on identified providers.

As a critical risk mitigation measure, a detailed site services investigation is proposed. This will include non-intrusive service tracing at ground level by a specialist services contractor, utilising current service provider plans, and survey equipment including ground penetrating radar (GPR) and cable avoidance tools (CAT and signal generator).

All services recorded during the site survey works will be further investigated where there is a potential of being encountered during the main work works using a small trailer mounted vacuum excavation technique due to access limitations. The investigation will be undertaken with awareness to typical services “booby-traps” found on former gasworks sites.

All service locations identified through non-intrusive and intrusive works will be recorded on a topographic survey with an as-built construction drawing being produced for use during the works. Should any additional services be encountered during any phase of remediation, then detailed records (logs/ photographs), demarcation and topographic survey works will be completed, with all the information being included in the final site verification report.

All excavations will be managed through a permit to dig system which will include positive identification of services and supervised by an environmental engineer.

4.3 Remedial Options Appraisal

Englobe has undertaken an Options Appraisal that considers a range of remedial options selected based on our remediation experience, the site constraints and client objectives specific to the site as outlined in the above sections. The Remedial Options Appraisal is summarised in Table 10.

Table 10 – Preliminary Assessment of Remedial Options – Options Appraisal

Remedial Option	Comments on Feasibility	Confirmation of Feasibility
Physical sorting	— Technique would be a feasible component of any site excavation works. — Re-use of site-won materials in accordance with a CL:AIRE Code of Practice Materials Management Plan would act to reduce and minimise volume of materials sent for disposal.	Feasible, but not a standalone technique
Capping with granular or impermeable cover	— Capping of site is not a suitable option as a standalone technique. — Gross contamination still has the potential to be flushed to shallow groundwater and surface waters. — Capping alone would not achieve this based on the available data and contamination at the site. — Capping is a suitable option to mitigate risks of inhalation/ direct contact with dusts/ asbestos that can blow to on or off-site receptors. — Capping also reduces accidental contact from onsite site users.	Feasible, but not a standalone technique
Product Recovery/heavily impacted perched waters	— Recovery and the treatment of heavily impacted perched waters is to be expected in the area of the impacted gasholders, pit, underling structures. and the immediate surrounds where free product may be identified and impacted by the springs on the northern boundary. — Product recovery would primarily be undertaken during the turnover and excavation of the remediation areas and the removal of contaminated material from the underground structures.	Feasible, but not a standalone technique
Excavation and Off-site Disposal at Landfill	— Based on the identification of heavily contaminated impacted made ground, excavation and off-site disposal to landfill is a potential requirement if other remediation techniques such as stabilisation not a suitable option. — Reasonably short timescales. — Considering sustainability, disposal to landfill, whilst feasible, shall, where possible, be greatly limited. Emphasis will be on site re-use and segregation of materials supported by verification of ground conditions. — High cost due to location and limited access to site (despite assuming an element of material management to minimise material volumes). — Access to the site is very difficult for larger items of plant and for the purposes of disposal material would need to be taken to the nearby Perrot Street car park under agreement with the local authority.	Feasible, but not a standalone technique

Remedial Option	Comments on Feasibility	Confirmation of Feasibility
	— Potential high residential impact with limited relatively narrow access to the site through terraced streets. — Selective sorting can help reduce off-site disposal. — Not a completely effective standalone method for areas with NAPL/perched water. — Could be replaced by geotechnically sound imported granular fill at expense. — Low technical risks. — Provides greatest flexibility for future use of the site.	
Excavation and Off-site Recycling of Contaminated Materials at a Soil Treatment Facility (STF)	— Reasonably Short timescale. — Access to the site is very difficult for larger items of plant and for the purposes of disposal material would need to be taken to the nearby Perrot Street car park under agreement with the local authority. — Potential high residential impact with limited relatively narrow access to the site through terraced streets. — Selective sorting can help reduce off-site disposal. — Not a completely effective standalone method for areas with NAPL/perched water. — Could be replaced by geotechnically sound imported granular fill at expense. — Recycling at a nearby STF allows materials to be beneficially reused with low transport footprint. — Low technical risks. — Provides greatest flexibility for future use of the site.	Feasible, but not standalone technique
In-situ or ex-situ treatments (e.g. Bio-physical, HVE, SVE, total fluids pumping, chemical oxidation, reductive dechlorination etc.)	— The effectiveness of in-situ techniques can be considered where free phase at depth poses a risk and can be removed without the need for excavations. — Ex-situ treatments such as bioremediation is a tried and tested technique which is feasible for a wide range of NAPL impacted soils with great flexibility in minimising costs due to the comparatively low treatment cost compared to disposal and ability to absorb greater volumes than expected. — It can be a timely process requiring lots of room with the potential to cause long term nuisance odours to nearby residential properties in the west and commercial enterprises /public buildings to the north and south. — There is less flexibility in the treatment of inorganics or gross contamination.	Feasible, but not standalone technique
Stabilisation/Solidification (S/S)	— A widely used tried and tested technique. — Non-destructive. — Based on required site usage for public open use, stabilisation would be suited to this site. This would minimise the need for offsite disposal of mobile organics tars and inorganics such as spent oxide impacted soils. — Inexpensive compared to offsite disposal. — Short term and manageable exposure to nuisance odours with suitable control measures. — Not suitable for soils containing significant amounts of inorganic contamination, ie spent oxide.	Feasible, but not standalone technique

4.4 Waste Hierarchy

The Waste Hierarchy forms part of the Waste Framework Directive and is a tool used in the evaluation processes that protects the environment alongside resource energy consumption from most favourable to least favourable actions. The hierarchy establishes preferred program priorities based on sustainability. Therefore, sustainable waste management cannot be solved only with technical solutions, but an integrated approach is necessary. A diagram showing the five stages of the Waste Hierarchy is shown within Figure 3 below.

In order to prevent and minimise the generation of waste, remedial works will be limited to the identified source areas, in a targeted approach and only excavate materials as necessary, in order to fulfil the environmental improvement objectives.

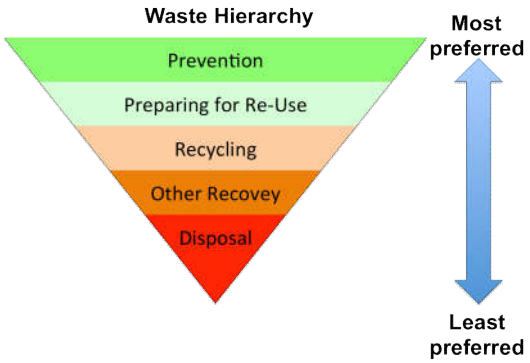


Figure 3 – The 5 steps of the Waste Hierarchy

The legitimate re-use of site won materials is being proposed in-line with CL:AIRE Definition of Waste (Development Industry) Code of Practice, 2011 (DoWCoP).

Where prevention or re-use are deemed unsuitable, solutions to enable the recycling or recovery of materials will take precedence to the least preferred approach of landfill disposal.

4.5 Proposed Best Practicable Technique (BPT)

Englobe's BPT to render the former gasworks at Quakers Yard suitable for its ongoing uses as a public open space is therefore, as follows:

Prevention – Risk mitigation through detailed Site Investigation and Risk Assessment. This will further define the S-P-R linkages and subsequent areas for remediation that pose a definite future unacceptable risk.

Preparing for Re-Use – The areas that are found to categorically pose a future unacceptable risk will be subjected to remediation. Based on the Options Appraisal and the Waste Hierarchy the remediation will be staged as follows;

— Excavation of impacted soils followed by physical sorting ensuring segregation and the subsequent priority categories.

— Suitable for re-use – material re-used on-site at appropriate depths.

— Treatment on-site – material treated on site using ex-situ stabilisation/ solidification (S/S) techniques.

Hydrocarbon impacted soils will be treated using stabilisation/ solidification (S/S) techniques and used as backfill in the gasholders with chemically suitable soils and crushed cover layer placed

above where the cycle path is to be replaced. Suitable softcover is to be used in less sensitive areas that have been remediated that do not require hardcover.

For any gross inorganic contamination encountered (e.g. pure spent oxide) that is unsuitable for treatment, the options appraisal indicates the BPT is to excavate the impacted soils and dispose these off-site to landfill. The excavations will be backfilled with site won soils and crushed site won artificial hard material meeting remedial targets. A reasonable proportion of the inorganic contaminated material (spent oxide) may be treated using S/S techniques with the materials used to condition other grossly contaminated materials such as soils impacted with considerable NAPL to aid with handling and treatment. However, in general, S/S treatment with soils with very high sulphur/ sulphate content is inappropriate due to the potential for breakdown of the treated soils. The use of some grossly contaminated material cannot be used in this process and will require removal off site as summarised below.

— Disposal to a Soil Treatment Facility; and lastly, but not expected.

— Disposal to Landfill.

To enable the recovery of contaminated material from within and around the tanks and surround impacted soils, perched groundwater and NAPL recovery will be required and undertaken in the following order:

— Temporary redirection of spring water outside remedial areas.

— Perched groundwater recovery with NAPL separation.

— Perched groundwater treatment on-site and disposal to foul sewer under consent if sewer available. If sewer not available, then upstream reinjection will be considered.

— Mass recovery during excavation of structures with skimmer or pump recovery; and

— Disposal of NAPL to a recycling facility.

Following remediation, the site will be backfilled with suitable site won verified materials and capped using site won granular stone (recycled and crushed on site) where required to match existing levels where possible. Soft standing material will, where possible and suitable be re-used but also imported if required.

It is not intended that site levels will be reduced to incorporate the cover layer but remodelled to help maximise reuse potential and minimise off-site disposal. There will be opportunities to reuse site won-soils without the need for off-site disposal and Englobe will always seek to maintain the existing levels where existing site egress and access is being used for the cycle track.

Based on the review of the Best Practicable techniques and the site setting as a whole, the main principal remediation treatment technique of stabilisation/solidification (S/S) has been selected due to the following factors:

It is a tried and tested technique, in which Englobe have a significant amount of experience on both gasworks sites owned by W&WU as well as other gasworks and non-gasworks sites.

— The technique has a short site works programme.

— The technique is durable in the long-term.

— Cost-effective with low technical risk.

— Ability to deal with moderate volume variations within the same programme/ price; and

— The technique is more sustainable than other remedial techniques such as offsite disposal.

Englobe have remediated numerous gasworks and closed out with statutory regulators using this stabilisation technique on many occasions and prior to remediation works. Englobe has determined, through experience and understanding of local authorities and NRW, that early regulator engagement is invaluable in ensuring the timely sign-off of the remediation.

5 Proposed Strategy

5.1 Preliminary Works

Various elements of work have already been undertaken as part of preparing this report and to finalise the outlined strategy being presented. These are interlinked with mitigating the identified site constraints and allow preparation of appropriate site works that is agreeable to all stakeholders while achieving both remedial and diversity requirements.

5.2 General Preliminary Works

5.2.1 Site Management and Logistics Survey

Cognisant of the lack of vehicular access and general site space the site management survey will confirm the most appropriate way to travel to the site and access the work areas. Englobe has agreed with Merthyr Tydfil County Borough Council to utilise a section of the Perrott Street car park to set-up a compound and storage area for the works. The area and the Licence for temporary takeover for the car park will be agreed by W&WU and the Council legal team in advance of the start of works. An area will be made secure and fenced off at the start of the works.

5.2.2 Monitoring Well Protection

Where required, Englobe will protect key boreholes whilst appropriately decommission others that are not required or will be lost as part of the works. Noting the locations on the constraints plan, some boreholes lie within tank structures and heavily impacted areas that require remediation and due to the nature of the remediation works are unlikely to be saved.

Wells will be appropriately decommissioned in-line with good practice presented in Environment Agency (EA) Science Report SC020093 'Guidance on the design and installation of groundwater quality monitoring points' and EA pamphlet on 'Good practice for decommissioning redundant boreholes and wells'.

Known wells to be decommissioned and lost during the remediation works due to their location within or immediately adjacent to excavation works are likely to include BH2; BH4; MW16-01; MW16-05; MW16-06; MW16-09; MW16-10; MW16-11; MW16-12 and MW16-13.

Wells to be protected for ongoing monitoring are hoped to include BH1A; BH3; MW16-02; MW16-03; MW16-04; MW16-08.

The locations of the various wells is shown on Drawing D1871/23/5302/A5 in Appendix A.

Should other boreholes be lost to remediation and be deemed necessary for the purposes of groundwater monitoring for ongoing regulatory agreement and sign-off, then they will be replaced either as per the original specification or to target a specific response zone which reflects the revised site conceptual model and support the validation of the works.

5.2.3 Stabilisation Bench Testing

Samples were collected from grossly impacted soils deemed suitable for stabilisation and sent to the Englobe testing facility for bench-scale mix testing. Noting the presence of spent oxide at the site as well as NAPL impacted soils, the potential impact of high-sulphate soils and the potential aggressivity of the chemical environment has been assessed primarily using Special Digest 1:5005, Concrete in Aggressive Ground (SD1).

Using this document, although developed for the construction industry, allows an assessment of the likely impact of higher sulphate environments on a stabilised cement-soil system.

The assessment includes the following:

— For assessing potential chemical aggressivity of pore waters of soils used for stabilisation:
    - Soluble sulphate in soil concentrations (or where not available a combination of solid sulphate concentrations, leachable sulphate are reviewed)
    - Soil pH
    - Soil leachate pH
— For assessing potential chemical aggressivity of external sulphate sources, such as groundwater:
    - Groundwater sulphate concentrations
    - Groundwater pH
    - Mobility of groundwater

The resulting values are used to determine the DS and ACEC class. An ACEC class of 3 or greater would be designated as a higher risk for stabilisation and the extent of this risk assessed in terms of the final location of the stabilised mass, likely final permeability of the mass, volume of "higher risk" soils within the total volume treated, etc. This risk is quantified at the bench test stage where for the Quakers Yard site, completion of 64-day tank tests were conducted, including an assessment of the chemical stability of the matrix of the produced stabilised material.

Based on the bench test trial data (details provided in Appendix E), the proposed percentage of additives will comprise those included within Table 11 below:

Table 11 – Stabilisation Additives

Soils to be Treated	OPC (% W/W)	PFA (% W/W)
Made Ground and Alluvium	8	16

5.2.4 Rehabilitation of the Existing French Drain

The current French Drain located towards the north eastern site boundary collects spring water. Although this appears to be working, it is unclear as to the type of ongoing and future maintenance required and whose responsibility it is currently to inspect and maintain.

Whilst the current French drain is still working at collecting and moving water, there is evidence during periods of wet weather of the spring water accumulating in the surrounding area leading to localised saturated ground indicating the drain may not be working optimally. Minor rehabilitation works were undertaken during the 2016 intrusive investigation to help increase the efficiency of the drainage in the short term but this has been more recently reviewed.

It is proposed to add a new system to better capture and move the identified spring water, with waters channelled through a non-perforated pipe prior to discharge to the river thus preventing the waters from passing through surrounding (what will be remediated) soils. The associated design drawings for the drainage works are provided in Appendix K.

5.2.5 Stakeholder Consultation and Public Engagement

A dialogue will be opened and maintained with regulators and all relevant interested parties to ensure that the appropriate approvals and permits are in place prior to commencement on site and so that they remain appraised of the progress of the works.

Further consultation will be carried out with local stakeholders to maintain good relations and ensure that they are aware of the works and any how the project will be manged such that the potential impacts from the works can be mitigated.

Public engagement with local residents and stakeholders will be undertaken, initially by way of a letter drop to local residents and businesses. The letter will include details of the intended works, duration and reassurance that the appropriate mitigation and control measures are in place. Welsh language versions of the letter will be available if requested.

A community event was hosted locally on 12th September 2023 to address any questions, queries or concerns which the local communities including Treharris and Quakers Yard may have with a dedicated Welsh language speaker present.

A dedicated W&WU community relations team has been appointed for this project and can be contacted by telephone on 0800 9122999 between 09:00 – 17:30 Monday – Friday or by emailing: enquiries@wwutilities.co.uk.

Information posters will be erected around site informing passers-by and interested parties of the works and the duration of footpath/cycle path closure. Emergency details will be communicated via a site notice board erected adjacent to the site compound in the car park but also on the closed bridge access off Mill Lane. Information relating the site security and contact details will also be communicated by way of signage erected around the site boundaries.

5.3 Main Site Works

5.3.1 Approach

Englobe's approach to the remediation site is to provide a viable and sustainable solution that minimises the impacts of the work on the local community and the environment whilst providing a robust solution achieving the long-term objectives for the site set out by W&WU.

We aim to undertake the works fully onsite, with minimal offsite disposal of materials (<1%) and to re-use site won recycled material over material importation.

Utilising existing access via the cycle access from the Perrot Street Carpark this approach will minimise road congestion, closures and significant lorry movements via the local road network which constrained at many points and passes through residential areas.

In addition, Englobe will look to use low emission plant and equipment with eco units for site set up that can be topped up with solar (and possibly wind) power.

5.3.2 Site Set-up/Compound and Pedestrian Access Routes

A compound area will be set-up in the Perrott Street car park and an area has been agreed with the local authority where this will be located and temporarily closed-off during the works. The compound area will link-up to the top of the cycle path which itself will be closed during the works. An agreement with the Local Authority and Sustrans has already been made enabling temporary closure of the cycle path during the works to enable secure access to the site.

The compound will be fenced and consist of a site office, canteen, decontamination unit/ changing rooms, toilet, store and parking. Office space, parking, storage and internet will be provided for the client's supervisor. An adjacent loading and unloading area will also be required for the delivery of site materials and collections of any waste.

The fencing in this area will extend to the top of the cycle path where closure will be in force for the length of the works. It is also noted that the car park is surrounded by a grassed soil bund which subject to agreement will in part be temporarily removed and civilised to facilitate less constrained access to the site.

Cognisant that the site set up would be approximately 200 m uphill and northeast of the working area, Englobe also propose to place a small welfare unit next to the nearby operational gas governor compound in an agreed area on Mill Street. 24-hour access for W&WU will still be maintained.

Site security requirements across the compound and working zone are expected to be mixed given consideration to several of the following items:

— Site area.

— Location of the compound site set up position.

— Location of where plant would be stored.

— Spatial position of the site within a steep wooded valley environment bounded in part by a river.

— The nearest houses 70 m to the north and downstream on Mill Street leading to Quakers Yard.

It would be the intention of Englobe to provide temporary fencing to surround much of the working area of the site where topography, ecological restrictions and woodland allows. A pragmatic approach would be required for the installation of some of the fencing that roughly adheres to the site boundary with particular attention paid to protecting the more exposed access and egress points to the site. Where natural protection is present e.g. heavy bramble thickets and steep banking, this may be utilised in preference of unneeded vegetation removal. Secondary fencing around the working and plant storage area will be used. It is expected that fencing would be used along the riverbank to act as both a security and safety feature.

The site compound includes provision for equipment storage with lighting and the working zone area where plant is stored would include CCTV coverage supported by 24 hr surveillance and call response if deemed required following a security survey. Englobe feel it is an unacceptable risk to store a fuel bowser in the plant storage away from the main compound and will utilise a small mobile bowser fed from a static compound based and transported to the refuelling area on site by a small articulated dumper.

Drawing D1871/23/5302/A3 presents the proposed location of the compound, access routes and the Traffic Management Plan is included in Appendix G.

With the nearby village centre and nursery school that leads to the Perrott Street Carpark, planning and consideration will be given to delivery times and traffic movements which due to the nature of the remediation are expected to be low. Larger deliveries such as plant and the water treatment system may require deliveries outside of normal work hours to minimise disruption. Standard deliveries and collections would be outside of school commuting times and when more residents are in work to reduce potential congestion. All delivery and set up options will be fully discussed and agreed following the logistics survey.

On arrival, all staff would be required to sign in at the site office. All works undertaken outside of the specified compound area would be classed as “Dirty” following use of the decontamination unit/ changing room.

Given the preferred remediation strategy of stabilisation, site traffic will be minimal and focussed on mobilisation and demobilisation activities and therefore a designated gateman is not warranted for these works with all site visitors required to adhere to the same site access routes. Access routes will also include provision for pedestrians.

A location/ contact plan will be posted at the main site access, communicated to all stakeholders and to delivery providers with detailed routes for deliveries. In addition, signage will be installed to aid access to the site.

5.4 Method Statement and SSOW

Detailed method statements will be prepared in advance of the various remediation activities proposed for the site. These will be submitted to the CDM Advisor in advance of the works. Where necessary, detailed drawings and specifications will be prepared in advance of the works and submitted with the detailed method statements.

5.5 Drainage Review and Disconnection

The remediation works may require the excavation and removal of various historical drainage runs, interceptors and service corridors where encountered. Prior to commencement of physical works, the condition, connectivity and flow of any remaining drains (surface and foul) will be reviewed. This will be tied in with the CCTV of drainage that will be used to discharge treated waters from the site.

The current review of the drainage notes that there is a foul sewer on Mill Street that has a viable connection downstream of the site near Quakers Yard inn and adjacent garages. A short access trench will be required to discharge into this point, with permission sought to run discharge pipework over the river at the pipes or footbridge then down the riverbank to this point. Alternative discharge locations will also be considered following a full drainage review with other fall-back options such as reinjection or discharge to river being considered if discharge to sewer is unviable.

5.6 Workforce and Visitors

A site attendance register will record all site staff and visitors. An induction process will be in place to inform workforce and visitors of the site works and procedures to comply with. Checks of competency will be undertaken prior to any person working on-site. Information regarding the site activities, health, safety, and emergency procedures will be provided prior to any person engaging in site activities. All site staff and visitors will be required to wear appropriate personal protective equipment (PPE) when on-site.

5.7 Remediation Works

The remediation works have been designed to provide a sustainable and appropriate strategy to deliver an effective solution to its location in the wooded valley that will have a positive physical and environmental impact on the site. The works will address immediate concerns regarding riverbank erosion and risk of collapse.

Cognisant of the difficult and tight access through the terraced streets of the town to get to the site and residential areas relatively near the site, the least disruptive form of remediation is proposed. To minimise potential nuisance issues generated by the work, stakeholder engagement and

proactive site management will be used together with nuisance mitigation through coverage, minimising open excavations, damping down and odour management as required.

In general, the works will involve the excavation, sampling and testing of materials for immediate re-use, treatment and re-use or unsuitable for re-use. The segregation, movement, sampling and testing of the materials will proceed in accordance with a Materials Management Plan (MMP) and tracking system in line with CL:AIRE DoWCoP to record and verify material re-use. Materials deemed unsuitable for re-use will be appropriately segregated, stockpiled and subject to waste classification prior to off-site disposal to appropriately Licenced facilities.

Three contamination source areas that potentially pose an unacceptable risk to human health and the wider environment have been defined as part of the DQRA and are discussed below in terms of the remediation options. These areas are outlined in Drawing D1871/23/5302/A6, Appendix A. The remediation works outlined in this section cover the headline actions of the remediation works plus any civils and drainage works proposed to render the site suitable for its ongoing use as public open space.

5.7.1 Stabilisation and Solidification

On the basis of the remediation options appraisal, stabilisation and solidification (S/S) was identified as the BPT and most effective and appropriate technique to deploy at the site. This technique is one that Englobe have a long history in deploying on both historic gasworks sites and those for other landowners.

S/S is a remediation technology that relies on the reaction between inorganic cementitious binders, such as ordinary Portland cement (OPC) or lime and the contaminated material to reduce the mobility of contaminants. Further extender products such as pulverised fly ash (PFA) or ground granulated blast furnace slag (GGBS) can be added as sustainable materials to aid the process. The S/S process involves the addition and mixing of relatively small amounts of reagents to the contaminated soil to produce a chemically and physically stable product. The treated material encapsulates and locks contaminants into the product.

The primary objectives of the S/S remediation technique as proposed are:

— To achieve environmental betterment by chemically and physically stabilising and reducing the mobility and leachability of contaminants within the Made Ground;

— To improve the strength of the Made Ground soil materials and form a lower permeability monolith; and

— To manage the moisture content of Made Ground soil materials as appropriate to ensure full curing of the treated materials.

Englobe propose to complete on-site stabilisation of impacted soil materials via in-situ (and where required ex-situ) stabilisation. The in-situ stabilisation works will be completed within the confines of Gasholders No. 1 & 2.

Stabilisation will be undertaken using a combination of mechanical plant including ~14 tonne mechanical excavator with mixing bucket attachment, grout mixing plant with grout delivery pipework. Stabilisation additives will be stored on-site in proximity of the stabilisation works to minimise transport requirements.

Materials deemed suitable for stabilisation (following mechanical segregation of non-treatable material such as wood, metal, plastic and oversize concrete/brick/masonry) shall be placed within the gasholders by mechanical excavator in advance of treatment. The use of the remaining gasholder structures will assist with the wider management of potential environmental issues such as noise, dust and odour. Materials placed in the gasholder for treatment shall be surveyed and recorded by volume in advance of mixing in additives.

Additives (cement and PFA) shall be added at a volume percentage ratio of 8 % and 16 % respectively for cement and PFA (as previously outlined in Table 11). Water requirements to support the proposed mix and to take account of variations in material would be between 2.5 and 5 % (based on cement % addition). The mixing plant and associated feedstocks of additives shall be located within a segregated and designated grout mixing area at ground level.

The monoliths produced at full scale will be subject to testing in a tank leaching test in accordance with EN NEN 7375. Samples are subject to the first four stages of the tank test (4 days) with chosen samples extended to the full 64-day duration. An assessment of sample durability and leaching characteristics of the final product will be made in accordance with EA NEN 7375.

Englobe shall upon completion of stabilisation demonstrate that the treated material is durable via a combination of strength and leachability testing in line with the EA NEN 7375 test. Englobe have significant experience undertaking stabilisation projects and have an extensive database to compare against including many successfully remediated gasworks sites.

5.7.2 Source Area A - Gasholder No. 1 & No. 2 Excavation and Stabilisation

Based on current estimations there is approximately 1,070 m^3 of capacity within the former holders that require excavation and processing with gross contamination stabilised back into the gasholder with other gross contamination from around the site.

In order to minimise the potential exposure of odorous material, the stabilisation will be undertaken in sections that sees the majority of material kept within the gasholder until it is stabilised. This approach has been undertaken at several gasworks sites with sensitive receptors and is proven to be successful.

Based on our experience of gasworks remediation and our estimations of the volumes that require remediation we would estimate that approximately 50% of the existing material within the gasholder would require stabilisation which provides space for the grossly contaminated material recovered from other areas of the site to be stabilised and reused in the remaining space under a suitable MMP.

It is not proposed to re-use stabilised material within 0.5 m of the final site surface and following stabilisation, material will then be covered with a hi viz geotextile and crushed site won material in preparation for the replacement of the overlying cycle track or soft standing based on current site conditions.

Drawing D1871/23/5302/A6, Appendix A presents the remediation areas at the site.

5.7.3 Source Area B - Former Central Processing Area

The central processing area covers the former buildings and processing structures throughout the centre of the site from the east of Gasworks House to Former Gasholder No. 2 where gross contamination of NAPLs in made ground and perched waters has been identified. This area is presented in Drawing D1871/23/5302/A6, Appendix A.

Works will be undertaken in this area to remove the made ground that overlies the original pre demolition gasworks ground level and process for reuse. Much of this overlying material is known to be demolition rubble and will be screened using a screening bucket to recover hard for crushing and soft for re-use in other parts of the site where verification analysis shows it to be appropriate.

Gross contamination will be stockpiled in a covered bunded area for later stabilisation into former Gasholders No.1 or No. 2 as the works progress.

Hardstand, walls, and foundations will be broken out and excavated to at least 1.5 m below formation levels unless temporary works design have shown that they are providing structural integrity at the site. Hard arising placed in stockpiles of ‘clean’, quarantine or ‘dirty’ for later crushing, testing, and appropriate reuse within the site.

If gross contamination is encountered within the made ground it will be excavated to the saturated zone with particular care of removal undertaken near the river as described in later sections.

In addition, redundant historical drainage, manholes, interceptors, tanks, and redundant services encountered will also be crushed and recycled or removed for offsite disposal where appropriate and conditions allow.

5.7.4 Source Area C - Gasholder No 3 and the West of the Site

As outlined in the data analysis, Area C represents the area of least gasworks impact westwards from around Gasworks House. With exception of the base of Gasholder No. 3, most of the structures are not expected to be significant and will be targeted for removal to provide useful hard for crushing and reuse at the site including the former Gasholder No. 3 base.

Shallow soil where asbestos fibres have been identified will be excavated as 'hot spots' and retested for appropriate reuse at depth within the site and soils overlying the former gasholder base will be excavated and screened to remove the demolition rubble hard for crushing and reuse.

Localised soils from Area C (tested and confirmed as being suitable for re-use) will be excavated and utilised as part of the re-engineered riverbank restoration works as described further in Section 5.16). Soils from below 2 m have no exceedances of this RTV and are therefore considered suitable for excavation and re-use along the riverbank, within 5m of the river's edge.

Works in Area C are not expected to be undertaken west of Gasholder No.3 where knotweed stands and thickets have been identified as being most prevalent.

5.7.5 Japanese Knotweed and Himalayan Balsam Impacted Ground

It is recognised that there was a knotweed treatment programme being undertaken at the site between 2018-2018 with particular attention to the west of the site. It is also recognised that new knotweed growth was evident in several areas at the site, surrounding the site and throughout the valley.

Knotweed and Balsam is particularly prevalent at the riverside in the south of the site which may be expected as floodwaters will re-impact these areas from upstream on a regular basis. Knotweed is also noted at the edge of cycle paths where those travelling through the site may aid its spread.

Where knotweed impacted soils are encountered and require removal for the purposes of remediation these soils will be used at depth within the stabilisation mass. The aggressive mixing process of the stabilisation equipment breaks up the knotweed roots and destroys them, so they become unviable. Where the Knotweed/Balsam fall outside remedial areas, they will be protected, fenced off and signage provided. Site workers will be provided a Tool Box Talk on invasive species identification and the areas of site where it has been found.

Englobe do not propose to undertake any long-term management of invasive weeds at the site and understand this is currently being managed by others.

5.7.6 Groundworks Volume Balancing and Cover Layer

It is the intention of Englobe to retain as much of the contaminated material on site as possible (with the exception of the most grossly impacted spent oxide). Englobe do not intend to import additional aggregate and will utilise suitable validated hard material recovered from site works to achieve site levels. Some localised imported aggregate may be required as part of any cycle track construction works if onsite won materials were not suitable.

Englobe recognise that asbestos fibres in soils are very common in gasworks setting and that mainly trace concentrations have been sparsely identified in several areas of the site. Subject to regulatory agreement and to avoid the need for removal it is the intention to retain asbestos soils impacted with fibres at the site providing that are used within the stabilised mass, beneath the later hardstand of the cycle track or at least 300 mm below final site levels with an asbestos free cover layer.

It would be the intention of Englobe only to use site won soils free of asbestos in the top 300 mm of soft standing. If required additional soils to provide additional coverage will be imported to the site. Considering the end use, it would not be intended to use a topsoil or subsoil to British Standard BS3882:2015 & BS8601:2013 respectively but a locally sourced as dug soil or screened soil providing it passes chemical reuse criteria.

Other than at the access and egress to the cycle path where it is key to maintain the surrounding site levels, the flexibility of the approach will allow for some subtle reprofiling of the site to maximise the reuse of material at the site which will in turn minimise the number of lorry movements in and out of the site, reducing impacts on the local road network and community while reducing transport related emissions.

5.8 Shallow/Perched Water Recovery During Remediation

A water treatment system (details provided in Appendix H) will be operational at the site to address any perched waters inside or outside structures, and free phase contamination encountered during excavations works.

It is proposed that the bunded pumping system will have both a LNAPL and DNAPL water separator, sand filters, carbon vessels to ensure discharge criteria (weekly testing) is achieved prior to disposal via a foul sewer consent or for reuse during the stabilisation process.

5.9 Groundwater Treatment

Based on the context of the site remediation goals and our current understanding of the site conditions, Englobe do not expect that any groundwater treatment will be required at the site. Shallow contamination will be addressed during the turnover and excavation works and it is expected that the high baseflow through the site has dispersed any significant product that can be recovered from the underlying alluvial stratum.

5.10 Off Site Disposal

It is the intention to retain as much of the material on site as possible, but it is recognised that some disposal works such as disposal of pipework or the most gross contamination is unavoidable. It is currently the intention of Englobe to create a managed collection area in the Perrot Street Carpark compound where Roll-on Roll-off skips can be deposited and collected when required. The skips will be covered when not in use.

5.11 Crushing and Screening

Crushing and screening will be undertaken using excavator mounted buckets and where required damping down will be undertaken to mitigate potential dust generation. The crusher operators will notify the Local Authority of the movement and application of their crusher onsite.

5.12 Asbestos on Site

Where non-Licenced (NL) or notifiable non-Licenced (NNL) asbestos containing materials (ACMs) are encountered, they will be collected by suitably trained and competent staff (NL and NNL), double bagged in line with current disposal requirements and stored in a lockable skip. The skip will be located within a quarantine area and appropriately signed to ensure no cross-waste contamination or disposal.

Asbestos in air monitoring will be actively carried out during asbestos works at the working face, to key workers and key boundary locations during the remediation by a specialist subcontractor.

All works shall be carried out in line with current legislation and industry best practice to including Control of Asbestos Regulations 2012 (CAR2012); Joint Industry Working Group (JIWG) CAR-SOIL (2016) Interpretation for Managing and Working with Asbestos in Soil and Construction and

Demolition Materials prepared by CL:AIRE with the support and approval of the HSE; CIRIA C733 ‘Asbestos in soil and made ground: a guide to understanding and managing risk’.

5.13 Unexpected Contamination

The potential to encounter unexpected contamination at the site exists on the basis of the site having an historic gasworks use. However, based on the completed investigation works the risks of encountering non gasworks related contamination is considered relatively low. The excavation and turnover works is expected to encounter any unknowns either contaminative or structures etc. during the works.

In the event that unexpected contamination is encountered, then Englobe will stop works and bring to the attention of the Client’s project team and notify the NRW and local authority contaminated land representatives with a strategy for investigation, characterisation, and mitigation.

It is however, considered that except for significant amounts of spent oxide or notifiable asbestos materials, additional contamination could be incorporated and or treated using stabilisation as the primary proposed remedial technique.

In the event materials are not suitable for treatment, such as grossly contaminated infrastructure, fibrous asbestos, or other high-risk substances, these shall be further segregated and stored appropriately to minimise nuisance emissions and potential risks to human health and the wider environment. Following appropriate classification, these materials will be disposed off-site to appropriately Licenced facilities.

5.14 Groundwater Monitoring

During the remediation works, it is proposed that two rounds of groundwater monitoring will be collected from key borehole locations in the east and west of the site. It is not proposed to sample groundwater from any boreholes containing free phase contamination, but NAPL thicknesses, if present, will be recorded, and samples recovered where necessary. Further groundwater validation sampling is discussed in Section 6.1.6.

5.15 Physical River Protection During Remediation

Care will be taken near the river during the works. Aside from relevant health and safety protection such as fencing other protections to prevent accidental release of any significant contamination will be in place such as removal of contamination and drainage at the banking at the earliest opportunity in the remediation works, provision of spill kits and refuelling away from the river. Material stockpiles will also be stored at least 6m away from the river’s edge.

The details will be provided in Englobe Construction Phase Health and Safety Plan and issued to the relevant NRW officers in-line with the agreed Flood Risk Assessment Permit (FRAP) for agreement prior to the start of works.

5.16 Riverbank Restoration and Protection

As discussed, parts of the site boundary along the riverbank with the Taff Bargoed is subject to ongoing erosion. Addressing the risk of this ongoing erosion and risk of collapse is key to successfully mitigating the risk the site poses to the river.

The river has, over several years, gradually eroded further into the site and exposed more of the former below ground gasholder, stone built buttress and made ground within the site. There are areas where the general made ground within the site is visible, has slipped down the riverbank and remnants of historical walls, structures and pipework. The effect of this becomes less downstream

and below the access bridge the opposite riverbank has concrete flood reinforcement supporting the Mill Street.

The Advisian 'Ad-hoc Riverbank Stability Assessment Report' dated December 2021 (included in Appendix D) documents in detail the deteriorating condition of the river bank between September 2017 and August 2021. The report also highlights sections of the riverbank 'lost' to erosion.

Since Englobe first visited the site, it has become noticeable how much erosion is occurring. The original topographical survey provided to Englobe by W&WU as part of the tender package has easily become outdated. Englobe have since undertaken a much more recent and accurate survey which has highlighted the erosion and need to urgently protect the riverbank to mitigate further erosion. Examples over time of the ongoing eroding riverbank is shown in the following figures.

Figure 4 – Panoramic view of riverbank at summer low levels (taken from Advisian, 2021)

Figure 5 – Riverbank in the East of the Site and Stone Buttress (low water conditions 2022)

Figure 6 – Ongoing Riverbank erosion exposing made ground and stone buttress (Winter 2023/24)

Figure 7 - Exposed stone buttress and ongoing erosion (low water winter conditions Winter 2023/24)

Englobe has procured CBEC, a specialist and reputable eco-engineering contractor to design and implement a suitable and sustainable riverbank solution. CBEC have surveyed the Taff Bargoed riverbanks and provided a solution utilising regained wood from the site clearance works, rock mattresses, brushwood fascines and live willow stakes.

Englobe will prepare and reprofile the riverbank, utilise site-won material from excavation works in Area C (tested and confirmed as being suitable for re-use) and place it in a 1m wide zone along the length of the riverbank protection. CBEC will then undertake the specialist element of the works to install the riverbank protection.

A copy of the detailed river bank solution design in provided in Appendix J and summarised in Drawing D1871/23/5302/A7 included in Appendix A.

5.17 Habitat Enhancement Plan

Following the remediation works and civilising site, habitat reinstatement works will be progressed at the site. Details of the habitat reinstatement and restoration works are summarised in Keystone Ecology's Ecological Management Plan (EMP) dated July 2023 and also Biodiversity Net Gain Feasibility and Design report, both included in Appendix I.

These documents provide details and specifications for the enhancement and management of habitat and other features of biodiversity interest on site. The Biodiversity Net Gain Assessment has been designed to provide a net neutral outcome.

The EMP describes the long-term objectives of the ecological mitigation, compensation and enhancement measures to be undertaken, and details how these measures will be managed and maintained once site clearance and planting have been completed.

In-channel works, and bank stabilisation works will be undertaken in accordance with a detailed Construction Environmental Management Plan (CEMP) and Method Statement that will have been approved by a suitably qualified ecologist.

The overall objective will comprise an environmentally conscious habitat that will enhance the site through the recycling of site won materials such as site timber/ mulch recovered during the vegetation removal and stones recovered from walls and foundations. Typical enhancements using site won materials include:

- Standing deadwood monoliths for;
  - Invertebrates,
  - Bird nesting feature, and
  - Bat roosts.
- Tree root stumps for;
  - Invertebrates,
  - Birds,
  - Small mammals, and
  - Herptiles.
- Reptile and amphibian basking banks, hibernacula, and log piles.
- Compost heaps for Grass Snake egg laying.
- Dead hedging from woody arisings and soft vegetation.
- Artificial Otter holts created from site won timber.

Keystone Drawing no. 223340/13/dwg2 included in the Biodiversity Net Gain Feasibility and Design report provides a summary of the proposed habitats enhancement plan.

In addition to the reuse of site won materials and a tree planting regime that will include planting 5 No. trees for each one removed. New plant species or seed mixes will be used which will provide

a quick boost to start the increase in biodiversity in the area while increasing the aesthetics. Figure 8 below is a collation of typical habitats and refugia that are planned to restore and enhance biodiversity.

Figure 8 – Site Habitat and Refugia

6 Verification Works

6.1 Verification Test Plan

6.1.1 General

In general, the aim of the verification test plan is to provide a regime of testing to demonstrate the following:

— How residual contaminants compare against the remediation criteria (RTVs presented in Table 4);

— and do not pose an unacceptable risk to human health or the wider environment;

— that materials have been appropriately treated and that remedial criteria have been achieved;

— that only appropriate materials have been imported to site; and

— that site originating materials are suitable for re-use.

Soil, groundwater and surface water samples (including Spring water) will be scheduled for the appropriate suite of analysis, as presented in Table 12 and Table 13, at UKAS accredited laboratories.

Sample retrieval, handling, storage and record keeping will be undertaken in line with Englobe standard operating procedures and will be subject to duplicate QA/QC assessment.

It is noted that the proposed aspirational RTVs have been generated based on some key factors as outlined in Section 7.2 of the DQRA report and Section 3.7 of this report which are considered crucial in the cost-benefit considerations of the remediation scheme.

The use and application of the RTVs is further discussed in Section 3.8 of this report. In general, it is noted that the RTVs should be considered and used carefully when comparing directly against site data. In general, the works will attempt to adopt the proposed aspirational RTVs of which some are acknowledged to be very low and potentially unachievable. The validation sample results will

be carefully reviewed and considered alongside the wider site setting and overall objectives for the site. The focus will remain on the key overall objective, regardless of always meeting performance criteria targets and will be considered alongside the overall cost benefit and site betterment objectives.

Table 12 – Testing Suites Solids

Grouping	Constituent COCs
Phenols	2,4,5-Trichlorophenol; 2,4,6-Trichlorophenol; 2,4-Dichlorophenol; 2,4-Dimethylphenol; 2-Chlorophenol; 2-Methylphenol; 2-Nitrophenol; 4-Chloro-3-methylphenol; 4-Methylphenol; total phenols.
Metals	Arsenic, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc.
PAHs	Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene.
BTEX	Benzene, Toluene, Ethylbenzene, p&m-xylene, o-xylene.
Cyanide	Free Cyanide, Complex Cyanide, Total Cyanide.
TPH	Speciated Aliphatic and Aromatic Hydrocarbons.
General inorganics	pH, Electrical Conductivity, Total Sulphate (as SO_4), Sulphide, Total Chloride, Ammonium as NH_4, Total Organic Carbon.
Asbestos	Asbestos ID, Asbestos quantification (following positive ID).

Table 13 – Testing Suites Groundwater & Surface Water

Grouping	Constituent COCs
Phenols	Catechol, Resorcinol, Ethylphenol & dimethyphenol, Cresols, Naphthols, Isopropylphenol, Phenol, Trimethylphenols, Total Phenols.
Metals	Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc.
PAHs	Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene.
BTEX	Benzene, Toluene, Ethylbenzene, p&m-xylene, o-xylene.
Cyanide	Free cyanide, complex cyanide, total cyanide.
TPH	Speciated aliphatic and aromatic hydrocarbons.
General inorganics	pH, Electrical Conductivity, Sulphate (as SO_4), Sulphide, Chloride, Ammonium as NH_4, Total Organic Carbon, Total Suspended Solids.

6.1.2 Excavation Extents

Verification sampling of excavation extents will be undertaken, on the following basis:

- Base of excavation at a frequency of 1 sample per 100 m^2, generally equivalent to one sample per 10 m x 10 m grid; and
- Boundary face of excavations at a frequency of 1 sample per 10 linear metres of excavation face.

Samples will be sent for solid chemical analysis as per Table 12 and results compared against the relevant RTVs and assessed in line with the text in Section 3.8

6.1.3 Material Re-Use

Verification sampling will be undertaken on site won Made Ground/topsoil type material at a frequency of one sample per 100 m^3.

Samples from produced/recovered from granular site won at a rate of at least 1 No. sample per 250 m^3 of material with a minimum of three samples per source.

Representative sampling will be undertaken in line with Englobe standard operating procedures, using sub-sampling methods and techniques such as cone and quartering.

Samples will be sent for solid chemical analysis as per Table 12 and results compared against the relevant RTVs.

It is noted that all re-used material will also be free from obvious/significant discolouration, odour and not contain deleterious waste material, asbestos, wood metal etc.

6.1.4 Imported Granular Cover

The import of granular cover is not expected; however, if required, only certified and tested granular material will be imported onto site. Virgin quarried material will not be subject to further laboratory testing other than that provided by the producer. All imported materials will be thoroughly visually inspected prior to use.

6.1.5 S/S Treatment

In order to demonstrate that the stabilised soils meet the remedial targets for the site, samples of treated soil will be recovered at a rate of 1 sample of 400 m^3 (minimum of three samples) and allowed to cure for 28 days in moulds kept at ambient temperatures.

Following curing, the samples will be subject to 64-day leachability tank testing in order to demonstrate the post-stabilisation immobilisation of the contaminants of concern. Testing will also be undertaken to demonstrate the strength and durability of the stabilised material.

Samples taken for validation purposes will be recovered from the treated material after blending with S/S additives, prior to any initial set or hardening occurring. Sufficient material will be collected and placed in moulds according to the methodology described below:

— Samples produced will be of uniform size, consistent with the testing requirements with duplicate samples being retrieved in case of damage;

— Material will be placed within moulds in layers, with hand pressure applied to ensure material extends into corners and edges of the moulds;

— The upper surface of the material will be smoothed, and the sample mould sealed;

— Samples will initially be kept in a designated safe and secure storage area and off the floor;

— Samples will then be transported to an appropriate testing facility as soon as is reasonably practicable, where they will be stored on shelving in a controlled environment for a minimum period of 28 days prior to testing; and

— Samples may be removed from their containers up to 7 days prior to testing to allow for sample preparation.

6.1.6 Groundwater and Surface Water Quality

Four rounds of groundwater and surface water (including Spring water) monitoring will be undertaken. One during the remediation works and three following the completion of remediation works to ensure water quality is stable and that concentrations present do not present an unacceptable risk to controlled waters. Samples will be collected from key boreholes and upstream/downstream locations as previously undertaken.

The samples will be sent for liquid chemical analysis as per Table 13 and groundwater results compared against the RTVs in Table 7. The surface water results will be compared against previous sampling data.

6.1.7 Disposal to Foul Sewer

If required, a discharge consent will be agreed with Welsh Water with established criteria and sample testing frequency, so that data can be retrieved and shown to demonstrate that appropriate water quality is being achieved prior to disposal to the sewer.

6.1.8 Geotechnical testing

In cycle/foot path reinstatement areas, the capping layer (or imported aggregate) will be subject to on-site 450 mm plate CBR tests at a frequency of one test per 100 m^2, with an aim to achieve a minimum CBR value of 5 %.

6.1.9 Summary of Testing Schedules

Table 14 provides a summary of the testing schedules described previously.

Table 14 – Summary of Testing Schedules

Testing Location	Testing Frequency	Testing Requirements
Base of excavations	1 per 100 m^2 Generally equivalent to one sample per 10x10m grid	Table 12
Material Re-use	Site-won Made Ground / Topsoil type material 1 per 100 m^3 Produced/recovered granular material 1 per 250 m^3	Table 12 Minimum 3 samples for standard solid suite (Table 12)
S/S treated material	1 per 400 m^3	Minimum 3 samples EA NEN 7371 test
Waste Materials	Dependant on receiving facility requirements, typically one representative sample per 100 m^3	Waste classification dependant on material type and substances present
Groundwater Monitoring	4 rounds of sampling from key boreholes	Table 13
Surface Water Monitoring (including Spring waters)	4 rounds of sampling from upstream and downstream river locations and also the Spring water	Table 13
Discharge water	To be agreed with Welsh Water	To be agreed with Welsh Water
Geotechnical testing	1 per 100 m^2	450mm plate CBR test

6.2 Record Keeping

Throughout the works extensive records will be maintained including (but not limited to) the following:

— A full and detailed description of the works completed;

— Site diaries, visitors, inductions etc. ;

— All progress meeting minutes and key correspondence

— Records of local community liaison / letter drops etc.;

— Environmental monitoring records (including asbestos air monitoring, noise, dust, odour and surface/ground water monitoring)

— Completed 'Soil Treatment' log sheets;

— Details of unforeseen contamination encountered during the works and subsequent remedial actions;

— Materials / Waste import / export records (including full Duty of Care documentation);

— Groundwater quality monitoring data and laboratory analytical certificates;

— Relevant approvals from Merthyr Tydfil County Borough Council, NRW and utilities companies

— Records of water treatment / disposal to sewer (including meter readings and laboratory analysis certificates);

— Laboratory certificates for soil analysis (for environmental and geotechnical testing purposes);

— The extent and location of all soil remediation works, including 'As Built' engineering plans showing the location of remedial excavations, location of validation sampling, backfilled soils, obstructions etc.;

— Records of all soil treatment (including volumes and validation testing analytical results);

— Records of post remediation groundwater monitoring;

— A photographic record;

— A summary of environmental monitoring and complaints; and

— Full copies of key regulatory correspondence.

6.3 Verification Reporting

A verification report will be prepared on completion of the remediation works. The report will contain details of all excavation works carried out, materials management aspects including details of the volumes of material excavated, treatment activities, disposal activities and material re-use on-site. Photographs of the works, environmental monitoring data and certificates of the laboratory verification testing for chemical and geotechnical properties of all soil material will also be included. The verification report shall be completed in accordance with current regulatory guidance and best practice.

7 Environmental Management Plan

Based on the proposed works which include mechanical excavation, breakout of hard materials, transport of materials on and off site, processing of materials and stabilisation treatment, the potential for pollution, as well as nuisance emissions such as odour, dust, noise, and vibration exist. These risks have been identified as part of pre-works planning and will be subject to on-going mitigation, management, and monitoring regimes throughout the works.

In-order to address and manage the identified risks, it is proposed that the following environmental management, mitigation, and monitoring measures are employed during the works. The proposed methods below also reflect the environmental management, monitoring, and mitigation measures. A Section 61 consent application for construction noise will also be submitted to Merthyr Tydfil County Borough Council.

The proposed working hours will be restricted to Monday to Friday 08:00 – 18:00 hrs. In the unlikely event that Saturday working is required, this will be restricted to 08:00 – 13:00 hrs. No works will be undertaken on Sundays or Public Holidays.

7.1 Ecological Assessment

As described in previous sections and detailed in the ecological documentation included in Appendix I, further ecological and habitat enhancement and restoration works will be undertaken in-line also with the Net Neutral target.

7.2 Pollution Prevention

Safeguards will be implemented to minimise risks of pollution associated with the proposed remediation activities as follows:

— Fuel required for the welfare and plant/equipment will be stored within secure (lockable), double bunded (minimum of 110% capacity) storage tanks with sufficient absorbents available;

— Refuelling will take place within a designated hardstand area, by trained and competent personnel;

— Oils and chemicals necessary for the works will be stored within a secure COSHH stores;

— Englobe shall restrict the movement of plant and position haul routes away from the sensitive boundaries with residential properties and minimise the works required in these areas;

— Materials will be temporarily stored within designated areas with bunds and covers being used to contain and prevent cross contamination and nuisance emissions;

— Treatment activities will be positioned as far away from sensitive receptors as reasonably practicable;

— Plant and machinery will be maintained in good working order and where available will be less than 3 years old and subjected to regular checks in-line with PUWER and LOLER Regulations;

— Wheel washing facilities will be available to cleanse the wheels of vehicles leaving site to prevent mud/debris leaving the site;

— Licenced waste carriers will be used for all waste transfers off-site and appropriately Licenced facilities will be used with waste duty of care documentation retained on-site throughout the duration of works and records included within the verification report.

7.3 Control and Monitoring of Dust

Dust levels will be visually assessed on an ongoing daily basis by all Englobe staff who shall be encouraged to manage and mitigate dust levels during their daily works and communicate any issues to the site manager.

Dust monitoring will be carried out at the 4 proposed environmental monitoring points (shown on Figure D1871/23/5302/A3, Appendix A), located around the site together with any additional monitoring locations based on actual working areas, which will be agreed at the daily activity briefing based on proposed works areas and activities.

Englobe will carry out environmental monitoring of dust continuously prior to and during the works on a visual basis. In addition, daily airborne particulate matter monitoring using a hand-held direct reading instrument and weekly deposition rate quantification measured using frisbee type gauges.

The dust collected from the frisbee type gauges will be measured on a fortnightly basis during the works. Results of dust monitoring will be required on a 5-working day turn around.

Should significant dust generation be identified, additional chemical analysis of the dust may be implemented. The threshold levels deemed appropriate for the works shall be based on other similar site agreements of 200 mg/m^2/day for airborne particulate matter (PM10) and Englobe work to the latest LAQM guidance when the works commence (190ug/m^3 over a 1-hour period) and pro rata to a shorter period for averaging purposes of 15 minutes at each monitoring location. Should these thresholds be approached or exceeded, the works on-site and contingency measures deployed will be reviewed with the aim of mitigating dust to below the threshold levels.

Dust mitigation measures will be undertaken pro-actively as part of the normal site operations and a management plan shall be in place as part of the Englobe site health and safety management plan. Should there be visible dust, or exceedance of the action level value for dust, then works will be stopped and the dust management measures re-assessed, adapted, or upgraded. Further follow

up monitoring shall be undertaken to confirm that the corrective actions have successfully managed dust levels.

Typical remedial actions to manage dust impacts that shall be deployed on site include:

— Traffic routes shall be sprayed with water to control potential dust generation. There will be a limit to all unnecessary traffic across the site and all haul routes shall be subject to routine and regular inspection.

— The speed limit for the site shall be limited to 5 mph in order to minimise the potential generation of debris/dust.

— Dust netting and fencing shall be erected in advance of works across areas of site on a phased basis to mitigate the potential for cross boundary migration.

— During periods of high winds (in the direction of key receptors) the works and activities with the potential to generate dust shall be suspended or amended until wind speeds reduce to acceptable levels and / or alternative working and control methods can be deployed.

Englobe propose to use a combination of fixed dust suppression systems in high dust risk activities areas such as break out and stabilisation with additional mobile suppression via dust cannons and rotary atomisers on site for deployment and relocation based on works progress and observed site conditions.

All monitoring data shall be recorded and presented within the verification report.

7.4 Control and Monitoring of Vapours and Gases

A method statement detailing how odours and vapours will be minimised for remediation works during the handling of contaminated materials (including stabilisation and bulk excavations) will be available as part of Englobe's safety, health, and environmental management plan.

Based on the known site contaminants and surrounding stakeholders, works will be progressed in a manner where practicable to minimise open excavations for extended periods, minimise contaminated material stockpile volumes and remove, where encountered, free NAPL and perched water within excavations with appropriate controlled on-site storage prior to off-site disposal. In addition, odour suppression equipment shall be made available which may include fixed boundary dispersal and mobile rotary atomiser systems to allow deployment and movement based on encountered conditions and contamination.

Mobile treatment plant for soils and waters will be under the strict control of Englobe and are unlikely to create significant emissions of vapours and gases during normal operations.

Monitoring of volatile organic carbons (VOCs) will be undertaken continuously during working hours for the duration of site works. Monitoring will be undertaken from the first day of site works before excavation and S/S treatment commence, in order to determine background levels. A Photo Ionisation Detection meter (PID meter) will be kept on-site for this purpose.

Englobe will be responsible for the environmental monitoring of VOCs in ambient air within Englobe work areas. Monitoring will be undertaken at a minimum of once per day, during working hours for the duration of site works. Monitoring will be undertaken prior to main works in order to determine baseline levels. A Photo Ionisation Detection meter (PID meter) will be kept on site for this purpose.

Monitoring will be carried out once a day for a duration of at least 15 minutes. Monitoring will be carried out with a PID meter fitted with a 10.6 eV lamp calibrated for total VOCs, to assess vapours quantitatively. The 15-minute average for each location and maximum concentration will be recorded, together with the time that the monitoring was carried out.

During periods where the intermittent monitoring is not being carried out, a PID meter will be located at a dust monitoring station or other location downwind of current works areas and set to log the average vapour concentration (time weighted average) at that location. Once again, the average vapour concentration at that location and maximum concentration will be recorded, together with the time that the monitoring was carried out.

Englobe will be responsible for daily calibration of any PID meter used on site. The site Engineer will record all monitoring information in electronic format (table format) on a weekly basis.

The threshold levels for vapour monitoring set out in EH40/2005 (Health and Safety Executive Workplace Exposure Limits) and subsequent amendments will be observed during the works. However, in practice, a maximum limit for the time weighted average concentration of 1 ppm will be set for vapours. If ambient levels on site approach or exceed this concentration, works on-site and contingency measures deployed will be reviewed with the aim of mitigating vapour levels to below the threshold levels.

Englobe will also monitor personnel most at risk from odours/ vapours and gases whilst on site and will provide sufficient personal monitoring instruments to do this. Typically, this will include excavation operators, banksmen, operatives carrying out hand excavation works and plant operators carrying out bulk excavation in the contaminated areas/ removal of gasworks structures. For personal monitoring, PID meters will be placed on the operative and set to record the average vapour concentration (time weighted average). The average vapour concentration and maximum concentration will be recorded, together with the time that the monitoring was carried out.

These procedures will be reviewed during the work and potentially revised for activities deemed to be higher risk.

7.5 Odour

Odour monitoring (olfactory sniff test) will be undertaken daily at the edge of the works zone and at the most relevant site boundary to offsite receptors, dependent on work locations and weather conditions. The FIDOL factors will be recorded which are represented as follows:

Frequency	How often an individual is exposed to odour
Intensity	The individual's perception of the strength of the odour
Duration	The overall duration that individuals are exposed to an odour over time
Odour unpleasantness	Odour unpleasantness describes the character of an odour as it relates to the 'hedonic tone', and will be measured on a standard none-point scale
Location	The location of odour and nature of human activities on the vicinity of an odour source, including receptor characteristics

Odour intensity will be measured and recorded on a 0-5 scale where:

0 – No detectable odour

1 – Faint odour (barely detectable, need to stand still and inhale facing into the wind);

2 – Moderate odour (distinct odour detected while standing still);

3 – Moderately strong odour (detectable while walking & breathing normally, possibly offensive);

4 – Strong odour (bearable, but offensive odour);

5 – Very strong odour (very offensive, possibly causing nausea).

The trigger criteria are as follows:

- **Action Levels** shall be set at 3 or above for intensity at which point odour reduction measures should be put in place. This includes covering of stockpiles, limiting area of open excavations and deodorising sprays.
- **Stop Work Levels** shall be set at 4 or above for intensity at which point works will cease until the odour problem can be rectified.

Remedial actions and mitigation measures shall be documented, and odour monitoring undertaken again to ensure that the remedial measures have achieved the appropriate level of improvement. If monitored odours are considered to exceed the action levels, records of sensitivity of the location will also be made as follow:

High Sensitivity Receptor	Surrounding land use where: – Users can reasonably expect enjoyment of a high level of amenity; and – People would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land Examples may include residential dwellings, hospitals, schools/education and tourist/cultural
Medium Sensitivity Receptor	Surrounding land use where: – Users would expect a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or – People wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land Examples may include places of work, commercial/retail premises and playing/recreational fields
Low Sensitivity Receptor	Surrounding land use where: – The enjoyment of amenity would not reasonably be expected; or – There is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land Examples may include industrial use, farms, footpaths and roads

The suggested descriptor for magnitude of odour effects is illustrated within Table 15. Where the overall effect is greater than 'slight adverse', the effect is likely to be considered significant.

Table 15 – Suggested Descriptor for Magnitude of Odour Effects

		Receptor Sensitivity		
Relative Odour Exposure (Impact)		Low	Medium	High
	Very large	Moderate adverse	Substantial adverse	Substantial adverse
	Large	Slight adverse	Moderate adverse	Substantial adverse
	Medium	Negligible	Slight adverse	Moderate adverse
	Small	Negligible	Negligible	Slight adverse
	Negligible	Negligible	Negligible	Negligible

Appropriate PPE and RPE will be made available for use by workers if odours exceed action levels. PPE and RPE shall be assessed under separate works and requirements presented within the Englobe safety health and environment report.

Englobe will proactively deploy odour management measures in addition to the controls detailed above as part of works. These shall be set in advance in areas of known contamination and could be relocated based on nature of contamination and odour assessment. It is proposed that both fixed and mobile odour suppression units shall be used to include fixed fence line atomisers and mobile atomisers. Englobe would, based on an assessment of odours, also look to deploy odour neutralising and masking agents via both mobile and fixed atomiser systems.

7.6 Monitoring/ Control of Noise and Vibration

Best practicable means of noise control will be applied during the remediation works to minimise noise (including vibration) at neighbouring residential properties and other sensitive receptors arising from the remediation activities. Excavations will proceed carefully and as quietly as possible.

A 360-degree excavator (approx. 14t), together with a 9t dump-truck will be utilised to excavate, transport and treat the materials. Although a hydraulic breaking hammer will be mobilised to site, it is not envisaged that significant hardstand (concrete/brickwork) will be required to be broken out during these remediation works. The areas of concrete hardstand that will need to be removed are the concrete base of the above ground gasholder in the west of the site.

It is anticipated that below ground obstructions requiring removal will be limited to pipework, tanks and foundations, associated with the known remnant gasworks infrastructure.

Englobe shall complete works in accordance with a submitted Section 61 document and deploy mitigation measures as required. Mitigation and planning shall include the following:

— Restrict site working hours to 08:00 – 18:00 Monday to Friday and 08:00 – 13:00 Saturdays and not work public holidays;

— Englobe shall position treatment activities as far away from sensitive receptors as reasonably practicable;

— Englobe shall restrict the movement of plant and position haul routes away from the sensitive boundaries and minimise the works required in this area;

— Englobe shall select plant and machinery in good working order and less than 3 years old and, where available, use quiet and low vibration equipment; and

— Vehicles and plant will be maintained in a good and effective working order and operated in a manner to minimise noise emissions.

Englobe shall review phasing and operations to limit the overlap and duration of highest noise and vibration level activities.

Noise monitoring shall be carried out by Englobe daily at the designated environmental monitoring points as per the works progression and phasing. These points shall be confirmed during the daily site briefings and confirmation of works areas. Noise monitoring shall be carried out using a calibrated and certified Decibel Noise Meter.

If Englobe operations produce and record unacceptable noise and vibration levels then additional measures including further acoustic shielding/enclosures, works re-phasing and assessment of operational hours shall be completed.

All monitoring data shall be available and provided to the Client's team as part of both weekly and monthly reporting with additional information to support remedial measures in the event of a complaint or continued exceedance of action levels.

7.7 Asbestos Monitoring

Based upon the ground investigation and laboratory testing undertaken at the site Englobe do not anticipate widespread or significant asbestos containing soils at site.

Background, reassurance, asbestos air monitoring shall be undertaken on a weekly basis during excavation works and cover operational areas and key identified receptors. Asbestos reassurance monitoring shall be completed by a specialist 3rd party sub-contractor with all results provided on day of testing to allow a proactive and immediate review and response based on any identified elevated concentrations.

The monitoring shall include occupational health monitoring of site staff, general works area monitoring and boundary monitoring targeting the most applicable potential receptors based on atmospheric conditions. Specific asbestos air monitoring shall be undertaken in works areas and the site boundary in the event previously unidentified or asbestos materials of a different nature are recorded.

A watching brief for asbestos in soils shall be undertaken by environmental monitoring staff and all other staff during the works. An asbestos watching brief and discovery strategy shall be formulated, agreed and distributed to all identified stakeholders. Any watching brief and associated further review of PPE and RPE shall be presented and updated as part of Englobe site-specific safety health and environmental report. Asbestos monitoring data shall be presented as part of both the weekly and monthly report submissions and immediately should levels dictate an immediate suspension or change to works, working methodologies, controls, PPE or RPE.

It is noted that the controls detailed for dust mitigation will also serve to mitigate any potential asbestos generation based on the current data and current low risk level.

8 Permit/Licence Requirements

Following discussions with Merthyr Tydfil County Borough Council Development Control the works have been classified as 'Permitted Development' and as such no Planning Consent is required. However, despite the works being undertaken voluntarily by W&WU, Englobe have been asked to consult with statutory authorities and gain their approval.

Englobe will deploy their Environmental Permit (EPR/AP3195FG). The proposed waste treatment activities, together with the management works of mitigation and control measures together with any other relevant supporting information will be submitted to NRW for review and acceptance prior to the commencement of any on-site activity.

Works shall also be undertaken in line with the CL:AIRE Definition of Waste: Development Industry Code of Practice (DoWCoP) and associated Materials Management Plan (MMP) requirements and a Declaration shall be made by an appropriately Qualified Person upon receipt of all supporting information and regulatory agreements. Works shall be completed in line with the submission and a verification report provided upon completion of works as per the DoWCoP requirements. Details of all on-site and off-site material movements will be recorded and completed in accordance with the Duty of Care regulations and MMP. Waste transfer/consignment notes and disposal certificates will be provided for each load of material removed from site so that an auditable trail of the dates, volumes and destination of material removed from site can be maintained.

In order to undertake the dewatering works a discharge to sewer consent will be required from Welsh Water to allow the temporary discharge of trade effluent resulting from the perched water treatment works.

The riverbank works will be undertaken under an NRW Flood Risk Activity Permit (FRAP).

A review of potential ecological related permit/Licence activity has been undertaken and confirmed that no formal licences will be required and extensive consultation with the Local Authority Ecologist has already occurred to confirm this.

9 Outline Programme

Englobe's proposed outline programme of works is included in Appendix C of this report. It is hoped that works will begin on-site in May 2024, the works to the river bank no sooner than 15th May due to the salmonoid spawning season.

Onsite works are expected to last approximately 12-14 weeks. This programme will be subject to review and subsequent revision based on progress throughout the works.

Appendix A
Drawings

Appendix B

Appendix C

Appendix D

Appendix E

Appendix F

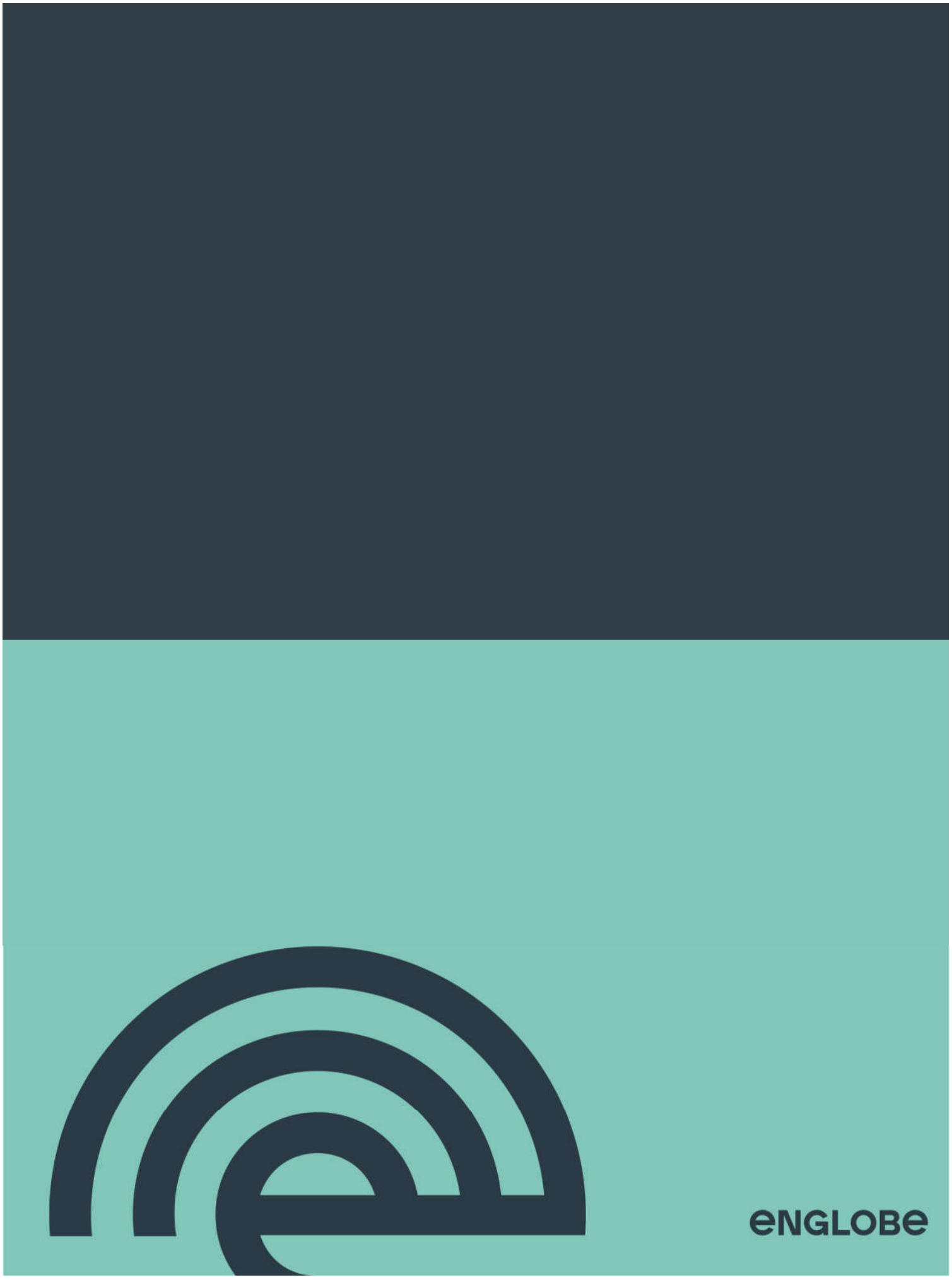
Appendix G

Appendix H

Appendix I

Appendix J
River Bank Design

Appendix K
Spring Drainage & Cycle Path Design



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