



e3p

Remediation Implementation Plan
Former Manox Works

Reference:13-887-R7
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Remediation Implementation Plan

Former Manox Works
Coleshill Street
Miles Platting
Manchester

Prepared for:
Landcare (East Manchester)

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Manox

Remediation Implementation Plan

July 2023

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Drawings:

13-887-001	Site Location Plan
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13-887-019	Response Zone Plan
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13-887-021	Visual and Olfactory Contamination Plan (Manox)
13-887-022	Carbon Disulphide Plan (Manox)
13-887-023	Cyanide Exceedances Plan (Manox)
13-887-024	Main Contamination Sources Plan
13-887-025	Hydraulic Flow Model
13-887-026	Main Contamination Sources Plan Degussa Operations
13-887-027	Location of Known Below Ground Structures
13-887-028	Canal Impact Section Plan
13-887-032	Constraints Plan (Manox)
13-887-033	Separate Phase Contamination Plan
13-887-034	Zone 5 & Zone 7 Remediation Issues Plan
13-887-035	Zone 5 and Zone 7 Human Health Exceedances Plan
13-887-036	Remediation Issues Plan - Manox Sector
13-887-040	Post Development Conceptual Site Model



1. INTRODUCTION

1.1. BACKGROUND

E3P has been instructed by Landcare (East Manchester) to develop a Remediation Implementation Plan (RIP) for the proposed residential development at the site known as the former Manox works in Miles Platting, Manchester.

For the purposes of investigation and assessment, the site was subdivided into defined phases; Manox site, Zone 5W and Zone 7. This Remediation Implementation Plan (RIP) has been prepared for the site as a whole, to define the remediation objectives, performance criteria and specification of works.

The remediation phasing is defined within Figure 1.1 below and included in Appendix III as a step-by-step phasing plan.

FIGURE 1.1 AGREED REMEDIATION PHASING



This report has been prepared in due consideration of the Site Investigation Reports, contaminated land risk assessment, Remediation and Enabling Works Strategy and derivation of site-specific remediation targets that have previously been produced for the site. All the aforementioned documents have been subject to comprehensive review by the regulatory authorities and the Detailed Remediation Strategy (ref: 13-887-R6-4, dated February 2023) has been approved by both Manchester City Council and Environment Agency.

It has been agreed that the subject site has been robustly characterised and is fully understood within the context of the potential pollutant linkages, sources identification and remediation requirements.

Extensive intrusive investigation and assessment has identified the presence of elevated concentrations of inorganic heavy metals including cyanide, PAH compounds, TPHs, BTEX and carbo disulphide. A tar channel is a primary source of SVOC, PAH and TPH with the presence of DNAPL



identified. Asbestos in the form of chrysotile and amosite, has been found within the Made Ground, which will require segregation. Zones 5W and 7 to the south of the Manox site, have not been subject to the same historical industrial land use.

These areas of contamination currently pose a risk to human health, controlled waters and the wider environ, therefore a phase of remediation is required.

This Remediation Implementation Plan has been prepared for the entire site following correspondence with the Environment Agency on its requirement to progress the remediation.

1.2. SUMMARY OF PARTIES INVOLVED

Function/interest	Name of Party
Local Planning Authority	Manchester City Council
Developer	Landcare (East Manchester)
Geoenvironmental Consultant	E3P
Main Contractor	TBC
Remediation/Enabling Works Contractor	McAuliffe Environmental / Geo-Stream
Human Health Regulator	Manchester City Council
Controlled Waters and Waste Regulator	Environment Agency

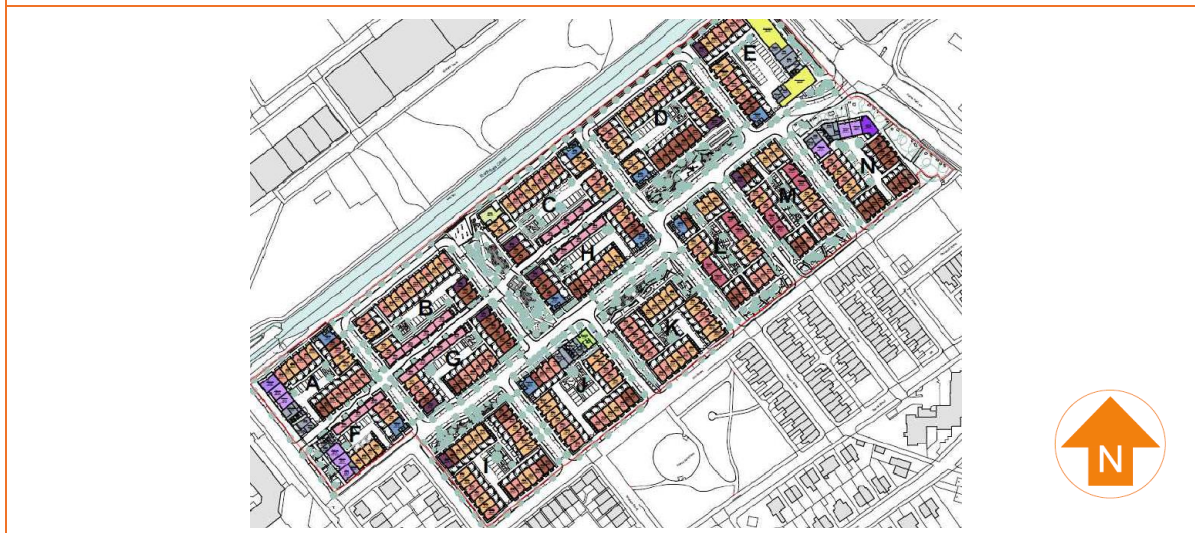
1.3. PROPOSED DEVELOPMENT

Landcare (East Manchester) have sought detailed planning permission for the redevelopment of the site for low rise residential housing comprising circa 409 dwellings with associated adopted estate roads and infrastructure.

It is the intention that the site will be remediated, and a development platform created with the site then taken by a house developer. For this reason, only items which are classed as remediation works are covered by this report and associated documents and it will not cover build phase items.



FIGURE 1.1 **SNAPSHOT OF THE PROPOSED DEVELOPMENT**



1.4. SITE DETAILS

Site Address	Land north of Coleshill Street, Miles Platting, Manchester, M40 7LE
National Grid Reference	N 386202, E 399393
Site Area	✦ Manox Zone (approximately 3.0 ha) ✦ Zone 5W (approximately 1.3 ha) ✦ Zone 7 (approximately 2.0 ha)

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

A site location plan is presented in Appendix III as Drawing 13-887-001.

1.5. OBJECTIVES

The objectives of this Remediation Implementation Plan (RIP) are as follows:

- ✦ Define the land and controlled water contamination issues;
- ✦ Provide full detail of specific protocols and mitigation that McAuliffe will undertake during the course of the remediation and enabling works;
- ✦ Define validation criteria that will be utilised to demonstrate the successful implementation of site remediation and enabling works plan; and,
- ✦ Provide an overview of the remediation and its successful implementation plan to demonstrate viability for the completion of the works within the project timescales.

1.6. OVERARCHING REMEDIATION OBJECTIVES

E3P has defined the following stated remediation objectives that will be achieved to demonstrate satisfactory and suitable remediation works.



The objective of these remediation works are to:

- ✳ Demonstrate the ongoing, short and long-term performance of the remediation solution and implementation.
- ✳ Track contaminant behaviour and movement to get an early warning of adverse trends and ensure successful implementation of control and remediation solutions.
- ✳ Prevent impact to the adjacent canal and the culverted Shooter's Brook to the south, in accordance with the stated aim of the Water Framework Directive to 'prevent and limit hazardous compound impact'. This will be achieved through a combination of the removal of all areas of 'primary' contamination impact (separate phase liquid coal tar, visible cyanide, arsenic or lead impact in the Made Ground) and remediation by stabilisation/solidification.
- ✳ Decommission of all interceptor tanks and active drainage infrastructure, including identification and removal of the known tar channel in the Manox sector.
- ✳ Install a low permeability sheet-piled barrier to the entirety of the northern boundary with the canal to reduce any potential of contaminated groundwater ingress or egress.
- ✳ Demonstrate by way of validation that the contamination has been successfully removed or remediated.
- ✳ Ensure no potential for 're-impact' post completion of treatment works.
- ✳ Achieve regulatory approval following completion of the remediation works.

1.7. SCOPE OF WORKS

The scope of work within this RIP includes the following elements:

- ✳ Identification and assessment of the lateral and vertical extent of the contamination.
- ✳ Provide timescales for the remediation activity and treatment.
- ✳ Evaluation of monitoring results which show the baseline conditions for all contaminants of concern.
- ✳ Provide validation and verification criteria.
- ✳ Detail the monitoring programme to be implemented throughout and after the treatment process (measure for success, rebound and validation).

1.8. LIMITATIONS

The limitations of this report are presented in Appendix I.



1.9. CONFIDENTIALITY

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



2. BASELINE CONDITIONS

2.1. OVERVIEW

The subject site is known to have a prolonged industrial use as a chemical manufacturing facility which has resulted in the gross impact of significant contamination to the soil and groundwater within the area identified as the 'Manox Sector'. Contamination 'hotspots' have also been identified in the Areas 5 and 7 of the site.

Several phases of site investigation have occurred at the site previously with the first reports prepared for the former site operator (Degussa) in 2004 while the facility was still operational, with subsequent intrusive investigations completed as part of the closure in 2004 and 2006. E3P has also reviewed more recent and detailed ground investigations in 2019 completed by RSK / Westlakes. A summary of these historic reports are included in E3P Report Contaminated Land Site Characterisation – Former Manox Works, ref: 13-887-R4-1, July 2020.

Extensive intrusive investigation and assessment has identified the presence of elevated concentrations of inorganic heavy metals including cyanide, PAH compounds, TPHs, BTEX and carbo disulphide. Asbestos in the form of chrysotile and amosite, has been found within the Made Ground, which will require segregation. Zones 5W and 7 to the south of the Manox site, have not been subject to the same historical industrial land use.

The primary contaminants of concern that cannot be addressed by what are considered standard remediation solutions for a brownfield development are identified as:

- ✿ Inorganic heavy metals (arsenic and lead)
- ✿ Cyanide salts
- ✿ Coal tar derived organic aromatic semi-volatile compounds
- ✿ Coal tar derived benzene based compounds

The issues associated with the contamination identified are compounded by the position of the Manox sector adjacent to the Rochdale Canal which undoubtedly presents a significant risk to controlled waters. Furthermore, the presence of a tar channel (which is a primary source of SVOC, PAH and TPH with the presence of DNAPL) identified in this same area, the exact position of which is not yet known, presents an additional issue that will require addressing.

The remediation approach will require the removal of the primary contaminant sources which include discolouration in the soils (metals and cyanide salts), separate phase coal tar (tar channel and any localised impact) and the subsequent remediation of site wide soils by stabilisation/solidification.

E3P and McAuliffe Geo-Stream define the specific design and implementation of the remediation solution within the latter sections of this RIP.

2.2. SOILS

The E3P Tier 1 Qualitative Human Health Risk Assessment identified concentrations of the following determinants at or above the screening criteria for assessing no unacceptable degree of risk to human health. The maximum concentrations recorded are included below in bold.

MANOX	ZONE 5 & 7
✿ Lead (6690 mg/kg) ✿ Arsenic (4810 mg/kg) ✿ Cadmium ✿ Copper (42000 mg/kg)	Zone 5 ✿ Arsenic (129 mg/kg) ✿ Lead (848 mg/kg)



✳ Chromium (VI) ✳ Cyanide (Free – 219 mg/kg) ✳ Mercury ✳ Iron ✳ Naphthalene (2900 mg/kg) ✳ Acenaphthene (810 mg/kg) ✳ Fluorene (520 mg/kg) ✳ Fluoranthene (690 mg/kg) ✳ Benzo(a)anthracene (130 mg/kg) ✳ Chrysene (93 mg/kg) ✳ Benzo (a)pyrene (23 mg/kg) ✳ Benzo(b)fluoranthene (39 mg/kg) ✳ Dibenz(a,h)anthracene (4.2 mg/kg) ✳ Phenanthrene (1300 mg/kg) ✳ TPH Aromatic C5-C6 (79 mg/kg) ✳ TPH Aromatic C6-C8 (130 mg/kg) ✳ TPH Aromatic C8-C10 (300 mg/kg) ✳ TPH Aromatic C10-C12 (48,000 mg/kg) ✳ TPH Aromatic C12-C16 (14,300 mg/kg) ✳ TPH Aromatic C16-C21 (4,400 mg/kg) ✳ TPH Aromatic C21-C35 (2400 mg/kg) ✳ Benzene (1.65 mg/kg) ✳ Chrysotile (0.802%) ✳ Amosite (0.02%)	✳ Benzo(a)anthracene (78.8 mg/kg) ✳ Benzo(a)pyrene (41.9 mg/kg) ✳ Benzo(b)fluoranthene (54.1 mg/kg) ✳ Chrysene (85 mg/kg) ✳ Dibenz(a,h)anthracene (6.88 mg/kg) ✳ Aromatic C16-C21 (1830 mg/kg) ✳ Aromatic C21-C35 (4560 mg/kg) Zone 7 ✳ Arsenic (646 mg/kg) ✳ Lead (2500 mg/kg) ✳ Free Cyanide (40 mg/kg) ✳ Complex Cyanide (4750 mg/kg) ✳ Benzo(a)anthracene (52.4 mg/kg) ✳ Benzo(a)pyrene (38.2 mg/kg) ✳ Chrysene (53.1 mg/kg) ✳ Dibenz(a,h)anthracene (4.06 mg/kg) ✳ Naphthalene (20.6 mg/kg) ✳ Aromatic C16-C21 (1240 mg/kg) ✳ Aromatic C21-C35 (3240 mg/kg)
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VOCs were also recorded above the limit of detection, including Dichloromethane up to 10 mg/kg in TP601 at 0.80 m bgl, Carbon Disulphide at WS603A, TP601, TP606, TP607, TP608, TP610, TP612, TP616, TP620, CP604, and CP605, 1,2,4-trimethylbenzene (**8.3 mg/kg**), 1,3,5-trimethylbenzene (**1.7 mg/kg**) and p-isopropyltoluene (**0.46 mg/kg**) are noted above the Atkins ATRISK thresholds in TP814.

In Zones 5 & 7, SVOC TICs were noted in three samples (TP502 at 1.50 - 1.60 m, CP702 at 1.50 - 1.60 m and TP705 at 1.50 - 1.60m). Relatively low concentrations of other PAH species were also detected within the SVOC suite above LOD on samples of Made Ground. However, no residential with plant uptake human health GAC are available.

These species include dimethyl phthalate, butylbenzyl phthalate, dibenzofuran, carbazole, bis(2-ethylhexyl)phthalate, 3+4-methylphenol, 2-methylphenol, 2,4- methylphenol 2-methylnaphthalene, perylene. No VOC TICs were identified. VOC detections above LOD were noted for 1,2,4-trimethylbenzene.

2.2.1. HEAVY METALS

The most significant concentrations of inorganic heavy metal impact are associated with Arsenic (**4,810 mg/kg**), copper (**42,000 mg/kg**) and lead (**6,690 mg/kg**). These are not associated with contamination hotspots but are more a widespread impact across the site.

Whilst varying levels of heavy metals can be associated with natural sources, historical industrial activities have led to the presence of heavy metal contamination on many sites. In the case of arsenic and lead, these are common in chemicals used extensively in the manufacture of pigments. Therefore it is highly probable that the identified impact (also likely to be associated with areas of green and blue discolouration in the soils) is indicative of a primary source of impact within localised areas of the site.



2.2.2. CYANIDE

Free cyanide (hydrogen cyanide or cyanide ion) is not identified at significant concentrations within the soil matrices, however, total cyanide was recorded as very high and distinct blue discolouration is recorded at numerous locations where the soil phase was not subject to laboratory analysis. It is therefore considered that cyanide is possibly present at higher concentrations than that currently reported as a primary contamination source.

The presence of cyanide in the soils is associated with the chemical industrial usage of the site historically.

2.2.3. ASBESTOS

Asbestos, in the form of chrysotile and amosite, quantified to be at 0.02% and 0.802% respectively, has also been identified within localised areas in shallow Made Ground deposits. No visual signs of asbestos-containing material (ACM) were encountered during the ground investigation.

2.2.4. CARBON DISULPHIDE

Carbon disulphide was detected in Zones 5 & 7 above the LOD in 2 samples (TP506 at 1.50 - 1.60 m, TP705 at 1.5-1.6m) of Made Ground at concentrations of **9 µg/kg** and **3 µg/kg**. There is considered to be no significant risk at the reported levels. However, should higher levels be identified during remedial works, the contractor should seek to remove these sources if deemed a risk to ensure no risk remains to the end user.

The detailed historical site analysis and assessment of former chemical processes have not identified any lines of evidence to suggest either the manufacture of carbon disulphide on-site or its use in the chemical manufacturing process.

The URS site audit of the operational Degussa facility reported that the primary solvent used in the small on-site laboratory was Toluene and not Carbon Disulphide as is used in some laboratory environments.

No primary source of Carbon Disulphide has been identified within the Manox site.

Carbon disulphide (CS₂) is a toxic, dense non-aqueous phase liquid (DNAPL) that is both highly volatile and highly flammable (Kalin et al., 2005). It is present in the environment due to anaerobic activity in sediments (Moret et al., 2000, Lovelock, 1974). Anthropogenic sources are considered to provide the primary source of CS₂ in the environment (Watts, 2000). Due to its high volatility and the fact that it can ignite or explode when exposed to air (Kalin et al., 2005), remediation of CS₂-contaminated sites is difficult and hazardous. Therefore, developing a remediation approach that removes CS₂ contamination from soil and groundwater without exposure to air is essential.

Carbon disulphide has historically been identified within the Rochdale Canal north of the subject site. The developed hydrological model suggests that the canal likely contributes to the perched water flow and down-hydraulic gradient to the south. It is therefore considered plausible that the residual (low-level) carbon disulphide impact within the Manox site, is a residue within a dissolved phase groundwater plume that originated within the chemical works to the north, where a significant primary source was located. It is understood that this primary source has been the subject of remediation.

The risk of a primary carbon disulphide source within the Manox site is considered to be **low** (considering the lines of evidence approach).



2.2.5. NAPHTHALENE

Significantly elevated Naphthalene (**919mg/kg**) is identified within the RSK / Westlakes intrusive investigation works and in the E3P supplementary investigation in 2021 (**2900 mg/kg**). This is to be anticipated given the known presence of a significant coal tar primary source (tar channel) and separate phase impact identified by URS (up-hydraulic gradient) of the tar channel. It should be noted that the exact position of the tar channel is as yet to be discovered as extensive intrusive investigation undertaken to date has not identified the location.

All phases of ground investigation within the Manox site describe discolouration and staining of the Made Ground across the Manox site, which represents a hydrocarbon impact (coal tar derived) for the complete site.

The presence of semi-volatile PAH (Naphthalene) is, therefore, to be anticipated and expected site-wide.

Naphthalene is part of the Aromatic Hydrocarbon C10-C12 range and is commonly found on sites affected by coal tar, also commonly in association with 1-methylnaphthalene and 2-methylnaphthalene.

2.2.6. BETANAPHTHYLAMINE

The potential presence of the dye precursor betanaphthylamine has been raised as a possible issue by MCC and is documented in the Smith Grant report. E3P has reviewed the later revision to the RSK / Westlakes report, which confirmed that this particular compound is not present at concentrations above the Limit of Detection for the analytical technique and therefore can be discounted as a pollution source.

2.2.7. PAHS

The presence of concentrations of several PAHs have been identified across the Manox sector, namely, acenaphthene, fluorene, fluoranthene, benzo(a)anthracene, chrysene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene and phenanthrene.

2.2.8. SVOCS

A number of coal tar-derived SVOCs including 1-Methylnaphthalene, 2-Methylnaphthalene, 3- & 4-Methylphenol, Carbazole, Dibenzofuran, Bis(2-Chloroisopropyl)ether, Bis(2-Ethylhexyl)phthalate, Biphenyl, Perylene, 2,4-Dimethylphenol, Trimethylbenzene and Bis(2-Ethylhexyl)phthalate, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, p-isopropyltoluene have been identified above the limit of detection.

2.3. GROUNDWATER

The E3P review of the factual ground investigation data and subsequent assessment of the identified contamination impact associated with the prolonged and significant industrial land use has confirmed extensive contamination impact within the area of the former Manox facility in particular.

Impact with Zone 7 and 5, associated with contaminants within the solid phase, is considered a secondary source and is notably reduced in terms of the contaminant load. This is represented by reduced dissolved phase impact, especially within the deeper groundwater monitoring wells. The monitoring wells in Zone 7 and 5 are considered to be generally down-gradient of the primary source (Manox) and clearly demonstrate significant reduction, which is indicative of the low mobility of the identified compounds of concern.



The two development parcels Zones 7 and 5, to the south of Manox, have not been subject to the same historical industrial land use, however, waste materials appear to have been deposited within former clay pits, which is contributing to some impact to controlled waters.

The Environment Agency (EA) website (accessed October 2013) shows the superficial deposits underlying the Site (Glacial Till) to be classified as unproductive strata. These generally relate to deposits with low permeability which are likely to reduce or prevent vertical migration, however it should still be noted that this is a groundwater body that is likely to flow with topography. With this in mind, it should still remain a consideration that a possibility exists of influence and impact from the adjacent main Manox site once remediation of this parcel commences and the current possible flow-pathway to the Rochdale canal is removed or reduced by the installation of the sheet pile wall.

Bedrock underlying the site (Upper Coal Measures strata) is classified as a Secondary A aquifer (aquifers formerly classified as minor aquifers). Secondary A aquifers are described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers. The Environment Agency indicates that the site is not located within a Groundwater Source Protection Zone for a public water supply abstraction.

The underlying coal measures aquifer is determined to be of reduced sensitivity due to elevated suspended soils and iron concentrations that are a direct result of prolonged coal mining.

The former mine entry in Zone 7 is identified as a conduit/preferential pathway to the aquifer; this feature will be subject to pressure grouting to remove the identified exposure pathway.

The Environment Agency has classified the current (2009) and predicted (2015) quantitative (yield) groundwater status as required under the Water Framework and Groundwater Directives 1 as poor. The Environment Agency has classified the current (2009) and predicted (2015) qualitative (chemical) groundwater status as deteriorating (poor) and poor, respectively.

During the historical ERM investigations (2009) only perched water within Made Ground deposits was encountered; this was largely confirmed by the 2019 RSK ground investigations. It is therefore considered that a perched water table is present, however its lateral and vertical migration is impeded by the clay aquitard which is proven to underlie the site to depths of circa 13.00 m bgl. No groundwater monitoring installations are installed within the granular horizons; however, this is not considered a viable aquifer, furthermore, no deep monitoring wells are installed within the coal measures.

Given the presence of low permeability clay deposits beneath the Made Ground, it is considered extremely unlikely that the shallow perched water encountered, will be in hydraulic continuity with the coal measures aquifer.

When considering the initial CSM and chemical structure of the key metalloids, inorganic salts (primarily cyanide), PAH and TPH compounds have reduced mobility when compared to other compounds that are known to have a greater potential for vertical and lateral migration.

The ground investigation data to date identify aromatic solvents, however, no chlorinated or halogenated compounds are identified; again, this corresponds with the site conceptual site model.

The primary contaminant groups are associated with aromatic hydrocarbons derived from the processing and refinement of coal tars and the resulting residues and inorganic and organic compounds (salts) either used in the refinement process or as a result of the chemical production.



2.3.1. FIELD OBSERVATIONS OF CONTAMINATION

During the historical site investigation works undertaken, the most common observations of impacts within the soil arisings included blue/green staining of fill materials and associated perched water; and dark brown/black staining of fill materials and the upper clay units, sometimes associated with oil/tarry odours. Again, these visual observations generally match the known contaminant grouping and chemical test data.

Anecdotal information suggests historical service clearance works reported drains as being blocked with a blue / black silty clay material and some of the water observed in the channels was blue in colour. Several chambers were also observed to have rubble and general waste in them, and the service clearance contractor noted during the works that the main chamber prior to off-site discharge was damaged.

Field observations and historical information confirm the presence of tar materials on-site, which comprise mainly TPH and PAH compounds. These tar materials appear to be in the mapped former tar channel beneath the site, albeit the exact location of the tar channel has not yet been identified. Previous investigations concluded the channel has been backfilled with granular fill, which was observed to be impacted with thick, black, glossy DNAPL with a tarry odour.

ERM reported that in 2008/2009 Manchester City Council report the egress of a potassium-like substance from the northern site boundary with the canal. Works were reportedly completed to ensure the area was made safe and no viable exposure of direct contact was possible. This anecdotal evidence confirms the presence of chemical waste materials that must be considered a primary source of contamination impact.

2.3.2. CONTROLLED WATERS RISK ASSESSMENT

The controlled waters risk assessment completed by E3P highlighted the prevalence of cyanide throughout the Made Ground in the Manox site at significant concentrations within the soil matrices that represent an ongoing and persistent source of pollution.

Arsenic and lead are locally impacted in discreet locations and considering their widespread presence in the soils and the potential for leaching, these compounds have also been considered from a controlled waters perspective.

Significant concentrations of SVOCs associated with the refinement of coal tar are identified within the solid and aqueous phases within all phases of historical ground investigation works. It should be noted that the contaminant load within both solid and perched water are dramatically reduced within all forms of sampling in Zone 7 and 5 to the south, indicating a lack of mobility and migration, which is to be anticipated when looking at the fate and transport of these compounds.

The deeper groundwater monitoring wells installed by RSK indicate an absence of significant or gross contamination impact within the underlying superficial drift deposits, which when considering the light non aqueous characteristics and relatively reduced solubility is to be anticipated.

The results of the historical data review and Tier 1 qualitative risk assessment has allowed E3P to draw the following conclusions in respect to the risk to controlled waters:

- ✳ There have been extensive multiple phases of historical ground investigation; this has enabled a detailed assessment of the site and reasonable characterisation of the pollution risk and potential to impact the critical receptor;
- ✳ The primary receptors are identified as the Canal to the north and culverted Shooters Brook to the south;



- ✳ The Canal is 'cut' into the glacial till clay aquitard, however when considering the detailed hydrological model, it would appear that the canal also loses water to the site and is contributing to the perched water flow across the low permeability clay to the south towards Shooters Brook;
- ✳ It is probable that impact to the canal will occur through migration of perched water in conduits such as relict drainage infrastructure as opposed to an actual dissolved phase plume and groundwater migration;
- ✳ Confined perched waters at a higher elevation that egress via conduits from the canal will be removed during the remediation works to negate this identified pollution pathway;
- ✳ Shooters Brook is at least 150m south; monitoring of installations immediately adjacent to the primary source area suggests that there is a significantly reduced contaminant load immediately adjacent to the site boundary. When considering the operational period of the Manox facility (>100yrs), the absence of gross contamination at the boundary substantiates the suggestion that lateral (down hydraulic gradient) migration is reduced;
- ✳ The underlying aquifer is not considered a high-risk receptor given the significant depth of glacial clay. In addition, it is noted that four mines are present directly beneath the site, therefore the groundwater will be of poor quality; and,
- ✳ The primary area of concern is the Manox site; numerous primary sources of pollution remain in the form of tar channels, chemical waste, tanks, drainage infrastructure and significantly impacted soils.

Based on the above, there exists a theoretical risk to controlled waters and remediation of the impacted soils is required to ensure there is no residual risk to the controlled water receptors following the completion of the remedial works. Due to this risk, a programme of remediation works was designed an detailed within the E3P Detailed Remediation Strategy (ref: 13-887-R4) and the most appropriate form of validation with respect to controlled waters to be the generation of site-specific screening targets (SSRTs) using the EA P20 RTM. This detailed controlled water risk assessment is summarised in Section 3.0.



3. REMEDIATION TARGETS & PERFORMANCE CRITERIA

3.1. OVERVIEW OF REMEDIATION CRITERIA

The hydrocarbon impact within the Made Ground in the location of the tar channel on the Manox site is considered to pose a potential long-term risk to the identified receptors (Rochdale Canal and Shooters Brook) associated with the leaching and mobilisation of potentially soluble compounds, which could eventually generate a complete pollutant linkage.

Subject to the removal of all significantly impacted soils, the disposal off-site of the separate phase coal tar and removal of a small quantity of perched groundwater (if present) with subsequent validation to demonstrate compliance with a set of Site Specific Remediation Targets (SSRTs) for the protection of controlled waters, the site can be delivered and remediated in a manner that would ensure the land poses no significant risk to controlled waters or the wider environ.

The P20 RTM has been utilised to guide the remediation of the site in two ways as follows:

-  **Source Area 1 – Tar Channel:** The tar channel, present in the Manox sector of the site, is mapped as being 10m wide and 100m in length. This is the location where the elevated TPHs and coal tar derived substances have been identified. Whilst the exact location of the tar channel has yet to be identified, this may still be modelled to generate appropriate site-specific screening values to allow the remediation of this locality and remove the current risk to controlled waters. The modelling of this source area will look at the aliphatic and aromatic hydrocarbon fractions, naphthalene, benzene, 2-methylnaphthalene, dibenzofuran, carbazole and naphthalene.
-  **Source Area 2 – Manox Sector:** This source area is more widespread than Source Area 1, due to the identified presence of inorganic metalloid contamination across this sector that will require addressing as part of the remediation of the site. The modelling of this source area will look at only arsenic, lead, copper and cyanide.

Figure 3.1 identifies the two source areas which will be modelled. Source Area 1 is denoted by the orange channel and Source Area 2, the purple border surrounding the Manox sector.



FIGURE 3.1 CONTAMINANT SOURCE AREAS



The Tier 1 controlled waters risk assessment alongside the human health risk assessment, has determined the following compounds of potentially soluble/mobile hydrocarbon compounds could present a theoretical risk to the identified receptors:

CONTAMINANT EXCEEDANCE

Arsenic	TPH Aromatic C8-C10
Lead	TPH Aromatic C10-C12
Copper	TPH Aromatic C12-C16
Cyanide	TPH Aromatic C16-C21
Benzene	TPH Aromatic C21-C35
2-methylnaphthalene	TPH Aliphatic C8-C10
Dibenzofuran	TPH Aliphatic C10-C12
Carbazole	TPH Aliphatic C12-C16
Naphthalene	TPH Aliphatic C16-C21
	TPH Aliphatic C21-C35

The DQRA has been undertaken using the soil and groundwater data obtained over the various phases of works in order to calculate RTM values for the shallow soils and groundwater to model the theoretical migration of the identified contaminants through the drift deposits and into the Rochdale Canal, Shooters Brooke or to the underlying Secondary A Aquifer.



3.1.1. P20 RTM

PHYSICAL AND CHEMICAL INPUT PARAMETERS

Detailed groundwater modelling has been undertaken during the previous ground investigations.

Groundwater strikes were encountered within a number of exploratory holes at the base of the Made Ground, perched on the cohesive drift deposits. Groundwater is considered to flow to the south east (away from Rochdale Canal), therefore the compliance point of **30m** from the contaminant source to Rochdale Canal is considered to be conservative.

Deep groundwater was not encountered in the glacial till during previous investigations. The glacial till is considered to inhibit migration to the controlled water receptors.

The hydraulic gradient at the site has been calculated using levelling data to be 0.01. E3P has also utilised soil analysis data for SOM within the Made Ground as obtained within the previous ground investigations. SOM was measured at a range of 2.2% to 25.9%, used to obtain a Fraction Organic Carbon (FOC), returning a value of **0.0812**.

Additionally, E3P has reviewed the annual rainfall data on the Met office for the area and taking into account evapotranspiration and the proposed development containing a large volume of hardstanding and residential buildings, a 1% infiltration figure has been calculated as **0.0000147**.

Further details regarding the various physical and chemical inputs required for the DQRA are included within Table 3.1 and 3.2.

TABLE 3.1 DQRA PHYSICAL INPUT PARAMETERS

TABLE 3.1: DATA FOR PHYSICAL INPUT PARAMETERS			
Parameter	Value	Source	Justification
Method of calculating partition co-efficient	Non-polar Organic Chemicals		
Analytical Solution	Ogata Banks		
Degradation Conditions (aerobic / anaerobic)	Assumed anaerobic conditions to remain conservative		
Level Three - Groundwater			
Pathway Aquifer	N/A	N/A	Migration is assumed to be via the clay loam to the Rochdale Canal or Secondary A Aquifer
Saturated aquifer thickness (m)	1.30	Estimate from borehole data	Approximation based on ground conditions encountered on site within boreholes.
Bulk density of aquifer materials (g/cm ³)	1.14	SR3	Taken from the value for clay loam within the Updated Technical Background CLEA-SR3
Air filled porosity (cm ³ /cm ³)	0.14	SR3	Taken from the value for clay loam within the Updated Technical Background CLEA-SR3
Water filled porosity (cm ³ /cm ³)	0.42	SR3	Taken from the value for clay loam within the Updated Technical Background CLEA-SR3
Effective porosity of the aquifer (cm ³ /cm ³)	0.56	SR3	Taken from the value for clay loam within the Updated Technical Background CLEA-SR3
Hydraulic gradient	0.01	Site Data	Calculated using site levelling data



Parameter	Value	Source	Justification
Hydraulic conductivity of the aquifer (m/d)	1.3	SR3	Taken from the value for clay loam within the Updated Technical Background CLEA-SR3
Distance to compliance point (m)	30	Site Compliance Point	The compliance point is believed to be the distance to Rochdale Canal from the source area
Assumed groundwater flow direction	SE	Site Data	Based on site data and groundwater modelling
Fraction Organic Carbon in aquifer (FOC)	0.0812	Site Data	Based on site soil samples.
Source Area 1 – Tar Channel			
Width of plume in aquifer at source (m)	10	Site Data	Based on site data and observations.
Length of plume in aquifer at source (m)	100	Site Data	Based on site data and observations.
Source Area 2 – Manox Sector			
Width of plume in aquifer at source (m)	86	Site Data	Based on site data and observations.
Length of plume in aquifer at source (m)	412	Site Data	Based on site data and observations.
Plume thickness at source (m)	1.3	Calculated within RTM	This value is calculated from the mixing thickness within the Level 2 soils in the RTM model



TABLE 3.2 GENERAL DQRA CHEMICAL INPUT PARAMETERS

Contaminant	Koc (l/kg)	Kd	Source	Anaerobic Deg. Half-life (d)	Aerobic Deg. Half-life (d)	Source	Henry's Law	Source
TPH Aliphatic C8-C10	30199.5172	-	LQM-CIEH	228	10	Conservative Estimate	41.5	LQM-CIEH
TPH Aliphatic C10-C12	239883.29	-	LQM-CIEH	112	28	Conservative Estimate	64.4	LQM-CIEH
TPH Aliphatic C12-C16	5370317.964	-	LQM-CIEH	3650	3650	Conservative Estimate	171	LQM-CIEH
TPH Aliphatic C16-C21	5754399373	-	LQM-CIEH	8560	8560	Conservative Estimate	1070	LQM-CIEH
TPH Aliphatic C21-C35	5754399373	-	LQM-CIEH	8560	8560	Conservative Estimate	1070	LQM-CIEH
TPH Aromatic C8-C10	1584.8932	-	LQM-CIEH	228	10	Howard et al-Ethylbenzene	0.253	LQM-CIEH
TPH Aromatic C10-C12	2511.8864	-	LQM-CIEH	258	258	Howard et al-Xylene (m)	0.0722	LQM-CIEH
TPH Aromatic C12-C16	5011.872	-	LQM-CIEH	1840	920	Conservative Estimate	0.00126	LQM-CIEH
TPH Aromatic C16-C21	14125.375	-	LQM-CIEH	7300	1898	Conservative Estimate	0.000695	LQM-CIEH
TPH Aromatic C21-C35	125892.541	-	LQM-CIEH	2117	530	Conservative Estimate	0.0000248	LQM-CIEH



Contaminant	Koc (l/kg)	Kd	Source	Anaerobic Deg. Half-life (d)	Aerobic Deg. Half-life (d)	Source	Henry's Law	Source
Benzene	67.6083	-	LQM-CIEH	730	16	Howard et al Benzene	0.116	LQM-CIEH
2-methylnaphthalene	2450	-	LQM-CIEH	360	28	Howard et al – 2-methylnaphthalene	0.0722	LQM-CIEH
Carbazole	5011.872	-	LQM-CIEH	28	7	Howard et al – Carbazole	0.00126	LQM-CIEH
Dibenzofuran	5011.872	-	LQM-CIEH	28	7	Howard et al - dibenzofuran	0.00126	LQM-CIEH
Naphthalene	645.65	-	LQM-CIEH	258	20	Howard et al Naphthalene	0.00662	LQM-CIEH
Arsenic	-	500	LQM-CIEH	9.99E+99	9.99E+99	EA	0	EA
Cyanide	-	100	LQM-CIEH	9.99E+99	9.99E+99	EA	0	EA
Copper	-	100	LQM-CIEH	9.99E+99	9.99E+99	EA	0	EA
Lead	-	500	Estimate	9.99E+99	9.99E+99	EA	0	EA



Existing concentrations in the soil and groundwater have been selected from the worst contaminated areas in the Manox sector.

With respect to the organic contamination in **Source Area 1** (Tar Channel), soil and groundwater concentrations have been selected from historical site investigation laboratory results from the locality of the tar channel, with the maximum concentrations taken for each contaminant of concern. The source area has been taken as the mapped area of the tar channel (10m x 100m).

With respect to the inorganic contamination in **Source Area 2** (Manox sector), input concentrations have been taken from the maximum soil concentrations in historic site investigation data with the model also run using leachate concentrations that have been utilised as worst-case scenario concentrations for the treatability trials undertaken by McAuliffe (detailed in the latter stages of this report). In relation to the leachate results taken from the treatability studies, these have been taken from the 'mix 5' concentrations as this mix is representative of the vast majority (90%) of the manox area soils in general, and removes the cyanide concentrations in soils which will not be suitable for stabilisation/solidification and will require removal off-site.

The source area is considered to be widespread across the Manox sector. It is important that with a remediation of this nature, a balance is achieved between successful validation and viability, to ensure the site may be remediated successfully, validated and delivered for residential development with the full protection to human health, controlled waters and the wider environs. With this in mind, with regards the inorganic metalloid contamination known to be present across the Manox sector, two sets of remedial target values are to be calculated:

- ✿ **Entire Manox area (86m x 412m)** – this will enable a set of values to be calculated that will be directly attributable to the entire sector as a whole, with values on a lower margin however in the vast majority of soils, will be largely achievable.
- ✿ **A modelled 10m x 10m square** – this will enable a set of values to be produced which are calculated utilising representative ground conditions and soil/leachate results to ensure a true representation of the contaminant makeup of the soils present in the Manox sector, but that are of a higher margin. Therefore for those soils which may be more contaminated with inorganic metalloids and which may not be able to be remediated to meet the remedial targets generated from the entire site area, to enable the successful remediation and validation in a cost effective manner but still ensuring the protection of controlled waters (and human health/wider environ), these set of remedial targets may be utilised.

TABLE 3.3 MAXIMUM SITE CONCENTRATIONS IN SOIL

Contaminant	Max Conc in Soil (mg/kg)	Site Source
Source Area 1 – Tar Channel		
TPH Aromatic C8-C10	300	TP606
TPH Aromatic C10-C12	48000	TP606
TPH Aromatic C12-C16	14300	TP606
TPH Aromatic C16-C21	4400	TP606
TPH Aromatic C21-C35	2400	WS503
TPH Aliphatic C8-C10	20	WS603A
TPH Aliphatic C10-C12	425	TP606
TPH Aliphatic C12-C16	504	TP606
TPH Aliphatic C16-C21	1170	TP420
TPH Aliphatic C21-C35	7560	TP420
2-methylnaphthalene	252	TP606
Dibenzofuran	237	WS603A



Carbazole	19.8	WS603A
Naphthalene	819	WS603A
Source Area 2 – Manox Sector		
Arsenic	4810	TP611
Cyanide	8270	WS603A
Copper	42000	WS606
Lead	6690	TP607

TABLE 3.4 MAXIMUM SITE CONCENTRATIONS IN GROUNDWATER/LEACHATE

Contaminant	Max Conc in Groundwater (mg/l)	Site Source
Source Area 1 – Tar Channel		
TPH Aromatic C8-C10	4.306	WS603
TPH Aromatic C10-C12	1.761	WS603A
TPH Aromatic C12-C16	5.706	WS603
TPH Aromatic C16-C35	0.815	WS603
TPH Aromatic C21-C35	0.815	WS603
TPH Aliphatic C8-C10	0.005	TP406
TPH Aliphatic C10-C12	0.037	TP406
TPH Aliphatic C12-C16	0.108	TP406
TPH Aliphatic C16-C21	0.087	TP406
TPH Aliphatic C21-C35	0.94	TP406
2-methylnaphthalene	0.059	WS603A
Carbazole	0.021	WS603A
Dibenzofuran	0.048	WS603A
Naphthalene	0.0081	WS603A
Source Area 2 – Manox Sector		
Arsenic	0.0085 (Leachate)	TP816 (mix 5 treatment trials)
Cyanide	0.34 (Leachate)	TP816 (mix 5 treatment trials)
Copper	0.0071 (Leachate)	TP816 (mix 5 treatment trials)
Lead	0.01 (Leachate)	TP816 (mix 5 treatment trials)

RESULTS

The results of the risk assessment are summarised in Table 3.5.

The results provide remediation target concentrations for the soils and groundwater which may be used for validation purposes following the remediation of the impacted Made Ground.

Soils will be mainly treated by stabilisation/solidification where impacted with validation of these soils being by leachability and therefore the site specific screening values for waters/leachate utilised for the purpose of this validation. Some soils, where there is organic contamination, may be suitable for bioremediation (see section 4.0), where validation will be undertaken of the soils and thus, the site specific screening criteria for soils will be utilised for validation purposes.



TABLE 3.5 RESULTS

Contaminant	Source Concentration used in RTM Model		Level 3 Remedial Target Concentration		
	Soils (mg/kg)	Waters/Leachate (mg/l)	Soils (mg/kg)	Waters/Leachate (mg/l)	Waters/Leachate (ug/l)
Source Area 1 – Tar Channel					
TPH Aromatic C8-C10	277	4.306	1060	0.854	854
TPH Aromatic C10-C12	48100	1.761	1920	0.959	959
TPH Aromatic C12-C16	14300	5.706	30.8	0.0102	10.2
TPH Aromatic C16-C21	4440	0.815	717	0.164	164
TPH Aromatic C21-C35	4560	0.815	18300	0.456	456
TPH Aliphatic C8-C10	20	0.005	304000	12.8	12800
TPH Aliphatic C10-C12	425	0.037	1.99 E+07	119	119000
TPH Aliphatic C12-C16	504	0.108	4.01E+06	0.796	796
TPH Aliphatic C16-C21	1170	0.087	3.79 E+09	0.695	695
TPH Aliphatic C21-C35	7560	0.94	3.79 E+09	0.695	695
2-methylnaphthalene	252	0.059	3340	164000	164000000
Carbazole	19.8	0.021	2.89E+8	6.84E+12	6.84E+15
Dibenzofuran	237	0.048	2.89E+8	6.84E+12	6.84E+15
Naphthalene	819	0.0081	1660	3.91E+6	3.91E+9
Source Area 2 – Manox Sector (10m x 10m grid)					
Arsenic	4810	0.0085	1090	2.18	2180
Cyanide	8270	0.34	2190	2.18	2180
Copper	933	0.0071	21.9	0.218	218
Lead	6690	0.01	1090	2.18	2180
Source Area 2 – Manox Sector (entire sector)					
Arsenic	4810	0.0085	28.4	0.0568	56.8
Cyanide	8270	0.34	5.7	0.0568	56.8
Copper	933	0.0071	0.57	0.00568	5.68
Lead	6690	0.01	28.4	0.0568	56.8

Remediation Target Concentrations have been produced from the RTM model, which may be used to compare validation samples of the soil and groundwater following remediation of the impacted soils to confirm there will be no long-term risk to the controlled water receptors.

Source Area 1 – Tar Channel

The results of the P20 modelled for Source Area 1 (Tar Channel) indicate that for TPH Aromatic C8-C35 fractions, based on existing conditions in the tar channel, the concentrations on site exceed the site-specific remedial targets, therefore a significant risk to controlled waters exists from the site in its current condition.

The site is to undergo a widespread phase of remediation and enabling works, during which the tar channel will be identified, delineated, excavated in its entirety, and chemically validated with any separate phase coal tar being disposed of offsite. Where materials demonstrate a significant exceedance of organic contamination (not including the separate phase oil which will be disposed of offsite), soils may undergo bioremediation to accelerate the aerobic degradation of the soils and reduce these to chemically suitable for retention on site. Any materials to remain on site will be chemically validated to ensure they do not exceed the site derived target values.

With this in mind, the current exceeding values for the Aromatic TPHs will no longer pose a risk to controlled waters and it is considered the tar channel area can be suitably remediated to render the site suitable for future residential development.



Source Area 2 – Manox Sector

The results of the modelling for the entire Manox sector have generated two sets of site-specific screening values; one utilising a modelled 10x10m grid and a second set using the actual measured area of the Manox sector, to ensure a suitable and deliverable remediation and validation programme.

The model has been completed utilising the worst inorganic metalloid contamination identified within monitoring results in the soils to generate soil remedial targets, along with leachate concentrations from the treatment trials mix 5, which represent most of the soils across the Manox sector (circa 90%).

The results from the modelling indicate that for the soils, currently the concentrations present exceed the remedial target values and thus pose a risk to the controlled water receptors and remediation works are required. For the water/leachate results however, using the model for the entire Manox sector, cyanide, copper and lead currently exceeds for leachate, however only marginally, and for arsenic, the remedial target is below the current concentrations. Furthermore, when looking at the model using the 10m x 10m square, none of the current leachate concentrations exceed the leachate remedial targets.

Looking also at the treatment trials that have been completed by McAuliffe and specifically, at the 'mix 5' trials which represents the vast majority of the soils present within this sector, looking across the 64 day leachate tank test, no breakthrough is noted that exceeds the calculated remedial target concentrations, confirming that these inorganic metalloid impacted soils may be successfully remediated to ensure the full protection of controlled waters.

Whilst there may be more contaminated soils present at the site, during the course of the remediation and enabling works, which will involve the stabilisation and solidification of contaminated soils across the Manox sector, soils which are not able to be stabilised suitably to remove the leaching risk and thus may still pose an unacceptable risk to controlled waters, will be disposed of off-site.

It should be noted however that the calculated remedial targets have also been compared to the treatment trial tank test for 'mix 14' which represents the worst contaminated materials (circa 10% of the contaminated materials) and, with the exception of the cyanide concentrations, the remedial targets calculated for the 10m x 10m square indicate that these materials may be successfully stabilised and solidified. Cyanide concentrations are significant in these soils however and limited treatment trials to date of this significantly contaminated material indicate that they may not achieve the remedial targets, and in this case, further stabilisation trials will be undertaken on these soils to determine an alternative solution, to ensure any remaining soils pose no unacceptable risk to controlled waters.

The treatment trials as referenced above are explained in further detail in the latter stages of the report and the full report is available in Appendix VIII.

3.1.2. TREATABILITY STUDY

McAuliffe have undertaken significant bench trials on the worst case impacted soils on site, utilising samples obtained from the E3P Supplementary Site Investigation in 2021. These bench trials demonstrated the level of betterment that can be expected in the full-scale works, using a selection of mix designs (see McAuliffe Stabilisation/Solidification Treatability Report, MC2906 Manox S/S Treatability, dated July 2022).



The McAuliffe study has shown there to be enough general reduction potential in the leachability of the worst case, although on the lower cyanide impacted materials present within the source soils, to be able to confirm that there are a number of suitable hydraulic binder system designs that can be used to achieve significant leachability performance, albeit with some modifications to mix designs presented here. It should also be noted that the study has confirmed that the use of the technique will improve the visual and olfactory nature of the most impacted materials likely to be present at the site.

The very high cyanide impacted soil hotspots need a separate assessment of mix design based on the results presented here. However, all the worst-case higher cyanide impacted materials only represent about 4% of the total soils to be treated using S/S across the site. Therefore, McAuliffe need to carry out an additional study on samples that represent the majority of soils to be treated in the full-scale works in order to confirm the most suitable mix design. The results presented here would suggest there are likely to be 3 mix designs adopted:-

- ✿ Mix 1. Hydraulic binder system for 96% of materials to be treated.
- ✿ Mix 2. Hydraulic binder system for circa 2% (lower CN impacted) materials to be treated.
- ✿ Mix 3. Combination system for circa 2% (very high CN impacted) materials to be treated.

Based on the treatability study, alongside the EA P20 RTM to generate site specific screening values, contaminated materials are deemed to be suitable for stabilisation/solidification. It has been demonstrated that these contaminated soils, once stabilised, will not pose a leaching risk that exceeds the site derived target values which are for the protection of controlled waters, and for those soils which cannot meet the targets (anticipated to be minimal), will be disposed of off-site to a suitable waste management facility.

That being said, additional treatment trials will be carried out on more representative, impacted soil samples from across the site in advance of the main remediation works, to determine the most appropriate S/S binder mix formulation for the majority of soils to be treated.



4. RIP CONTRACTOR METHODOLOGY

This remediation methodology proposed for the Manox site has been prepared by McAuliffe Environmental Ltd following discussions with E3P, key project team members and a review of current documentation. Reference should be made to the full McAuliffe Environmental Remediation Method Statement, MC2906/RMS/FINAL/Rev A, dated June 2023 included in Appendix IV.

The McAuliffe Group has the capability to provide turnkey remediation solutions to sites by offering a full range of services to remediate soils and groundwater delivering a build ready development platform.

The proposed works for the Manox site will be undertaken in order to render the site suitable for future residential development. The site will be left as a remediated platform to hand over to the future developer. We understand that the objective of the remediation methodology is to remediate the highly contaminated soils with a particular focus on the inorganic contamination (cyanide and arsenic specifically) and PAH, TPH and DNAPL, which includes the tar channel which currently pose an unacceptable risk to the controlled water receptors (and consequently, the future site users).

4.1. SUPPORTING INFORMATION

The following documents have been reviewed in assessing the remediation requirements at the site:

- ✳ URS – Contaminated Land Site Audit July 2004
- ✳ URS – Phase II Site Investigation, dated September 2004
- ✳ URS – Phase III Site Assessment Investigation, dated October 2006
- ✳ URS – Synopsis of URS soil and Groundwater Investigation, dated November 2006
- ✳ Environmental Resources Management Limited (ERM) – Northern Boundary Area Assessment Report, Former Manox Factory, dated 23rd June 2009. Ref 0098997.
- ✳ RSK–Factual Ground Investigation Report, Former Manox Dye Works dated November 2019. Ref: 11432-04.
- ✳ E3P – Geo-Environmental Site Characterisation Assessment. Ref: 13-887-R3, dated August 2020, Prepared for Landcare.
- ✳ E3P – Outline Remediation and Enabling Works Strategy. Ref: 13-887-R5, dated June 2022, Prepared for Landcare.
- ✳ McAuliffe – Stabilisation / Solidification Treatability Report. Ref: MC2906 Manox S/S Treatability, dated July 2022. Prepared for Engie.
- ✳ E3P – Remediation and Enabling Works Strategy. Ref: 13-887-R6, dated February 2023, Prepared for Landcare.



4.2. SCOPE OF WORKS

After careful review of the information referenced, considering the agreed E3P Remediation and Enabling Works Strategy, McAuliffe determined that the scope for the remediation and enabling works for the development, maximising re-use of materials, will be as follows:

- ✿ Develop a site-specific health and safety plan;
- ✿ Produce a Materials Management Plan (MMP) for submission as a Declaration by a Qualified Person, to the Environment Agency as per the Definition of Waste Code of Practice (DoW CoP);
- ✿ Submit a deployment notice under McAuliffe's Environmental Permit (Mobile Treatment Licence - MTL) to detail the remediation of contaminated soils and groundwater on site. All works will be carried in compliance with the conditions within our Environmental Permit (MTL) (see Appendix D) (this has been done and the EA notification letter has been received, see Appendix D);
- ✿ Mobilise to site and establish welfare and office compound, soil treatment areas and water treatment plant;
- ✿ Collect and record background environmental monitoring data in line with the requirements of the MTL for the duration of the treatment works;
- ✿ Pre-works air quality boundary monitoring for, VOCs, dust and asbestos, before any breakout of hardstanding and earthworks commence and during the earthworks;
- ✿ Removal and treatment of all invasive plant species in accordance with specialist contractor method statement, validation and independent certification.
- ✿ General site clearance and stockpiling of all cleared surface vegetation, including the removal of any trees. Works to be conducted in line with the ecological constraints;
- ✿ Carry out additional Stabilisation/Solidification treatability studies to confirm full-scale performance on more representative soil samples from across the site;
- ✿ Installation of low permeability sheet piled groundwater cut-off wall along site boundary with the Rochdale Canal;
- ✿ Removal/treatment of the Tar Channel materials, the excavation also acting as a sump to help lower the perched water table;
- ✿ Confirm soil hotspot areas requiring targeted removal/treatment;
- ✿ Break out and subsequent crushing / processing of concrete slabs across site. Concrete to be stockpiled for processing with other hard materials;
- ✿ Break out and subsequent crushing / processing of all surface and sub-surface structures including foundations, redundant drains and any further buried obstructions (where present).
- ✿ Decommission of all interceptors and tanks using our inhouse method for the remediation of USTs, based on current APEA guidance;
- ✿ Process aggregates with requisite validation testing for asbestos ID/quantification and grading verification;



- ✿ Excavation of impacted made ground hotspot areas, screening on a 10m grid. Soils with PID readings above 10ppm will be segregated for treatment as outlined below;
- ✿ Excavation/turnover of made ground to a minimum 2.5mbgl or interface with natural ground; removing all obstructions encountered and any residual items surveyed;
- ✿ In situ screen to remove oversize material for processing before re-compacting back into the excavation suitable for a piled foundation solution. This activity will be overseen by a suitably experienced supervisor to identify any visual/olfactory unexpected contamination;
- ✿ Control/treatment of perched waters where encountered during excavations, with discharge to foul sewer;
- ✿ Ex-situ treatment of impacted hotspot soils identified, including organic materials from infilled ponds, using S/S and/or bioremediation for reuse on site;
- ✿ Optional chemical oxidation using OBC (refer to Appendix F of the McAuliffe RMS) as the specific substrate for the treatment of impacted soils where required to target residual impacts if required, for enhanced betterment of conditions;
- ✿ Tracking of all material movements across the site ;
- ✿ Cut and Fill earthworks as per the Volumetric Assessment;
- ✿ Provide suitable development platforms to facilitate the construction of proposed roadways, drainage infrastructure, pavements and areas of hardstanding;
- ✿ Management of all works to ensure that no environmental nuisance is created through dust emissions, noise or vibration levels. Monitor appropriately for asbestos in the stockpiles and made ground, and the necessity to ensure airborne fibres are not released (all in accordance with our permit conditions);
- ✿ Complete a validation report on completion of the works in accordance with this method statement and the agreed remediation strategy, including representative testing of soil and water throughout the works and recording of environmental conditions.

4.3. EX-SITU S/S TREATMENT OF CONTAMINATED SOILS

Where the delineation investigations have identified concentrations of the contaminants of concern (CoC), namely TPH, PAH, cyanide and metalloids, above the SSRT, the material will be subject to Stabilisation/Solidification and/or bioremediation, depending on levels of contamination and the combination of CoC present, to meet the acceptable leachability targets and/or on-site re-use targets (see Section 3.0). An indicative hotspot location plan is included in Appendix III. This work will be conducted under the deployment of the McAuliffe Mobile Treatment License, submitted to the EA in advance of the work.



4.3.1. STABILISATION/SOLIDIFICATION PROCESS

S/S treatment is a physicochemical process used to convert contaminated soils, liquids and sludges into chemically and physically stable solid material, producing effective immobilisation of contaminants with the use of binding materials and additives. The destruction or removal of the contamination is not the objective of S/S. It is effectively two processes in one:

- ✿ **Solidification** - involves the reduction in mobility of the contaminated material by the mechanical encapsulation of contaminants within a monolithic solid. It reduces the ingress of any potential transportation agents and improves certain engineering properties of the material i.e. increases the strength, decreases the permeability and decreases the compressibility. A range of binding materials is commercially available including cementitious materials, silicates, lime, thermoplastics and polymers.
- ✿ **Stabilisation** - involves the use of additives to chemically fix the contaminants in order to minimise the rate of contaminant migration and reduce the level of the toxicity. The stabilizing agents tend to be contaminant specific, being used to treat certain organics, inorganics and/or heavy metals.

S/S treatment provides both a physical and chemical encapsulation, so if at any time the physical integrity of the S/S material is breached, the contaminants would still be chemically bonded to the stabilising agent.

Physical and Chemical Mechanisms

There are certain physical and chemical mechanisms that are involved in S/S treatment. These include:

- ✿ **Macroencapsulation** - contaminants are physically entrapped in discontinuous pores within the structural matrix of the solidified material.
- ✿ **Microencapsulation** - contaminants are entrapped within the crystalline structure of the solidified material.
- ✿ **Absorption** - liquid contaminants are soaked up by a sorbent material (sponge-like action).
- ✿ **Adsorption** - contaminants are bonded electrochemically to the surface of the stabilising agent.
- ✿ **Precipitation** - this is applicable to the treatment of metal contaminants in solution where they are precipitated out into less mobile and less hazardous forms, such as hydroxides, sulphides, silicates, carbonates and phosphates; that are then contained within the solidified material.

4.3.2. LONG-TERM PERFORMANCE

Treatability studies, using the contaminated source materials from the site, although conducted over a relatively short time scale, are enough to understand the behaviour of the mixes and eliminate the potential for failures following full-scale treatment works.

A fundamental aspect of the testing regime is that worst-case leachate testing can be undertaken on the treated materials, in the form of batch leachate tests, as the sample preparation involves a reduction in the particle size/structure of the S/S samples, thus eliminating the macroencapsulation aspect of the treatment and so relying solely on chemical fixation processes at the microencapsulation level.



This is beneficial in understanding potential longer-term behaviour should weathering effects impact on the materials in the near surface ground. Particle reduction seeks to simulate more extreme effects of mechanisms, such as carbonation, sulphate attack and freeze-thaw, which might reduce the physical integrity of the material depending on severity.

This, therefore, provides an understanding of the effects of worst-case leaching potential. As data from most on-site studies is only available for a maximum of 20 to 30 years, reliance is placed on the results of modelling in order to provide confidence in the much longer-term performance.

4.3.3. FULL SCALE REMEDIATION WORKS

- ✿ McAuliffe have already carried out significant bench trials on the worst case impacted soils on site, which have demonstrated the level of betterment that can be expected in the full-scale works, using a selection of mix designs (see McAuliffe Stabilisation/Solidification Treatability Report, MC2906 Manox S/S Treatability, dated July 2022, included in Appendix VIII of agreed E3P Remediation and Enabling Works Strategy Report). However, additional treatment trials will be carried out on more representative, impacted soil samples from across the site in advance of the main remediation works, to determine the most appropriate S/S binder mix formulation for majority of soils to be treated.
- ✿ Establishment of S/S treatment zone. The area will be prepared with a low permeability formation to reduce infiltration from contaminated soils. The area will have a segregation plan for the most contaminated material which will be clearly marked and recorded by the Remediation Engineer. The treatment zone will be bunded to mitigate the surface run off.
- ✿ Material will be loaded into a dump truck and placed in a stockpile in the S/S treatment zone marked 'Initial Screening Area.
- ✿ Material screening to remove oversize and mid-size hard or deleterious material. Stockpile separately the smaller fractions into 250m³ stockpiles within the S/S treatment zone for preliminary characterisation, under a strict stockpile tracking management system, using unique identifiers.
- ✿ Mix admixtures homogenised into screened soils at appropriate ratios, based on treatability study work, using mechanical excavator and specialist mixing tool attachment and/or batcher plant ensuring homogeneity is achieved. Dust suppression will be applied to the mixing area to protect operatives from airborne dust. Toolbox talks and exclusion zones will be implemented.
- ✿ Collect validation samples of the material for testing – refer to Section 3.0 for validation requirements.
- ✿ Treated material is to be loaded into dumper trucks and laid in the 'wet' state and surveyed in position.
- ✿ Material movements will be tracked and recorded throughout the S/S treatment process by the Remediation Engineer.



4.4. EX-SITU BIOREMEDIATION OF CONTAMINATED SOILS

Screening of materials with volatile phase constituents will be carried out to assess suitability for bioremediation treatment. Soils will be placed in bunded and lined treatment areas, covered if required and treated until concentrations are proven to have reduced enough to meet remedial targets for re-use on site. Accelerated natural aerobic degradation will include pre-treatment during soil homogenisation using liquid nutrients, oxygen enriched water, bacteria or fungi followed by placement into managed windrows, where temperature, humidity, pH, redox potential, moisture content and nutrient availability are strictly controlled to ensure optimum conditions are maintained for degradation to occur.

The location of each windrow will be marked out on site and clean material placed along a boundary with an excavator to form a single long bund to an approximate height of 1m. Further bunds will be placed perpendicular to this bund to create separate windrows for different categories of soil material, as required. Identification markers will be used to display the different materials accordingly. If the base ground has no natural slope a slight fall between 3-7 degrees will be graded to ensure leachate and surface water runs off in one direction. Where applicable, a small French drain and collection sump will be installed to enable collected leachate and water to be pumped to temporary storage tanks for either re-use during dosing or transfer to the on-site water treatment plant.

Mechanical turning will be carried out periodically using an excavator, to enhance oxygenation and to add water and/or nutrients. The windrows will be covered with heat retaining fleeces to ensure optimum conditions are maintained for thorough degradation of contaminants. Treated material to be loaded into dumper trucks and placed as required, then surveyed in position. Material movements will be tracked and recorded throughout the treatment process by the Remediation Engineer.

All material movements will be tracked and recorded throughout the treatment process by the Remediation Engineer. All stockpiles will be formed with good housekeeping in mind, covered as appropriate and best practicable measures utilised to keep stockpiles from being visible from external lines of sight beyond the boundary walls and/or fence heights. Adequate signposting will be provided for the identification of stockpiles.

Haul roads will be kept clean and in good order. A traffic light system will be used on stockpile identification markers:

 **Green:** material suitable for re-use on site or disposal; Orange: materials undergoing treatment.

 **Red:** suspected contaminated materials prior to determination by testing.

4.5. CHEMICAL OXIDATION AS REQUIRED

There is a low risk of carbon disulphide (CS₂) impacted soils to be present in some isolated locations across the Manox site. It is highly volatile and extremely flammable, having a wider explosive range in air than hydrogen and a lower ignition energy (LEL >1), with an odour of rotting cabbages. When it has been identified as present in a location, in accordance with the consultant's discovery strategy, the area will be isolated and activated persulphate oxidant (Oxygen BioChem - OBC) will be injected into the subsurface to degrade the CS₂ in a controlled manner. The approach avoids the production of heat or off-gas and avoids the requirement to excavated soils and prevents the health and safety problems associated with handling CS₂ impacted soils. Chemical oxidation will also be used to target other impacted hotspots if required to aid the betterment of conditions.



Oxygen BioChem (OBC) is a mixture of sodium persulphate and calcium peroxide that can be used for both in-situ and ex-situ applications. The mixture supports a two-fold mechanism for destroying contaminants of concern by delivering a peroxygen for short term oxidation, as well as delivering electron acceptors (oxygen and sulphate) for longer term biological oxidation. The predominant short-term reaction is chemical oxidation, while the longer-term remediation process is biological oxidation. Activated persulphate can remain available in the subsurface for months providing a combination of power and stability. The addition of calcium peroxide provides several benefits. First, it imparts alkalinity needed to activate the persulphate. Second, when mixed with water it provides a long-term slow-release source of hydrogen peroxide and calcium hydroxide. The hydrogen peroxide that is slowly formed decomposes to oxygen and water, providing an extended oxygen source for subsequent bioremediation of organics.

OBCTM has the advantage over traditional oxygen compounds used for bioremediation in that it works on a broader range of contaminants which include TPH, BTEX, MTBE, PAH and chlorinated solvent contamination.

The typical plant set-up for this approach if utilised would include the following:

- ✿ Geoprobe direct push injection rig
- ✿ Mobile chemical mixing plant Water storage tanks
- ✿ Associated bunding and pipework

The proprietary reagent, OBC (see Appendix F of the McAuliffe RMS for data sheet) will be delivered to site in powder form and placed in a designed chemical storage area near the proposed application location, within the secure boundary of the site. A mobile mixing plant will be used to dilute the reagent in batches, to the required solution concentrations in accordance with the task specific RAMS.

4.6. INSTALLATION OF LOW PERMEABILITY GROUNDWATER CUT-OFF WALL

A groundwater cut-off wall will limit dissolved phase contamination migration on/off site along the boundary with the Rochdale Canal, stated as a primary receptor, as shown in the plan included within Appendix III. This will be installed into the cohesive Glacial Till, so a depth to toe of 1m embedment into the clay or deeper if required by the retaining design.

To achieve the low permeability groundwater cut-off, a sealed clutch steel sheet piled wall will be installed following the methodology below.

- ✿ The crane will pick up the first pile using a pitching shackle connected to the top of the pile, the pile is then lowered so in contact with the platform, at this point the rig will be tracked into position and under the instruction of the Supervisor the reduced vibration leader rig vibro-hammer is slewed over the head of the pile, the hammer is lowered, jaws clamped to the head of the pile, a final check is then made to ensure all is secure, the quick release shackle is then released – the Leader Rig has control of the pile.
- ✿ At no point must anyone walk under or be positioned under a suspended load.
- ✿ All operatives must be clear of crush zones prior to commencement of lifting.
- ✿ The slinger signaller must be separated from any lifts, but still maintaining visual contact with the crane operator at a safe distance.



- ✿ The pile is then moved by the Leader Rig into the correct position with the aid of a laser the pile is positioned along the correct alignment.
- ✿ Once aligned correctly the pile will be driven approximately 1.0m into the ground before being checked for verticality and position.
- ✿ After checking the pile for line and level, the pile is then driven further and is then periodically checked for line and level and corrected as necessary.
- ✿ The installation Supervisor must ensure that he is in a place of safety once vibratory installation commences, which will be behind the exclusion zone barriers – crowd barriers.
- ✿ However, to allow the Supervisor to check pile line and verticality, he must intermittently stop the vibratory installation and check the sheet pile.
- ✿ Once driven to the required intermediate level the hammer is then released and the rig slews out of the way.
- ✿ The next pile and all subsequent piles are picked up using the ground release pitching shackle fixed to a pitching hole in the top/centre of the pile.
- ✿ The pile is picked up to the vertical position and pitched into the interlock of the previously driven pile. Once the pile is interlocked the shackle is released and the hammer is re-positioned on top of the pile gripping the head of the pile in the jaws.
- ✿ This pile is then driven to the same level as the initial pile before releasing the hammer and slewing the rig away to allow the next pile to be pitched. Pre-augering will be carried as required.



5. VALIDATION

5.1. VALIDATION TESTING

Validation testing will be undertaken in accordance with the E3P Remediation Strategy and will ensure the site will pose no further risk to human health, controlled waters or the wider environ.

Soils will be mainly treated by stabilisation/solidification where impacted with validation of these soils being by leachability and therefore the site specific screening values for waters/leachate utilised for the purpose of this validation. Some soils, where there is organic contamination, may be suitable for bioremediation (see section 4.0), where validation will be undertaken of the soils and thus, the site specific screening criteria for soils will be utilised for validation purposes. See table 3.5 for site specific screening criteria for validation of both the soils by solid form and by leachate analysis.

5.2. VALIDATION TESTING FREQUENCY

The sampling frequency for materials to be managed under the agreed Remediation Strategy is presented in Table 5.1. McAuliffe will not be importing soils for use in the garden cover systems as part of the remediation works as these will be addressed as part of the future developer works.

TABLE 5.1 SPECIFICATION OF CHEMICAL VALIDATION LABORATORY ANALYSIS

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Site-Generated		
Site-Generated 6F2	1 Sample per 1000 m ³	A/B/C/D
Site-Won Made Ground General Backfill	1 Sample per 250 m ³ (if contamination identified)	G
Site-Won Made Ground General Backfill	1 Sample per 1000 m ³	A/B/C/D
Site-Won Natural Backfill	1 Sample per 2000 m ³	A/B/C/D
Site-Generated Subsoil (450 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Hotspot Validation Samples	1 Sample per 10 m of linear excavation to base and sidewall	E/G
Organic Contaminated Materials (treated soils)	1 sample per 100m ³ 1 sample per 250m ³	G F
Inorganic Contaminated Materials (treated soils only)	1 sample per 500m ³ 1 sample per 1000m ³	H I
Imported		
6F2	1 Sample per 1000 m ³	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 1000 m ³	A/B/C/D

Notes

Suites of Analysis:

- A. Speciated PAH.
- B. Speciated TPH (C5-C35).
- C. Asbestos (ID).
- D. CLEA Inorganic Heavy Metals.



- E. Speciated PAH, Banded TPH and VOCs.
- F. SVOC/Speciated TPH
- G. On-Site Screening for VOC Using Calibrated PID.
- H. Leachate Analysis of Inorganic Heavy Metals (specifically free and complex Cyanide and arsenic)
- I. 64 day tank tests

All analysis prescribed above to be completed by UKAS-accredited laboratory.

This will include the treated soils, to be carried out over the course of the works, to inform the performance monitoring and validation reporting.

Post-treatment validation testing of S/S treated materials will be:

- 🔧 TPH, PAH, Sulphate and Heavy Metal impacted materials - batch leachate testing at a frequency of 1 sample per 2,000m³.
- 🔧 Cyanide impacted materials – batch leachate testing at a frequency of 1 sample per 500m³ and tank testing at a frequency of 1 sample per 1000m³.

The above requirements will be assessed based on the CoC with the highest concentrations in the pre-treated materials.

Post-treatment validation testing of Bio-treated materials will be based on solid testing for TPH and PAH at a frequency of 1 sample per 2000m³.

The chemical threshold criteria for each validation sample will be evaluated depending on their place of reuse on site. The chemical criteria are presented in Appendix V.

5.3. SITE-SPECIFIC SCREENING VALUES FOR THE PROTECTION OF CONTROLLED WATERS

The site-specific screening values calculated for the protection of controlled waters are included in Table 5.2. These are to be utilised within the Manox sector of the site for the validation of soils and ensure any residual soils will be protective of controlled waters.

As explained in Section 5.1, soils will be mainly treated by stabilisation/solidification where impacted, with validation of these soils being by leachability and therefore the site-specific screening values for waters/leachate utilised for the purpose of this validation. Some soils, where there is organic contamination, may be suitable for bioremediation (see section 4.0), where validation will be undertaken of the soils and thus, the site-specific screening criteria for soils will be utilised for validation purposes. See table 3.5 for site specific screening criteria for validation of both the soils by solid form and by leachate analysis.



TABLE 5.2 SSRTs FOR CONTROLLED WATERS

Contaminant	Source Concentration used in RTM Model		Level 3 Remedial Target Concentration		
	Soils (mg/kg)	Waters/Leachate (mg/l)	Soils (mg/kg)	Waters/Leachate (mg/l)	Waters/Leachate (ug/l)
Source Area 1 – Tar Channel					
TPH Aromatic C8-C10	277	4.306	1060	0.854	854
TPH Aromatic C10-C12	48100	1.761	1920	0.959	959
TPH Aromatic C12-C16	14300	5.706	30.8	0.0102	10.2
TPH Aromatic C16-C21	4440	0.815	717	0.164	164
TPH Aromatic C21-C35	4560	0.815	18300	0.456	456
TPH Aliphatic C8-C10	20	0.005	304000	12.8	12800
TPH Aliphatic C10-C12	425	0.037	1.99 E+07	119	119000
TPH Aliphatic C12-C16	504	0.108	4.01E+06	0.796	796
TPH Aliphatic C16-C21	1170	0.087	3.79 E+09	0.695	695
TPH Aliphatic C21-C35	7560	0.94	3.79 E+09	0.695	695
2-methylnaphthalene	252	0.059	3340	164000	164000000
Carbazole	19.8	0.021	2.89E+8	6.84E+12	6.84E+15
Dibenzofuran	237	0.048	2.89E+8	6.84E+12	6.84E+15
Naphthalene	819	0.0081	1660	3.91E+6	3.91E+9
Source Area 2 – Manox Sector (10m x 10m grid)					
Arsenic	4810	0.0085	1090	2.18	2180
Cyanide	8270	0.34	2190	2.18	2180
Copper	933	0.0071	21.9	0.218	218
Lead	6690	0.01	1090	2.18	2180
Source Area 2 – Manox Sector (entire sector)					
Arsenic	4810	0.0085	28.4	0.0568	56.8
Cyanide	8270	0.34	5.7	0.0568	56.8
Copper	933	0.0071	0.57	0.00568	5.68
Lead	6690	0.01	28.4	0.0568	56.8

5.4. GROUNDWATER LEVEL MONITORING

As part of the remediation works, a low permeability sheet pile barrier will be installed along the boundary with the Rochdale Canal to ensure no ingress/egress of contaminated water between the site and canal. In order to confirm the efficacy of the sheet pile wall, two boreholes will be installed on either end of the sheet pile wall in order to measure the water level prior to installation and following.

5.5. SURFACE WATER MONITORING

Surface water monitoring of the Rochdale Canal will be undertaken at an upstream and downstream point to the site. This will seek to ensure that there is no contaminant mobilisation migrating to the canal during the course of the remediation works.

Surface water samples will be obtained on a monthly basis across the duration of the remediation works, increasing to 2-weekly basis should there be any evidence of contaminant mobilisation. Samples will be scheduled for a suite of analysis that includes TPH by CWG method, BTEX, SVOC, VOC and Inorganics including cyanide.

All samples will be collected using appropriate personal protective equipment (PPE) and sampling equipment, which will be cleaned at each sampling location.



A detailed copy of E3P Ltd sampling methodology, QA procedures and laboratory chain of custody forms will be documented within the site records and presented with the final validation report for the Site.

All analysis prescribed above to be completed by UKAS-accredited laboratory.

5.6. REMEDIATION CONTRACTOR'S SITE MANAGEMENT AND RESPONSIBILITY

The appointed remediation contractor will take full and overarching responsibility for all methods of work required to complete the site remediation and enabling operations to ensure the delivery of the Site and the completion of the objectives in a safe, legislatively compliant manner that ensures no pollution to the subject site or the wider environs.

For individual remediation operations as set out within this performance specification, the contractor will provide site-specific methods of work for individual operations pertaining to the removal and treatment of contaminated liquids and soils. For each and every operation as set out herein, the contractor will provide a written methodology of works to be supplied to the supervising geoenvironmental engineer prior to the instigation of operations on Site.

The site manager will be responsible for documentation of each day's activities with a full recorded schedule of works completed and corresponding site-specific method statements that have been utilised to ensure the completion of the task to the required standard.



6. CONCLUSIONS AND RECOMMENDATIONS

Extensive intrusive investigation and assessment has identified the presence of elevated concentrations of inorganic heavy metals including cyanide, PAH compounds, TPHs, BTEX and carbo disulphide. Asbestos in the form of chrysotile and amosite, has been found within the Made Ground, which will require segregation. Zones 5W and 7 to the south of the Manox site, have not been subject to the same historical industrial land use.

The issues associated with the contamination identified are compounded by the position of the Manox sector adjacent to the Rochdale Canal which undoubtedly presents a significant risk to controlled waters. Furthermore, the presence of a tar channel (which is a primary source of SVOC, PAH and TPH with the presence of DNAPL) identified in this same area, the exact position of which is not yet known, presents an additional issue that will require addressing.

These areas of contamination currently pose a risk to human health, controlled waters and the wider environ, therefore a phase of remediation is required.

The remediation approach will require the removal of the primary contaminant sources which include discolouration in the soils (metals and cyanide salts), separate phase coal tar (tar channel and any localised impact) and the subsequent remediation of site wide soils by stabilisation/solidification.

A Detailed Controlled Waters Risk Assessment was undertaken to generate site specific remedial targets for the protection of controlled waters and enable the remediation and validation of site soils.

The treatment works in the Manox sector will be verified through the installation and periodical sampling and analysis of groundwater monitoring boreholes located at the site periphery following the installation of the low permeability groundwater sheet pile wall on the site boundary to the Rochdale Canal along with periodic surface water sampling of the Rochdale canal at an upstream and downstream point.

END OF REPORT



APPENDIX I

LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the client as indicated in Section 1.3.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the Site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the Site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the Site limited the locations where sampling locations could be installed and the techniques that could be used.
6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.
8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.
10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.



APPENDIX II

GLOSSARY

TERMS

ACM	Asbestos-containing material	MMP	Materials management plan
ADS	Acoustic design statement	ND	Not detected
AST	Above-ground storage tank	NDP	Nuclear density probe
BGS	British Geological Survey	NMP	Noise management plan
BSI	British Standards Institute	NPSE	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	NR	Not recorded
CA	Coal Authority	PAH	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	PCB	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	PI	Plasticity index
CIRIA	Construction Industry Research Association	PID	Photo ionisation detector
CLEA	Contaminated land exposure assessment	POS	Public open space
CML	Council of Mortgage Lenders	PPE	Personnel protective equipment
CoC	Contaminants of concern	ProPG	Professional practice guidance
CSM	Conceptual site model	QA	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	SGV	Soil guideline value
DWS	Drinking water standard	SPH	Separate-phase hydrocarbon
EA	Environment Agency	SPT	Standard penetration test
EQS	Environmental quality standard	SVOC	Semi-volatile organic compound
FFL	Finished floor level	TPH	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	UKWIR	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	UST	Underground storage tank
HCV	Health criteria value	VCC	Vibro-concrete column
ICSM	Initial conceptual site model	VOC	Volatile organic compound
LEL	Lower explosive limit	VRSC	Vibro-replacement stone columns
LMRL	Lower method reporting limit	VSC	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	WHO	World Health Organisation
MCV	Moisture condition value	WRAP	Waste and Resources Action Programme

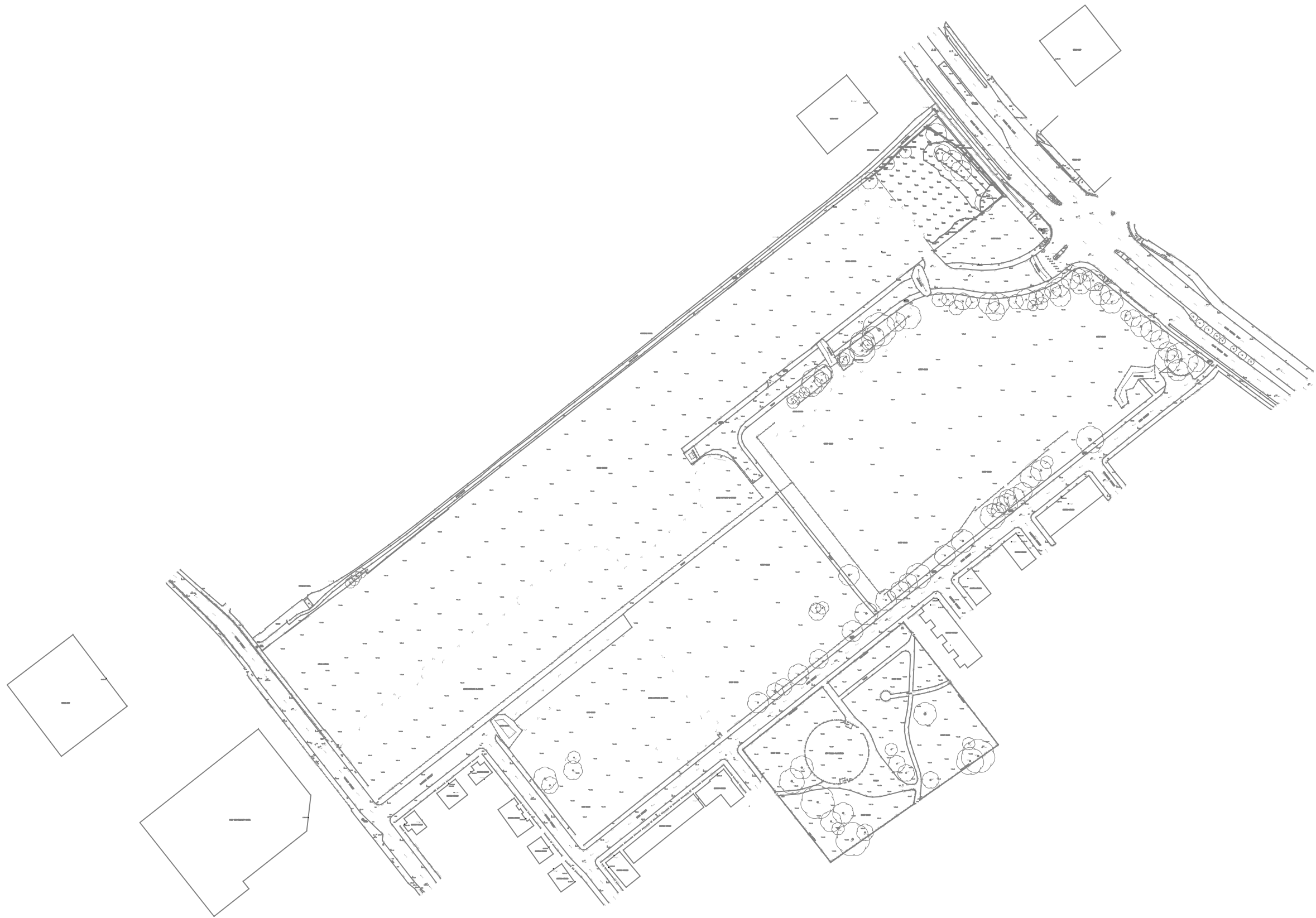


MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	kN/m²	Kilonewtons per metre squared
ppb	Parts per billion	µm	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	SSRT	Site Specific Remediation Target
PSD	Particle Size Distribution	DD	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	Mc	Moisture Content
ρ	Bulk Density	GPR	Ground Penetrating Radar
NDP	Nuclear Density Probe	FFL	Finished Floor Level
LEL	Lower Explosive Limit	UKWIR	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	LOD	Limit of Detection



APPENDIX III

DRAWINGS



Notes:

Client:

Job No:

Date:

13-887

14.01.2020

Drawing No:

Scale:

001

NTS



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P1	-	14.01.2020	DRAFT	HM	MD
Phase	Revision	Date	Issue	Drawn	Checked

Job Title:

Manox

Drawing Title:

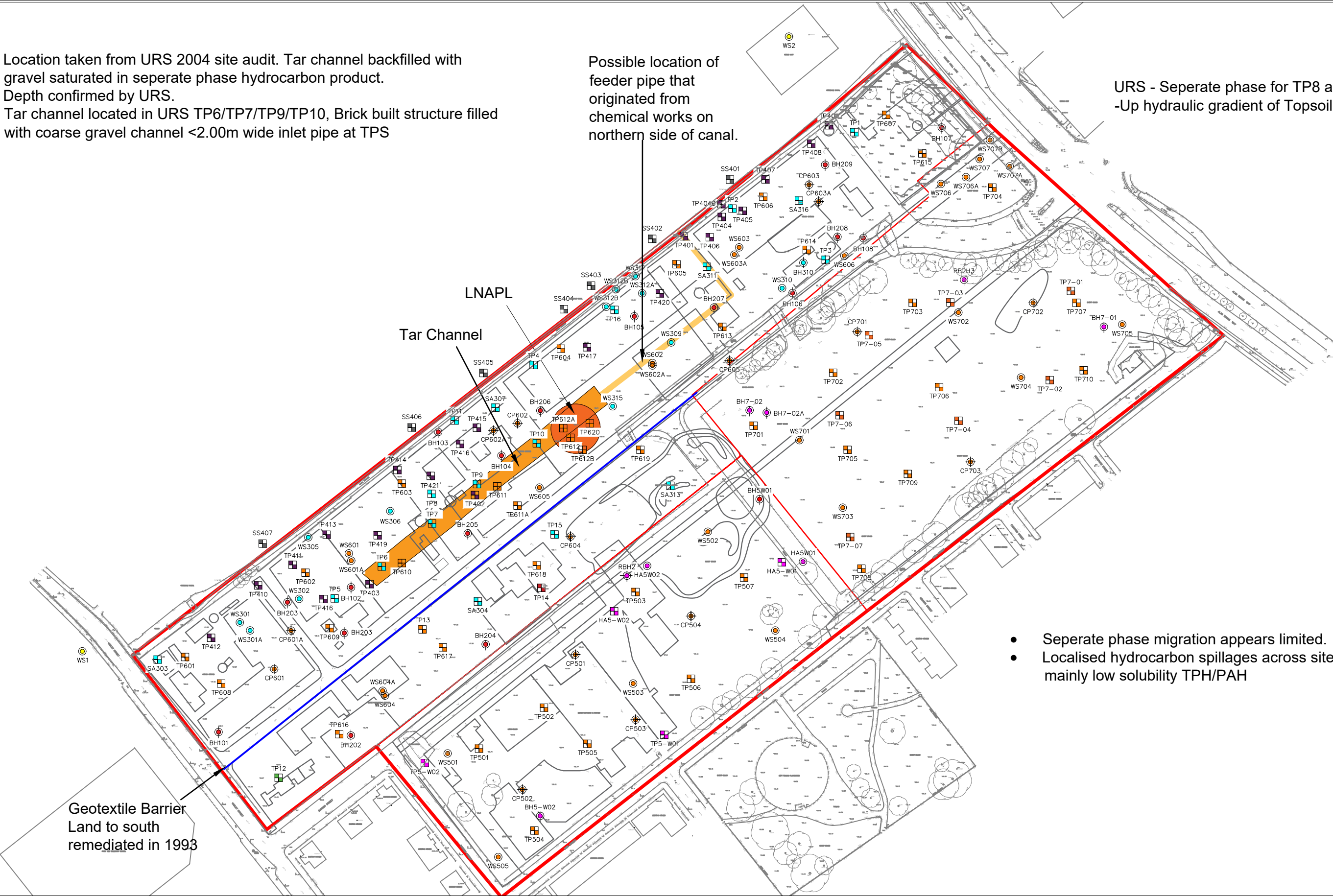
Site Location

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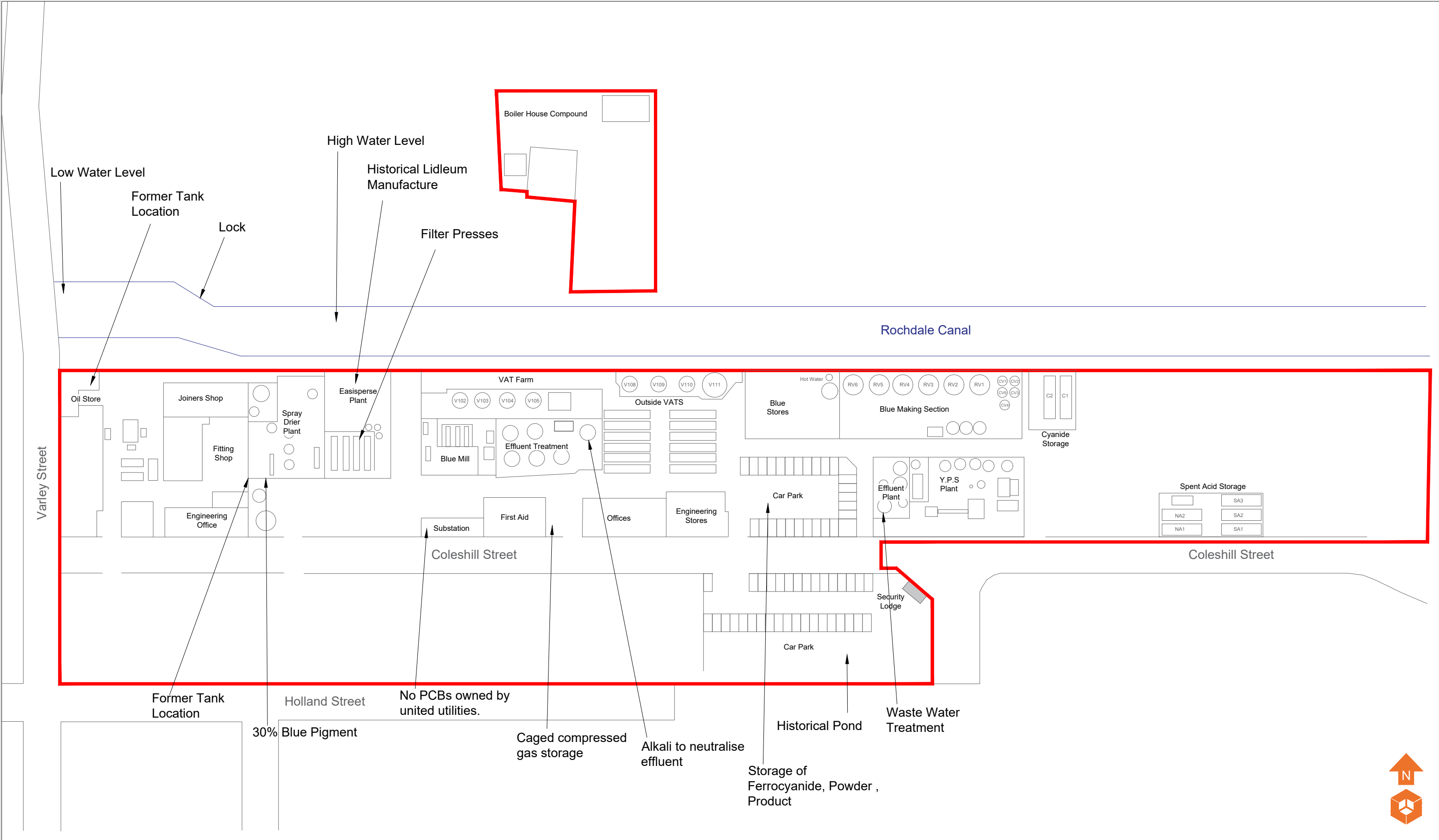
Location taken from URS 2004 site audit. Tar channel backfilled with gravel saturated in seperate phase hydrocarbon product.
Depth confirmed by URS.
Tar channel located in URS TP6/TP7/TP9/TP10, Brick built structure filled with coarse gravel channel <2.00m wide inlet pipe at TPS

Possible location of feeder pipe that originated from chemical works on northern side of canal.

URS - Seperate phase for TP8 and TP4.
-Up hydraulic gradient of Topsoil Hotspot



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						Engie		13-887		04.08.2020																										
								Drawing No:		Scale:																										
								011		NTS																										
Job Title:						Drawing Title:						The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.																								
<table><tr><td>P1</td><td>R1</td><td>04.08.2020</td><td>REVISION</td><td>HM</td><td>OJ</td></tr><tr><td>P1</td><td>-</td><td>04.02.2020</td><td>DRAFT</td><td>LM</td><td>EM</td></tr><tr><td>Phase</td><td>Revision</td><td>Date</td><td>Issue</td><td>Drawn</td><td>Checked</td></tr></table>						P1	R1	04.08.2020	REVISION	HM	OJ		P1	-	04.02.2020	DRAFT	LM	EM	Phase	Revision	Date	Issue	Drawn	Checked	Manox						Tar Channel and DNAPL Manox Site					
						P1	R1	04.08.2020	REVISION	HM	OJ																									
						P1	-	04.02.2020	DRAFT	LM	EM																									
Phase	Revision	Date	Issue	Drawn	Checked																															



	<i>Notes:</i>						<i>Client:</i> Engie	<i>Job No:</i> 13-887	<i>Date:</i> 30.07.2020	Environmental Engineering Partnerships Ltd City Heliport & Business Centre Eccles, Manchester, M30 7RU Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk																	
								<i>Drawing No:</i> 020	<i>Scale:</i> NTS																		
	<table><tr><td>P1</td><td>R1</td><td>30.07.2020</td><td>REVISION</td><td>LM</td><td>MD</td></tr><tr><td>P1</td><td>-</td><td>20.07.2020</td><td>DRAFT</td><td>LM</td><td>MD</td></tr><tr><td>Phase</td><td>Revision</td><td>Date</td><td>Issue</td><td>Drawn</td><td>Checked</td></tr></table>						P1	R1	30.07.2020		REVISION	LM	MD	P1	-	20.07.2020	DRAFT	LM	MD	Phase	Revision	Date	Issue	Drawn	Checked	<i>Job Title:</i> Manox	<i>Drawing Title:</i> Former Manox Works Plan
P1	R1	30.07.2020	REVISION	LM	MD																						
P1	-	20.07.2020	DRAFT	LM	MD																						
Phase	Revision	Date	Issue	Drawn	Checked																						

CS2 above LoD (< 1ug/kg)

- Risk tested 27 samples
- URS 5 Samples (2004)
- URS 24 Samples (2006)



Location Symbols

- Approximate Rotary Borehole Location (URS 2004)
- Approximate Trial Pit Location (URS 2006)
- Approximate Window Sample Probehole Location (URS 2006)
- Approximate Shell and Auger Location (URS 2006)
- Approximate Trial Pit Location (ERM 2009)
- Approximate Trial Pit Location (Westlakes 2019)
- Approximate Window Sample Probehole Location (Westlakes 2019)
- Approximate Cable Percussive Borehole Location (Westlakes 2019)
- Approximate Trial Pit Location (Westlakes 2019)
- Approximate Window Sample Probehole Location (Westlakes 2019)
- Approximate Cable Percussive Borehole Location (Westlakes 2019)
- Approximate Trial Pit Location (Parson Brickenhoff 2007)
- Approximate Test Location (Parson Brickenhoff 2007)
- Approximate Sample Probehole Location (Parson Brickenhoff 2007)
- Approximate Trial Pit Location (Parson Brickenhoff 2007)
- CS2 above LoD (< 1ug/kg)

Notes:

Client:

Engie

Job No:

13-887

Date:

20.07.2020

Drawing No:

022

Scale:

NTS



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Job Title:

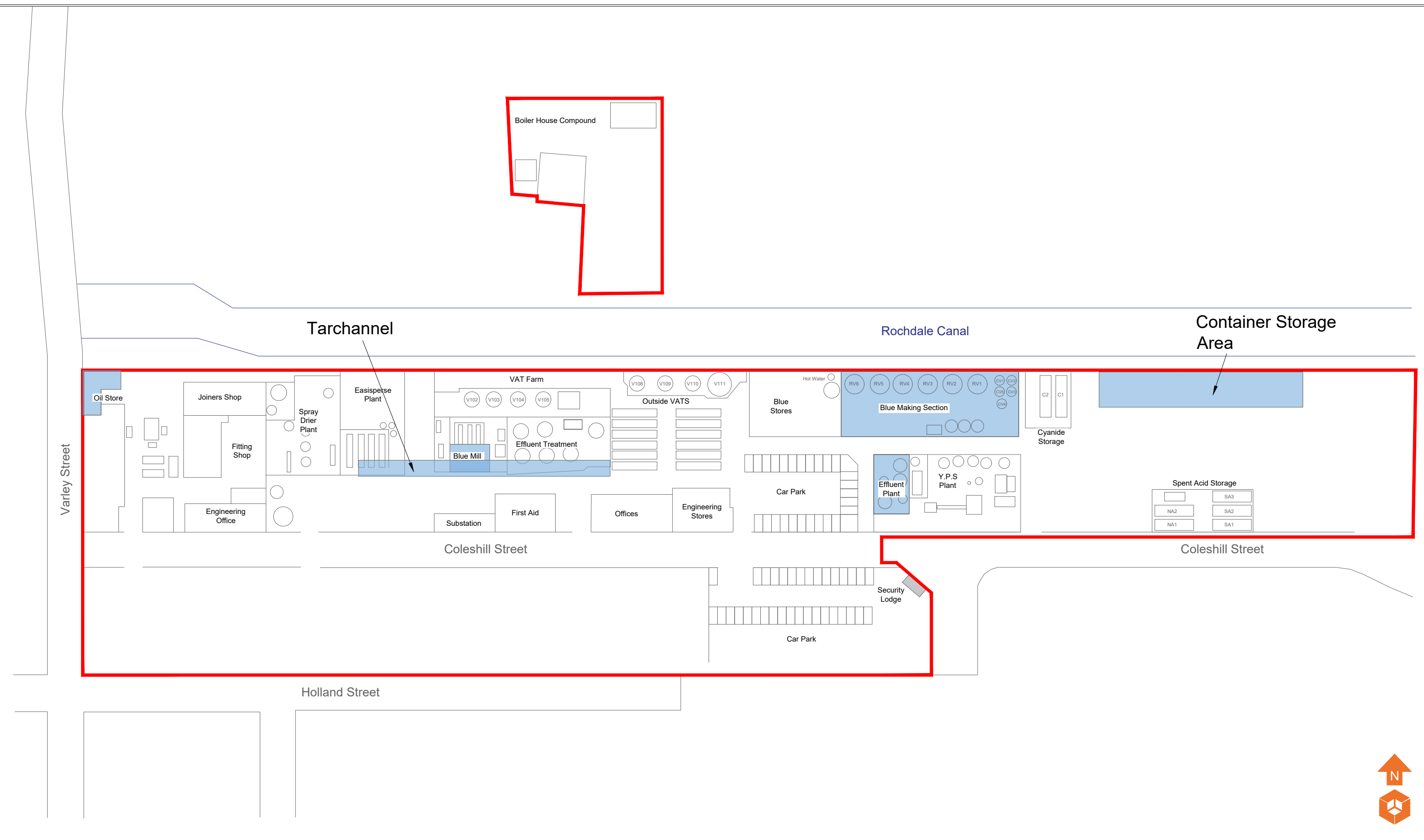
Manox

Drawing Title:

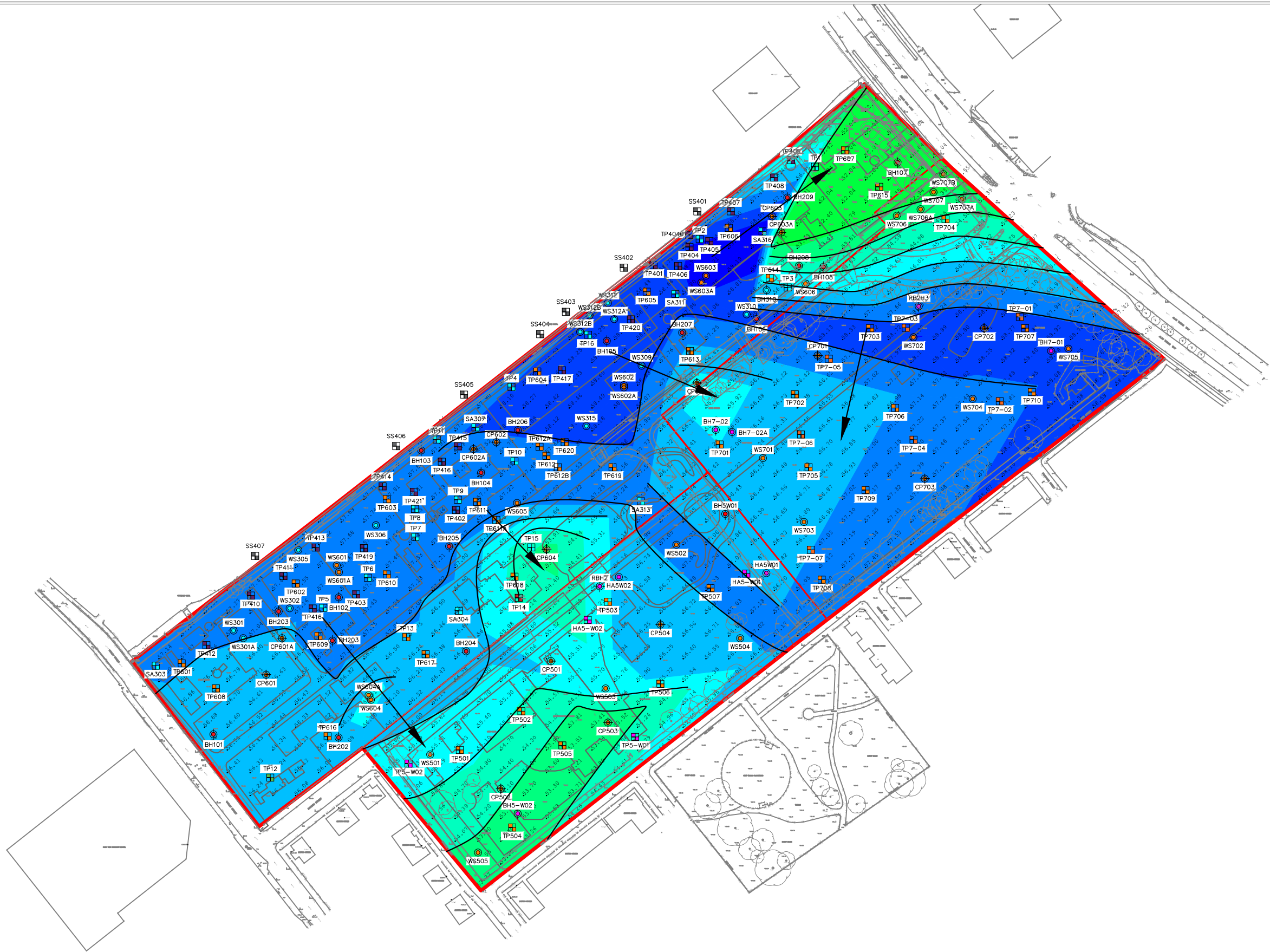
Carbon Disulphate Plan

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Phase	Revision	Date	Issue	Drawn	Checked



	Notes:					Client: Engie	Job No: 13-887	Date: 20.07.2020	 Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk	
							Drawing No: 024	Scale: 1:1000 @ A3		
						Job Title: Manox	Drawing Title: Main Contamination Sources			The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.
	P1	REVA	20.07.2020	CB	MD					
	Phase	Issue	Date	Drawn	Checked					



Location Symbols

- Approximate Window Sample Probehole Location with Install
- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Trial Trench Location
- Approximate Groundwater Flow

Depth to Groundwater AOD (m)

- Depth to Groundwater 51.00 - 51.99m
- Depth to Groundwater 52.00 - 52.99m
- Depth to Groundwater 53.00 - 53.99m
- Depth to Groundwater 54.00 - 54.99m
- Depth to Groundwater 55.00 - 55.99m
- Depth to Groundwater 56.00 - 56.99m
- Depth to Groundwater 57.00 - 57.99m
- Depth to Groundwater >58.00

Notes:

P1	R1	29.07.2020	REVISION	HM	OJ
P1	-	28.07.2020	DRAFT	HM	OJ
Phase	Revision	Date	Issue	Drawn	Checked

Client:

Engie

Job Title:

Manox

Job No:

13-887

Drawing No:

025

Date:

29.07.2020

Scale:

NTS

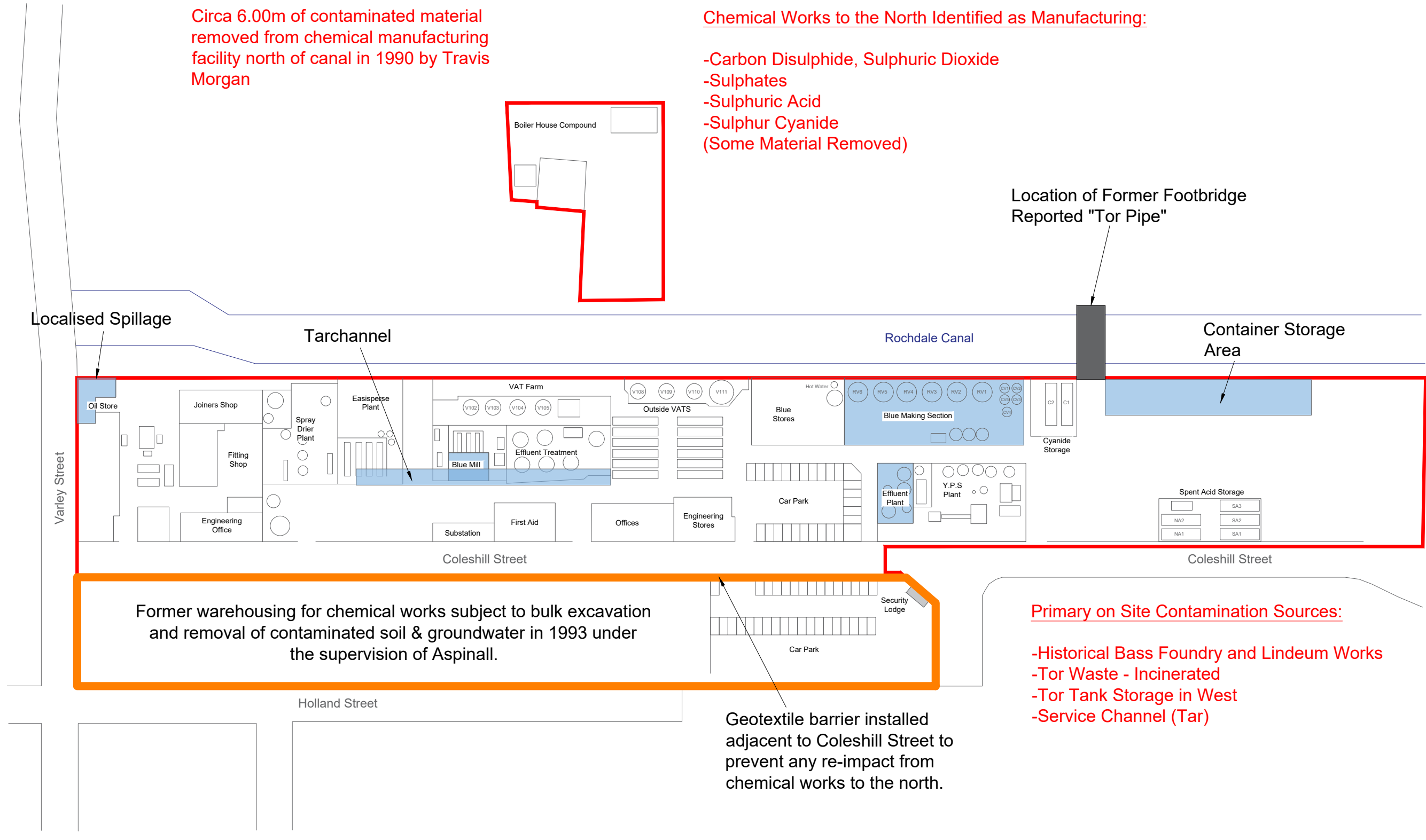
Drawing Title:

Depth to Ground
Water (AOD) Plan



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Circa 6.00m of contaminated material removed from chemical manufacturing facility north of canal in 1990 by Travis Morgan

Chemical Works to the North Identified as Manufacturing:

- Carbon Disulphide, Sulphuric Dioxide
- Sulphates
- Sulphuric Acid
- Sulphur Cyanide
- (Some Material Removed)

Location of Former Footbridge Reported "Tor Pipe"

Primary on Site Contamination Sources:

- Historical Bass Foundry and Lindeum Works
- Tor Waste - Incinerated
- Tor Tank Storage in West
- Service Channel (Tar)



Notes: This Drawing Defines the Known Operations By Degussa in ~ 2004					
P1	R1	04.08.2020	REVISION	HM	OJ
P1	-	30.07.2020	DRAFT	LM	MD
Phase	Revision	Date	Issue	Drawn	Checked

Client: Engie
Job Title: Manox

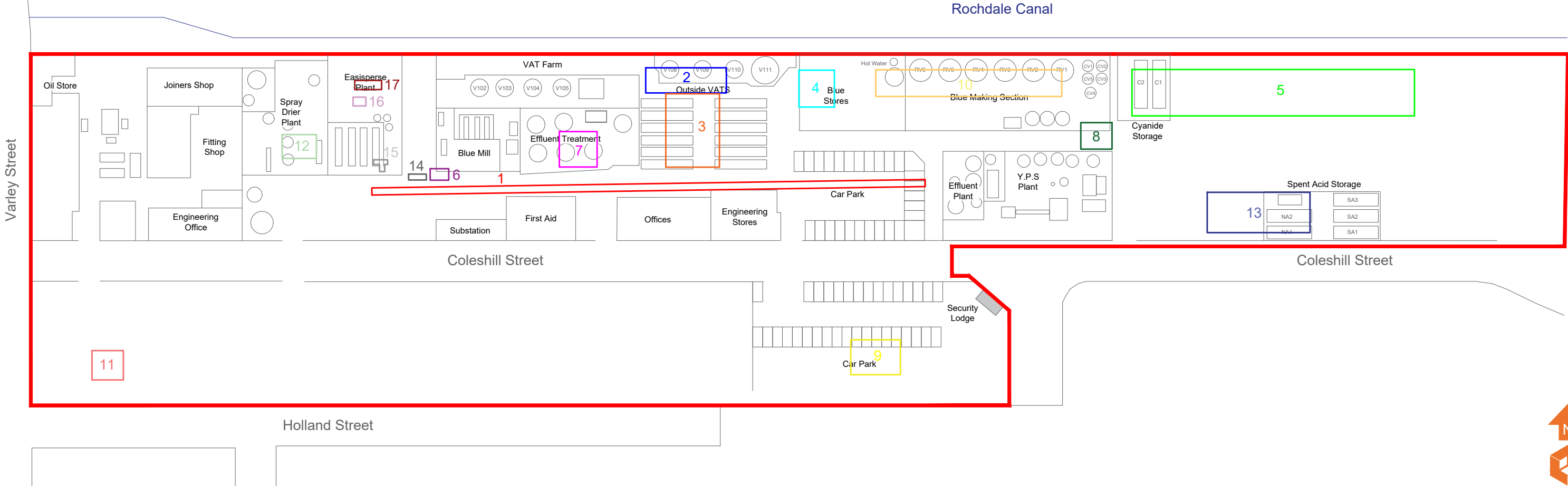
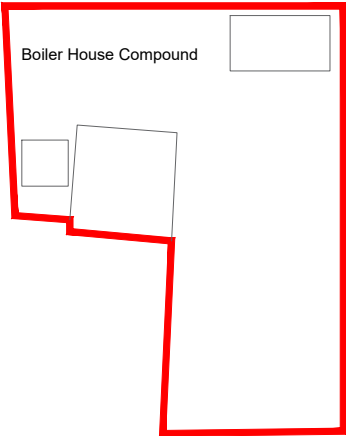
Job No: 13-887	Date: 04.08.2020
Drawing No: 026	Scale: NTS
Drawing Title: Main Contamination Sources Degussa Operations	



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1	Inferred position of Tar channel
2	Reinforced concrete bund base and concrete hardstanding
3	Buried flagstone horizon
4	Brick/Concrete construction sump/basement with metal top cover.
5	Brick/Concrete plinth/hardstanding horizon
6	Sump or chamber
7	Potential brick built chamber
8	Brick built foundations (unknown structure)
9	Buried basement or former hardstanding horizon
10	Bund floor
11	Foundations of Former residential properties
12	Brick build foundations
13	Concrete basement/hardstanding horizon
14	Network or drainage channels
15	Below ground chamber (with stains)
16	Pit for lift shaft (suspected)
17	Pit for recessed plant



Notes:				
P1	REVA	30.07.2020	LM	MD
Phase	Issue	Date	Drawn	Checked

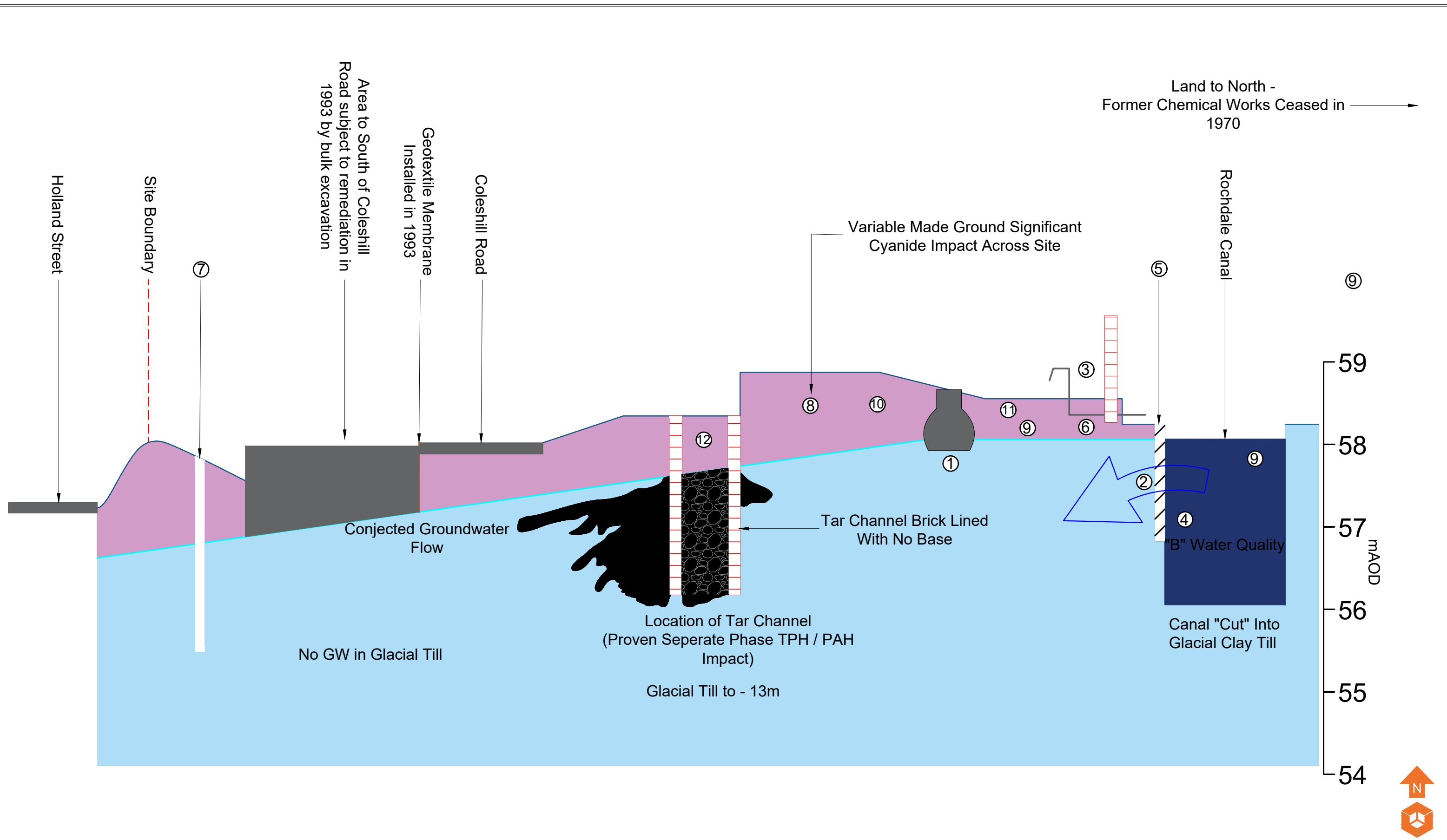
Client:	Engie
Job Title:	Manox

Job No:	13-887	Date:	30.07.2020
Drawing No:	027	Scale:	1:1000 @ A3
Drawing Title:	Location of Known Below Ground Structures		



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Location Symbols

① Localised separate phase TPH (With PAH) impact of near surface representation of surface spillage. (Not delineated) Limited migration to south down hydraulic gradient. Vertical migration confined by clay walls

② Canal "Up" hydraulic graient likely scenerario is canal is contributing to hydrology & shallow perched water confined above law permeability clay

③ Former / Remenant drainage infrastrucutre represents a preferntial pathway to canal. All infrastructure to be removed & pathway negated

④ Canal wall lining limit hydraulic impact

⑤ ERM Investigation confirmed visual leakage of contaminants through boundary wall to canal considered to be leaching not GW hydraulic conductivity.

⑥ Perched water confirmed by walls at higher elevation to canal and is seeping through and impacting. remediation to solidify and stabilise cyanide impact will remove this pathway

⑦ Monitoring wells down hydraulic gradient do not show significant cyanide impact

⑧ Made ground in Manox sector impacted by semi volatile and volatile organic compounds. No tox data readily available to inform robust SSR's mitigate pathway by vapor membrane.

⑨ Carbon disulphide (CS2) off site primary source CS2 impact known in canal and sediment. Low level CS2 impact onsite no primary CS2 source identified on Manox.

⑩ Significant aromatic semi volatile PAH/SVOC impact on site in MG across Manox.

⑪ Significant arsenic and lead impact in MG multiple instances of discoloration (Blue and Green) suggesting primary source.

⑫ Salt glazed feeder pipe to tar channel

Conjected Groundwater Flow

Rochdale Canal

Tar Channel

Glacial Clay Till

Notes:

P1	R1	03.08.2020	REVISION	HM	MD
P1	-	31.07.2020	DRAFT	HM	MD
Phase	Revision	Date	Issue	Drawn	Checked

Client:

Engie

Job No: 13-887

Date: 03.08.2020

Drawing No: 028

Scale: NTS

Job Title: Manox

Drawing Title: Canal Impact Section Plan

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Location Symbols

- | | | | |
|--|---|--|---|
| | Approximate Rotary Borehole Location (URS 2004) | | Approximate Cable Percussive Borehole Location (Westlakes 2019) |
| | Approximate Trial Pit Location (URS 2006) | | Approximate Rotary Borehole Location (Parson Brickenhoff 2007) |
| | Approximate Window Sample Probehole Location (URS 2006) | | Approximate Test Location (Parson Brickenhoff 2007) |
| | Approximate Shell and Auger Location (URS 2006) | | Approximate Sample Probehole Location (Parson Brickenhoff 2007) |
| | Approximate Trial Pit Location (ERM 2009) | | Approximate Trial Pit Location (Parson Brickenhoff 2007) |
| | Approximate Trial Pit Location (Westlakes 2019) | | Stockpile |
| | Approximate Window Sample Probehole Location (Westlakes 2019) | | Vegetation / Trees |
| | Approximate Cable Percussive Borehole Location (Westlakes 2019) | | Hardstanding |
| | Approximate Trial Pit Location (Westlakes 2019) | | Services (BT/Gas/Electricity/Sewer/Surface water) |
| | Approximate Window Sample Probehole Location (Westlakes 2019) | | |

Notes:

Client:

Engie

Job No:

13-887

Date:

03.08.2020

Drawing No:

032

Scale:

NTS



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Job Title:

Manox

Drawing Title:

Constaints Plan

P1	-	03.08.2020	DRAFT	HM	OJ
Phase	Revision	Date	Issue	Drawn	Checked

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Location Symbols

- Approximate Rotary Borehole Location (URS 2004)
- Approximate Trial Pit Location (URS 2006)
- Approximate Window Sample Probehole Location (URS 2006)
- Approximate Shell and Auger Location (URS 2006)
- Approximate Trial Pit Location (ERM 2009)
- Approximate Trial Pit Location (Westlakes 2019)
- Approximate Window Sample Probehole Location (Westlakes 2019)
- Approximate Cable Percussive Borehole Location (Westlakes 2019)
- Approximate Trial Pit Location (Westlakes 2019)
- Approximate Window Sample Probehole Location (Westlakes 2019)

- Approximate Cable Percussive Borehole Location (Westlakes 2019)
- Approximate Rotary Borehole Location (Parson Brickenhoff 2007)
- Approximate Test Location (Parson Brickenhoff 2007)
- Approximate Sample Probehole Location (Parson Brickenhoff 2007)
- Approximate Trial Pit Location (Parson Brickenhoff 2007)

Remediation Issues

- Hardstanding / Obstruction
- Soft / Loose natural ground
- Dense Vegetation
- Semi - mature Trees
- Carbon Disulphide detected, removal required between 1.50 - 1.60m
- Visual / Olfactory Contamination
- Human health exceedance requiring removal

Notes:

P1	-	10.11.2020	REVISION	LM	OJ
Phase	Revision	Date	Issue	Drawn	Checked

Client:

Engie

Job Title:

Manox

Job No:

13-887

Drawing No:

034

Date:

10.11.2020

Scale:

NTS

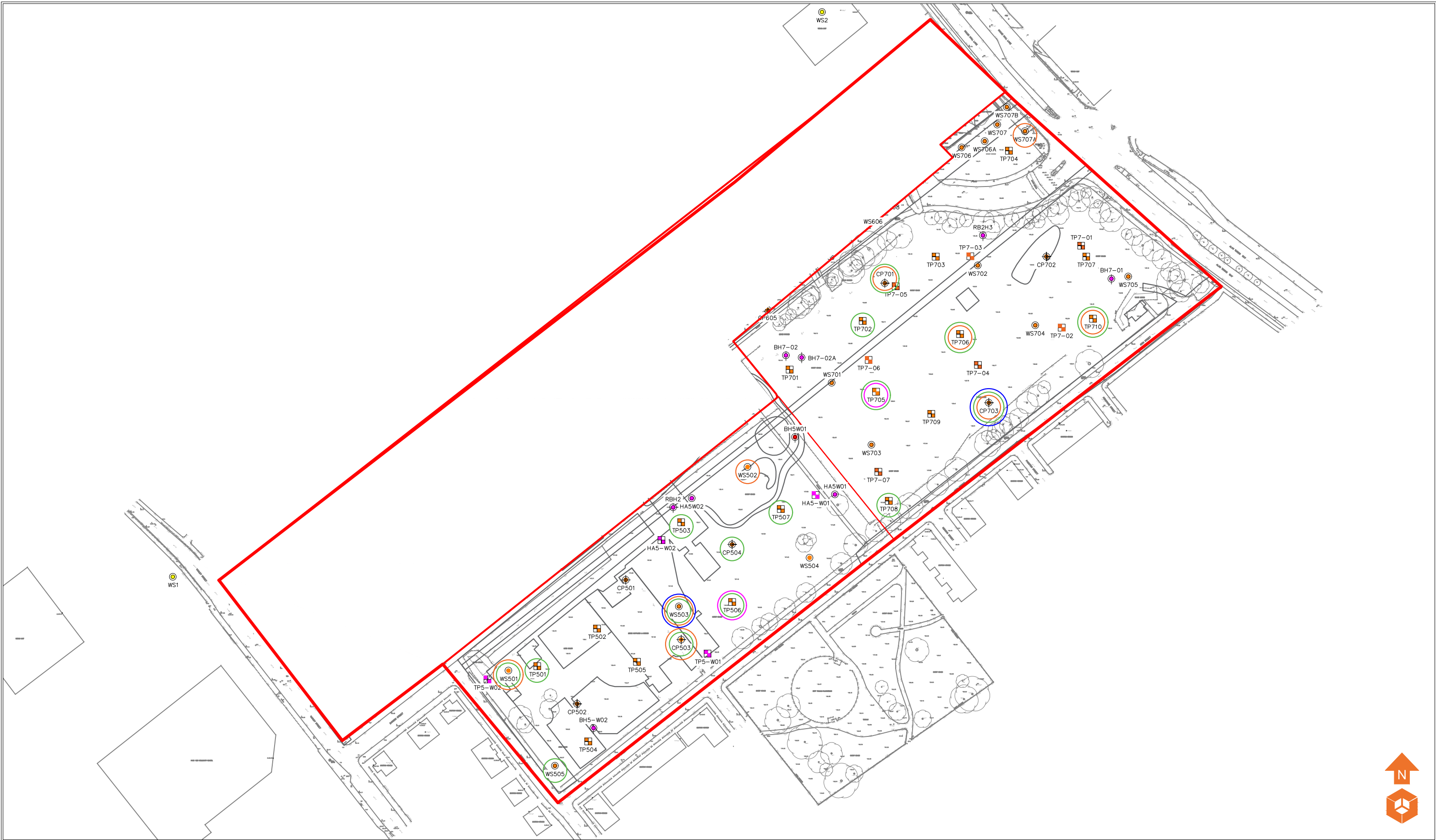
Drawing Title:

Zone 5 and Zone 7
Remediation Issues Plan



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Location Symbols

- Approximate Rotary Borehole Location (URS 2004)
- Approximate Trial Pit Location (URS 2006)
- Approximate Window Sample Probehole Location (URS 2006)
- Approximate Shell and Auger Location (URS 2006)
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- Approximate Trial Pit Location (Westlakes 2019)
- Approximate Window Sample Probehole Location (Westlakes 2019)

- Approximate Cable Percussive Borehole Location (Westlakes 2019)
- Approximate Rotary Borehole Location (Parson Brickenhoff 2007)
- Approximate Test Location (Parson Brickenhoff 2007)
- Approximate Sample Probehole Location (Parson Brickenhoff 2007)
- Approximate Trial Pit Location (Parson Brickenhoff 2007)

Contamination Exceedances

- PAH
- TPH
- Carbon Dioxide
- Heavy Metals

Notes:

P1	-	10.11.2020	REVISION	LM	OJ
Phase	Revision	Date	Issue	Drawn	Checked

Client:

Engie

Job Title:

Manox

Job No:

13-887

Drawing No:

035

Date:

10.11.2020

Scale:

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Zone 5 and Zone 7 Human Health Exceedances Plan

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Post Remediation gas + vapour monitoring required

Focused treatment of TPH soils and delineation of tar channel.

Focused treatment of Metalloid impacted soils.

0.80m bgl
0.038%

1.60m bgl
0.802%

1.00m bgl
0.020%

Focused treatment of Metalloid impacted soils.

Full turnover of Made Ground and 1000mm cover system within all residential gardens.



Location Symbols

- Approximate Rotary Borehole Location (URS 2004)
- Approximate Trial Pit Location (URS 2006)
- Approximate Window Sample Probehole Location (URS 2006)
- Approximate Shell and Auger Location (URS 2006)
- Approximate Trial Pit Location (ERM 2009)
- Approximate Trial Pit Location (Westlakes 2019)
- Approximate Window Sample Probehole Location (Westlakes 2019)
- Approximate Cable Percussive Borehole Location (Westlakes 2019)
- Approximate Trial Pit Location (Westlakes 2019)
- Approximate Window Sample Probehole Location (Westlakes 2019)

- Approximate Cable Percussive Borehole Location (Westlakes 2019)
- Approximate Rotary Borehole Location (Parson Brickenhoff 2007)
- Approximate Test Location (Parson Brickenhoff 2007)
- Approximate Sample Probehole Location (Parson Brickenhoff 2007)
- Approximate Trial Pit Location (Parson Brickenhoff 2007)

Remediation Issues Plan

- Hardstanding / Obstruction
- Areas requiring Treatment
- Dense Vegetation
- Asbestos hotspot requiring removal

Notes:

Client:

Engie

Job No:

13-887

Date:

10.11.2020

Drawing No:

036

Scale:

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Job Title:

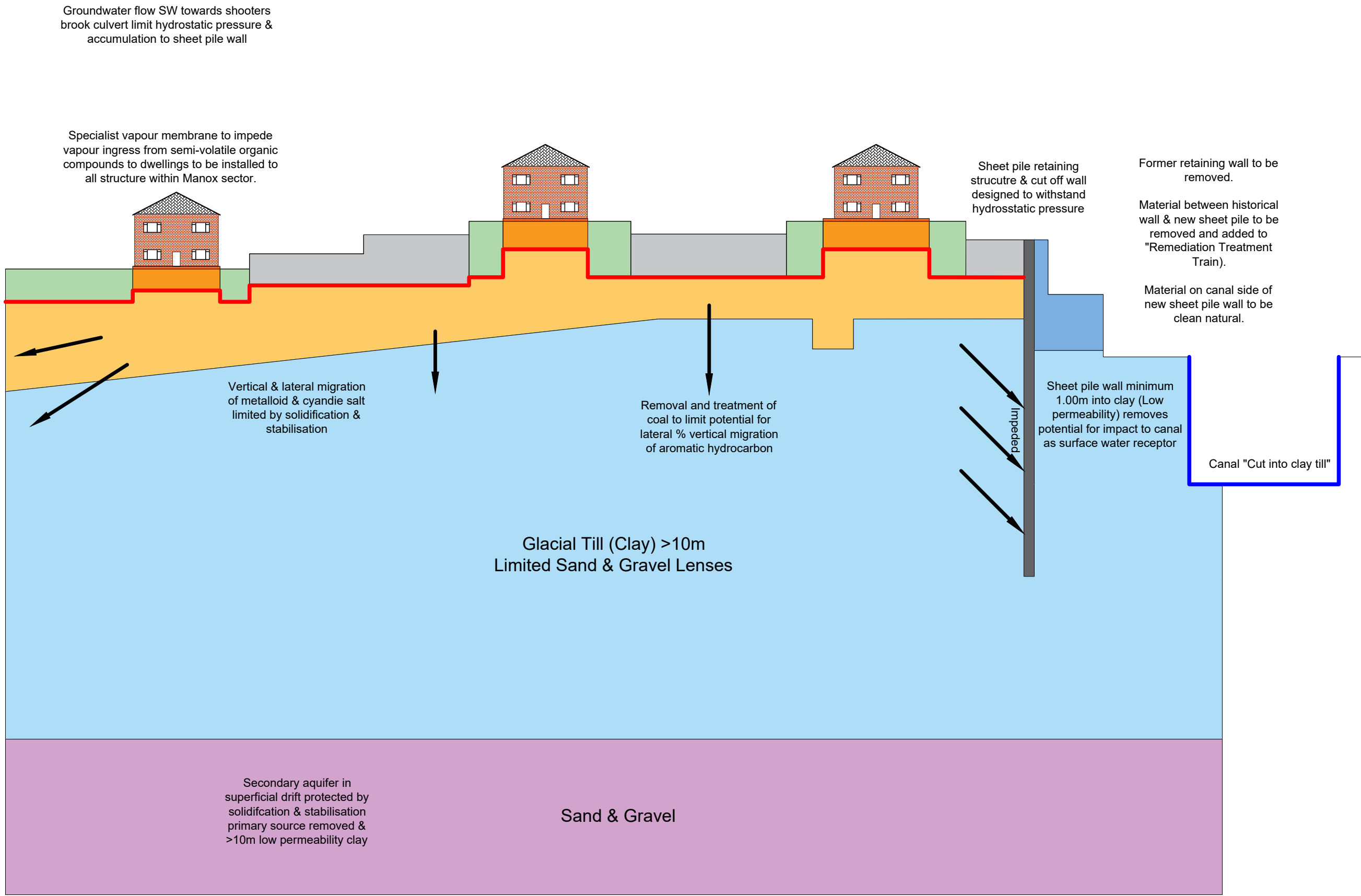
Manox

Drawing Title:

Remediation Issues Plan -
Manox Sector

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P1	-	10.11.2020	REVISION	LM	OJ
Phase	Revision	Date	Issue	Drawn	Checked



CSM Features

- Inert import & Sub-Structure
- Inert import & Highways & Driveways
- 1000mm clean cover to garden / Landscaping to remove direct exposure
- Full depth excavation of made ground across Manox site. All material enters "Remediation Train" prior to treatment, analysis & Re-use
- Glacial Till (Clay)
- Sand & Gravel
- Subformation or "Remediation platform level"
Gardens 1000mm / Roads / Drives & Plots - 750mm

Notes:

P1	-	17.11.2020	DRAFT	HM	EM
Phase	Revision	Date	Issue	Drawn	Checked

Client:

Engie

Job Title:

Manox

Job No:

13-887

Drawing No:

040

Date:

17.11.2020

Scale:

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Post Remediation
Developed Conceptual
Site Model

APPENDIX IV MCAULIFFE REMEDIATION METHOD STATEMENT

McAuliffe Environmental Ltd.

REMEDIATION METHOD STATEMENT

Job No:	MC2906
Job Name:	MANOX
Report No:	MC2906/RMS/FINAL/Rev A
Client:	Landcare (East Manchester) Limited
Site Address:	Manox - Land off Coleshill St, Miles Platting, Manchester, M40 7LE
Date:	June 2023



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Document Control

<i>DOCUMENT STATUS</i>	DRAFT FOR ISSUE
<i>DATE</i>	June 2023
<i>PREPARED BY</i>	Dr Chris Evans MSc, PhD, FGS, CEng, MICE Technical Director
<i>SIGNATURE</i>	
<i>REVIEWED BY</i>	
<i>SIGNATURE</i>	

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APPENDICES

- Appendix A:* Drawings - General
- Appendix B:* Drawings – Remediation
- Appendix C:* E3p Remediation and Enabling Works Strategy
- Appendix D:* Environmental Permit (MTL) Deployment and EA Notification Letter
- Appendix E:* Volumetric Appraisal
- Appendix F:* OBC Data/Technical Brief
- Appendix G:* SSPW Location Plan and Sealant Specification

1. INTRODUCTION

McAuliffe Environmental Ltd. (McAuliffe) have been instructed by Landcare (East Manchester) Ltd (the client) to prepare this Remediation Method Statement (RMS) for the proposed works at the site located off Coleshill Street, Miles Platting, Manchester. The aim of the report is to confirm the proposed methodology and demonstrate deliverability of a technically viable remediation solution, in accordance with the E3P Remediation and Enabling Works Strategy 13-887-R6—4, dated 28 Feb 2023, for a residential development.

1.1 Site Reference Documentation

The following documents have been used as references in the Remediation Method Statement (RMS):

URS – Contaminated Land Site Audit July 2004

URS – Phase II Site Investigation, dated September 2004

URS – Phase III Site Assessment Investigation, dated October 2006

URS – Synopsis of URS soil and Groundwater Investigation, dated November 2006

Environmental Resources Management Limited (ERM) – Northern Boundary Area Assessment Report, Former Manox Factory, dated 23rd June 2009. Ref 0098997.

RSK–Factual Ground Investigation Report, Former Manox Dye Works dated November 2019. Ref: 11432-04.

E3P – Geo-Environmental Site Characterisation Assessment. Ref: 13-887-R3, dated August 2020, Prepared for Landcare.

E3P – Outline Remediation and Enabling Works Strategy. Ref: 13-887-R5, dated June 2022, Prepared for Landcare.

McAuliffe – Stabilisation / Solidification Treatability Report. Ref: MC2906 Manox S/S Treatability, dated July 2022. Prepared for Engie.

E3P – Remediation and Enabling Works Strategy. Ref: 13-887-R6, dated February 2023, Prepared for Landcare.

2. Site Description

2.1 Site Background and Remediation Rationale

There is an established line of previous investigation works and remediation proposals associated with the site (see referenced documents within Section 1.1). Following consultation with the Environment

Agency, a Remediation and Enabling Earthworks Strategy is now being developed, considering the site investigations and contaminated land assessments previously undertaken for the site.

The site was previously subdivided into three discrete parcels to represent the differing prior land uses, for the purposes of environmental assessment, namely Manox Site, Zone 5W and Zone 7. See Appendix A.

Manox Site:- the site is approximately 3Ha and has had extensive development and a number of industrial uses including clay extraction, coal tar distillation and refining, brass foundry and textiles manufacturing. It has been used to manufacture chemicals including spent acid, cyanide-based pigments, carbon disulphide, sodium hexacyanoferrate and ammonium sulphate. It has also been used for the storage of waste products involved in the coal gas production, including iron oxide (containing toluene, benzene, thiocyanates and naphthalene) also tar waste and sulphur. All structures have been demolished, with the site primarily surfaced by concrete hardstanding. Dense woodland is present throughout the south western and eastern parts of the site. There are several stockpiles of demolition rubble and fly tipped material.

Zone 5W:- this zone is approximately 1.3Ha and has remained largely undeveloped except for some localised clay works in the south and a school. Earthworks were undertaken near the school in 1990 forming small embankments. Demolition was completed in circa 1994. The centre and western sector of the site are surfaced by hardstanding, overgrown vegetation and trees. The east of the site is predominantly surfaced by long grasses. Trees border the periphery of the site.

Zone 7:- this zone is approximately 2.0Ha and reportedly had a coal pit with a mine shaft and small spoil pit. A large portion of the site was formerly excavated for brick clay. The site was later subject to infilling, presumably with industrial and domestic waste predominantly of ash. The east of the site is currently used as a recreational area by the public and is surfaced by grassland. The west of the site is surfaced by gravel and is used by Stobart Rail as a storage compound. Trees border the periphery of the site.

Previous investigation works have revealed the presence of a range of contaminants to be present within soils and perched water beneath the site. Within the area of the former Manox facility are impacts of heavy metals, PAHs, TPHs, BTEX, cyanide and carbon disulphide. A tar channel is a primary source of SVOC, PAH and TPH, with the presence of DNAPL identified. Asbestos in the form of chrysotile and amosite, has been found within the Made Ground, which will require segregation. Zone 5W and 7 to the south of Manox have not been subject to the same historical industrial land use.

The proposed development of the site will include hard cover and the importation of certified subsoil and topsoil in areas of private gardens and landscaping (importation of clean cover and topsoil by

others), thus removing the direct contact and inhalation pathways to end users. However, remediation will be required for cyanide and the primary source of SVOC, PAH and TPH impacted soils, considered to be related to the identified tar channel.

The controlled waters DQRA P20 RTM, as summarised in Section 3 of the E3P Remediation and Enabling Works Strategy, confirms that the primary contaminant group for controlled waters for Source Area 1 (Tar Channel) is TPH aromatic C8-C35 bandings and for Source Area 2 (Manox Sector) is metalloids as both soil and groundwater remediation targets are significantly exceeded by the recorded site investigation data. .

Considering the above contaminant impacts and the primary receptors, namely the adjacent Rochdale Canal to the north and the culverted Shooters Brook to the south, the most suitable overall remediation strategy is as follows;

- Management of all soils impacted by trace asbestos fibres;
- Removal/treatment of primary contamination sources;
- Construction of physical barrier to ensure no impact to Rochdale Canal;
- Removal/treatment of impacted soils deemed a secondary source;
- Treatment of any perched water that might be recovered during excavation works;
- Validation of treated soils to demonstrate a reduction in total contaminant loading/leachability by assessment of residual contaminant concentrations and mass balance calculation for metalloids, salts and inorganics and show that all residual hydrocarbon concentrations are at acceptable levels compared to derived site-specific remediation targets (SSRT), as detailed within Section 3 of the E3P Remediation Strategy for the protection of human health, controlled waters and the wider environ;
- Construction of a suitable cover system to mitigate the risk associated with non-volatile/insoluble compounds (to be completed by others)
- All surface water monitoring will be carried out by E3P

The above will be carried out by the progressing the following outline scope of works;

1. Additional remediation treatment trials on more representative impacted soils from across the site. This will involve a series of leachate and tank tests of different design mixes;
2. Controlled removal of some trees and vegetation;
3. Removal and treatment of all invasive plant species in accordance with specialist contractor method statement, validation and independent certification.
4. Installation of low permeability sheet piled wall groundwater cut-off wall along site boundary with the Rochdale Canal (considered a primary receptor).

5. Removal/treatment of Tar Channel, with disposal of materials that cannot be treated.
6. Control/treatment of perched waters encountered during excavations.
7. Removal/treatment of any secondary source.
8. Stabilisation/solidification and/or Bioremediation treatment of targeted soil impacts.
9. Disposal of materials that cannot be treated.
10. Chemical oxidation of hotspot impacts if required to aid betterment;
11. Removal of all structures, relict foundations and buried features in their entirety.
12. Segregation of organic topsoil deemed unsuitable for use within a residential garden and placement in an area of no sensitivity or removal from site in accordance with UK waste management legislation.
13. Decommission of all interceptors, tanks and active drainage infrastructure ensuring no environmental impact.
14. Management and/or removal of all anthropogenic material impacts where practical in a controlled and legislatively compliant manner.
15. Identification, delineation and removal/treatment of organic materials within infilled ponds.
16. Removal of all materials considered geotechnically deleterious.
17. Excavation and processing of Made Ground in a controlled manner with the sorting, processing and segregation of identified deleterious materials to geotechnical specification.
18. Validation sampling and leachate testing to confirm material retained on site poses no unacceptable risk to the residential end users, controlled waters or wider environ.
19. Cut and fill earthworks to development levels.
20. Importation of suitable material (if required) to achieve the required development levels.
21. Replacement of materials in accordance with the E3P Geotechnical Engineering Specification.
22. Surface water monitoring by E3P.
23. Any groundwater monitoring required by E3P.

2.2 Summary of Ground Conditions

Site Investigation works have proved the following ground conditions to be present at the site:

Manox Site:-

- Predominantly surfaced by hardstanding concrete or asphalt and demolition rubble.
- Made Ground – rubble of brick and concrete fragments with some metal and wood waste and sandy clayey silt gravel (possible reworked natural) with inclusions of brick with ranged between 0.8m and 3.1mbgl. It was not fully penetrated in several locations (TP401, TP402, TO405, TP406, TP407, TP408, TP419 and TP421) due to the presence of an underlying concrete slab. It is likely that substructures and foundations remain.

- Drift - silty sandy clay with fragments of COAL. Granular Glacial Till was encountered from 2.6m to 5.45mbgl in WS605.
- Bedrock - dense grey MUDSTONE and SILTSTONE bands and strong grey siltstone with mudstone bands.

Zone 5W:-

- Predominantly surfaced by hardstanding of tarmac and Made Ground topsoil.
- Made Ground – site wide from ground level to an average depth of 2.0mbgl.
- Deep Made Ground - encountered in four locations at a depth greater than 2.0mbgl including 3.1m (TP415), 2.9m (TP506), 3.4m (WS501) and 4.2mbgl (CP503). Generally granular comprising brown sand and/or gravel, with some silt and clay. Gravel comprised pottery, glass, wood, asphalt, slag, clinker and coal. Ash was also noted in several locations. Full depth of Made Ground was encountered within most locations in the most recent Site Investigation.
- Drift - firm to stiff cohesive clay, which was sandy/ gravelly in places to a depth of 7.5mbgl.
- Bedrock – Upper Coal Measures of dense grey MUDSTONE with bands of SILTSTONE encountered at 26.5mbgl.

Zone 7:-

- A thin layer of imported topsoil was present beneath the turf in the recreation area to 0.2mbgl.
- Made Ground – site wide to 2.6mbgl comprising clayey sand and gravels, gravelly clays, sandy gravels and gravels of slag, clinker, brick, glass, ash, baked shale, coke, coal and occasional timber.
- Drift – encountered at most locations comprising firm to stiff cohesive CLAY to 31.0mbgl.
- Bedrock - Pennine Upper Coal Measure encountered at 31.0mbgl.

3. Remediation Implementation

3.1 General Scope of Works

After careful review of the information referenced, considering the agreed E3P Remediation and Enabling Works Strategy, McAuliffe determined that the scope for the remediation and enabling works for the development, maximising re-use of materials, will be as follows:

- Develop a site-specific health and safety plan;

- Produce a Materials Management Plan (MMP) for submission as a Declaration by a Qualified Person, to the Environment Agency as per the Definition of Waste Code of Practice (DoW CoP);
- Submit a deployment notice under McAuliffe's Environmental Permit (Mobile Treatment Licence - MTL) to detail the remediation of contaminated soils and groundwater on site. All works will be carried in compliance with the conditions within our Environmental Permit (MTL) (see Appendix D) (this has been done and the EA notification letter has been received, see Appendix D);
- Mobilise to site and establish welfare and office compound, soil treatment areas and water treatment plant;
- Collect and record background environmental monitoring data in line with the requirements of the MTL for the duration of the treatment works;
- Pre-works air quality boundary monitoring for, VOCs, dust and asbestos, before any breakout of hardstanding and earthworks commence and during the earthworks;
- Removal and treatment of all invasive plant species in accordance with specialist contractor method statement, validation and independent certification.
- General site clearance and stockpiling of all cleared surface vegetation, including the removal of any trees. Works to be conducted in line with the ecological constraints;
- Carry out additional Stabilisation/Solidification treatability studies to confirm full-scale performance on more representative soil samples from across the site;
- Installation of low permeability sheet piled groundwater cut-off wall along site boundary with the Rochdale Canal;
- Removal/treatment of the Tar Channel materials, the excavation also acting as a sump to help lower the perched water table;
- Confirm soil hotspot areas requiring targeted removal/treatment;
- Break out and subsequent crushing / processing of concrete slabs across site. Concrete to be stockpiled for processing with other hard materials;
- Break out and subsequent crushing / processing of all surface and sub-surface structures including foundations, redundant drains and any further buried obstructions (where present).
- Decommission of all interceptors and tanks using our inhouse method for the remediation of USTs, based on current APEA guidance;
- Process aggregates with requisite validation testing for asbestos ID/quantification and grading verification;
- Excavation of impacted made ground hotspot areas, screening on a 10m grid. Soils with PID readings above 10ppm will be segregated for treatment as outlined below;
- Excavation/turnover of made ground to a minimum 2.5mbegl or interface with natural ground; removing all obstructions encountered and any residual items surveyed;

- *In situ* screen to remove oversize material for processing before re-compacting back into the excavation suitable for a piled foundation solution. This activity will be overseen by a suitably experienced supervisor to identify any visual/olfactory unexpected contamination;
- Control/treatment of perched waters where encountered during excavations, with discharge to foul sewer;
- Ex-situ treatment of impacted hotspot soils identified, including organic materials from infilled ponds, using S/S and/or bioremediation for reuse on site;
- Optional chemical oxidation using OBC (refer to Appendix F) as the specific substrate for the treatment of impacted soils where required to target residual impacts if required, for enhanced betterment of conditions;
- Tracking of all material movements across the site ;
- Cut and Fill earthworks as per the Volumetric Assessment included within Appendix E;
- Provide suitable development platforms to facilitate the construction of proposed roadways, drainage infrastructure, pavements and areas of hardstanding;
- Management of all works to ensure that no environmental nuisance is created through dust emissions, noise or vibration levels. Monitor appropriately for asbestos in the stockpiles and made ground, and the necessity to ensure airborne fibres are not released (all in accordance with our permit conditions);
- Complete a validation report on completion of the works in accordance with this method statement and the agreed remediation strategy, including representative testing of soil and water throughout the works and recording of environmental conditions.

3.2 Ex-situ S/S treatment of Contaminated Soils

Where the delineation investigations have identified concentrations of the contaminants of concern (CoC), namely TPH, PAH, cyanide and metalloids, above the SSRT, the material will be subject to S/S and/or bioremediation, depending on levels of contamination and the combination of CoC present, to meet the acceptable leachability targets and/or on-site re-use targets (see Section 5). An indicative hotspot location plan is included in Appendix B. This work will be conducted under the deployment of the McAuliffe MTL, submitted to the EA in advance of the work.

S/S Process:-

S/S treatment is a physicochemical process used to convert contaminated soils, liquids and sludges into chemically and physically stable solid material, producing effective immobilisation of contaminants with the use of binding materials and additives. The destruction or removal of the contamination is not the objective of S/S. It is effectively two processes in one:-

- Solidification - involves the reduction in mobility of the contaminated material by the mechanical encapsulation of contaminants within a monolithic solid. It reduces the ingress of any potential transportation agents and improves certain engineering properties of the material i.e. increases the strength, decreases the permeability and decreases the compressibility. A range of binding materials is commercially available including cementitious materials, silicates, lime, thermoplastics and polymers.
- Stabilisation - involves the use of additives to chemically fix the contaminants in order to minimise the rate of contaminant migration and reduce the level of the toxicity. The stabilizing agents tend to be contaminant specific, being used to treat certain organics, inorganics and/or heavy metals.

S/S treatment provides both a physical and chemical encapsulation, so if at any time the physical integrity of the S/S material is breached, the contaminants would still be chemically bonded to the stabilising agent.

There are certain physical and chemical mechanisms that are involved in S/S treatment. These include:-

- Macroencapsulation - contaminants are physically entrapped in discontinuous pores within the structural matrix of the solidified material;
- Microencapsulation - contaminants are entrapped within the crystalline structure of the solidified material;
- Absorption - liquid contaminants are soaked up by a sorbent material (sponge-like action);
- Adsorption - contaminants are bonded electrochemically to the surface of the stabilising agent
- Precipitation - this is applicable to the treatment of metal contaminants in solution where they are precipitated out into less mobile and less hazardous forms, such as hydroxides, sulphides, silicates, carbonates and phosphates; that are then contained within the solidified material.

Long-term Performance:-

Treatability studies, using the contaminated source materials from the site, although conducted over a relatively short time scale, are enough to understand the behaviour of the mixes and eliminate the potential for failures following full-scale treatment works. A fundamental aspect of the testing regime is that worst-case leachate testing can be undertaken on the treated materials, in the form of batch leachate tests, as the sample preparation involves a reduction in the particle size/structure of the S/S samples, thus eliminating the macroencapsulation aspect of the treatment and so relying solely on

chemical fixation processes at the microencapsulation level. This is beneficial in understanding potential longer-term behaviour should weathering effects impact on the materials in the near surface ground. Particle reduction seeks to simulate more extreme effects of mechanisms, such as carbonation, sulphate attack and freeze-thaw, which might reduce the physical integrity of the material depending on severity. This, therefore, provides an understanding of the effects of worst-case leaching potential. As data from most on-site studies is only available for a maximum of 20 to 30 years, reliance is placed on the results of modelling in order to provide confidence in the much longer-term performance.

Full scale remediation works:-

- McAuliffe have already carried out significant bench trials on the worst case impacted soils on site, which have demonstrated the level of betterment that can be expected in the full-scale works, using a selection of mix designs (see McAuliffe Stabilisation/Solidification Treatability Report, MC2906 Manox S/S Treatability, dated July 2022, included in Appendix VIII of agreed E3P Remediation and Enabling Works Strategy Report). However, additional treatment trials will be carried out on more representative, impacted soil samples from across the site in advance of the main remediation works, to determine the most appropriate S/S binder mix formulation for majority of soils to be treated.
- Establishment of S/S treatment zone. The area will be prepared with a low permeability formation to reduce infiltration from contaminated soils. The area will have a segregation plan for the most contaminated material which will be clearly marked and recorded by the Remediation Engineer. The treatment zone will be bunded to mitigate the surface run off;
- Material will be loaded into a dump truck and placed in a stockpile in the S/S treatment zone marked 'Initial Screening Area';
- Material screening to remove oversize and mid-size hard or deleterious material. Stockpile separately the smaller fractions into 250m³ stockpiles within the S/S treatment zone for preliminary characterisation, under a strict stockpile tracking management system, using unique identifiers;
- Mix admixtures homogenised into screened soils at appropriate ratios, based on treatability study work, using mechanical excavator and specialist mixing tool attachment and/or batcher plant ensuring homogeneity is achieved. Dust suppression will be applied to the mixing area to protect operatives from airborne dust. Toolbox talks and exclusion zones will be implemented;
- Collect validation samples of the material for testing – refer to Section 5 for validation requirements;
- Treated material is to be loaded into dumper trucks and laid in the 'wet' state and surveyed in position;
- Material movements will be tracked and recorded throughout the S/S treatment process by the Remediation Engineer.

3.3 Ex-situ Bioremediation of Contaminated Soils

Screening of materials with volatile phase constituents will be carried out to assess suitability for bioremediation treatment. Soils will be placed in bunded and lined treatment areas, covered if required and treated until concentrations are proven to have reduced enough to meet remedial targets for re-use on site. Accelerated natural aerobic degradation will include pre-treatment during soil homogenisation using liquid nutrients, oxygen enriched water, bacteria or fungi followed by placement into managed windrows, where temperature, humidity, pH, redox potential, moisture content and nutrient availability are strictly controlled to ensure optimum conditions are maintained for degradation to occur.

The location of each windrow will be marked out on site and clean material placed along a boundary with an excavator to form a single long bund to an approximate height of 1m. Further bunds will be placed perpendicular to this bund to create separate windrows for different categories of soil material, as required. Identification markers will be used to display the different materials accordingly. If the base ground has no natural slope a slight fall between 3-7 degrees will be graded to ensure leachate and surface water runs off in one direction. Where applicable, a small French drain and collection sump will be installed to enable collected leachate and water to be pumped to temporary storage tanks for either re-use during dosing or transfer to the on-site water treatment plant.

Mechanical turning will be carried out periodically using an excavator, to enhance oxygenation and to add water and/or nutrients. The windrows will be covered with heat retaining fleeces to ensure optimum conditions are maintained for thorough degradation of contaminants. Treated material to be loaded into dumper trucks and placed as required, then surveyed in position. Material movements will be tracked and recorded throughout the treatment process by the Remediation Engineer.

All material movements will be tracked and recorded throughout the treatment process by the Remediation Engineer. All stockpiles will be formed with good housekeeping in mind, covered as appropriate and best practicable measures utilised to keep stockpiles from being visible from external lines of sight beyond the boundary walls and/or fence heights. Adequate signposting will be provided for the identification of stockpiles.

Haul roads will be kept clean and in good order. A traffic light system will be used on stockpile identification markers:

Green: material suitable for re-use on site or disposal;

Orange: materials undergoing treatment;

Red: suspected contaminated materials prior to determination by testing.

3.4 Chemical Oxidation as required

There is a low risk of CS₂ impacted soils to be present in some isolated locations across the Manox site. It is highly volatile and extremely flammable, having a wider explosive range in air than hydrogen and a lower ignition energy (LEL >1), with an odour of rotting cabbages. When it has been identified as present in a location, in accordance with the consultant's discovery strategy, the area will be isolated and activated persulphate oxidant (Oxygen BioChem - OBC) will be injected into the subsurface to degrade the CS₂ in a controlled manner. The approach avoids the production of heat or off-gas and avoids the requirement to excavated soils and prevents the health and safety problems associated with handling CS₂ impacted soils. Chemical oxidation will also be used to target other CoC impacted hotspots if required to aid the betterment of conditions.

Oxygen BioChem (OBC) is a mixture of sodium persulphate and calcium peroxide that can be used for both *in situ* and ex-situ applications. The mixture supports a two-fold mechanism for destroying contaminants of concern by delivering a peroxygen for short term oxidation, as well as delivering electron acceptors (oxygen and sulphate) for longer term biological oxidation. The predominant short-term reaction is chemical oxidation, while the longer-term remediation process is biological oxidation. Activated persulphate can remain available in the subsurface for months providing a combination of power and stability. The addition of calcium peroxide provides several benefits. First, it imparts alkalinity needed to activate the persulphate. Second, when mixed with water it provides a long-term slow release source of hydrogen peroxide and calcium hydroxide. The hydrogen peroxide that is slowly formed decomposes to oxygen and water, providing an extended oxygen source for subsequent bioremediation of organics.

OBC™ has the advantage over traditional oxygen compounds used for bioremediation in that it works on a broader range of contaminants which include TPH, BTEX, MTBE, PAH and chlorinated solvent contamination. The typical plant set-up for this approach if utilised would include the following:-

Geoprobe direct push injection rig

Mobile chemical mixing plant

Water storage tanks

Associated bunding and pipework

The proprietary reagent, OBC (see Appendix F for data sheet) will be delivered to site in powder form and placed in a designed chemical storage area near the proposed application location, within the secure boundary of the site. A mobile mixing plant will be used to dilute the reagent in batches, to the required solution concentrations in accordance with the task specific RAMS.

3.5 Installation of low permeability groundwater cut-off wall

A groundwater cut-off wall will limit dissolved phase contamination migration on/off site along the boundary with the Rochdale Canal, stated as a primary receptor, as shown in the plan included within Appendix G. This will be installed to key into the cohesive Glacial Till, so a depth to toe of 1m embedment into the clay or deeper if required by the retaining design.

To achieve the low permeability groundwater cut-off, a sealed clutch steel sheet piled wall will be installed following the methodology below (see sealant specification in Appendix G) :-

The crane will pick up the first pile using a pitching shackle connected to the top of the pile, the pile is then lowered so in contact with the platform, at this point the rig will be tracked into position and under the instruction of the Supervisor the reduced vibration leader rig vibro-hammer is slewed over the head of the pile, the hammer is lowered, jaws clamped to the head of the pile, a final check is then made to ensure all is secure, the quick release shackle is then released – the Leader Rig has control of the pile.

At no point must anyone walk under or be positioned under a suspended load.

All operatives must be clear of crush zones prior to commencement of lifting.

The slinger signaller must be separated from any lifts, but still maintaining visual contact with the crane operator at a safe distance.

The pile is then moved by the Leader Rig into the correct position with the aid of a laser the pile is positioned along the correct alignment.

Once aligned correctly the pile will be driven approximately 1.0m into the ground before being checked for verticality and position.

After checking the pile for line and level, the pile is then driven further and is then periodically checked for line and level and corrected as necessary.

The installation Supervisor must ensure that he is in a place of safety once vibratory installation commences, which will be behind the exclusion zone barriers – crowd barriers.

However, to allow the Supervisor to check pile line and verticality, he must intermittently stop the vibratory installation and check the sheet pile.

Once driven to the required intermediate level the hammer is then released and the rig slews out of the way.

The next pile and all subsequent piles are picked up using the ground release pitching shackle fixed to a pitching hole in the top/centre of the pile.

The pile is picked up to the vertical position and pitched into the interlock of the previously driven pile.

Once the pile is interlocked the shackle is released and the hammer is re-positioned on top of the pile gripping the head of the pile in the jaws.

This pile is then driven to the same level as the initial pile before releasing the hammer and slewing the rig away to allow the next pile to be pitched. Pre-augering will be carried as required.

3.6 Excavations (General)

Slabs butting up to adjoining structures will be assessed to ensure a clean, natural separation will occur (sometimes on a nearby joint), if required a saw cut will be made. The presence of any voids, basements, cellars, machine pits & service trenches etc below the slab will be assessed by the Site Manager to ensure the machines operate on solid / stable ground.

Where applicable the method & sequence of works will consider retained / sensitive underground services.

To safeguard against flying fragments and debris the area will be contained as far as is practicable - personnel and / or the public will be kept away from plant operation by use of a banksman or exclusion fencing. Additional screens, such as Heras fencing with debris netting are to be erected close to the activity when the risk of flying fragments increases e.g. when using hydraulic breakers.

The excavator will puncture holes across the surface to weaken the slab, the number of holes required will depend on the condition of the slab and any existing weak spots e.g. cracks, joints etc. Using a bucket or ripper tooth the slab will be lifted. This allows the slab to break up along the puncture lines under the mechanical strength of the excavator to avoid excessive use of the breaker and minimise vibration.

Deeper foundations present within the footprint of the building will be removed whole where possible. If required the foundation will be hammered *in situ*, broken up and dug out. Tarmac roads and car parks will be lifted in a similar manner to slabs, although the use of a breaker is likely to be less frequent. As slabs and foundations are removed they may be further processed in preparation for crushing on site. Resultant ground openings and voids will be locally regraded or backfilled with suitable site won material, such as crushed demolition arisings, to provide a safe and level site ready for any follow-on works, as required.

Known localised areas of contamination & hotspots will be marked on site and targeted for removal and segregation ahead of other works to prevent cross contamination with other areas. 360° excavators will dig out the contaminated material to a predetermined level (using GPS) assessing the quality of soils for future processing.

Unsuitable material will be separated & stockpiled or loaded directly into an awaiting ADT. Suitable fill areas will be prepared ahead of hotspot excavation where possible so that material can be placed directly to fill, negating the need for separate quarantine. If this is not possible, materials will be segregated and quarantined as the procedure below.

Removal of the hotspot will be validated with the base & sides of the hotspot excavation sampled and tested for contaminants of concern. If validation is not achieved, further excavation will be carried out to remove contamination and the testing process repeated until the base & sides are validated.

When unknown hotspots are discovered e.g. following the removal of any USTs or for other visual hotspots, these will be marked on site and the following procedure adopted:

- A bunded quarantine area for each type of contamination will be constructed on an impermeable surface
- The hotspot material will be excavated down to known depth of contamination, or as directed by the site consultant or a geo-environmental engineer, and placed in the quarantine area
- Typically, the hotspot should be excavated to form a square approx. 2m x 2m min. to enable the base and sides to be inspected and tested for validation
- Inspection & testing for validation will be by the consultant or a geo-environmental engineer
- The excavation is to be surveyed, left open and fenced off until such time as laboratory results are received to validate the base and sides
- If validation is not achieved, further excavation will be carried out to remove contamination and the testing process repeated until the base & sides are validated
- Analysis of the quarantined materials will be carried out to determine a further course of action (i.e. treatment, re-use on site or disposal).

3.7 Pump and Treat System for perched groundwater

It is intended to have a full-time water treatment plant during the remediation works on the Manox site to enable on going treatment of perched waters and achieve the potential concentrations required to enable discharge of treated perched waters to foul sewer. GeoStream, a wholly owned subsidiary company, has designed a Physico-Chemical water “treatment train” solution with a suitable capacity to deal with the current known contaminants of concern. Following the system build, located on a suitably prepared hardstanding/platform, it will be optimised and commissioned ready for use. An outline schematic of the proposed processes is included within Appendix B.

Perched waters generated by sump pumping from excavations, including the tar channel, will be piped to our on-site groundwater treatment plant (gwt). The water will initially be collected into an equalization tank of circa 10m³. DNAPL will be removed here for off-site disposal. Waters will be then pumped to the physico-chemical section of the plant, incorporating alkaline chlorination, flocculation and coagulation processes, in order to treat the metals. This will be followed by sedimentation and filtration, incorporating sand filter, oxide-hydroxide filter (As polishing) and GAC (organic adsorption). This state-of-the-art plant will ensure compliance at the discharge point. Testing will be carried out accordingly.

The intention of the water treatment plant is to remove any latent contamination present within the perched water which effectively flushes the site in a controlled manner allowing the natural recharge with cleaner groundwater. This will also assist with excavation of known hotspot areas and also dealing with any unidentified areas of contamination encountered during the controlled turnover of the site and removal of obstructions. This combined with the treatment of the source contamination in the soils will

provide significant betterment. Records of the volume of treated water / throughput will be provided as part of the validation process.

3.8 Unexpected Contamination

Some asbestos impacted materials have been identified in the site investigation works. However, it is also possible that hotspots of additional unexpected contamination will be identified during the full turnover and remediation excavation works. Therefore, a suitably experienced supervisor will supervise the works with a watching brief. Visual or olfactory evidence of contamination identified during this supervision is likely to be either ACM, volatiles (VOC/TPH) or blue staining associated with cyanide complex oxide impacted soils. The approaches to be adopted are as follows:-

ACM

- All McAuliffe operatives on site will have Category 2 asbestos training (identification and handling non-licenced ACM);
- All works will follow guidance from CL:AIRE CAR-SOIL;
- On discovery, works will stop and the remediation engineer/site manager be informed;
- ACM will then be picked and removed with according to classification:
 - Non-licenced ACM – McAuliffe staff to pick, remove and bag asbestos and place in appropriate waste skip;
 - Licenced ACM – McAuliffe subcontracted licenced asbestos company will be employed to pick and remove the ACM into bags and an appropriate waste skip. This may require prior notification;
- If the material is at depth, the soils will be excavated to bring material to the surface on an area of hardstanding or lining to be picked at ground level;
- Picked material to be placed in an area of the site with a low risk of future disturbance following the conceptual model in the E3P Remediation Strategy;
- Dust suppression will be applied to the material during movement and before picking;
- Suitable PPE/RPE will be worn prior to operatives picking ACM contaminated materials;
- Samples of the base and sidewall will be collected and analysed as validation of the excavation;
- The excavation and placement area as will be surveyed in position for the validation report.

Volatile (VOC/TPH) and visually impacted contamination

- Any soils significantly impacted with VOC/TPH (to be assessed with hand-held PID) or visually stained, will be treated on site for re-use, as part of the works using S/S;

- Impacted soils will be excavated under supervision of a remediation engineer (e3p) until the vertical and horizontal extents have been sufficiently removed;
- The sidewalls and base of the excavations will be sampled for validation reporting;
- Excavated material will be sampled for baseline concentrations and transported to the treatment zone and quarantined accordingly, with unique identifiers for stock management and tracking;
- Procedures will follow those described previously for S/S works;
- Excavation extents and placement locations of remediated material will be surveyed for validation reporting.

Underground Tank Removal

- On discovery of unexpected underground tanks, prior to removal of tanks, contents will need to be identified to determine an appropriate method to clean, de-gas and remove. Removal of contents will be carried out under a separate method statement, specific to the work and according to the identification of tank contents;
- Following the removal of tanks, a visual and olfactory inspection will be carried out to the underlying soils and side walls for any evidence of contamination leakage. Any contaminated soils will be assessed for requirement for treatment, with initial screening using a hand-held PID and will be removed and placed in the soil treatment area as outlined above. Confirmatory soils sampling will be undertaken to ensure no contamination is present above agreed target values;
- If on-site soil treatment is required, this will be out under McAuliffe's Environmental Permit utilising bioremediation techniques or S/S;

4. Permits and Regulations

The remediation and reuse of materials on site will be notified to the Environment Agency through two means:

1. The use of a Materials Management Plan (MMP) as per the Definition of Waste Code of Practice (DoW CoP), signed off by a CL:AIRE Qualified Person (QP);
2. The deployment of the McAuliffe Mobile Treatment Licence (MTL).

The MMP will detail exactly how the material from site will be reused and should be read in conjunction with the MTL deployment. The stockpiles of demolition rubble and fly tipped material will be specifically referenced within the MMP, along with plans and schedules for material movements across site. The MMP will satisfy the validity of the reuse of material on site in accordance with UK Waste Regulations through CL:AIRE, the administrative body for the DoW CoP. Any imported material to make up

development levels will be assessed and reported as a direct transfer into the site, ensuring that only clean, naturally occurring materials are used. No excavation works shall begin until the QP declaration has been accepted by CL:AIRE by way of receipt.

The verification report for the remediation works will include a section for the MMP, where the reuse of all material on site will be proven in accordance with the original plan. Evidence of all materials tracking across site and within the treatment zones, will be recorded and reported, along with any pertinent laboratory analysis.

Actions for the presence of unexpected contamination will also be identified in the MMP document, including handpicking of asbestos contaminated soils, remediation of volatile and visually impacted materials. The MTL has been submitted to the regulators for acceptance in advance of any remediation work being undertaken, with the subsequent EA acceptance notification letter included in Appendix D for reference.

A treated water discharge consent will be obtained from United Utilities.

5. Testing and Validation

5.1 Proposed Validation Testing

Validation testing protocol will be in accordance with the agreed E3P Remediation Strategy. See below remedial targets for protection of Controlled Waters. Leachate targets will be as those for waters. The Human Health remedial targets are presented in Appendix IV of the E3P Remediation Strategy. Each validation sample will be evaluated depending on their place of reuse on site.

SITE SPECIFIC REMEDIATION TARGETS FOR THE PROTECTION OF CONTROLLED WATERS

Contaminant	Level 3 Remedial Target Concentration		
	Soils (mg/kg)	Waters (mg/l)	Waters (ug/l)
Source Area 1 – Tar Channel			
TPH Aromatic C8-C10	1060	0.854	854
TPH Aromatic C10-C12	1920	0.959	959
TPH Aromatic C12-C16	30.8	0.0102	10.2
TPH Aromatic C16-C21	717	0.164	164
TPH Aromatic C21-C35	18300	0.456	456
TPH Aliphatic C8-C10	304000	12.8	12800
TPH Aliphatic C10-C12	1.99 E+07	119	119000
TPH Aliphatic C12-C16	4.01E+06	0.796	796
TPH Aliphatic C16-C21	3.79 E+09	0.695	695

TPH Aliphatic C21-C35	3.79 E+09	0.695	695
2-methylnaphthalene	3340	164000	164000000
Carbazole	2.89E+8	6.84E+12	6.84E+15
Dibenzofuran	2.89E+8	6.84E+12	6.84E+15
Source Area 2 - Manox			
	Soils (mg/kg)	Leachate (mg/l)	Leachate (ug/l)
Arsenic	1090	2.18	2180
Cyanide	219	2.18	2180
Copper	21.9	0.218	218
Lead	1090	2.18	2180

The E3P testing frequencies are shown below.

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Site-Generated		
Site-Generated 6F2	1 Sample per 1000 m ³	A/B/C/D
Site-Won Made Ground General Backfill	1 Sample per 250 m ³ (if contamination identified)	G
Site-Won Made Ground General Backfill	1 Sample per 1000 m ³	A/B/C/D
Site-Won Made Ground General Backfill	1 Sample per 2000 m ³	I
Site-Won Natural Backfill	1 Sample per 2000 m ³	A/B/C/D
Site-Generated Subsoil (450 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Site-Generated Topsoil Cover (150 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Hotspot Validation Samples	1 Sample per 10 m of linear excavation to base and sidewall	E/G
Cyanide Contaminated Materials	1 sample per 500m ³ 1 sample per 1000m ³	J K
Imported		
6F2	1 Sample per 1000 m ³	A/B/C/D
Subsoil Greenfield Source (450 mm Garden Cover)	1 Sample per 200 m ³	A/B/C/D
Subsoil Brownfield Source (450 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Topsoil Greenfield Source (150 mm Garden Cover)	1 Sample per 200 m ³	A/B/C/D
Topsoil Brownfield Source (150 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 1000 m ³	A/B/C/D

Suites of Analysis:

- A. Speciated PAH.
- B. Speciated TPH (C5-C35).
- C. Asbestos (ID).
- D. CLEA Inorganic Heavy Metals.
- E. Speciated PAH, Banded TPH and VOCs.
- F. SVOC/Speciated TPH/Speciated cyanide.
- G. On-Site Screening for VOC Using Calibrated PID.
- H. Leachate 2:1 Speciated PAH and Banded TPH.
- I. Leachate Analysis of Inorganic Heavy Metals, TPH, Sulphate and PAH.
- J. Leachate Analysis of Inorganic Heavy Metals (specifically free and complex Cyanide)
- K. 64 day tank tests

This will include the following for treated soils, to be carried out over the course of the works, to inform the performance monitoring and validation reporting.

Post-treatment validation testing of S/S treated materials will be :-

TPH, PAH, Sulphate and Heavy Metal impacted materials - batch leachate testing at a frequency of 1 sample per 2,000m³.

Cyanide impacted materials – batch leachate testing at a frequency of 1 sample per 500m³ and tank testing at a frequency of 1 sample per 1000m³

The above requirements will be assessed based on the CoC with the highest concentrations in the pre-treated materials.

Post-treatment validation testing of Bio-treated materials will be based on solid testing for TPH and PAH at a frequency of 1 sample per 2000m³.

Surface water monitoring will be carried out by E3P in accordance with the Remediation Strategy. We note, however, there is no requirement for groundwater remediation on site, only to treat perched waters for off-site disposal.

Any imported materials will be tested in accordance with the E3P Remediation Strategy.

All geotechnical testing will be in accordance with the E3P Geotechnical Engineering Specification, included within the Remediation Strategy.

5.2 Validation Reporting

The validation report will provide a complete record of the remediation activities undertaken at the site and the data collected as part of the verification plan to support compliance with remediation objectives and criteria. It will also include descriptions of the works with associated 'as built' drawings and details

of any unforeseen conditions encountered during the works and how they were dealt with. The report will detail the following:

- Detailed surveys of all excavations and production of as-built drawings for the earthworks;
- Soils and groundwater treatment undertaken;
- Post-treatment validation results;
- Copy of consignment notes relating to the movement of wastes to a licensed waste management facility;
- Detailed drawings showing all sampling locations for both chemical and geotechnical testing;
- Detailed photographic log of the works;
- Chemical test results;
- Geotechnical test results;
- Details of qualified persons signed declaration; and
- Monitoring results (e.g. asbestos in air, water).

6. Nuisance Mitigations

Monitoring for environmental nuisances will be a requirement of the works, including background monitoring of the site perimeter. This is covered and outlined as part of the requirements of the Environmental Permit (MTL) which will be implemented before any remediation works are undertaken. General items for control of dust and noise are as follows:

6.1 Dust Control

Mains water sourced on site will provide the water feed and the quantity of water emitted will be regulated and controlled to prevent any flooding at ground level (if mains water is unavailable a licensed standpipe will be used, provided hydrants are available and accessible).

Depending on the level of dust generated, either or a combination of the following dust suppression methods will be utilised:

- Dust Fighter unit: creates a mist curtain to prevent dust migration with a 30-40m range
- Water cannon (like dust fighter units)
- Piped water feed to spray bars fitted to demolition plant (e.g. high reach excavators, crushers)
- Fire hose / hose pipe used by an operative from a strategic but safe place (may involve using a MEWP to target the water from the most effective position)

Dust monitoring will be undertaken periodically to confirm the control measures in place are effective. If required, methods and control measures will be reviewed if dust levels become excessive or are

elevated unacceptably during the works. Consideration of current and forecast weather conditions will also be made e.g. wind speed, direction, rain.

6.2 Noise Control

The noise generated by site activities (plant movement/crushing process) is comparable to road noise at the site boundary. Treatment zones will be towards the centre of the site away from the receptors on the boundary. Noise assessments will be carried out as required to determine ear protection zones. Plant noise will be managed by maintaining operating times to outlined planning condition site hours and using low impact silenced or enclosed generators where possible.

6.3 Odours and VOCs

Odours and VOCs (treatment soils and perched waters): As well as monitoring for emissions around the treatment area, boundary monitoring will also be conducted regularly to assess impact for off-site receptors (see sections below and monitoring location plans as included in Appendix A). Should concentrations of VOCs in the ambient air around the treatment area exceed 10ppm, processing of the material will halt, and all stockpiles covered to prevent odour release to the boundary.

6.3.1 Olfactory/Odour Monitoring

Training will be given to all relevant persons to make sure they are competent in completing olfactory assessment forms to ensure sufficient monitoring and reporting of odours can be carried out.

Qualitative monitoring will be carried out daily as a minimum. This information will be captured with other emissions data such as dust and noise levels at 6no. boundary monitoring points located around the site, and also at up to 4no. monitoring points in and around the treatment area. Odour levels will also be gauged at the work face during phases of excavation. Wind direction will also be monitored.

Olfactory testing will be routinely carried out by competent staff. The assessor should not:

- Smoke or consume strongly flavoured food or drink for at least 30 minutes before the assessment;
- Consume confectionary or soft drinks immediately before the assessment, or,
- Apply scented toiletries, such as perfume or aftershave immediately before an assessment.

Starting points of assessments should be downwind of the site, progressing towards the site boundary and then away from the site in an upwind direction. The person carrying out the assessment should walk slowly and breathe as normal.

6.3.2 Complaints Monitoring

All odour complaints will be investigated promptly and appropriate remedial action will be taken if the complaint is validated. Complaints will be recorded and retained on file.

Complaints to the Local Authority / Environment Agency will also be recorded and taken into account. An olfactory assessment survey will be carried out from where the complaint was made and from any convenient locations between the complainant/receptor and the site so that the complaint is quantified.

6.3.3 Contingency and Emergency Plans

In accordance with the Environment Agency's guidance, contingency plans will be put in place to react to situations where monitoring indicates that a potential odour source is not completely under control, meteorological conditions are unfavourable or that adverse impact has occurred.

If excessive odours are detected at the site boundary, other monitoring point, or a complaint is received, the following remedial procedures will be taken:

- Firstly, identify the odour source; is it from:
 - Site operations; or,
 - An off-site source.
- Secondly, if on site:
 - Report incidence to the site or technically competent manager;
 - Identify the point of release of the odour;
 - Identify the cause if the release i.e. machine breakdown, leakage, etc.;
 - Identify a solution;
 - Implement the solution;
 - Carry out olfactory tests to check the mitigation measures are working;
 - Record actions taken on relevant forms and site diary as required by this plan

The actions to take if odour is being produced on site will be:

- a) Normal Operations: The offending odour will be traced and the reason for the cause of the problem will be investigated. Once solutions are in place, olfactory monitoring will

be carried out to ensure the solutions put in place are having the desired effect.

- b) Abnormal Conditions: Adverse weather conditions can promote generation of odour and inhibit its effective dispersion e.g. hot weather with little wind, resulting in increased risk of odour to receptor locations. If this happens odour causing operations will be minimized until more favourable meteorological conditions return.

6.3.4 Corrective Actions for Various Situations

The table below summarises the various problems likely at the site and the standard responses available, which will assist in reducing odour potential.

Process	Problem	Corrective Action
Excavation/treatment	Odours due to material being excavated and processed	Consider stopping works or dampening down area with odour neutralizing product & atomizer plant. Olfactory test to be conducted to pinpoint source of odour & ensure contingency and emergency plans are adhered to in full.
Arisings/Groundwater Processing	Odorous emissions detected	

6.3.5 Local Community Liaison - Odour Panel

In the extreme event of a significant odour release, neighbours will be contacted to advise them of the situation and the action being taken.

An open-door policy will be encouraged to enable any complaints from neighbouring premises, if received, to be dealt with immediately. The complainant will then be notified of remedial actions taken and any procedures or measures put in place to reduce or ideally eradicate the likelihood of a subsequent complaint.

Volunteers will also be sought from the local area to form an odour panel to provide an impartial assessment of the odour levels coming from site. Information on how to become part of the odour panel will be included in the letter notification that will be distributed around the local area ahead of the commencement of site works.

6.4 Monitoring

Boundary monitoring and point source monitoring locations, together with specific monitoring frequencies, are shown in the Sensitive Receptors Risk Assessment in the Environmental Permit Deployment in Appendix D. Also, included are the Monitoring Location Plans. The site is currently unoccupied and there are no emissions of known pollutants.

Background monitoring for VOCs, dust and noise will be quantified prior to full scale works starting to contextualise the likely impact of emissions on sensitive receptors (see Sensitive Receptors Risk Assessment in Environmental Permit Deployment in Appendix D) .

Emissions monitoring for site will be conducted for VOCs/odours will include for olfactory, hand-held PIDs and static Maybe units. A trigger level of 1ppm above background concentrations will be adopted for emissions monitoring, based on the HI Guidance for relevant trigger level. Qualitative assessment of any odours will be made during the boundary monitoring recordings collected each day and acted on swiftly by thorough assessment of specific and unexpected site conditions as and when they occur. Consideration to neighbouring land use will be considered in the planning of any stockpile placement. Should limits be exceeded, works will immediately stop until the cause has been confirmed and alternative fugitive emission control measures have been put in place.

Dust monitoring at the boundary monitoring points (see Monitoring Location Plan as detailed above) will be conducted, with 200mg/m³ suspended solids the exposure limit for the dust concentrations, in line with M17 Guidance. Real time dust monitoring will be conducted, using 6no. monitors, to monitor this boundary emission during all treatment operational working hours (specifications to follow). This will be backed up with qualitative assessment of dust emissions with implemented control measures such as water suppressant applied as appropriate and recorded. Should emissions exceed the limits then additional control measures should be put in place prior to works continuing in the same manner, i.e. additional water suppressant, review of site conditions and working operations etc.

Noise monitoring will also be conducted at the boundary points daily to ensure that 5 dB above background levels are not exceeded. Background levels will be collected on the initial days of operation and averaged to give a suitable baseline figure. Noise levels will be monitored using a digital sound level meter calibrated according to the manufacturer's instructions.

All results will be reported to the McAuliffe Project Manager, site manager and appointed WAMITAB TCM to interpret the data and advise on necessary measures for site operations and operatives in the event of exceeding the boundary conditions. The Project Director has over 25 years' experience in remediation, the Project Manager is a Chartered Member of CIWEM and a Chartered Scientist with 8

years' experience of contaminated land and remediation and the Site Manager has 15 years' experience of remediation projects. In the event of all exceedances of boundary emissions detailed above, site works are to halt immediately until an agreed solution is determined and tested prior to full-scale operation returning.

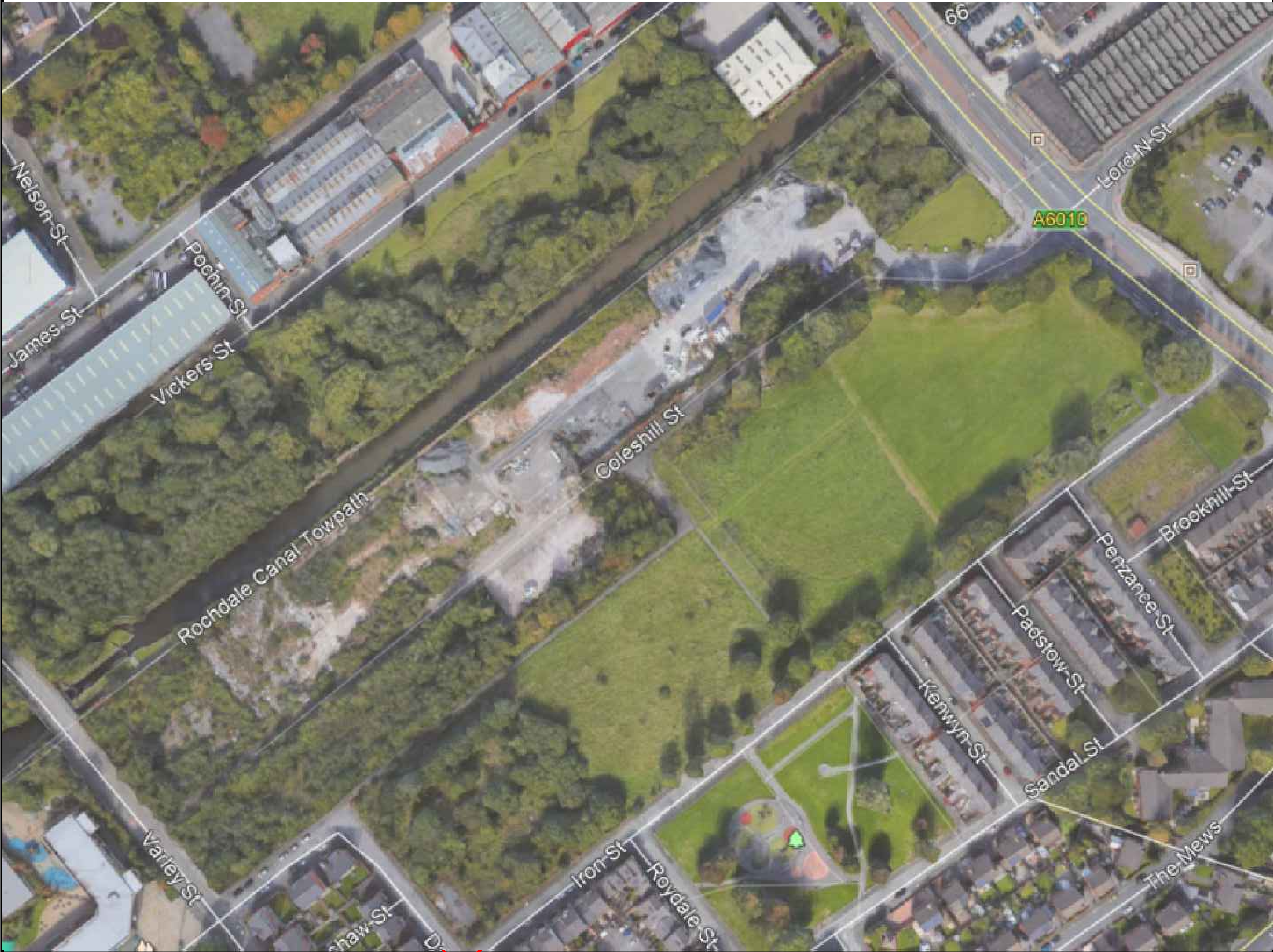
Due to the relatively close proximity of residential dwellings, asbestos in air monitoring in accordance with HSG248 may be required to confirm that no asbestos fibres have been generated from the enabling works activities. Where asbestos is identified, the airborne emissions will be monitored by an experienced environmental analyst holding UKAS accreditations to guarantee competence in the role including the relevant amount of experience. The CL:AIRE CAR-SOIL guidance document determines from the Control of Asbestos Regulations 2012 that the appropriate fibre concentrations based on a STEL of 10 minutes is 0.6 f/cm³ of air. This monitoring will only be applied in the event of bulk asbestos identification or licenced asbestos identified requiring removal.

In the event it is required, the analyst will set up boundary monitoring positions around the work area at the site boundary and collect samples of airborne asbestos fibres once per day from the work area and personal monitor if required. Should the exposure limits be exceeded then the works will stop immediately to assess the viability of additional damping down or selecting a more appropriate scope of works for the remediation. Background concentrations of asbestos fibres will be monitored during the course of the initial works to give relevance to the data collected during remediation works. Samples will be analysed and reported on site immediately, according to industry practice. Background asbestos air monitoring will be conducted for the duration of the asbestos remediation work.

Surface water monitoring will be carried out by E3P at three locations weekly during the works to ensure no adverse contaminant impacts (locations to be confirmed).

APPENDIX A

DRAWINGS - GENERAL



N

Approx North



Surveying & Engineering Department

Contact : doug@mcauliffegroup.co.uk

Mobile : 07939463928

Legend

JOB
MANOX
COLESHILL STREET

DRAWING
SITE ZONES

DATE: 09/04/2020 | DRAWN: JY | SCALE: N.T.S

www.mcauliffegroup.co.uk



McAuliffe Civil Engineering Ltd.

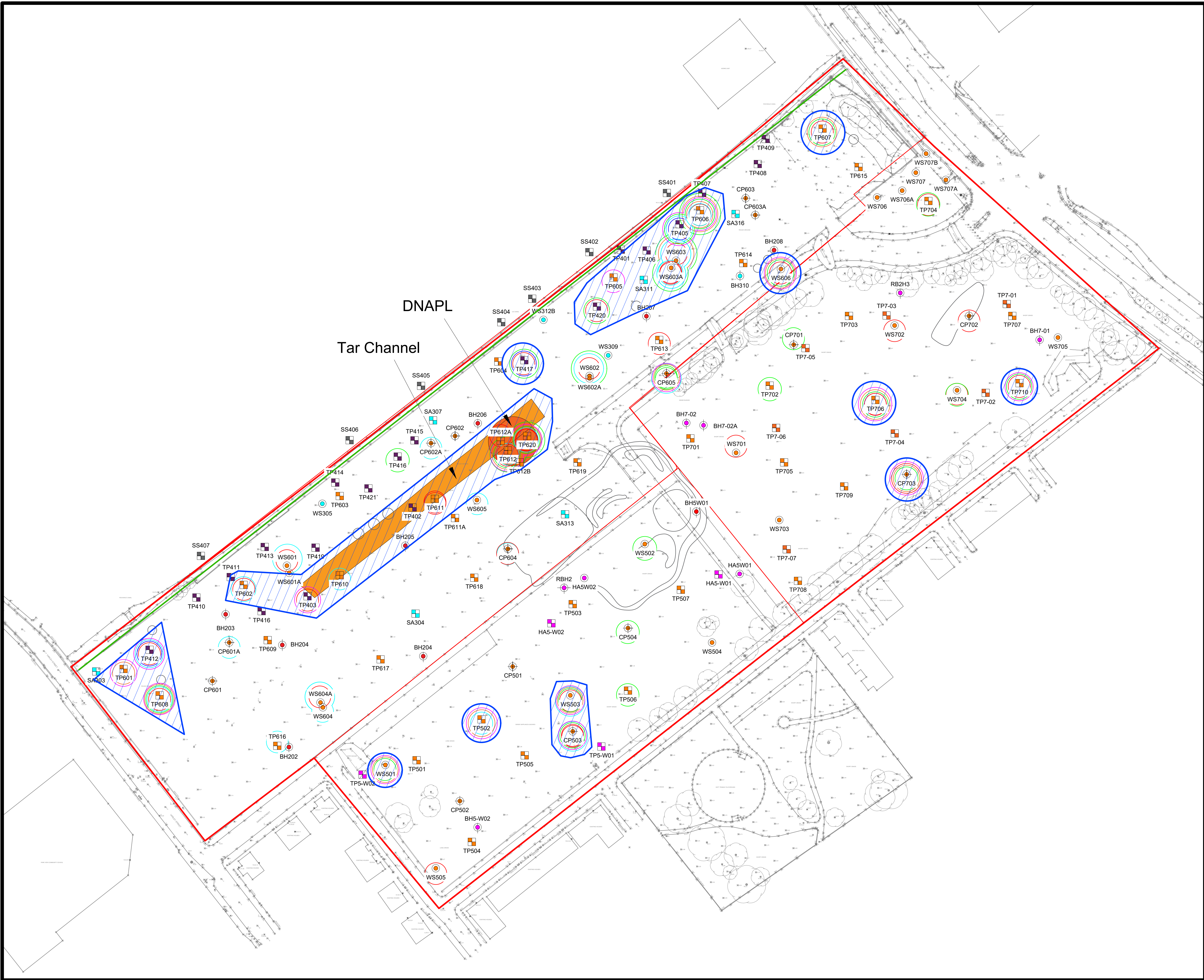
McAuliffe House
Northcott Road
Wolverhampton
West Midlands
W V14 OTP
Tel: 01902 354400

St Baldred's Hall
239 Ashley Road
Hale
Cheshire
WA15 9NE
Tel: 0161 928 7740

DRAWING No: MC 2906 SZ 200409

APPENDIX B

DRAWINGS – REMEDIATION



Legend

Soil-mixed groundwater cut-off wall

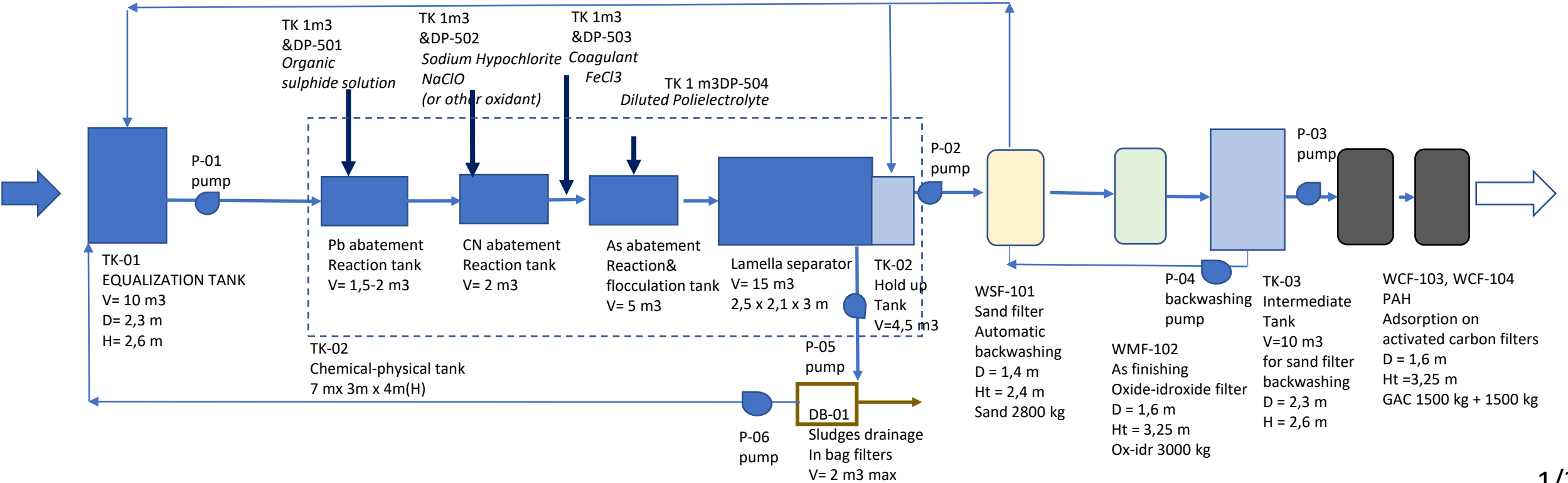
Indicative S/S hotspot areas (including tar channel)

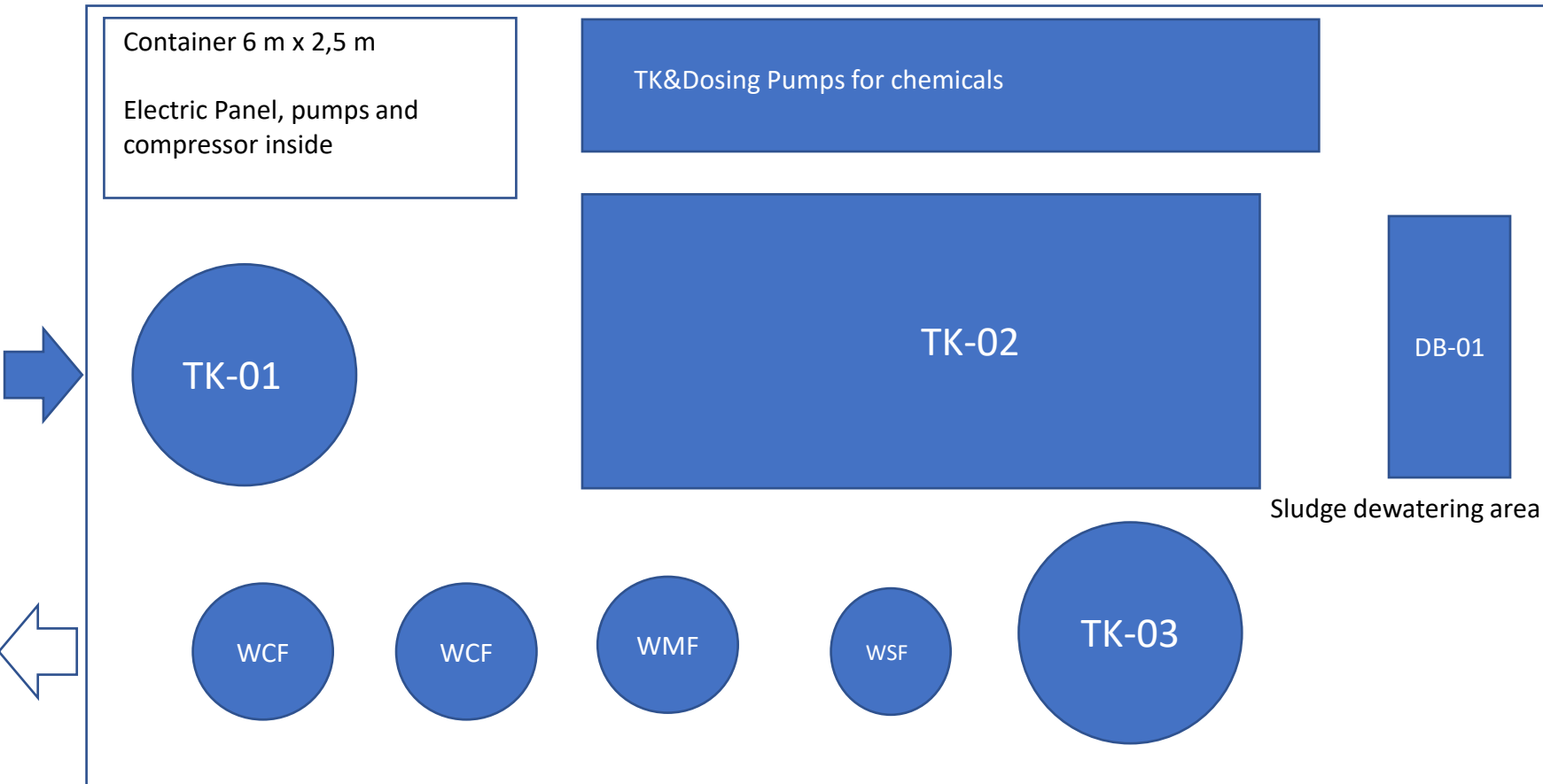
Proposal for a 20 m3/h plant capacity – preliminary Process Flow Diagram

Max Concentrations Detected	Manox Site	Zone 7	Zone 5	LIMITS
As (ug/L)	1800	18000	32	
Cr(III) (ug/L)	1026	9	8	
Cd (ug/L)	9,9 -			
Cu (ug/L)	6	150	6	
Total Cn (ug/L)	310.500	930	90	1000
Pb (ug/L)	16430	64	64	
Ni (ug/L)	270	9	7	
Zn (ug/L)	2150	27	16	
PAH (ug/L)	1036	2,1	2,1	
				10000
TPH (ug/L)	10640 -		19	0
total metals	19882			10000

Pollutants to be treated and related processes:

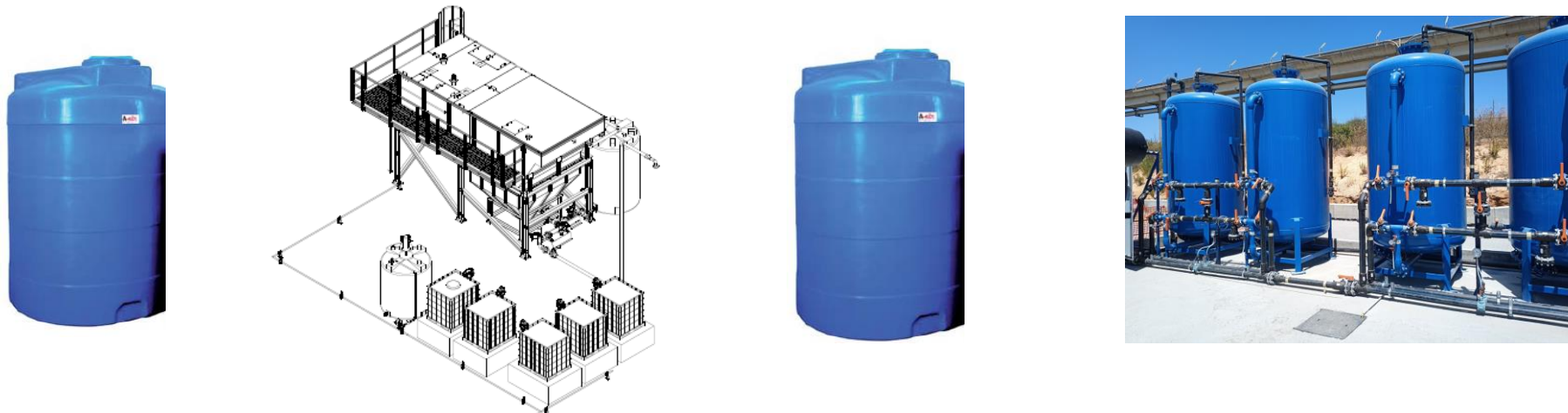
- Metals (mainly Pb, CN, As): chemical physical treatment
- As: adsorption on oxide-idrooxide filters
- PAH, TPH, other organic pollutants, : adsorption on activated carbons





Minimum footprint 10 m x 15 m

Installed power approx. 20 kW



APPENDIX C

E3P REMEDIATION AND ENABLING WORKS STRATEGY

**Ref: 13-887-R6-4 February 2023
accessible under CDN/22/0742**

APPENDIX D

ENVIRONMENTAL PERMIT (MTL) & EA NOTIFICATION LETTER

McAuliffe Civil Engineering Ltd
McAuliffe House
Northcott Road
Bilston
West Midlands
WV14 0TP

Our ref: AP3992FW/W0037

Date: 11/05/2023

Dear Sir or Madam.

Environmental Permitting (England and Wales) Regulations 2016

Deployment ref: AP3992FW/W0037

Permit holder: McAuliffe Civil Engineering Ltd

Location of the deployment: Land north of Coleshill Street, Manox & Zones 5w &7, Miles Platting, Manchester, M40 7LE,

Following assessment of your deployment notification reference number AP3992FW/W0037 I can confirm that we have agreed your deployment form and you may now start to operate.

You have up to 12 months to notify us that your deployment activities are commencing. Once notified your deployment lasts for Fifty-Two(52) weeks, if you wish to continue beyond this period you can request an extension up to a maximum of 12 months or submit a new deployment application for a further 12 month extension. Please see section 4.1 of the [Land and groundwater remediation deployment form guidance](#).

You must comply with your permit and carry out the activities in accordance with the requirements of the agreed deployment form and further information,
Supply of;

- Submission direct into GWCL / AREA and Environmental Health of an updated Remediation Strategy.

Confirmation off;

- Structure, integrity, powering and security of Water Treatment Plant.
- Monitoring will be continued for potential rebound from Water Treatment process by 'E3P' post finishing of remediation activities.
- Foul Sewer discharge consent from local water authority to be sought on issue of this permit.
- That no 'Daughter Products' will be generated as part of the Solidification and Stabilisation process.
- All leachate a surface waters from Windrow and Bio-piles will be passed through Water Treatment Plant prior to discharge to Foul sewer.
- Management, infrastructure and integrity of putting in and maintaining a Sheet Pile Wall as part of Remediation.
- Acknowledgment that this permit only covers 52 weeks and that the intended 66 weeks will necessitate another application if works are to continue beyond the limits of this permit.
- 64-day test(s) to be implemented to measure contaminant levels within soils.
- Focused remediation, outside of Parcels '5W' and '7' which are lesser contaminated, on hotspot removal and the grouting of relic mine workings (inc. a mining shaft) at depth and associated with the nearby Bradford Mine complex.

- Primary focus of remediation on former 'Manox' area.
- Northern boundary wall within site to be monitored and maintained to ensure the integrity of the Remediation activities intended on site.
- Impacted materials found on site to be treated onsite for onsite reuse.

Provided by email and sent by Mr. Chris Evans of McAuliffe Civil Engineering Ltd. on 30th March 2023 at 17:55.

Supply of;

- Updated Plan showing siting of all treatment activities intended, materials management, fuel storage, quarantine, foul sewer discharge location and storage areas across site.

Confirmation off;

- Activities being outside of 50m from *"Rochdale Canal Stott's Lane – Ducie Street Basin"*.
- Spent GAC filters being sent to regulated facility(s) offsite post 'life expectancy'
- Earth bunding and Silt Fencing being deployed as part of the management of the intended implementation of a Sheet Pile Wall.

Provided by email and sent by Mr. Chris Evans of McAuliffe Civil Engineering Ltd. on 06th April 2023 at 14:32.

Supply of;

- Discharge of condition nos. 54 (detailed remediation phasing plan); 57 (detailed risk assessment); 58 (detailed remedial options appraisal and remedial strategy) attached to planning permission referenced 131895/jo/2021

Provided by email and sent by Mr. Chris Evans of McAuliffe Civil Engineering Ltd. on 10th May 2023 at 12:50.

You must seek written permission from us if any of the details provided in the deployment form change.

This approval letter is associated with the mobile plant permitting regime only. As the operator, it is your responsibility to agree other authorisations, for example, planning permission, remedial strategy, abstraction or discharge consents with the relevant regulatory authority.

Please note that operating under your Mobile Plant Permit / Mobile Treatment Licence does not imply that the remediation processes used will be suitable for meeting any remediation objectives specified. These issues must be considered separately by the developer/consultant and our local area Groundwater and Contaminated Land team. These must be defined in the site remedial strategy which sets out the remediation options to reduce or control the risks from pollution linkages associated with the site as a whole. You may need to carry out further remediation if an unacceptable risk to the environment remains at the site.

Please notify us at least seven days prior to starting the remediation activities, at psc@environment-agency.gov.uk & GMMCLandandWater@environment-agency.gov.uk

If you have any queries about this matter please contact us by telephone on 03708 506 506 or email us at enquiries@environment-agency.gov.uk quoting your deployment application reference AP3992FW/W0037.

Yours faithfully

Natasha Hatswell
Team Leader,
National Permitting Service

Standard rules SR2008No27 - mobile plant for the treatment of soils and contaminated material, substances or products

Introductory note

This introductory note does not form part of these standard rules

When referred to in an environmental permit, these rules will allow the operator to operate mobile plant. The mobile plant shall be for the treatment of soils and the treatment of contaminated material, substances or products, for the purpose of remedial action with respect to land or controlled waters.

The operator is allowed to use the following technology and associated plant necessary to facilitate the treatment or remedial action, including the use of that technology and plant in combination with others listed:

- Air sparging
- Bioremediation – insitu and exsitu (windrows, biopiles, in-vessel bioreactors)
- Biosparging
- Bioventing
- Chemical Treatment (including oxidation, dehalogenation)
- Ex-situ treatment of pumped groundwater (chemical treatment, biological treatment, air stripping, filtration, carbon adsorption)
- Soil Vapour Extraction (including dual phase SVE)
- Soil Flushing (including steam injection)
- Soil Washing
- Solidification
- Stabilisation
- Thermal treatment (including thermal desorption and steam injection), and
- Treatment plant for blending, mixing, bulking, screening, shredding, particle size reduction and / or particle separation in order to facilitate remedial action.

End of introductory note

Rules

1 – Management

1.1 General management

- 1.1.1 The operator shall manage and operate the activities:
- (a) in accordance with a written management system that identifies and minimises risks of pollution, including those arising from operations, maintenance, accidents, incidents, non-conformances, closure and those drawn to the attention of the operator as a result of complaints; and
 - (b) using sufficient competent persons and resources.
- 1.1.2 Records demonstrating compliance with rule 1.1.1 shall be maintained.
- 1.1.3 Any person having duties that are or may be affected by the matters set out in these standard rules shall have convenient access to a copy of them kept at or near the place where those duties are carried out.
- 1.1.4 The operator shall comply with the requirements of an approved competence scheme.

1.2 Avoidance, recovery and disposal of wastes produced by the activities

- 1.2.1 The operator shall take appropriate measures to ensure that:
- (a) the waste hierarchy referred to in Article 4 of the Waste Framework Directive is applied to the generation of waste by the activities; and
 - (b) any waste generated by the activities is treated in accordance with the waste hierarchy referred to in Article 4 of the Waste Framework Directive; and
 - (c) where disposal is necessary, this is undertaken in a manner which minimises its impact on the environment.
- 1.2.2 The operator shall review and record at least every four years whether changes to those measures should be made and take any further appropriate measures identified by a review.

2 – Operations

2.1 Permitted activities

- 2.1.1 The operator is only authorised to carry out the activities specified in table 2.1 below ("the activities").
- 2.1.2 Treatment activities under these rules shall not begin at any site until the Environment Agency has agreed a deployment form in writing for that particular site.
- 2.1.3 All process plant and equipment shall be commissioned, operated and maintained, and shall be fully documented and recorded, in accordance with the agreed deployment form.

Table 2.1 activities	
Description of activities	Limits of activities
R13: Storage of wastes pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced) R3: Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes) R4: Recycling/reclamation of metals and metal compounds R5: Recycling/reclamation of other inorganic materials	Storage and treatment for recovery consisting only of use of the following technology and associated plant including the use of that technology and plant in combination with others listed: ▪ Air sparging ▪ Bioremediation – insitu and exsitu (windrows, biopiles, in-vessel bioreactors) ▪ Biosparging ▪ Bioventing ▪ Chemical Treatment (including oxidation, dehalogenation) ▪ Ex-situ treatment of pumped groundwater (chemical treatment, biological treatment, air stripping, filtration, carbon adsorption) ▪ Soil Vapour Extraction (including dual phase SVE) ▪ Soil Flushing (including steam injection) ▪ Soil Washing ▪ Solidification ▪ Stabilisation ▪ Thermal treatment (including thermal desorption and steam injection), and ▪ Treatment plant for blending, mixing, bulking, screening, shredding, particle size reduction and / or particle separation in order to facilitate remedial action.

2.2 Waste acceptance

- 2.2.1 The total quantity of waste soils and contaminated material, substances or products treated at any site shall not exceed that stated in the agreed deployment form for that particular site.
- 2.2.2 Only those waste soils and contaminated materials, substances or products types listed in the agreed deployment form can be stored and treated under these standard rules.

2.3 Operating techniques

- 2.3.1 The activities shall be operated using the techniques and in the manner described in Table 2.3 below.

Table 2.3 Operating techniques

- | |
|--|
| <ol style="list-style-type: none">1. Unless otherwise stated in the agreed deployment form, waste soils and contaminated materials, substances or products shall be kept and treated on an impermeable surface with sealed drainage system.2. Inert wastes shall be kept and treated on hard standing or on an impermeable surface with sealed drainage system. |
|--|

2.4 Hazardous waste storage and treatment

- 2.4.1 Hazardous waste shall not be mixed, either with a different category of hazardous waste or with other waste, substances or materials, unless it is authorised by table 2.1 and appropriate measures are taken.

3 – Emissions and monitoring

3.1 Emissions to air, water or land

- 3.1.1 There shall be no point source emissions to air, water or land, except from the sources listed in the agreed deployment form.
- 3.1.2 The limits given in the agreed deployment form shall not be exceeded.

3.2 Emissions of substances not controlled by emission limits

- 3.2.1 Emissions of substances not controlled by emission limits (excluding odour) shall not cause pollution. The operator shall not be taken to have breached this rule if appropriate measures, including, but not limited to, those specified in any approved emissions management plan, have been taken to prevent or where that is not practicable, to minimise, those emissions.
- 3.2.2 The operator shall:
- (a) if notified by the Environment Agency that the activities are giving rise to pollution, submit to the Environment Agency for approval within the period specified, an emissions management plan;
 - (b) implement the approved emissions management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.
- 3.2.3 All liquids in containers, whose emission to water or land could cause pollution, shall be provided with secondary containment, unless the operator has used other appropriate measures to prevent or where that is not practicable, to minimise, leakage and spillage from the primary container.

3.3 Odour

- 3.3.1 Emissions from the activities shall be free from odour at levels likely to cause pollution outside the site, as perceived by an authorised officer of the Environment Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved odour management plan, to prevent or where that is not practicable, to minimise, the odour.
- 3.3.2 The operator shall:
- (a) if notified by the Environment Agency that the activities are giving rise to pollution outside the site due to odour, submit to the Environment Agency for approval within the period specified, an odour management plan;

- (b) implement the approved odour management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.

3.4 Noise and vibration

- 3.4.1 Emissions from the activities shall be free from noise and vibration at levels likely to cause pollution outside the site, as perceived by an authorised officer of the Environment Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved noise and vibration management plan, to prevent or where that is not practicable, to minimise, the noise and vibration.
- 3.4.2 The operator shall:
 - (a) if notified by the Environment Agency that the activities are giving rise to pollution outside the site due to noise and vibration, submit to the Environment Agency for approval within the period specified, a noise and vibration management plan;
 - (b) implement the approved noise and vibration management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.

3.5 Monitoring

- 3.5.1 The operator shall undertake monitoring for the parameters, at the locations and not less than the frequencies specified in the agreed deployment form.
- 3.5.2 The operator shall maintain records of all monitoring required by these standard rules including records of the taking and analysis of samples, instrument measurements (periodic and continual), calibrations, examinations, tests and surveys and any assessment or evaluation made on the basis of such data.

4 – Information

4.1 Records

- 4.1.1 All records required to be made by these standard rules shall:
 - (a) be legible;
 - (b) be made as soon as reasonably practicable;
 - (c) if amended, be amended in such a way that the original and any subsequent amendments remain legible or are capable of retrieval; and
 - (d) be retained, unless otherwise agreed by the Environment Agency, for at least 6 years from the date when the records were made.
- 4.1.2 The operator shall keep on site all records, plans and the management system required to be maintained by these standard rules, unless otherwise agreed in writing by the Environment Agency.

4.2 Reporting

- 4.2.1 The operator shall send all reports and notifications required by these standard rules to the Environment Agency using the contact details supplied in writing by the Environment Agency.
- 4.2.2 Within one month of the end of each quarter, the operator shall submit to the Environment Agency using the form made available for the purpose, the information specified on the form relating to each site and the waste accepted and removed from it during the previous quarter.

4.3 Notifications

- 4.3.1 The Environment Agency shall be notified without delay following the detection of:
- (a) any malfunction, breakdown or failure of equipment or techniques, accident or emission of a substance not controlled by an emission limit which has caused, is causing or may cause significant pollution;
 - (b) the breach of a limit specified in these standard rules and the agreed deployment form; or
 - (c) any significant adverse environmental effects.
- 4.3.2 Written confirmation of actual or potential pollution incidents and breaches of emission limits shall be submitted within 24 hours.
- 4.3.3 Where the Environment Agency has requested in writing that it shall be notified when the operator is to undertake monitoring and/or spot sampling, the operator shall inform the Environment Agency when the relevant monitoring and/or spot sampling is to take place. The operator shall provide this information to the Environment Agency at least 14 days before the date the monitoring is to be undertaken.
- 4.3.4 The Environment Agency shall be notified within 14 days of the occurrence of the following matters except where such disclosure is prohibited by Stock Exchange rules:
- a) Where the operator is a registered company:
 - any change in the operator's trading name, registered name or registered office address; and
 - any steps taken with a view to the operator going into administration, entering into a company voluntary arrangement or being wound up.
 - b) Where the operator is a corporate body other than a registered company:
 - any change in the operator's name or address; and
 - any steps taken with a view to the dissolution of the operator.
 - c) In any other case:
 - the death of any of the named operators (where the operator consists of more than one named individual);
 - any change in the operator's name(s) or address(es); and
 - any steps taken with a view to the operator, or any one of them, going into bankruptcy, entering into a composition or arrangement with creditors, or, in the case them being in a partnership, dissolving the partnership.
- 4.3.5 The operator shall notify the Environment Agency at least 7 days prior to commencement of agreed deployment.

4.4 Interpretation

- 4.4.1 In these standard rules the expressions listed below shall have the meaning given.
- 4.4.2 In these standard rules references to reports and notifications mean written reports and notifications, except when reference is being made to notification being made "without delay", in which case it may be provided by telephone.

"accident" means an accident that may result in pollution.

"authorised officer" means any person authorised by the Environment Agency under section 108(1) of The Environment Act 1995 to exercise, in accordance with the terms of any such authorisation, any power specified in Section 108(4) of that Act.

"contaminated material, substances or products" means contaminated material, substances or products for the purpose of remedial action with respect to land and controlled waters.

"deployment form" means the Environment Agency form that requires site specific information and control measures to be provided and agreed prior to the use of any mobile plant at a site.

"emissions of substances not controlled by emission limits" means emissions of substances to air, water or land from the activities, either from emission points specified in these standard rules or from other localised or diffuse sources, which are not controlled by an emission limit.

"emissions to land", include emissions to groundwater.

"groundwater" means all water, which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.

"impermeable surface" means a surface or pavement constructed and maintained to a standard sufficient to prevent the transmission of liquids beyond the pavement surface, and should be read in conjunction with the term "sealed drainage system" (below).

"pollution" means emissions as a result of human activity which may—

- (a) be harmful to human health or the quality of the environment,
- (b) cause offence to a human sense,
- (c) result in damage to material property, or
- (d) impair or interfere with amenities and other legitimate uses of the environment.

"quarter" means a calendar year quarter commencing on 1 January, 1 April, 1 July or 1 October.

"sealed drainage system" in relation to an impermeable surface, means a drainage system with impermeable components which does not leak and which will ensure that:

- (a) no liquid will run off the surface otherwise than via the system;
- (b) except where they may lawfully be discharged, all liquids entering the system are collected in a sealed sump.

"site" means the place where mobile plant is deployed as detailed in the agreed deployment form(s).

"year" means calendar year commencing on 1st January.

End of standard rules

APPENDIX E

VOLUMETRIC APPRAISAL

APR 2023 COMBINED TOPO SURVEY (EXCLUDING STOCKPILES) COMPARED TO REGRADE LEVELS						
Group	Volumes			Areas		
	Cut/Material (m³)	Fill/Void (m³)	Balance (m³)	Cut/Material (m²)	Fill/Void (m²)	Combined (m²)
Apartments	5892	0	5892	3947	1	3948
Boundary Areas	764	37	726	802	143	945
Courtyards & Parking Areas	6208	1774	4433	6987	3222	10208
Frontages	1238	150	1088	1509	267	1776
Plots	17332	3089	20106	14243	6439	26545
POS	3594	90	3504	5114	866	5980
Retaining Wall	388	234	154	898	599	1497
Roads (Adopted)	3615	0	3615	3425	2	3427
Roads (Unadopted)	3174	1011	2163	4924	2327	7251
Total	42205	6386	35819	47711	13866	61578

Existing trees to be retained
Area omitted from regrade
model and cut/fill calculations.

Group	APR 2021 COMBINED TOTO SURVEY (EXCLUDING STOCKPILES), COMPARED TO REGRADE LEVELS					
	Volumes			Areas		
	Cu/Maternal (m ³)	Fill/Void (m ³)	Balance (m ³)	Cu/Maternal (m ²)	Fill/Void (m ²)	Combined (m ²)
Apartments	680	15	0	679	825	1
Boardwalk Area	33	15	0	48	41	7
Confer/CA & Parking Areas	240	15	0	628	63	1
Convenience	222	230	0	354	278	826
CPD	105	105	0	275	266	0
POS	175	105	36	197	977	402
Rest (Adapted)	105	105	0	160	160	0
Rest (Undeveloped)	175	23	255	233	184	149
Total	682	603	255	1967	1867	1158

[illegible]

APR 2023 COMBINED TOP SURVEY (EXCLUDING STOCKPILES) COMPARED TO REGRADE LEVELS						
Group	Volumes			Area		
	Cut/Material (m³)	Fill/Void (m³)	Balance (m³)	Cut/Material (m²)	Fill/Void (m²)	Combined (m²)
Apartment	755	0	755	473	0	0
Boundary Area	144	154	195	195	195	0
Corporals & Parking Areas	406	0	406	274	0	274
Drainages	143	0	143	143	0	143
Grass	866	0	866	1167	0	1167
PCS	1049	0	1049	1049	0	1049
Roofs (Asphalt)	1365	166	1531	1195	166	1365
Roofs (Unasphalt)	1937	16	1728	1455	140	1300
			19521		161	161

Volume of surplus material between current topographical survey levels and regrade profile as per the parameters circa 35,819m³.

This calculation does not include any existing stockpiles on site - See separate stockpile plan drawing.

This is an indicative sensitivity analysis only.

- + Apartments = -1400mm FFL
- + Plots = -750mm FFL
- + Adopted Roads = -950mm FL
- + Unadopted Roads = -450mm FL
- + Courtyards & Parking areas = -450mm FL
- + Boundary Area = -600mm below finished levels
- + Frontages = graded between nearest features
- + POS areas = -450mm FL / graded between nearest features
- + Retaining Wall = toe level along wall line then battered back at 1in3 to surrounding grade levels



Apartments

Plots



Surveying & Engineering Department

Cut	
Fill	
Zero	
Planning levels	12.345
Topographic levels	12.345

Isopachyte relates to current topographical survey (excluding stockpiles) compared to regrade levels.

This drawing must only be used taking into full account the Earthworks Parameters and the associated qualifications relating to working tolerances, which are ± 50 mm unless otherwise stated.

The re-grade levels should be considered with reference to the site as-built drawing, as works will only be completed to the extent that suitable site won materials allow, unless otherwise stated.

Where site boundary features are higher than the grade of formation, a safe barrier may be left in place to retain such features (i.e. surrounding topography).

Where site constraints such as tree protection, live services, and boundary features are encountered, piling mats and/or formation may be left short to avoid any disturbance.

- + Rev A - Added external site boundary
- + Rev B - Added site phasing
- + Rev C - Added road layout
- + Rev D - Added site zones/phases
- + Rev E - New layout, levels and regrade parameters
- + Rev F - Parameters adjusted
- + Rev G - Parameters adjusted and boundary amended
- + Rev H - Parameters adjusted and boundary amended
- + Rev I - Parameters adjusted
- + Rev J - Parameters adjusted - Plots moved to -750mm FFL
- + Rev K - Retaining wall model adjusted and revised top
- + Rev L - Retaining wall model adjusted
- + Rev M - Retaining wall / regrade / topo models updated.
- + Rev N - Retaining wall and regrade model updated.

Drawings used for calculations:				
Title	Revision	Consultant	Date	Notes
• 364TR I.B.- Landscape Levels_20200810.dwg	-	Engie	09/10/2020	-
• 07D26 - Proposed Highway Levels - 07D26 - Proposed Highway Levels Model.dwg	-	Engie	05/10/2020	-
• C040601 (St-Utility and Top Survey) dwg	-	Leyer Systems	2020	-
• 364TR I.B.-Landscape General Arrangement.dwg	-	Curtine	23/01/2021	-
• 07D26-CURS.XXX-CRS-5-S40C1D23-5-656	P02	Curtine	16/12/2022	-

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JOB
MANOX
MANCHESTER

DRAWING

VOLUMETRIC APPRAISAL (REV N)

INCLUDING ISOPACHYTE

DATE: 09/05/2023	DRAWN: JY	CHECKED: PC	SCALE: N.T.S.
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McAuliffe House Northcott Road Wolverhampton West Midlands W V14 0TP Tel: 01902 354400	St Baldred's Hall 239 Ashley Road Hale Cheshire WA15 9NE Tel: 0161 928 7740
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www.mcauliffegroup.co.uk

DRAWING No: MC2906 VA REV-N

APPENDIX F

OBC DATA/TECHNICAL BRIEF



Oxygen BioChem (OBC)™ is used to promote chemical oxidation and aerobic bioremediation of petroleum compounds in groundwater. OBC is a mixture of oxidants for short-term *in situ* chemical oxidation (ISCO) and provides electron acceptors for longer-term biological oxidation.

CHEMICAL/PHYSICAL DATA

Form	Solid
Appearance	Off-white fine granular solid
Odor	Odorless
Specific Gravity	2.60-2.92 g/mL
pH	11.3-12.1 @ 25° C / 1 hour
Melting Point	Decomposes on heating (~275° C)
Vapor Pressure	< 1 mm Hg
Solubility in Water	18% insoluble @ 25° C 73% soluble @ 25° C

APPLICATIONS

OBC is used for *in situ* treatment of petroleum groundwater contaminants by chemical oxidation and aerobic bioremediation. These types of contaminants include BTEX (benzene, toluene, ethylbenzene, and xylene), MTBE (methyl tertiary butyl ether), PAHs (polycyclic aromatic hydrocarbons), chlorinated alkenes, chlorinated alkanes, 1,4-dioxane, PCBs (polychlorinated biphenyls), and pentachlorophenol.

SHIPPING CONTAINERS

5-gallon pail (19-L) Made of high-density polyethylene (HDPE). The net weight is 45 lbs (20.4 kg). The pail stands approximately 14.6 in (37.1 cm) tall. The diameter of the outside of the pail is 11.8 in (29.9 cm) wide at the top and 10.5 in (26.6 cm) at the base. (Domestic and international)

HANDLING, STORAGE, AND INCOMPATIBILITY

Store in an area away from strong oxidants and reducing agents. Store unopened in a cool, clean, dry place away from point sources of heat.

Fires may be controlled and extinguished by using large quantities of water. Do not use carbon dioxide or other gas filled fire extinguishers. Refer to MSDS or eSDS for more information. For first aid measures, refer to the MSDS or eSDS for more information.

SHIPPING

OBC is classified by the Hazardous Materials Transportation Board (HMTB) as an oxidizer.

Proper Shipping Name:	Oxidizing solid, n.o.s. (sodium persulfate, calcium peroxide)
Hazard Class:	5.1 (oxidizer)
Identification Number:	UN 1479
Label Requirements:	5.1 (oxidizer)
RCRA Waste Number:	D001

CARUS CORPORATION

CORPORATE HEADQUARTERS | 315 Fifth Street, Peru IL 61354 | Tel + 1.815.223.1500 / 1-800-435-6856 | Fax + 1.815.224.6697 | Web: www.caruschem.com | E-Mail: salesmkt@caruschem.com
CARUS EUROPE | Parque Empresarial de ASIPO | C/Secundino Rocas 3, Planta 1, Oficina 13-14 | 33428 Cayes, Llanera Spain | Tel +34.985.78.55.13 / Fax +34.985.78.55.10

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RESPONSIBLE CARE®
OUR COMMITMENT TO SUSTAINABILITY

CARUS®



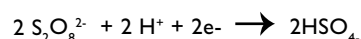


INFORMATION

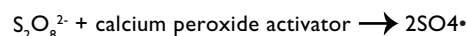
Recent applications of *in situ* chemical oxidation (ISCO) have shown that ISCO can be a cost-effective remedial strategy for organic contaminants in groundwater and soil. The application of ISCO to contaminated source areas usually results in an immediate benefit to groundwater in the area. In addition, contaminant flux can be reduced or eliminated mitigating further contaminant plume issues. Redox Tech, LLC has recently formulated a mixture of sodium persulfate and calcium peroxide that can be employed for ISCO applications.

The mixture in Oxygen BioChem (OBC)[™] supports a two-fold mechanism for treating contaminants of concern. OBC delivers one of the strongest chemical oxidants for short-term ISCO, and also provides electron acceptors (oxygen and sulfate) for longer-term biological oxidation.

Sodium persulfate has emerged recently as an important oxidant for *in situ* remediation of volatile and semi-volatile organic compounds. Persulfate is the strongest oxidant within the peroxygen family, with an oxidation potential of 2.12 volts. As illustrated below, the direct oxidation half-cell reaction for persulfate involves a two-electron transfer:



However in most cases, rapid destruction of the contaminant of concern requires that the persulfate be activated in order to generate sulfate radicals. Sulfate radicals are powerful oxidizing agents, with an oxidation potential of 2.6 volts. Activated persulfate is catalyzed with the peroxide and base provide by the calcium peroxide:



Activated persulfate can remain available in the subsurface for months providing a combination of power and stability.

The calcium peroxide provides several benefits. First, it imparts the alkalinity and peroxide needed to activate the persulfate using activation chemistry. Second, when mixed with water it provides a long-term, slow release source of hydrogen peroxide and calcium hydroxide.



The hydrogen peroxide that is slowly formed decomposes to oxygen and water, providing an extended oxygen source for subsequent bioremediation of petroleum hydrocarbons.



The resultant calcium hydroxide (hydrated lime) that is produced serves several purposes. First of all, it increases the total dissolved ion concentration, which makes the solution less likely to leach metals from the soil into the groundwater. Secondly, the calcium from the hydrated lime will precipitate the sulfate that is produced during the consumption of the persulfate. The calcium sulfate (gypsum) precipitation helps to reduce sulfate groundwater concentrations, which may impact the secondary drinking water standard of 250 ppm.

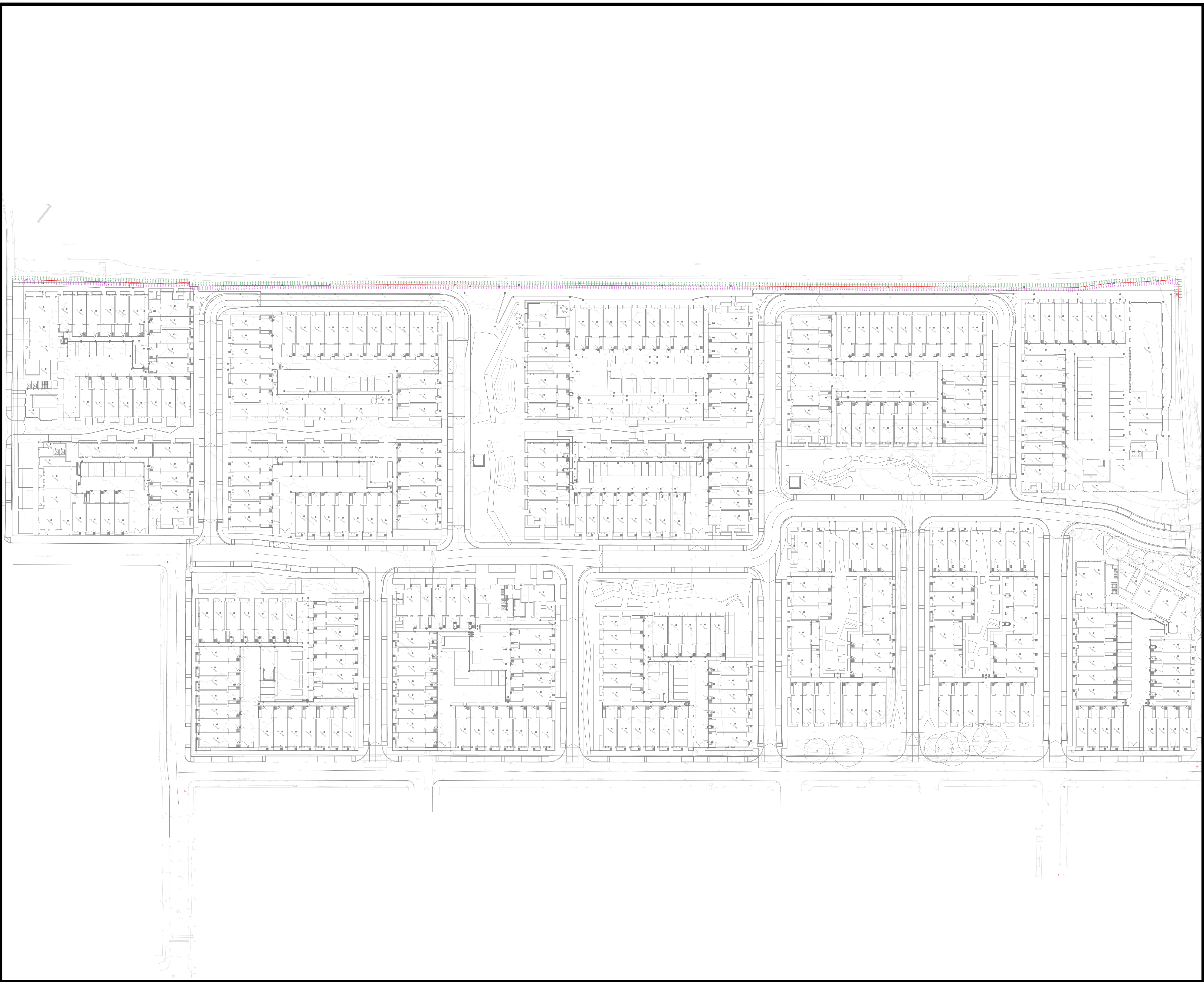
The mixture in Oxygen BioChem (OBC)TM provides chemical oxidation as well as electron acceptors (oxygen and sulfate) for longer-term biological oxidation. The predominant short-term reaction is chemical oxidation, while the longer-term remediation process is biological oxidation. Table I lists commonly treated contaminants by OBC.

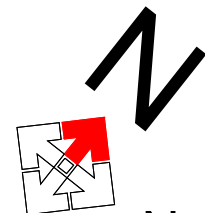
Below is a list of advantages and strengths of OBC:

- Works on a wide range of contaminants
- Oxygen content about 46% by weight
- Facilitates both chemical oxidant and bioremediation
- Typically 40% by weight solubility for the persulfate

Table I. Contaminants Commonly Treated by OBC

CONTAMINANTS COMMONLY TREATED	
BTEX	1,4-dioxane
MTBE	PCBs
PAHs	Pentachlorophenol
Chlorinated Alkenes	Chlorinated Alkanes





Approx North



Surveying & Engineering Department

Legend

Wall alignment

Toe Levels (from topo)

Top Levels (McA regrade)

12.345

12.345

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JOB

MANOX
MANCHESTER

DRAWING

PROPOSED WALL LEVELS

DATE: 09/05/2023

DRAWN: JY

CHECKED: PC

SCALE: N.T.S



McAuliffe House
Northcott Road
Wolverhampton
West Midlands
W V14 0TP
Tel: 01902 354400

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WA15 9NE
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www.mcauliffegroup.co.uk

DRAWING No:

MC2906 PWL 230509

APPENDIX G

SSPW LOCATION PLAN & SEALANT SPECIFICATION



Make Your Sheet Pile Watertight

WADIT

The Proven Sheet Pile Interlock Sealant



WADIT® = Water Tight Corrosion Inhibitor

WADIT is a purpose-built and globally proven sheet piling interlock sealant and corrosion inhibitor. The creators of WADIT know first-hand the installation and long-term challenges faced when sealing all types of hot rolled or cold formed sheet piling interlocks.

With an unmatched success rate in real-world applications, WADIT provides both water-stopping and corrosion protection. The application of WADIT in the WOF chamber minimizes corrosion by sealing the interlock. WADIT also acts as a pile lubricant by reducing friction and preventing interlocks from "heating up"; this allows for the contractor to choose to drive socket first, if needed.

For any application where water leakage presents a problem, from dewatering cofferdams to barrier and cutoff walls for site remediation, WADIT is the smart sheet pile sealant of choice.



Benefits

TESTED AND CERTIFIED

WADIT fortifies your project. This real-world and lab-tested sealant keeps water out and protects against hazardous substances. Comprehensive third party test data clearly states that the permeability of a sheet pile lock with WADIT is zero because there is NO water flow through the sheet pile lock at five bars (-70 psi) of differential water pressure. Please refer to the University of Dortmund Water-Tightness Study under the Technical Documents on wadit.com.

HIGHLY DURABLE

WADIT performs in every environment, from the tropics to the arctic, where high pressure sealing is required with extreme temperature ranges. The longevity of your sheet pile project is guaranteed with this durable sealant.

EXTREMELY FLEXIBLE

WADIT has exceptional memory rebound properties. Conventional materials may harden like glass in temperatures of just 50F (10C). WADIT, on the other hand, remains extremely flexible even in groundwater.

NON-PROPRIETARY

Made by and for sheet pile professionals, WADIT can be installed in any interlock system or used with U-, Z-, or O-type of walls or combined SSP.

ENVIRONMENTALLY FRIENDLY

WADIT's non-toxic and made from sustainable, natural raw materials. Internationally lab-tested and certified, WADIT is safe and can be used without any restriction in sheet pile wall interlocks for ground and surface water use.

IMPERVIOUS TO WEATHER

No matter the climate, WADIT can be applied, transported and stored in any weather condition, ensuring a fast and problem-free sealant application.

PROFESSIONALLY INSTALLED

Certified technicians professionally install the WADIT Sealant System to ensure the perfect seal every time. You can be confident that the quality of your project will never be compromised.

The Proven Sheet Pile Interlock Sealant

WADIT: A Professionally Installed Sealant System

WADIT's unmatched success rate is the result of professional application. Applied by trained and tested WADIT installation crews, the WADIT Sealant System guarantees an effective, durable, sheet pile interlock seal every time. WADIT is sold pre-installed into any sheet pile type on a per foot or per metre of interlock basis.

Call PilePro at 866-666-7453 to find an authorized WADIT distributor in your area and/or to receive a quote for PilePro to carry out the WADIT installation.



WADIT is great solution for any project where water leakage through the wall presents a problem.

Internationally Lab-Tested and Certified

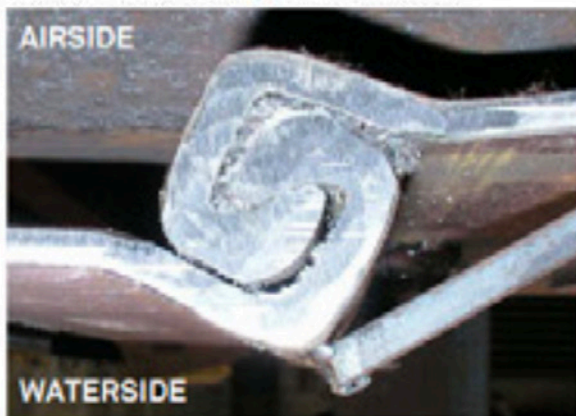
WADIT has been repeatedly proven as a safe material for use in potable water projects. The Bavaria State Trade Department (LGA), the German equivalent of the EPA, has certified WADIT for use in areas with potable water.



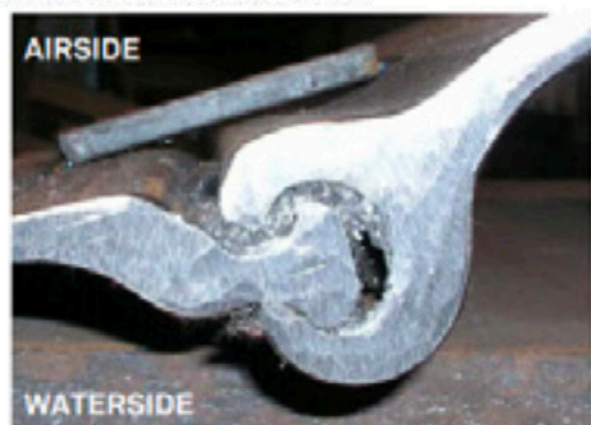
“The reports by the LGA come to the conclusion that WADIT sealant can be used without any restrictions in sheet pile wall interlocks in ground and surface water areas. There are no fears of harmful effects if it is used in the area of drinking water extraction systems.”

Read the full report at WADIT.com

WADIT Provides a Watertight and Long-Lasting Seal



Larssen connectors



Ball and Socket Connectors

We have the right solutions for
all of your sheet pile projects.

Contact us at
866-666-7453 or 512-243-1228
info@WADIT.com
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APPENDIX V

CHEMICAL VALIDATION

CRITERIA

HUMAN HEALTH REMEDIATION TARGETS – LOW-RISE RESIDENTIAL END USE (TO ALSO BE USED FOR THE VALIDATION OF ANY IMPORTED MATERIALS)

DETERMINANT	UNITS	WITHIN COVER SYSTEM 700MM (GARDEN)	HARD STANDING AND BENEATH 700MM COVER	PUBLIC OPEN SPACE 700 mm COVER	PUBLIC OPEN SPACE > 600 mm & BENEATH HARDSTAND >1000MM	PATH -WAY
Arsenic	mg/kg	37 ⁽ⁱ⁾	40 ⁽ⁱⁱ⁾	79 ⁽ⁱⁱⁱ⁾	640 ^(iv)	1
Cadmium	mg/kg	11 ⁽ⁱ⁾	85 ⁽ⁱⁱ⁾	120 ⁽ⁱⁱⁱ⁾	532 ^(iv)	1
Chromium (Hexavalent)	mg/kg	6 ⁽ⁱ⁾	6 ⁽ⁱⁱ⁾	7.7 ⁽ⁱⁱⁱ⁾	220 ^(iv)	1
Lead	mg/kg	210 ^(vi)	330 ^(vii)	760 ^(viii)	760 ^(viii)	1
Elemental Mercury	mg/kg	1.2 ⁽ⁱ⁾	1.2 ⁽ⁱⁱ⁾	16 ⁽ⁱⁱⁱ⁾	30 ^(iv)	2
Nickel	mg/kg	180 ⁽ⁱ⁾	180 ⁽ⁱⁱ⁾	230 ⁽ⁱⁱⁱ⁾	3400 ^(iv)	1
Selenium	mg/kg	250 ⁽ⁱ⁾	430 ⁽ⁱⁱ⁾	1100 ⁽ⁱⁱⁱ⁾	1800 ^(iv)	1
Copper	mg/kg	2400 ⁽ⁱ⁾	7100 ⁽ⁱⁱ⁾	12,000 ⁽ⁱⁱⁱ⁾	44,000 ^(iv)	1
Total Cyanide	mg/kg	791	791	791	791	1
Zinc	mg/kg	3700 ⁽ⁱ⁾	40,000 ⁽ⁱⁱ⁾	81,000 ⁽ⁱⁱⁱ⁾	170,000 ^(iv)	1
Phenol	mg/kg	280 ^{(i)(xi)}	280 ^{(xiv)(xi)}	760 ^{(iii)(xi)}	760 ^{(iv)(xi)}	2
Naphthalene	mg/kg	2.3 ^{(i)(xi)}	2.3 ^{(xiv)(xi)}	1200 ^{(iv)(xi)}	1200 ^{(iv)(xi)}	2
Acenaphthylene	mg/kg	170 ^{(i)(xi)}	500 ^(v)	15,000 ^{(iii)(xi)}	29,000 ^{(iv)(xi)}	3
Acenaphthene	mg/kg	210 ^{(i)(xi)}	500 ^(v)	15,000 ^{(iii)(xi)}	29,000 ^{(iv)(xi)}	1
Fluorene	mg/kg	170 ^{(i)(xi)}	500 ^(v)	9900 ^{(iii)(xi)}	20,000 ^{(iv)(xi)}	1
Phenanthrene	mg/kg	95 ^{(i)(xi)}	500 ^(v)	3100 ^{(iii)(xi)}	6200 ^{(iv)(xi)}	3
Anthracene	mg/kg	500 ^{(i)(xi)}	500 ^(v)	74,000 ^{(iii)(xi)}	150,000 ^{(iv)(xi)}	3
Fluoranthene	mg/kg	280 ^{(i)(xi)}	500 ^(v)	3100 ^{(iii)(xi)}	6300 ^{(iv)(xi)}	3
Pyrene	mg/kg	500 ^{(i)(xi)}	500 ^(v)	7400 ^{(iii)(xi)}	15,000 ^{(iv)(xi)}	3
Benzo(a)Anthracene	mg/kg	7.2 ^{(i)(xi)}	11 ^{(ii)(xi)}	29 ^{(iii)(xi)}	49 ^{(iv)(xi)}	3
Chrysene	mg/kg	15 ^{(i)(xi)}	30 ^{(ii)(xi)}	57 ^{(iii)(xi)}	93 ^{(iv)(xi)}	3
Benzo(b)Fluoranthene	mg/kg	2.6 ^{(i)(xi)}	3.9 ^{(ii)(xi)}	7.1 ^{(iii)(xi)}	13 ^{(iv)(xi)}	3
Benzo(k)Fluoranthene	mg/kg	77 ^{(i)(xi)}	110 ^{(ii)(xi)}	190 ^{(iii)(xi)}	370 ^{(iv)(xi)}	3
Benzo(a)Pyrene	mg/kg	2.2 ^{(i)(xi)}	3.2 ^{(ii)(xi)}	5.7 ^{(iii)(xi)}	11 ^{(iv)(xi)}	3
Indeno(123-cd)Pyrene	mg/kg	27 ^{(i)(xi)}	45 ^{(ii)(xi)}	82 ^{(iii)(xi)}	150 ^{(iv)(xi)}	3
Dibenzo(a,h)Anthracene	mg/kg	0.24 ^{(i)(xi)}	0.31 ^{(ii)(xi)}	0.57 ^{(iii)(xi)}	1.1 ^{(iv)(xi)}	3
Benzo(ghi)Perylene	mg/kg	320 ^{(i)(xi)}	360 ^{(ii)(xi)}	640 ^{(iii)(xi)}	1400 ^{(iv)(xi)}	3
TPH C ₅ -C ₆ (aliphatic)	mg/kg	42 ^{(i)(xi)}	42 ^{(ii)(xi)}	42 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2



TPH C₆-C₈ (aliphatic)	mg/kg	100 ^{(i)(xi)}	100 ^{(ii)(xi)}	100 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C₈-C₁₀ (aliphatic)	mg/kg	27 ^{(i)(xi)}	27 ^{(ii)(xi)}	27 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C₁₀-C₁₂ (aliphatic)	mg/kg	130 ^{(i)(xi)}	130 ^{(ii)(xi)}	130 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C₁₂-C₁₆ (aliphatic)	mg/kg	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C₁₆-C₂₁ (aliphatic)	mg/kg	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C₂₁-C₃₅ (aliphatic)	mg/kg					1
TPH C₅-C₇ (aromatic)	mg/kg	70 ^{(i)(xi)}	370 ^{(ii)(xi)}	370 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C₇-C₈ (aromatic)	mg/kg	130 ^{(i)(xi)}	860 ^{(ii)(xi)}	860 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C₈-C₁₀ (aromatic)	mg/kg	34 ^{(i)(xi)}	47 ^{(ii)(xi)}	47 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C₁₀-C₁₂ (aromatic)	mg/kg	74 ^{(i)(xi)}	250 ^{(ii)(xi)}	250 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C₁₂-C₁₆ (aromatic)	mg/kg	140 ^{(i)(xi)}	1800 ^{(ii)(xi)}	1800 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C₁₆-C₂₁ (aromatic)	mg/kg	260 ^{(i)(xi)}	1900 ^{(ii)(xi)}	1900 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C₂₁-C₃₅ (aromatic)	mg/kg	1000 ^{(xiv)(xi)}	1900 ^{(ii)(xi)}	1900 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	1
Asbestos	Fibres Volume Weight (%)	NFD	0.001%	NFD	0.1%	4

Notes 1

NFD = No Fibres Detected

Asbestos will be screened visually on site by a qualified environmental consultant and where potential ACM is identified, representative samples will be subject to quantitative analysis of % volume by weight.

Should any ACM be identified within the soil matrices, further detailed % assessment would be required when the reported laboratory result exceeds the limit of detection for the analytical method at 0.01% by volume (weight).

Notes 2

Excludes matrices where free product is observed.

No viable exposure pathway beneath hardstanding and cover system.

Notes 3

Main exposure pathways: 1 = soil ingestion, 2 = vapour inhalation (indoor), 3 = dermal contact and ingestion, 4 = dust inhalation.

Abbreviations: GAC = general assessment criteria, n = number of samples, MC = maximum concentration, N/A = Not Applicable (no exceedance of assessment criteria), Loc of MC = location of exceedances.

- i. Value derived from LQM Sutable 4 Use Levels (S4ULs) for residential end use with plant uptake.
- ii. Value derived from LQM Sutable 4 Use Levels (S4ULs) for residential end use without plant uptake – these levels used below 600 mm cover system within residential gardens as soils will be present within a residential setting yet soils will not be disturbed and garden plants will not reach these soils.



- iii. Value derived from LQM Suitable 4 Use Levels (S4ULs) for public open space (POS) residential.
- iv. Value derived from LQM Suitable 4 Use Levels (S4ULs) for public open space (POS) park – these levels used below 300 mm POS cover system as soils will not be disturbed by any future site users and exposure to these soils will be similar to a park end use.
- v. Value derived from LQM Suitable 4 Use Levels (S4ULs) alongside assessment with WM3 to ensure that materials remaining on site do not exceed the WM3 toxicity criteria for hazardous waste.
- vi. Value derived from Category 4 Screening Levels (C4SL) for residential land use with homegrown produce.
- vii. Value derived from Category 4 Screening Levels (C4SL) for residential land use without homegrown produce.
- viii. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) residential.
- ix. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) park.
- x. Mercury – based on elemental mercury.
- xi. PAH and TPH levels used are for 1% SOM.
- xii. Xylenes based on p-xylene (o-xylene 2600 mg/kg, m-xylene 3500 mg/kg) and is capped by its solubility.
- xiii. Value derived from LQM Suitable 4 Use Levels (S4ULs) for residential end use with plant uptake due to the volatilisation risk.
- xiv. BTEX is not SOM-related due to inhalation pathway.



SITE SPECIFIC REMEDIATION TARGETS FOR THE PROTECTION OF CONTROLLED WATERS

Contaminant	Level 3 Remedial Target Concentration		
	Soils (mg/kg)	Waters (mg/l)	Waters (ug/l)
Source Area 1 – Tar Channel			
TPH Aromatic C8-C10	1060	0.854	854
TPH Aromatic C10-C12	1920	0.959	959
TPH Aromatic C12-C16	30.8	0.0102	10.2
TPH Aromatic C16-C21	717	0.164	164
TPH Aromatic C21-C35	18300	0.456	456
TPH Aliphatic C8-C10	304000	12.8	12800
TPH Aliphatic C10-C12	1.99 E+07	119	119000
TPH Aliphatic C12-C16	4.01E+06	0.796	796
TPH Aliphatic C16-C21	3.79 E+09	0.695	695
TPH Aliphatic C21-C35	3.79 E+09	0.695	695
2-methylnaphthalene	3340	164000	164000000
Carbazole	2.89E+8	6.84E+12	6.84E+15
Dibenzofuran	2.89E+8	6.84E+12	6.84E+15
Source Area 2 - Manox			
	Soils (mg/kg)	Leachate (mg/l)	Leachate (ug/l)
Arsenic	1090	2.18	2180
Cyanide	219	2.18	2180
Copper	21.9	0.218	218
Lead	1090	2.18	2180

