ardmore point

Phase 2 Ground Inves ga on Report

Russells Yard Alloa

Issue No 01 Dec 2023

AGS Association of Geotechnical & Geoenvironmental Specialists

CONTROL SHEET

CLIENT: ARKA Architects

PROJECT TITLE: Old Russell's Yard, Alloa

PROJECT REFERENCE: AP1916

Status: Revision 1

Issue and Approval Schedule			
Issue 1	**Name**	**Signature**	**Date**
Prepared By	Genna Stewart (Geo-environmental engineer)	[redacted]	08/12/2023
Approved By	Stuart Mitchell (Managing Director)	[redacted]	08/12/2023

Executive Summary		
Site Information & Setting		
Client	ARKA Architects	
Site Name	Russell's Yard, Alloa	
Site Location	Russells Yard, Clackmannan Road, Alloa FK10 4DA	
Proposed Development	It is understood that the intended land use is for a new commercial development comprising of a Fast-food Restaurant Gregs retail building with a drive through and carparking and associated areas of soft landscaping	
Site Description		
Site Area	0.48 hectares	
Current Site Use	The site is current developed with a garage, paving company, scrap yard, fencing company, and plant hire company.	
Adjacent Site Uses	The site is bounded on the north by the A907 and railway, to the east by an agricultural field with historical monument, to the south by Alloa Park Drive and residential developments and to the west by Alloa Park Drive and Retail Park with fuel station.	
Desk Study Summary		
Environmental Setting	Geology	Superficial Geology: Raised marine deposits underlain by Glacial Till Deposits Bedrock Geology: the Scottish Lower Coal Measures.
	Sensitive Land Uses: No designated environmentally sensitive sites were identified on site.	
Hydrogeology	Surface Waters: The closest surface water feature is the Black Devon (ID: 4402) located 390m to the southeast of the site. In 2020 SEPA classified this surface water receptor as having a moderate ecological overall status. The Black Devon is a tributary of the Upper Forth Estuary (ID:200437). In 2020 SEPA classified this surface water receptor as having an overall status of moderate. We therefore consider this to be the sites most sensitive receptor. Groundwater: The northern area of the site is underlain by the Chirnside ground water body (ID:150525). In 2020 SEPA classified the overall status of this ground water body as poor. The southern area of the site is underlain by the Fogo groundwater body (ID: 150593). In 2020 SEPA classified the overall status of this ground water body as poor.	
	The landmark site check consultants have identified the site to have a low risk of flooding.	
Radon	The site is in a lower probability radon area; meaning less than 1% of homes are estimated to be at or above the action level. It is therefore considered that no radon protective measures are necessary in the construction of new dwellings or extensions to existing buildings.	
Ground Model		
10 No. trial pits were excavated to a maximum depth of 3.50mbgl until termination across the site to explore the ground conditions, ground bearing capacity and to retrieve samples for contamination testing. 2 No. mineral rotary boreholes were sunk to a maximum depth of 30.00mbgl to explore the ground conditions, ground bearing capacity, the mineral stability and ground gas and groundwater regime.		
Ground Conditions	Made ground was encountered in all exploratory holes across the site, recorded from the depths of ground level to a maximum depth of between 0.50 and 3.50mbgl. The made ground is variable across the site and comprised of several layers.	
	Obstructions were encountered in 2 No. trial pits conjectured to be boulders.	
	Groundwater was recorded in the rotary boreholes at a depth of 12.00mbgl and 21mbgl in R1 and 16.00mbgl and 19.20mbgl in R2. Water ingress was noted in TP04 and TP05 at a depth of 3.50mbgl and TP07 at a depth of 1.65mbgl. Groundwater monitoring is ongoing, however no groundwater was encountered.	
Ecology & Archaeology	No area of ecological or archaeological significance were identified.	
Geotechnical Assessment		
Foundation Options	The site investigation indicated the site to be underlain by made ground, sand and gravel and glacial till. Made ground deposits are a variable degree of compaction and not considered to be a suitable bearing horizon in their current condition.	

	As the superficial deposits are generally variable (i.e. loose sand or medium dense boulder clay), we consider vibro piling to rockhead to be the most viable solution for the building in the north. The natural bedrock is consider to provide a bearing capacity of 100kPa.
Road Construction	We recommend a 600mm capping layer rolled with a 13t vibrating drum roller is place beneath roads. Plate bearing tests should be undertaken after to confirm suitability after the initial site clearance.
Sulphate Assessment	In accordance with the BRE Special digest 1:2005 'Concrete in Aggressive Ground', recommendations for concrete would be aggressive chemical environment (ACEC) classification AC-1s with design sulphate class of DS-1
Water Supply Pipework	We consider a barrier pipe (PE-AL-PE) and a wrapped steel pipe to be suitable for use along the proposed tract.
Mining Stability	There is not enough rock cover to negate the risk of surface instability.
Contamination Findings	
Human Health	The GQRA did not identify any exceedances. No asbestos was identified. We therefore do not consider there to be a risk to human health and No remedial measures are required.
Ground Gas	Ground gas monitoring is ongoing, a ground gas risk assessment will be undertaken once all rounds of monitoring are complete and will be issued as an addendum to this report.
Radon Gas	No radon protection measures are required.
Plant Life	No phytotoxic exceedances were recorded We therefore do not consider there to be a risk plant life and no remedial measures are required.

Contents

Appendices

Contents of Tables

1.0 Introduction

Ardmore Point Ltd was commissioned by ARKA Architects to in October 2023, to complete a Phase 2 ground investigation and report for a site called 'Russell Yard. The site location Plan is included in Appendix A.

It is understood that the intended land use is for a new commercial development comprising of a Fast-food Restaurant Gregs retail building with a drive through and carparking and associated areas of soft landscaping

1.1 Guidance

This report has been prepared in accordance with current recommended legislative practices. The following guidelines and practices (not limited to) have been adopted during the preparement of our site works; British Standards BS5930:2015, BS10175:2011+A2:2017 and all normative references.

The Science Report SC050021/SR3 and CIRA 552 including Land Contamination Risk Management guidance, and Model Procedures for the Management of Land Contamination were used in the development of Conceptual site models and risk assessments.

1.2 Ground Investigation Proposal

The objective of the investigation was to provide the following

Soil profile beneath proposed development areas of the site
Chemical Contamination conditions
Geotechnical characteristics of the material
Foundation bearing characteristics and horizons
Ground gas and groundwater regime

1.3 Limitations

This report is based upon interpretations of the ground conditions established by exploratory pits, boreholes and the chemical and geotechnical testing undertaken on the samples retrieved. While we have carried out analysis and interpretations of the ground conditions in the exploratory holes it should be recognised that natural strata and groundwater conditions may vary from point to point.

While it is attempted in reporting to assess the likelihood and extent of such variations, conditions may nevertheless exist which remain undisclosed by the investigation. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths at the time of investigation. At intermediate locations, conditions can only be inferred.

This report has been prepared for ARKA Architects, and their appointed professional advisors and may not be relied upon by a third party for any purpose without the written consent of this practice.

2.0 Summary Of Desk Study Information

2.1 Site History

An investigation of the past usage of the site can often provide an indication of the presence of potentially contaminated soils arising from processes associated with former land uses. This research can help to identify any potential constraints to developments upon which physical investigations can then concentrate. Past copies of Ordnance Survey Maps were examined, and the summary of the historical land uses identified on and adjacent to the site are described below.

It should be noted that there is considerable periods of time missing between successive Ordnance Survey Map editions and the possibility that further land uses may have occurred in the intervening years cannot be discounted. Although we have tried to ascertain the complete site historic record, the possibility that other significant land uses occurred, while considered unlikely cannot be disregarded.

Table 1: Historical Land Uses

Ordnance Survey Edition (Appendix E)	On Site	Surrounding Area (within 500m)
1865 (1:2,500)	Undeveloped land.	Railway recorded to the north of the site within 100m of the north boundary.
1900 (1:2,500)	No significant change	Old gravel pit recorded to the east of the site within 250m. Whinhill Pit (Coal) recorded to the north within 250m.
1913 (1:10,560)	No significant change	Old shafts and clay pits recorded to the north within 500m of the site. Mostly undeveloped land and air shafts to the south and residential to the east and west.
1920 (1:10,560	No significant change	No significant change
1922 (1:2,500)	No significant change	No significant change
1948 (1:10,560)	No significant change	Whinhill Pit (Coal) no longer recorded to the north. Clay pit to the north no longer recorded.
1951 (1:10,560)	No significant change	No significant change
1954 (1:10,560)	No significant change	No significant change
1959 (1:1,250)	No significant change	No significant change
1960 (1:2,500)	No significant change	No significant change

1967 (1:10,560)	No significant change	Warehouses recorded to the north where the clay pit used to be.
1968 (1:1,250)	Refuse Tip located on the eastern boundary entering the site to the south	Garage was recorded to the west of the site. Fire station also recorded to the west of the site.
1973 (1:2,500)	Refuse tip no longer recorded. Tank recorded on site.	No significant change
1974 (1:2,500)	No significant change	No significant change
1976 (1:1,250) 1976 (1:10,000)	Transport Depot recorded on the north section of the site in the 1:1,250 edition. Depot recorded on the 1:10,000 edition	Large increase in residential to the west of the site.
1985 (1:10,000)	No significant change	No significant change.
1989 (1:1,250)	Depot no longer recorded on site.	Small development record to the east of the fire station.
1992 (1:1,250)	Garage recorded on the north section of the site and scrap yard recorded in the south section.	Garage to the west no longer recorded. Filling station recorded on the site of the previous garage.
1992-2023 (1:10,000 & 1:2,500)	No significant change. Garage is recorded on the eastern boundary of the site.	Car park recorded to the west south of the filling station. Substation recorded to the south of the site in 2010 with an increase in residential as well.

A review of the earliest historical map indicates the site was vacant unoccupied land from 1865 till 1968. From 1968 to 1973 a refuse tip was recorded within the boundary of the site. In 1973 the refuse tip was no longer recorded, and a tank was recorded within the centre of the site. Between 1976 and 1989 a depot was recorded in the north section of the site. From 1992 to 2023 the southern section of the site has been occupied by a scrap yard. Sometime between 1989 and 1992 the tank was removed from the site.

The site walkover revealed that the site area is currently occupied by the scrap yard mentioned above and a paving contractor in the south section of the site. A plant and machinery hire is located in the northern section.

The historical Ordnance Survey maps indicated the surrounding area was generally unoccupied to the south, east and west of the site with undeveloped land and Alloa Park within 500m of the site. From 1865 to 1948 the immediate surrounding area to the north of the site was occupied by a railway and the Whinhill Pit (Coal). An old gravel pit was also recorded near to the pit. Between this period the south was undeveloped land with the occasional air shaft. Most residential developments were recorded to the west of the site with the occasional developments to the east.

From 1948 the Whinhill Pit was no longer recorded; however, the railway remained and is used to this day. In 1967 there was a significant increase in residential developments to the west of the site. Warehouses were also recorded to the north just above the former pit. There wasn't any significant change until 2001 where the area to the west of the site was developed with a road. In 2010 this was extended and residential developments were built to the south of the site. A development was recorded to the west of the site which is believed to be the current Morrisons Retail Store. Between 2010 and 2023 there was some change to the surrounding area with an increase in residential developments.

In consideration of the above we anticipate made ground deposits on the site and conjecture it to be associated with the construction and subsequent demolition of the buildings and made ground associated with the surrounding residential development may be present. There are periods of time unaccounted for and while considered unlikely contamination associated with any other land-uses cannot be disregarded. We therefore require a ground investigation is undertaken to confirm the ground conditions of the site.

2.2 Published Geological Information

Superficial Deposits

Given the development of the site Made ground is conjectured beneath the site and considered to be associated with the construction and subsequent demolition of the buildings previously on site.

The British Geological Society (BGS) BGS has indicated the site is underlain by raised marine deposits, Devensian, comprising of clay, silt, sand, and gravel. Historical BGS boreholes located approximately 30m west describe the soils as 'Very soft SILT and mottled CLAY' underlain by stiff grey boulder clay.

Solid Geology

The solid geology underlying the superficial deposit are indicated by BGS to belong to the Scottish Lower Coal Measures Formation. Sandstone, siltstone, and mudstone in repeated cycles with seatclay or seatearth and coal at the top. Coal seams are common, and many exceed 0.3m in thickness. BGS boreholes located 30m west indicate bedrock to be at depths of between 15.00mbgl and 35.50mbgl.

Hydrology

The site is considered to be comprised of 4 geological units; Made ground, raised marine deposits, Glacial till and sedimentary Bedrock. The typical permeability is recorded in Table 2

Table 2: Permeability

Strata Type	Permeability Range
Made Ground	Variable
Raised marine Deposits	Moderate to high
Glacial Till	Low to moderate
Sedimentary Bedrock	Low to high

Surface water infiltration is consider to be low as the site is surfaced predominantly in hardstanding.

No commercial groundwater abstraction wells were recorded within, or within the immediate vicinity (>500 m) of, the site boundary. We would, however, highlight that groundwater abstraction has only recently become a licensed activity in Scotland and therefore further unrecorded (independent) 'well' could also exist in the area.

Made ground is conjectured to be present, associated with the previous historical development. Made ground has a variable permeability which can allow the lateral and vertical movement of water and potentially mobile contaminants. Underlying the made ground is raised marine deposits which have a moderate to high permeability. SEPA do not indicate a superficial groundwater table to underlie the site that satisfies UK TAG guidance of $10m^3$ a day.

The site is underlain by the Alloa groundwater body (ID:150536). In 2020 SEPA classified the overall status of this groundwater body as poor. This bedrock is indicated to be a moderately productive aquifer, virtually all flow is through fractures and discontinuities (Refer to Appendix G). As the site is considered to be underlain by raised marine deposits which has a variable permeability, we consider there to be a moderate risk for potential leaching of the soil into the groundwater table. The risk to the groundwater table from potential leaching of the soil can be classified as low where the site is underlain by clay as this will act as a barrier (Environmental Agency – Project Summary SC040016).

The closest surface water feature is the Black Devon (ID: 4402) located 390m to the southeast of the site. In 2020 SEPA classified this surface water receptor as having a moderate ecological overall status. The Black Devon is a tributary of the Upper Forth Estuary (ID:200437). In 2020 SEPA classified this surface water receptor as having an overall status of moderate. We therefore consider this to be the sites most sensitive receptor

2.3 Ground Gas

Made ground can be a potential source of ground gas. Infilled ground onsite or off site can allow the migration of ground gas. We conjecture the site to be underlain by made ground associated with the previous buildings. Infilled ground is likely to be present to the east and north of the site where former gravel pits and coal pits were recorded.

We consider there to be a potential risk to the proposed development due to ground gas and further investigations will be required to determine if gas preclusion measures are required.

The site is within an area of low radon potential (<1%). We therefore do not consider there to be a risk to the proposed development from radon and radon protection measures will not be required.

2.4 Conservation Areas

From the Historical Ordnance survey maps potential areas of historical significance were identified approx. 150m from the site boundary. A scheduled ancient monument was located 161m east of the site and is recorded as Parkmill, cross slab. It is unlikely that the proposed development would have any significant impact on the monument.

2.5 Preliminary Mining Assessment

Ardmore Point Ltd conducted a Coal Mining Investigation & Risk Assessment report for the site at Clackmannan Road, Alloa in 2022. It was found that six coal seams had been worked beneath the site from depths of 29mbgl to 44mbgl as part of the Whinhall Colliery. The depth to the coals and time that has elapsed since working ceased will have ensured that all subsidence will have long since taken place. In line with CIRIA Special Publication 32 – Construction over Abandoned Mine Workings (1984) for the site to be considered stable the rock cover above the workings needs to be 10x the coal seam thickness and consist of competent rock. Only three of the workings associated with the Whinhall Colliery near to or beneath the site met this criteria, therefore the site is considered to be unstable and would require mitigation measures. Mine gas was considered unlikely to affect the proposed development due to the depth of the workings and the impermeable layer of clay above the bedrock.

2.6 Preliminary Conceptual Site Model

A preliminary site conceptual model (CSM) is formed by presenting all sources, pathways and receptors identified and/or suspected during the desk study review. Guidance from the science Report SC050021/SR3 and CIRA 552 was used to help develop a robust site-specific Conceptual Site Model (CSM). The CSM forms a crucial foundation of contaminated land risk assessment using detailed site-specific information and the potential interpretations on the behaviours and characteristics of contaminants, pathways and receptors.

Source Characterisations

Potential on-site and off-site sources of contamination have been identified through the historical review and Landmark Report. Potential sources located at a distance greater than 250m from the site have been discounted purely on the basis of distance from the subject site. Refer to table 3 for contaminants of concern.

<u>On-Site</u>

Un-recorded made ground associated with the construction/demolition of the buildings.

Potential on-site and off-site sources of contamination have been identified through the historical review and Groundsure Report.

On-Site

Un-recorded made ground associated with the construction of the buildings located within the site.

Given the age of the buildings that occupied the site, it is considered that any made ground deposits associated with the structures are considered to present a source of asbestos.

Potential hydrocarbon contamination from leakage and/or spillage from the tank.

Potential heavy metal, hydrocarbon, and oil contamination from the scrap yard.

Potential heavy metal, hydrocarbon, PCB and oil contamination from the previous garage and depot.

Contamination from the historical refuse tip.

Off-Site

Unrecorded deposition of contaminated fill materials associated with the nearby residential and commercial developments.

Potential contamination of heavy metals, hydrocarbons and oils from the adjacent garage and filling station.

Un-recorded made ground associated with the railway and coal pit.

Preliminary Conceptual Site Model (CSM)

Using information retrieved during the desk study allowed potential sources, receptor, pathways and pollutant linkages to be identified and used to create a preliminary Conceptual Site model. Refer to page 16 for the preliminary CSM.

Industrial Activity/ Site Use	CONTAMINANTS OF CONCERN								
	Metals (As, Mg, Cd, Cr, Ni, Zn, Cu, Hg Pb)	TPH	PAH VOCs SVOCs	PCBs	Asbestos	Ground Gas (CO_2 & CH_4)	Petroleum hydrocarbons (PHCs)	Phenols	Potential Pathways
ON SITE (Current and previous)									Deposition of waste materials (Unrecorded made ground) Generation and accumulation of ground gases (made ground) Migration of ground gases (on/off site) Leakage or spillages from the previous tank. Leaching of contaminants to groundwater via permeable sand/silt deposits. Inhalation of vapours and/or dust/particles.
Unrecorded deposition of made ground associated with the former buildings and current buildings located on site. Potential hydrocarbon contamination from leakage and/or spillage from the tank. Potential heavy metal, hydrocarbon, and oil contamination from the scrap yard. Potential heavy metal, hydrocarbon, PCB and oil contamination from the previous garage and depot. Contamination from the historical refuse tip.	Y	Y	Y	N	Y	Y	Y	N	
	LEACHABLE CONTAMINANTS								
OFF SITE (Current and previous)	Metals Semi metals and non-metals	TPH	PAH	PCBs	Asbestos	Ground Gas (CO_2 & CH_4)	Petroleum hydrocarbons (PHCS)	Phenols	Potential Pathways
Unrecorded deposition of contaminated fill materials associated with the nearby residential	Y	Y	Y	N	Y	Y	Y	N	Deposition of waste materials (Unrecorded made ground)

Table 3: Contaminants of concern

and commercial developments. Potential contamination of heavy metals, hydrocarbons, PCBs and oils from the adjacent garage and filling station. Un-recorded made ground associated with the railway and coal pit.									Generation and accumulation of ground gases (made ground) Migration of ground gases (on/off site) Leakage or spillages from the previous tank. Leaching of contaminants to groundwater via permeable sand/silt deposits. Inhalation of vapours and/or dust/particles.

Table 3a: Abbreviations and Key for Table 3.

List of Abbreviations	KEY
PAH – Polycyclic Aromatic Hydrocarbons	Y Further Investigation Required.
VOC – Volatile Organic Compounds	N No Further Investigation Required.
SVOC – Semi-Volatile Organic Compounds	
PCBs – Poly-Chlorinated Biphenyl	
PHCs – Petroleum Hydrocarbons	

2.4 Qualitative Preliminary Environmental Risk Assessment

Potential source-receptor-pathway linkages identified during desk study research for the site are displayed in the Conceptual Site Model on page 19 and in table 4. The CSM was a crucial part of helping identify the risks for a generic preliminary risk assessment based on assumptions from information retrieved during the desk study research. We therefore require a site investigation to confirm or otherwise identify the existence of such linkages in addition to providing further geological conditions and geotechnical data. An approach based on CIRIA report C552 has been adopted. For each of the pollutant linkages, an estimate is made of the potential 'Severity of Risk' and the 'Probability of Risk Occurring'. These are then used for an overall qualitative evaluation of the level of risk, as defined below in tables taken from CIRIA report C552 (refer to Appendix H).

The risk assessment has been undertaken by assessing the severity of the potential consequence, considering both the potential severity of the hazard and the sensitivity of the target, based on the categories given below.

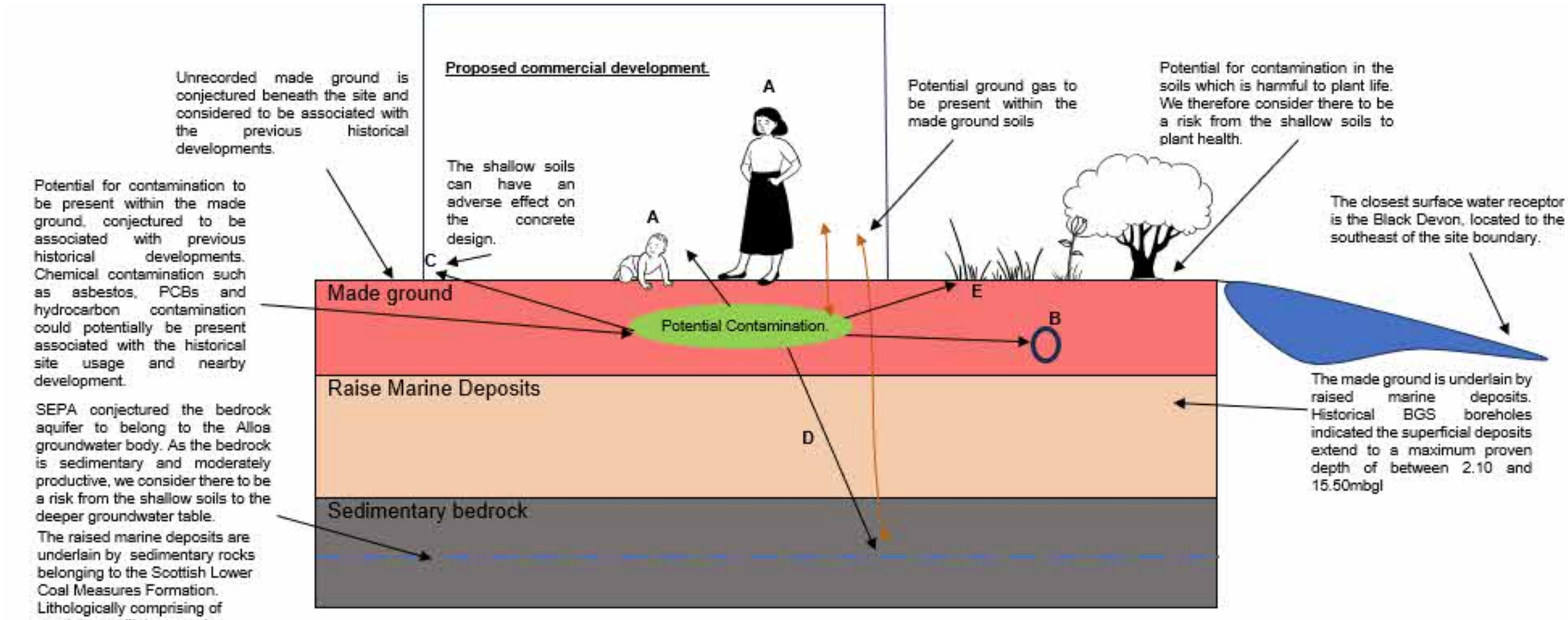
2.5 Preliminary Risk Assessment Summary

The desk study review identified potential sources both on-site and off-site. It is therefore considered that there is potential for pollutant linkages to exist within the site. Contamination associated with the previous historical usage within the site is considered likely. We therefore consider there to be a risk to human health, plant life and the water environment from the shallow soils and a ground investigation will be required. Once a ground investigation is carried out which will confirm or otherwise the presence of these pollutant linkages, and updated CSM and a risk assessment will be carried out using the findings.

The proposed development comprises of a new restaurant with drive-thru, associated roads, car parking and soft landscaping. The areas where there is hardstanding (building footprint, access roads and car parking areas) would break a moderate amount of the potential linkages to human health end users; however potential linkages would not be broken within the areas of soft landscaping.

Risks to property, water supply pipes, buried concrete and the water environment also require further assessment given the nature of the site. In order to confirm and assess the presence of the possible sources of contamination present on-site; an intrusive investigation was considered to be required.

Illustrated Preliminary Conceptual Site Model



Potential sources

Contaminated made ground
Ground Gas

A

Potential Receptors (Site Users/Construction personal)

Potential Exposure Pathways	
1.	Outdoor ingestion of dust
2.	Indoor ingestion of dust
3.	Skin contact with indoor dust
4.	Skin contact with outdoor dust
5.	Outdoor inhalation of dust
6.	Inhalation of dust
7.	Outdoor inhalation of soil vapor
8.	Indoor inhalation of soil vapor
9.	Ingesting soil
10.	Skin contact with dust.
11.	Eating contaminated vegetables

B

Potential Receptors Plastic water supply pipes

Potential Exposure Pathways	
1.	Permeation of plastic supply pipes

C

Potential Receptors Buried Concrete (foundations/services)

Potential Exposure Pathways	
1.	Adverse effects on buried concrete.

D

Potential Receptors Ground Water

Potential Exposure Pathways	
1.	Leaching of contaminants to groundwater
2.	Migration of contaminants in ground water

E

Potential Receptors Plant Life

Potential Exposure Pathways	
1.	Direct contact with contaminated soils and ground water
2.	Uptake of contaminants from the soil or groundwater into the plant

Table 4: Preliminary Qualitative Risk Assessment

Source	Contaminants of concern associated with the source	Pathway/Pollutant Linkage	Pathway	Receptor	Assessment	Likely Hood of occurrence	Severity of Conseque	Risk Rating
Onsite: Un-recorded made ground associated with the construction of the buildings located within the site. Given the age of the buildings that occupied the site, it is considered that any made ground deposits associated with the structures are considered to present a source of asbestos. Potential hydrocarbon contamination from leakage and/or spillage from the tank. Potential heavy metal, hydrocarbon, and oil contamination from the scrap yard. Potential heavy metal, hydrocarbon, PCB and oil contamination from the previous garage and depot. (Refer to section 5.1 for details) Contamination from the historical refuse tip. Off site: Unrecorded deposition of contaminated fill materials associated with the nearby residential and commercial developments. Potential contamination of heavy metals, hydrocarbons, PCBs and oils from the adjacent garage and filling station. Un-recorded made ground associated with the railway and coal pit. (Refer to section 5.1 for details)	Metals (As,Mg, Cd, Cr, Ni, Zn, Cu, Hg, Pb) PAH, VOCs, SVOCs, Chlorides, TPH, PCBs, Phenols Asbestos Ground Gas (CO_2, CH_4)	Dust Ingestion (indoors) Ingestion (outdoors) Dermal (indoor) Dermal (outdoors)	Inhalation or digestion of particles/dust from potentially unrecorded made ground soils from on and/or off-site sources – (indoors and outdoors)	Humans – Site end-users Humans -Construction and maintenance workers	Potential spillages/leakages of contaminants impacting shallow soils Contaminated materials may have been buried or deposited within the site. Contaminants have the potential to compromise the integrity of any water supply pipes and subsequently lead to consumption of contaminated water supply. Ground gas and vapours have the potential to build up in confined spaces and pose an explosion or asphyxiation risk to site end users. Excessive exposure may occur under some manual activities. The potential for asbestos containing material within the shallow soils is considered to increase the risk rating to this receptor. Construction and maintenance workers have the potential to come into contact with contaminated ground. Excessive exposure may occur under some manual activities. The potential for asbestos containing material within the shallow soils is considered to increase the risk rating to this receptor			
		Soil Vapour & Gases Inhalation (indoors) Inhalation (outdoors)	Rising vapours and gases from potentially unrecorded made ground soils from on and/or off-site sources – (indoors and outdoors)					
		Soil Dermal contact with soil Ingesting soil Eating vegetables grown in contaminated soil	Tracking back of contaminated soil/dust from soft landscaped areas into home/commercial property					
			Wind generated dust and/or dust generated from groundworks.					
		Soil Direct contact with the soil Uptake of contaminants from the soil	Leaching of contaminants from made ground soils on/offsite to the permeable natural (raised marine soils).	Plant Life – areas of soft landscaping	Direct contact or uptake of contamination from the soil or groundwater could adversely affect any plants grown. Migrating of ground gases from unrecorded shallow made ground deposits that adversely affect plant growth.			
		Groundwater Direct contact with the groundwater – Uptake of chemicals from the groundwater	Migrating of contaminated groundwater via the permeable superficial deposits into site adversely affecting plant growth.					
		Gases Migration of potential gases from made ground deposits into the site	Migrating of ground gases (from potential made ground) into site adversely affecting plant growth					
		Water Leaching of contaminants to groundwater Migration of contaminants in groundwater via the conjectured shallow groundwater	Leaching of contaminants or transport of contaminants from the shallow made ground deposits or from another contaminated site via the permeable (tidal flat) superficial deposits.	Groundwater – Superficial	Contaminants may be leached and potentially mobilised from the soil by percolation and/or shallow groundwater movement. Contaminants could impact the groundwater and migrate offsite. Where superficial groundwater is present mobile contaminants from on-site sources have the potential to leach into the superficial groundwater body, which may then migrate laterally to off-site receptors, causing potential pollution of the wider water environment.			
		Water Leaching of contaminants to groundwater	Leaching of contaminants from the made ground soils via the	Groundwater – Bedrock Aquifer	Contaminants could impact the groundwater and migrate offsite.			

		Migration of contaminants in groundwater via the conjectured groundwater body.	permeable sand and silt deposits.		Mobile contaminants from onsite sources (made ground) have the potential to leach into the bedrock aquifer, which may then migrate laterally to offsite receptors, causing potential pollution of the wider water environment			
		Water Leaching of contaminants to the surface water Migration of contaminants in groundwater and discharged into the surface water receptor	Direct entry of contaminants into surface water via accidental spillage/leakage or from discharge pipework. Outfall of contaminated surface water into the Black Devon, via cracks in water drainage system.	Surface Water Receptor – River	Contaminants could migrate in the groundwater and act as base flow for surface water recharge.			
		Water Permeation of plastic supply pipes Soil Permeation of plastic supply pipes	Leaching of contaminants to groundwater via the permeable superficial sand/silt deposits Migration of contaminants in groundwater	Services - Plastic Water supply Pipes	Contaminants could affect the drinking supply and water supply for residential houses. Presence of contaminants in soil that may permeate water supply pipes.			
		Soil Migration of contaminants in soil Migration of ground gases within the shallow soils	Aggressive chemical environments within the unrecorded made ground or superficial deposits affecting the built environment	Built environment - Buried concrete/Houses	Potential for aggressive chemical environments for concrete due to sulphate and acidic conditions. Direct contact with this contamination in both soil and superficial groundwater can result in damage to the concrete fabric and services in a similar fashion to that described above for water supply pipes in service trenches.			

KEY 1 (Classification of Consequence)	
	Minor
	Mild
	Medium
	Severe

KEY 2 (Classification of probability)	
	Unlikely
	Low likelihood
	Likely
	High Likely Hood

KEY 3 (Risk Rating)	
	Very low risk
	Low Risk
	Moderate Risk
	High Risk
	Very High Risk

3.0 Site Investigations

3.1 Objective of The Site Investigation

The intrusive site investigations were undertaken by Ardmore Point in November 2023 and were designed in relation to the conceptual site model, preliminary risk assessment and in recognition of the nature of the proposed development.

The aim of the site investigation was the provide information on the following

Soil profile beneath proposed development areas of the site
Chemical Contamination conditions
Geotechnical characteristics of the material
Foundation bearing characteristics and horizons
Rotary Mineral Boreholes

3.2 Scope of Site Investigation

Ardmore Point were commissioned in October 2023 to undertake an intrusive site investigation. The scope of the works are detailed below in table 5. The sampling undertake was non targeted and carried out in accordance with BS:10175(2011)+A2(2017) to ensure sufficient coverage of the site. A Plan for the exploratory holes is included in Appendix B.

Table 5: Scope of Site investigation Summary

Site Investigation	Objective
10 No. trial pits were excavated by an Ardmore Point Engineer to a maximum depth of 3.50mbgl until termination on an obstruction or potential rockhead	Soil profile beneath proposed development areas of the site Chemical Contamination conditions Geotechnical characteristics of the material Foundation bearing characteristics and horizons
2 No. rotary boreholes were sunk by Phoenix to a maximum depth of 30mbgl.	Soil profile beneath proposed development areas of the site Geotechnical characteristics of the material Foundation bearing characteristics and horizons Mineral stability Ground gas and ground water regime

Logging of Soil

The strata encountered during the excavation of exploratory pits was generally described in accordance with the guidelines provided by Code of Practice Site investigations BS:5930(2015). The properties described include the strength, colour, composition, density, weathering and any other feature.

Sampling Strategy - Chemical Sampling

Samples are taken at regular depths throughout the made ground and natural soils to allow for a robust human health risk assessment or any changes in horizon or when visible contamination was present. Samples that are taken at ground level to a maximum depth of 1.00m are to assess human or animal intake arising from ingestion or inhalation, surface water run-off, wind generated dust causing the inhalation of chemicals, surface leaching and uptake by plants.

Samples taken in depths greater than 1.00m are to assess intake ingestion or inhalation in humans during excavation of the soils, up taking by deep rooted trees, construction which includes sewer installations, foundation digging and water supply pipe installation. See the extent of made ground, if it contains any gas generating materials and leachable materials.

All soil samples recovered for chemical analysis were tested for the potential contaminants identified in the preliminary risk assessment. All results from the samples were analysed in a site-specific risk assessment in accordance with the current legislative guidance for human health and SEPAS guidance for the water environment.

All samples recovered for analysis were sealed in plastic tubs, labelled and kept in a cool unit to maintain natural temperature. Amber jars and vials were used when hydrocarbon, PAHS and organic contamination was expected to prevent the samples from deviating. This procedure is designed to maintain sample integrity and ensure that the chemical analysis is as representative of the site conditions as possible.

The chemical analysis was undertaken by i2 Scotland, a registered UKAS accredited laboratory.

Drilling works were undertaken by Phoenix Drilling Ltd and suitably accredited sub-contractor.

Samples were analysed by the lab DETS, for potential sources of contamination on site. The nature of the contamination analyses used for soil samples is detailed below:

Metals: arsenic, water soluble boron, cadmium, chromium, copper, lead, mercury, nickel, zinc
Inorganic: total cyanide, organic matter, Sulphate Aqueous Extract as SO4
Petroleum Hydrocarbon: Aliphatic C5-C6, Aliphatic C6-C8, Aliphatic C8-C10, Aliphatic C10-C12, Aliphatic C12-C16, Aromatic C5-C7, Aromatic C7-C8, Aromatic C8-C10, Aromatic C10-C12, Aromatic C12-C16, Aromatic C16-C21, Aromatic C21-C35
PAHs: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Chrysene, Fluoranthene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene, Pyrene, Total PAH - USEPA 16
Asbestos: chrysotile, amosite, crocidolite, anthophyllite, tremolite and actinolite

The i2 Laboratory Test Results are included in Appendix E and the chain of custody Appendix F.

4.0 Ground Conditions Recorded

4.1 Summary of Ground Conditions

The following section presents the ground conditions encountered in the site investigation. The conditions are consistent with the sequence of strata indicated in the desk study. A summary of the ground conditions. The trial pit logs window sample logs and are included in Appendix C and D.

A summary of the ground conditions encountered are summarised below.

Table 6: Summary of Ground Conditions

Soil Type	Depth of Top (mbgl)	Depth of Base (mbgl)	Strata Thickness (m)
Made Ground	0.00	0.50 – 3.50	0.50 – 3.50
Alluvial/Glacial Till	0.50 - 3.50	14.50 – 16.60	13.10 – 14.00
Sedimentary bedrock	14.50 – 16.60	30.00	-

Made Ground

Made ground was encountered in all exploratory holes across the site, recorded from the depths of ground level to a maximum depth of between 0.50 and 3.50mbgl. The made ground is variable across the site and comprised of several layers

The site is predominantly surfaced in type one stone, tarmac, stone ash fill recorded from ground level to a maximum depth of 0.20mbgl.

Underlying the hardstanding is made ground typically comprised of variable amounts of blaes and ash and/ or type one. Recorded from the depth of 0.20mbgl to a maximum proven depth of between 0.60mbgl and 0.85mbgl.

Underlying the blaes layer was made ground generally comprised of brown sandy clay ‘fill’. Recorded from the depths of between 0.60mbgl and 0.85mbgl to maximum proven depth of between 0.70mbgl and 3.50mbgl.

Superficial Deposits

The made ground deposits were underlain by sand and gravel deposits generally described as fine to coarse sand, gravel is fine to coarse angular to subrounded sandstone and siltstone with frequent clay bands. Recorded from the depth of between 0.50mbgl and 3.50mbgl to a maximum depth of between 13.70mbgl in R1. Underlying the sand and gravel in R1 and underlying the made ground in R2 is very sandy boulder clay with occasional gravel bands. Recorded to a maximum proven depth of between 14.50mbgl and 16.60mbgl.

Bedrock

Bedrock was encountered in the rotary boreholes at depths of between 14.50 and 16.60mbgl, proven to a maximum depth of 30mbgl.

The sedimentary predominantly comprised of mudstone, sandstone and with occasional coal seams. Note that R2 encountered possible packed waste (mine working) between 19.20mbgl and 20.40mbgl.

Obstructions

Obstructions were encountered in 2 No. No. trial pits terminated on boulders or potential bedrock and 1 No. trial pit conjectured to be a boulder.

Groundwater

Groundwater was recorded in the rotary boreholes at a depth of 12.00mbgl and 21mbgl in R1 and 16.00mbgl and 19.20mbgl in R2. Water ingress was noted in TP04 and TP05 at a depth of 3.50mbgl and TP07 at a depth of 1.65mbgl

Monitoring wells were installed within R1 and R2 to provide a more accurate assessment of the groundwater behaviour within the superficial deposits. Groundwater monitoring is ongoing; 3 No. visit had been undertaken at the time of reporting.

Table 7: Groundwater Monitoring Summary

	Borehole	
	R1	R2
Minimum Depth (mbgl)	DRY	DRY
Maximum Depth (mbgl)	DRY	DRY
Average Water Thickenss	DRY	DRY

Once all monitoring is complete a groundwater risk assessment will be undertaken and will be issued as an addendum to this report once all rounds of groundwater monitoring are complete. The results of the groundwater monitoring are present in Appendix G and summarised in the table above.

We consider the groundwater recorded during the drilling and excavation prosses to be reflective of pockets of groundwater held in more granular layers in the natural glacial till deposits and pockets in the granular made ground soils. The glacial till soils would be largely prohibitive to vertical or lateral groundwater movement therefore we do not consider there to be a pervasive groundwater table within the superficial soils.

In consideration of the above and the no recharge noted during groundwater monitoring, it is considered that the groundwater recorded within the soils would not meet the minimum criteria to be classified as a water body i.e., able to sustain a 10 m 3 per day extraction.

Deeper groundwater bodies may be present at or below the bedrock level. These are considered to exist as separate systems due to the presence of overlying low permeable clay soils.

5.0 Contamination Risk Assessment

5.1 Contaminated Land

The statutory definition of contaminated land is given in the Environmental Protection Act 1990 and was introduced by the Environment Act 1995. It is land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

Significant harm is being caused or there is a significant possibility of such harm being caused
Significant pollution of water environment is being caused, or there is a significant possibility of such pollution being caused from the soils within the Site.

5.2 Relative Risk Assessment Screening Criteria

Human Health Guidelines.

The following section presents the information relating to the preliminary risk assessment which established potential pollutant linkages, chemical testing undertaken as part of the non-targeted ground investigation. The objectives of the ground investigation was to provide coverage of the site in line with British standards BS:10175(2011) +A2(2017).

A generic quantitative risk assessment (GQRA) has been carried out as part of this assessment. Chemical soil samples have been analysed in order to identify potential risks to human health and plant life, leachate has been retrieved and assessed in terms of the risk posed to the water environment.

The generic risk assessments utilized are the Suitable 4 Use Levels (S4ULs) derived from LQM/CIEH, based on changes to the CLEA exposure parameters, as outlined in the DEFRA publication SP1010 (category 4 screening levels (C4SLs, March 2014). Other recognised scientific authoritative assessment criteria's have been used to identify the potential risk from contaminants; the updated Environmental Agency Soil Guideline Values (2009) (uSGV), CL:AIRE (2009) – The Soil Generic Assessment for Human Health Risk Assessment and ICRCL 64/85 Asbestos on Contaminated sites (1990).

This risk assessment has been prepared in terms of sensitive end-use (Commercial with plant uptake)

Groundwater and Surface water Risk Assessment

The following information is has been used to carry out a risk assessment for the water environment; SEPA Position Statement WAT-PS-10-01, 'Assigning Groundwater Assessment Criteria for Pollutant Inputs' (August 2014), WHO guidelines for drinking water quality, UK EQS Guidelines, SEPA WAT-SG-53 (2009) Environmental Quality Standards for surface water and Directive 98/83/EC – The Drinking Water Directive.

Ground Gas Risk Assessment

The potential presence of ground gases such as carbon dioxide and methane have been targeted in compliance to BS Standard 8485:2015 +A1(2019) 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.' The risk assessment is generally based on those detailed in the CIRIA C665, 'Assessing Risks posed by Hazardous Ground Gases to Buildings', CIRIA 2007 and by Wilson and Card (1999).

Building Materials Assessment

To determine the suitability of water supply pipes, a preliminary assessment based in UKWIR guidance has been undertaken. Further consideration has also been given to BRE Special Digest 1 Concrete in Aggressive Ground.

6.0 Human Health Risk Assessment

6.1 Soil Contamination

Samples collected were subject to analysis for a range of contaminants with results compared to their retrospective generic assessment criteria shown in the table below. The risk assessment has been based upon the guidelines for residential developments. The exposure assumptions for the main receptor in this case is based on a young female child, ages 0-6 years, being exposed to the contaminant(s) indoors or outdoors. Should any more sensitive end-use be envisaged, the assessment should be revised accordingly.

The results of the soils analyses have been compared to the LQM/S4ULs, and the DEFRA C4SLs for lead and BS 3882 (2015) for phytotoxic zinc guidance determined in accordance with current legislation and guidance. The results are detailed overleaf. The tabulated results are included in Appendix E.

Table 8: Exceedance of Guideline Values (Commercial) (2.5% SOM)

Contaminant	Units	LOD	Effect	Concentration Range (mg/kg)	Measured concentrations in excess of S4UL/GSV/SGV (mg/kg)		Guidance Level (mg/kg)	Measured Exceedance Concentration
					Made ground	Natural		
Arsenic	mg/kg	0.2	Toxic	3 – 9.2	0 out of 11 samples	-	640	-
Boron, Water Soluble	mg/kg	0.2	Toxic	<0.2 – 0.4	0 out of 11 samples	-	240000	-
Cadmium	mg/kg	0.1	Toxic	<0.2 – 0.4	0 out of 11 samples	-	190	-
Chromium III	mg/kg	0.15	Toxic	14 - 27	0 out of 11 samples	-	8600	-
Chromium VI	mg/kg	1	Toxic	-	0 out of 11 samples	-	-	-
Copper	mg/kg	0.2	Toxic	16 - 69	0 out of 11 samples	-	68000	-
Copper*	mg/kg	0.2	Phyto-toxic	16 - 69	0 out of 11 samples	-	200	-
Lead	mg/kg	0.3	Toxic	7.1 – 47	0 out of 11 samples	-	200	-
Mercury	mg/kg	0.05	Toxic	<0.03	0 out of 11 samples	-	58	-
Nickel	mg/kg	1	Toxic	13 – 26	0 out of 11 samples	-	980	-
Nickel*	mg/kg	1	Phyto-toxic	13 – 26	0 out of 11 samples	-	110	-
Zinc	mg/kg	1	Toxic	22 - 120	0 out of 11 samples	-	730000	-
Zinc*	mg/kg	1	Phyto-toxic	22 - 120	0 out of 11 samples	-	300	
Petroleum Hydrocarbons								
Aliphatic C5-C6	mg/kg	0.01	Toxic	<0.020	0 out of 11 samples	-	3200	-
Aliphatic C6-C8	mg/kg	0.01	Toxic	<0.020	0 out of 11 samples	-	17000	-
Aliphatic C8-C10	mg/kg	0.01	Toxic	<0.050	0 out of 11 samples	-	4800	-

Aliphatic C10-C12	mg/kg	1.5	Toxic	<1.0 - 170	0 out of 11 samples	-	23000	-
Aliphatic C12-C16	mg/kg	1.2	Toxic	<2.0 – 2800	0 out of 11 samples	-	82000	-
Aliphatic C16-C21	mg/kg	1.5	Toxic	<8.0 – 5500	0 out of 11 samples	-	1700000	-
Aliphatic C21-C35	mg/kg	3.4	Toxic	<8.0 – 1200	0 out of 11 samples	-	1700000	-
Aromatic C5-C7	mg/kg	0.01	Toxic	<0.010	0 out of 11 samples	-	46000	-
Aromatic C7-C8	mg/kg	0.01	Toxic	<0.010 – 0.012	0 out of 11 samples	-	110000	-
Aromatic C8-C10	mg/kg	0.01	Toxic	<0.0.50 – 0.077	0 out of 11 samples	-	8100	-
Aromatic C10-C12	mg/kg	0.9	Toxic	<1.0 - 30	0 out of 11 samples	-	28000	-
Aromatic C12-C16	mg/kg	0.5	Toxic	<2.0 – 920	0 out of 11 samples	-	37000	-
Aromatic C16-C21	mg/kg	0.6	Toxic	<10 – 3000	0 out of 11 samples	-	28000	-
Aromatic C21-C35	mg/kg	1.4	Toxic	<10 - 11000	0 out of 11 samples	-	28000	-
PAHS								
Naphthalene	mg/kg	0.03	Toxic	<0.05 – 0.53	0 out of 11 samples	-	460	-
Acenaphthylene	mg/kg	0.03	Toxic	<0.05	0 out of 11 samples	-	97000	-
Acenaphthene	mg/kg	0.03	Toxic	<0.05 – 0.09	0 out of 11 samples	-	9700	-
Fluorene	mg/kg	0.03	Toxic	<0.05 – 0.08	0 out of 11 samples	-	68000	-
Phenanthrene	mg/kg	0.03	Toxic	<0.05 – 6.7	0 out of 11 samples	-	22000	-
Anthracene	mg/kg	0.03	Toxic	<0.05 – 1.1	0 out of 11 samples	-	54000	-
Fluoranthene	mg/kg	0.03	Toxic	<0.05 – 2.2	0 out of 11 samples	-	23000	-
Pyrene	mg/kg	0.03	Toxic	<0.05 – 2.6	0 out of 11 samples	-	54000	-
Benzo(a)anthracene	mg/kg	0.03	Toxic	<0.05 – 0.99	0 out of 11 samples	-	170	
Chrysene	mg/kg	0.03	Toxic	<0.05 – 1.3	0 out of 11 samples	-	350	-
Benzo(b)fluoranthene	mg/kg	0.03	Toxic	<0.05 – 0.45	0 out of 11 samples	-	44	
Benzo(k)fluoranthene	mg/kg	0.03	Toxic	<0.05 – 0.41	0 out of 11 samples	-	1200	-
Benzo(a)pyrene	mg/kg	0.03	Toxic	<0.05 – 0.67	0 out of 11 samples	-	35	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	Toxic	<0.05 – 0.25	0 out of 11 samples	-	510	-
Dibenzo(a,h)anthracene	mg/kg	0.03	Toxic	<0.05	0 out of 11 samples	-	3.6	
Benzo(g,h,i)perylene	mg/kg	0.03	Toxic	<0.03 – 0.47	0 out of 11 samples	-	4000	-
BTEX								
Benzene	ug/kg	<5.0	Toxic	<0.5 – 0.53	0 out of 11 samples	-	27	-
Toluene	ug/kg	<5.0	Toxic	<0.5 – 17	0 out of 11 samples	-	110000	-
Ethylbenzene	ug/kg	<5.0	Toxic	<0.5	0 out of 11 samples	-	13000	-
p & m-xylene	ug/kg	<5.0	Toxic	<0.5	0 out of 11 samples	-	14000	-

o-xylene	ug/kg	<5.0	Toxic	<0.5	0 out of 11 samples	-	15000	-
Other								
Asbestos	mg/kg	Detection	Toxic	NAD	0 out of 11 samples	-	Detection	

Based on some of 3.9%

The GQRA did not identify any contamination exceedances. No asbestos was identified.

In consideration of the above, we do not consider there to be a risk to human health from the shallow made ground soils. Remedial measures will not be required.

No phytotoxic exceedances were recorded. We therefore do not consider there to be a risk to plant life.

7.0 Risk to Construction Materials and Development

7.1 Sulphate Assessment

Laboratory testing was undertaken on selected soil samples from the site to determine the sulphate content and acidity. The data retrieved is used to determine the concrete class. Data is based on BS 8500-1 & 2 and BRE Special Digest 1, which covers a range of chemical aggressiveness. A summary of the recorded S04 and Ph are detailed in the table below.

Table 9: Sulphate and Ph Summary

Factor	Recorded Values	SD1 Ds Class	ACEC class for site
pH	7.2 – 11.6	DS-1	AC-1s
Total Sulphate SO_4	43 - 320		

In accordance with the BRE Special digest 1:2005 'Concrete in Aggressive Ground', recommendations for concrete would be aggressive chemical environment (ACEC) classification AC-1s with design sulphate class of DS-1.

7.2 Water Supply Pipework

The UK Water Industry Research (UKWIR) document 'Guidance for the Selection of Water Supply Pipes to be Laid in Brownfield Sites', ref 10/WM/03/21 is used to assess the risk to water supply pipes. The UKWIR guidance states that on brownfield sites, MDPE/HDPE water supply pipes could be at risk from organic contaminants including mineral oils, VOC's and SVOC's, if the pipes are laid within 15 m of recorded contamination. Additionally, UKWIR states that where metallic pipes are being considered for use, conductivity, pH, and redox state of the soil should be assessed to determine if the pipes are at risk of being corroded.

2 No. samples were retrieved from trial pits excavated along the proposed water pipe alignment at depths of 1.0mbgl in TP01 and TP09. Testing was undertaken for the mandatory analytical testing suite outlined in the UKWIR guidance. UKWIR testing is undertaken in order to identify the pipe material most suitable for use within the site. Results are included in Appendix E. The tables below summaries the chemical results .

Table 10a: Pipe Selection

Parameter Group		Pipe Material All Threshold Concentrations are in mg/kg					
		PE	PVC	Barrier Pipe (PE-Al-PE)	Wrapped Steel	Wrapped Ductile Iron	Copper
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC	0.5	0.125	Pass	Pass	Pass	Pass
1a	+ BTEX + MTBE	0.1	0.03	Pass	Pass	Pass	Pass
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C5 – C10)	2	1.4	Pass	Pass	Pass	Pass
2e	+ Phenols	2	0.4	Pass	Pass	Pass	Pass
2f	+ Cresols and chlorinated phenols	2	0.04	Pass	Pass	Pass	Pass
3	Mineral oil C10-C20	10	Pass	Pass	Pass	Pass	Pass
4	Mineral oil C21-C40	500	Pass	Pass	Pass	Pass	Pass
5	Corrosive (Conductivity, Redox and pH)	Pass	Pass	Pass	Corrosive if pH < 7 and conductivity > 400µS/cm	Corrosive if pH < 5, Eh not neutral and conductivity > 400µS/cm	Corrosive if pH <5 or >8 and Eh positive

Table 10b: Summary of UKWIR results

Laboratory Name: i2		Date: 05/10/23	Maximum Concentrations Detected		
Group No	Parameter Group	Depth (mbgl): 1.00			
		Units	Detection Limit	Concentration	Sample Code/Hole
1	Extended VOC suite (with TIC)	mg/kg	0.01	<0.5	ALL
1a	BTEX + MTBE	mg/kg	0.01	<5.0 – 18	ALL
2	Extended SVOC suite (with TIC)	mg/kg	0.1	<0.1 - <0.3	ALL
2e	Phenols	mg/kg	0.1	<0.1	ALL
2f	Cresols and chlorinated phenols	mg/kg	0.1*	<0.1	ALL
3	Mineral Oils C11 – C20	mg/kg	10	<10 - 200	ALL
4	Mineral Oils C21 – C40	mg/kg	10	<10 - 54	ALL
5	Corrosive (Conductivity, Redox and pH)				
	Conductivity	µS/cm	1	150 – 210	ALL

	Redox Potential	Volt	N/A	190.4 – 194.4	ALL
	pH	-	-	7.3 – 7.9	ALL

Table 10c: Results summary table

		Pipe Material					
		All Threshold Concentrations are in mg/kg					
Parameter Group		PE	PVC	Barrier Pipe (PE-Al-PE)	Wrapped Steel	Wrapped Ductile Iron	Copper
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC	x	x	✓	✓	✓	✓
1a	+ BTEX + MTBE	x	x	✓	✓	✓	✓
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C5 – C10)	✓	✓	✓	✓	✓	✓
2e	+ Phenols	✓	✓	✓	✓	✓	✓
2f	+ Cresols and chlorinated phenols	x	x	✓	✓	✓	✓
3	Mineral oil C11-C20	x	✓	✓	✓	✓	✓
4	Mineral oil C21-C40	✓	✓	✓	✓	✓	✓
5	Corrosive (Conductivity, Redox and pH)	✓	✓	✓	✓	✓	✓
	Pipes that pass chemical thresholds	FAIL	FAIL	PASS	PASS	FAIL	FAIL

In consideration of the above we consider a barrier pipe (PE-AL-PE) and a wrapped steel pipe to be suitable for use along the proposed tract.

Note that no cresols values were given in the laboratory results, however PVC water pipes are not approved for use by Scottish water.

7.3 Phototoxicity

The soil results have been compared to BS3882:2015 Specifications for Topsoil and BS8601:2013 Specifications for Subsoil. Nitric acid extractable zinc, copper and nickel are potentially phytotoxic elements which when present in excess have the potential to inhibit plant growth or kill plants. A summary of the test results vs the recommended guidance levels are provided in Table 11.

Table 11: Phototoxicity Contamination

Contaminant	Concentration Range (mg/kg)	Guidance Level (mg/kg)	No. Samples Tested	No. of Exceedances	Pass/Fail
Zinc	22 – 120	310	11	0	PASS
Copper	16 – 69	200	11	0	PASS
Nickel	13 - 26	75	11	0	PASS

No phytotoxic contamination was recorded. We therefore do not consider there to be a risk to plant life.

8.0 Ground Gas Risk Assessment

8.1 General

A ground gas risk assessment is required to assess the associated risks with carbon dioxide and methane to new residential properties and their end-users. No sources of ground gas (degradable materials) were identified within the made ground soils.

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report C665 (Assessing risks posed by hazardous ground gases to buildings, 2007. This classification system has been further developed by Wilson and Card (1999), and Boyle and Witherington (2006) and a revised industry guidance has been provided within CIRIA Report C665 (2007) and BS:8485(2015).

The gas monitoring data was used to prepare a risk assessment in line with British Standards BS:8485(2015).

8.2 Results

Ground gas monitoring installs were installed in 2 No. boreholes (R1-R2). Ground gas monitoring is ongoing. Ground gas monitoring had been undertaken on 3 No. occasion at the time of reporting. 6 No. rounds are required over a period of three months. A ground gas risk assessment will be undertaken once all rounds of monitoring are complete and will be issued as an addendum to this report.

Monitoring rounds are undertaken using a portable gas meter.

Measurements were taken at a variety of atmospheric conditions. The barometric pressure was at 1001mB. Carbon dioxide concentrations were recorded to range between 0.0 and 3.3% vol, oxygen was recorded to range between 0.8. and 18.5% vol. Methan concentration concentrations were recorded as 0%.

A steady flow rate of 0.0 l/hr was recorded on this occasion. The gas monitoring results are included in Appendix G. Please note that monitoring is ongoing and the ground gas risk assessment will be updated once all rounds are complete.

8.3 Assessment

Gas screening values have been calculated in line with CIRIA 665 and BS:8485(2015). Refer to table below for how the hazardous gas flow rate is calculated.

Table 12a: Hazardous Gas Concentration Calculation

Hazardous Gas Concentration Calculation						
Hazardous Gas flow rate (GSV)	= (equals)	Measures Gas Concentration	(/) Divide	By 100	(x) Times	the flow rate (l/hr)

Hazardous gas rates were calculated using the worst case scenario on the 07/12/23 in R1 where CO_2 was 3.3% and a steady gas flow rate of 0.0 l/hr was recorded. In the absence of any steady flow rate a flow rate of 0.1 l/hr has been utilized. Refer to table overleaf for the hazardous flow calculation

Table 12b: Calculated GSV

Hazardous Gas Concentration Calculation						
0.0033	=	3.3	/	100	x	0.1 (l/hr)

The value derived is consider to be the highest hazardous gas flow calculated. Note that this will be updated once all gas monitoring rounds are complete.

The CIRIA C665 states that the maximum GSV for carbon dioxide and methane is <0.07l/hr for Characteristic Situation 1 / Green NHBC Traffic Light Classification and therefore the site would fall into this bracket.

Table 12c: Assessment of Gas Characteristics

Assessment of Gas Characteristics			
Characteristic Situation	Hazard Potential	GSV	Constraints
1	Very low	<0.07	Methane is <1% vol Carbon Dioxide is <5% vol
2	Low	0.07 to <0.7	If l/hr exceeds 70l/hr increase to CS3
3	Moderate	0.7 to <3.5	-
4	Moderate to high	3.5 to <15	-
5	High	15 to <70	-
6	Extremely High	>70	-

Using the guidance the calculated GSV corresponds to 'Characteristic Situation 1'. However we consider it prudent to upgrade this to 'Characteristic Situation 2' due to the shallow mine working encountered in R2. Note that ground gas monitoring had been undertaken on 3 No. occasion at the time of reporting. 6 No. rounds are required over a period of three months. A ground gas risk assessment will be undertaken once all rounds of monitoring are complete and will be issued as an addendum to this report.

The construction and use of the building, together with the control of future structural changes to the building and its maintenance should be assessed, since potential risks posed by ground gases are strongly influenced by these factors. The assessment should lead to the categorisation of the building as a whole, or each different part of the building, into one of four building types: Type A, Type B, Type C or Type D.

The structural integrity of the building and any other potential structural changes should be assessed since the potential risks posed by ground gases are strongly influenced by these factors. The assessment should categorise the development into one of the four buildings types (A-D), detailed in the table below:

Table 12b: Building Type and Description

Building Types and Description	
Building Type	Description
A	Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
B	Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.
C	Commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).
D	Industrial style building having large volume internal space(s) that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floor areas, warehouses. (Small rooms within these style buildings should be separately categorized as Type B or Type C).

From the Characteristic situation and type of building the minimum gas protection score is 3.5. The calculation is detailed in the table below.

Table 12c: Gas Protection Scores.

	Minimum Gas Protection Score			
Characteristic Situation	High Risk	Moderate		Low Risk
	Building A	Building B	Building C	Building D
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5	5.5	4.5	3.5
5	-	6.5	5.5	4.5
6	-	-	7.5	6.5

As the gas protection score is 3.5, there is a moderate risk to the proposed development from ground gas and gas preclusion measures will be required. A structural barrier, ventilation measures and a gas resistant membrane should be implemented to achieve the gas protection score. The relevant protective measures are detailed in the following tables.

Table 12d: Gas Protection Score via Structural Barrier

Structural Barrier	
Floor and Substructure design	Score
Basement Floor and walls conforming to BS 8102:2009 Grade 3 Waterproofing.	2.5
Basement Floor and walls conforming to BS 8102:2009 Grade 2 Waterproofing.	2
Cast in situ reinforced ground-bearing raft or reinforced concrete cast in situ suspended floor slab with minimal penetrations	1 or 1.5
Cast in situ ground bearing floor slab (only mesh reinforcement)	0.5
Beam and block (pre-cast suspended segmented subfloor)	0

Table 12e: Gas Protection Score Via Ventilation

Ventilation		
Protection Element	Comments	Score
Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park).	Assumes that the car park is vented to deal with car exhaust fumes, designed to Buildings Regulations 2000, Approved Document F[9].	4
Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".	1.5 – 2.5
Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance".	1.5 to 2.5
Passive sub floor dispersal layer: Very good performance (vg): Good performance (G): Media used to provide the dispersal layer are: Clear void. Polystyrene void former blanket. Geocomposite void former blanket. No-fines gravel layer with gas drains. No-fines gravel layer.	The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer.	2.5 (vg) 1.5 (G)

Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero.	0.5

Table 12f: Gas Protection Score Via Gas Resistant Membrane

Gas Membrane		
Protection Element	Comments	Score
Sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m2/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; Sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); Capable, after installation, of providing a complete barrier to the entry of the relevant gas; Verified in accordance with CIRIA C735.	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.	2

It is recommended that gas preclusion measures summarised in the below table are implemented. Once these measures have been completed we consider the risk to human health to be low.

Table 12g: Risk Assessment Summary

Protection element	Detail	Score
Structural Floor Slab	Cast in situ reinforced ground-bearing raft or reinforced concrete cast in situ suspended floor slab with minimal penetrations	1.5
Ventilation	Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5
Gas Membrane	Installed by a Specialist Installer with NVQ2 qualification and suitably validated (good performance)	2
	Total Score	4

8.4 Radon

The site is not in a radon affected area, as less than 1% of properties are above the Action Level, Therefore no radon protection measures are required for new buildings or extensions on the site.

9.0 Water Environment Risk Assessment

9.1 Water Environments

The site is underlain by the Alloa groundwater body (ID:150536). In 2020 SEPA classified the overall status of this groundwater body as poor. This bedrock is indicated to be a moderately productive aquifer, virtually all flow is through fractures and discontinuities (Refer to Appendix G). As the site is considered to be underlain by raised marine deposits which has a variable permeability, we consider there to be a moderate risk for potential leaching of the soil into the groundwater table. The risk to the groundwater table from potential leaching of the soil can be classified as low where the site is underlain by clay as this will act as a barrier (Environmental Agency – Project Summary SC040016).

The closest surface water feature is the Black Devon (ID: 4402) located 390m to the southeast of the site. In 2020 SEPA classified this surface water receptor as having a moderate ecological overall status. The Black Devon is a tributary of the Upper Forth Estuary (ID:200437). In 2020 SEPA classified this surface water receptor as having an overall status of moderate. We therefore consider this to be the sites most sensitive receptor

9.2 Groundwater and Surface Water Assessments

Adhering to SEPA's Position Statement WAT-PS-10-0: 'Assigning Groundwater Assessment Criteria for Pollutant Inputs', August 2014. Noted that there is a number of receptors that may be impacted by inputs to groundwater. See table below for a summary of receptors.

Table 13: Receptors.

Receptor
Surface waters
Transitional waters
Coastal water
Present and future human uses (e.g. abstractions)
Groundwater dependent terrestrial ecosystems (wetlands)

The assessment should carried out to identify potential pollutant linkages to the water environment by identifying which of the receptors detailed above may be affected by contamination sources. The concentrations of contaminants should be screened against relevant values at the recommended assessment point. The assessment should then evaluate the remedial measures outcome i.e. very costly, risk to further receptors or potential to cause the deterioration of the natural environment.

9.2 Surface Water Assessment

No contamination was identified in the shallow soils. We therefore do not consider there to be a risk to the water environment.

Should groundwater samples be retrieved during groundwater monitoring, an updated groundwater risk assessment will be issued.

9.3 Groundwater Assessment

As the site is underlain by boulder clay, we consider this will provide a barrier in largely prohibiting the vertical migration of water and thus leaching of contaminants. No contamination was identified.

In consideration of above and the lack of recharge noted within the groundwater monitoring we do not consider there to be a risk to the shallow groundwater table.

10.0 Geotechnical Assessment

10.1 General

Visual assessment of soils during sinking or boreholes was supplemented by in-situ standard penetration test (SPTs). SPT testing of soils provide more reliable data than visual assessment alone.

10.2 Recorded Ground Conditions

Made Ground

Made ground was encountered in all exploratory holes across the site, recorded from the depths of ground level to a maximum depth of between 0.50 and 3.50mbgl. The made ground is variable across the site and comprised of several layers

The site is predominantly surfaced in type one stone, tarmac, stone ash fill recorded from ground level to a maximum depth of 0.20mbgl.

Underlying the hardstanding is made ground typically comprised of variable amounts of blaes and ash and/ or type one. Recorded from the depth of 0.20mbgl to a maximum proven depth of between 0.60mbgl and 0.85mbgl.

Underlying the blaes layer was made ground generally comprised of brown sandy clay 'fill'. Recorded from the depths of between 0.60mbgl and 0.85mbgl to maximum proven depth of between 0.70mbgl and 3.50mbgl.

Superficial Deposits

The made ground deposits were underlain by sand and gravel deposits generally described as fine to coarse sand, gravel is fine to coarse angular to subrounded sandstone and siltstone with frequent clay bands. Recorded from the depth of between 0.50mbgl and 3.50mbgl to a maximum depth of between 13.70mbgl in R1. Underlying the sand and gravel in R1 and underlying the made ground in R2 is very sandy boulder clay with occasional gravel bands. Recorded to a maximum proven depth of between 14.50mbgl and 16.60mbgl.

Bedrock

Bedrock was encountered in the rotary boreholes at depths of between 14.50 and 16.60mbgl, proven to a maximum depth of 30mbgl.

The sedimentary predominantly comprised of mudstone, sandstone and with occasional coal seams. Note that R2 encountered possible packed waste (mine working) between 19.20mbgl and 20.40mbgl.

Obstructions

Obstructions were encountered in 2 No. No. trial pits terminated on boulders or potential bedrock and 1 No. trial pit conjectured to be a boulder.

10.3 In-Situ Testing

In-situ geotechnical testing was conducted on site using Standard Penetration Tests (SPT). SPT's were conducted in 4 No. Window samples at regular depths.

The recorded uncorrected SPT Values and there classifications are displayed below.

Table 16a: Uncorrected SPT Values

N Values	Classification
0 – 4	Very Loose/Very Soft
4 – 10	Loose/soft
10 – 30	Medium Dense / Firm
30 – 50	Dense/ Very stiff
>50	Very Dense/ Very Stiff

Table 16b: Standard Penetration Test Results

SPT Depth	R01	R02
0.60m		
1.20m	15	10
2.00m	3	15
3.00m	7	17
4.00m		
5.00m		
6.00m		
7.00m		
8.00m		
9.00m		
10.00m		
11.00m		
12.00m		
13.00m		
14.00m		
15.00m		
16.00m		
17.00m		

Table 16c: Key

Key	
	Made Ground
	Clay
	Sand and gravel

The SPT testing within the made ground deposits indicate the made ground is variable ranging from very soft to firm

The natural sand and gravel deposits are indicated to be loose. No other SPTs were carried out at depths greater then 3.0mbgl. SPTs indicated the boulder clay to be medium dense.

11.0 Foundation Recommendations

11.1 Details of the Development

It is understood that the intended land use is for a new commercial development comprising of a Fast-food Restaurant Gregs retail building with a drive through and carparking and associated areas of soft landscaping

11.2 Foundations

The site investigation indicated the site to be underlain by made ground, sand and gravel and glacial till. Made ground deposits are a variable degree of compaction and not considered to be a suitable bearing horizon in their current condition.

As the superficial deposits are generally variable (i.e. loose sand or medium dense boulder clay), we consider vibro piling to rockhead to be the most viable solution for the building in the north. The natural bedrock is consider to provide a bearing capacity of 100kPa.

Once the development layout has been finalised, we would advise that discussions are held with us to ensure the pertinence of our recommendations.

11.3 Road Construction

We recommend a 600mm capping layer rolled with a 13t vibrating drum roller is place beneath roads. Plate bearing tests should be undertaken after to confirm suitability after the initial site clearance.

12.0 Mining

12.1 General

A review of the Coal Authority interactive viewer indicated that the site lies within a development high risk area, surface resource area, past shallow coal mine workings, probable shallow coal mine workings and coal outcrops and mine entries are indicated within the surrounding area.

The Consultants Coal Mining Report indicated 6 No. coal seams ' Four Foot, Branxton and more coal seams' had been worked beneath the site from depths of 29mbgl to 44mbgl as part of the Whinhall Colliery. Probable unrecorded shallow workings were indicated. No mine entries or faults were recorded within 100m of the site boundary.

Following the desk study research outlined above we consider there to be a potential stability and mine gas risk from the shallow workings to the proposed development.

12.2 Mining Methods

The methods of mining historically adopted in the area may be generally categorised as variations on two different techniques – the 'stoop and room' and 'longwall' systems of extraction. In the 'longwall' method of mining, extraction was virtually total with the seam face accessed via supported roadways. In the areas from which the seam had already been removed, the roof was generally allowed to collapse behind the face or was partially supported by spoil or 'waste' deposited within the works. While the workings would be generally closed on abandonment with the withdrawal of roof support, roadways would be expected to remain open and artificially supported long after the operations had ceased.

A variation of the longwall method is the technique commonly used in deep mining today but was generally only applied to the recovery of ironstones or coals of restricted thickness in the 19th century. In this instance, the longwall systems of mining were not undertaken. The method of mining indicated in the workings beneath the site was the 'stoop and room' system.

In the stoop and room or pillar and stall method as it is known in England, partial excavation of the mineral was conducted with the seam recovered from rooms and the roof supported by retained stoops or pillars of the mineral.

Normally at least 50% of the seam would remain intact as stoops within the mine, but occasionally higher levels of extraction took place either due to favourable geological conditions, or as a result of poorer controls on the mine management and safety. Often 'stoops' were removed on abandonment of the mine in a practice commonly known as 'stooping' or 'pillar robbing'.

The dimensions of the stoops and rooms varied depending on the geological conditions and seam thicknesses, but their width would normally average at about 3 to 4 times the height of the seam. Where more slender stoops were left, the additional support required for the roof would often be provided by artificial props, which would usually be timber.

This form of mining was prevalent through the 19th Century where seams of generally greater than about 0.7 m thickness were involved. As the operations became increasingly mechanised and more sophisticated supports introduced, the stoop and room method became less widely adopted for coal mining in Scotland.

12.3 General Principles of Surface Instability

Deterioration within old mine workings can lead to collapse a considerable time after abandonment. The mechanisms of failure are varied and complex but generally involve either a yield in the roof of the mine between supports, or collapse as a direct result of failure of the supports.

Except in instances where the mine workings are very shallow for example, less than 10 m deep, the stability is comparatively unaffected by enhanced loadings from buildings or by vibrations from heavy traffic. Progressive deterioration within the workings can, however, advance to a stage where instability is reached and collapses occur. In most cases, however, it is impossible to predict with any degree of accuracy if, and when, such movements will take place.

Accordingly, it is generally accepted that old abandoned mine workings are susceptible to collapse. Researches based on observations and past experience do, however, permit some assessment of the likelihood of any collapses within the mines being experienced at the surface as subsidence. It is also possible to make reasonable assessment of the magnitude of movements which may occur under assumed failure conditions.

The subsidence assessments consider various elements of the geological and mining configuration. These include the nature and thickness of the rock and soil overburden, the extracted height of the workings and the typical mine configuration.

The subsidence assessments consider various elements of the geological and mining configuration. These include the nature and thickness of the rock and soil overburden, the extracted height of the workings and the typical mine configuration.

Where a suspected worked coal seam occurs beneath a site, we have sought to achieve a rock/overburden cover thickness of 10 times the seam extraction height for stoop and room mining extraction. This is consistent with a number of studies in the field of mining stability assessment.

12.4 Geology and Mining

2 No. rotary boreholes were sunk in November 2023 to a maximum depth of 30.00mbgl. R02 indicated shallow mine workings as packed waste was recorded between 19.20mbgl and 20.40mbgl. A summary of the conditions encountered is included below.

Table 17: Summary of conditions encountered within the mineral boreholes

Borehole No.	Location	Borehole type	Surface Level (mAoD)	Rockhead (mAoD)	Rockhead (mbgl)	Borehole depth (m)	Remarks
R01	Northern site area	Probe	24.00	7.40	16.60	30.00	Solid Geology: Interbedded sandstone, mudstone and coal seams

							Coal (INTACT): Encountered at 0.50mAoD – 0.00mAoD (0.50 thick) (23.50mbgl – 24.00mbgl)
R02	Southern Site area	Probe	24.00	9.50	14.50	30.00	Solid Geology: Interbedded sandstone, mudstone and coal seams
							Coal (WORKED): Soft badly broken, possible packed waste encountered at 4.80mAoD – 3.60mAoD (1.20 thick) (19.20mbgl – 20.40mbgl)

although no working was recorded in R01 in the north of the site. We consider the site to be underlain by shallow mine workings in the south of the site. Note that in order for there to be sufficient rock cover we require 10 X the thickness of the worked seam (CIRIA Special Publication 32 – Construction over Abandoned Mine Workings. 1984). R02 recorded 1.20m working described as packed waste between 19.20mbgl and 20.40mbgl. In order for the site to be classified as stable 12.00m of rockhead was required above the working. As rockhead is at 14.50mbgl, there is only 4.70m of rockhead above the working, we therefore consider there is insufficient rock overburden.

To conclude we consider there to be a potential surface instability risk to the proposed development and remedial measures will be required.

12.5 Mine Entries

No mine entries were recorded within 100 metres of the site boundary.

12.6 Mine Gas

We consider there to be a potential risk to the proposed development from ground gas due to shallow mine workings identified in the rotary holes. Gas risk assessment is detailed in the ground gas section above.

12.7 Potential for Future Mineral Extractions

While we consider it unlikely that underground or surface mineral extractions will occur beneath or within the site in the future, we have not carried out detailed assessments of this matter. This should be examined by the client's legal advisors.

12.8 Drilling and Grouting Operations

Mine stabilisation by drilling and grouting involves the drilling of a grid of treatment boreholes across the identified areas of instability and the subsequent injection of a cementaceous grout to fill in areas of voidage in the former mine-workings. Areas of open space would not be subjected to grouting works.

The stabilisation scheme would be designed by a suitably qualified engineer, supervised on a full-time basis, and validated by Ardmore Point and would be undertaken by a specialist contractor. During the works our engineering geologist would monitor the geological conditions disclosed by the borehole drilling in order to ensure that the design is appropriate to the precise geological conditions. It should also be noted that as part of the design process we would apply to the Coal Authority for the required license to proceed with the works.

Works will be completed in accordance with the specification and our satisfaction. A completion report will be completed once all stabilisation works have been completed and will be provided to the council and coal authority.

13.0 Revised Conceptual Site Model

12.1 Contamination Sources

Human Health

The GQRA did not identified any contamination exceedances. No Asbestos was identified. We therefore do not consider there to be a risk to human health.

Plant Life

No phytotoxic exceedances were recorded. We do not consider there to be a risk to plant life.

Water Environment

We consider the risk of the shallow soils adversely affecting the water environment to be low.

Ground Gas

Ground gas monitoring is ongoing. However, we consider it prudent to upgrade to characteristic situation 2 due to the mine working recorded in the southern site area.

Built Environment

In accordance with the BRE Special digest 1:2005 'Concrete in Aggressive Ground', recommendations for concrete would be aggressive chemical environment (ACEC) classification AC-1s with design sulphate class of DS-1.

We consider a barrier pipe (PE-AL-PE), and a wrapped steel to be suitable for use along the proposed tract.

Mining

R02 recorded 1.20m working described as packed waste between 19.20mbgl and 20.40mbgl. In order for the site to be classified as stable 12.00m of rockhead was required above the working. As rockhead is at 14.50mbgl, there is only 4.70m of rockhead above the working, we therefore consider there is insufficient rock overburden. Remedial measures will be required.

12.2 Pollutant Linkage Assessment

Base on ground and groundwater conditions at the site potential sources have been identified (See pre-development conceptual site model on page 42). Remedial measures will be required to break the source-pathway-receptor pollutant linkages.

12.3 Remediation Strategy

Human Health and Plant life

The GQRA did not identified any contamination exceedances. No asbestos was identified. We therefore do not consider there to be a risk to the proposed development and remedial measures will not be required.

No phytotoxic exceedances were recorded. We do not consider there to be a risk to plant life.

Water Environment

We consider a low risk to the water environment from the shallow soils.

The Built Environment

In accordance with the BRE Special digest 1:2005 'Concrete in Aggressive Ground', recommendations for concrete would be aggressive chemical environment (ACEC) classification AC-1s with design sulphate class of DS-1.

We consider a barrier pipe (PE-AL-PE), and a wrapped steel to be suitable for use along the proposed tract.

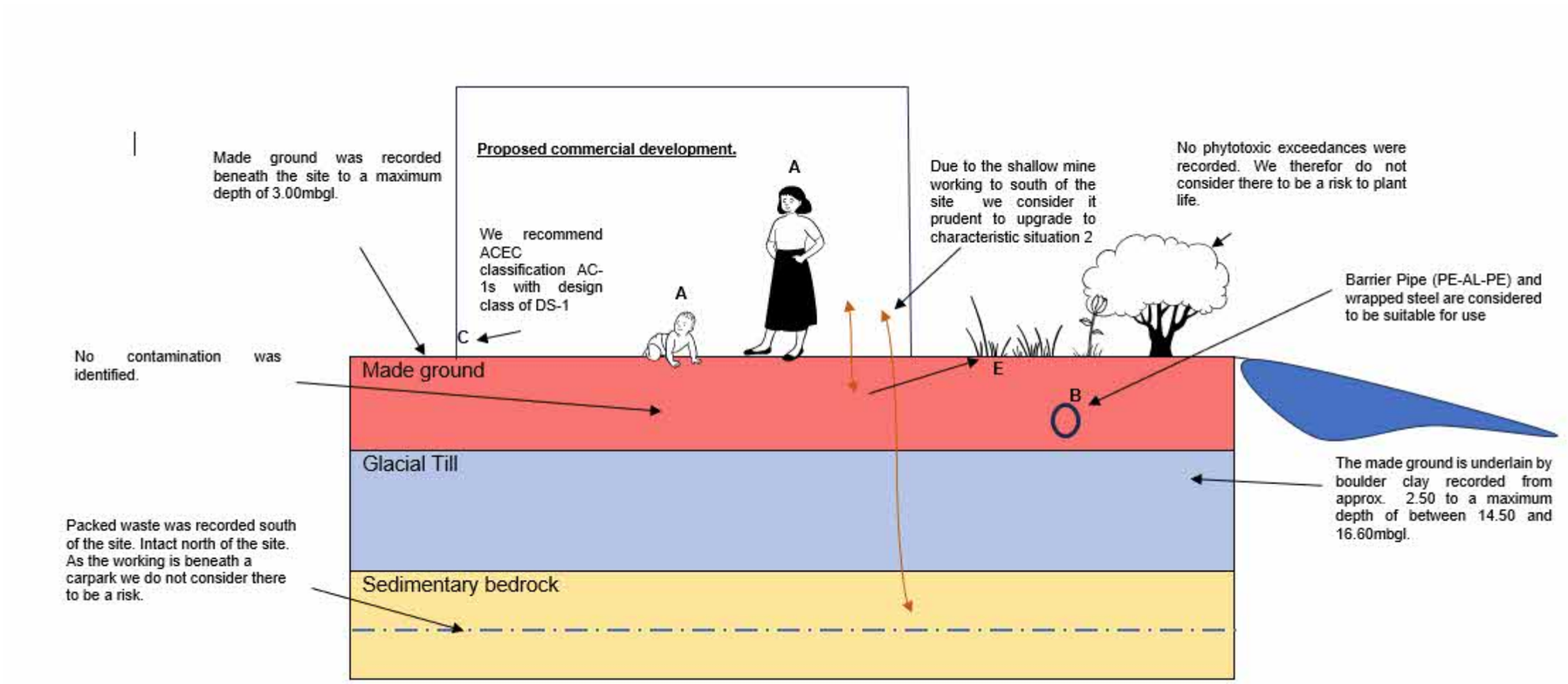
Note that once remedial measures are incorporated no source-pathway and receptor pollutant linkages have been identified. Refer to post development conceptual site model and risk assessment.

Mining

R02 recorded 1.20m working described as packed waste between 19.20mbgl and 20.40mbgl. In order for the site to be classified as stable 12.00m of rockhead was required above the working. As rockhead is at 14.50mbgl, there is only 4.70m of rockhead above the working, we therefore consider there is insufficient rock overburden. Remedial measures will be required.

Mine stabilisation by drilling and grouting involves the drilling of a grid of treatment boreholes across the identified areas of instability and the subsequent injection of a cementaceous grout to fill in areas of voidage in the former mine-workings. Areas of open space would not be subjected to grouting works.

Pre Development Conceptual site model.



Potential sources

Mine gas

A

Potential Receptors (Site Users/Construction personal)
Potential Exposure Pathways
1. Outdoor ingestion of dust
2. Indoor ingestion of dust
3. Skin contact with indoor dust
4. Skin contact with outdoor dust
5. Outdoor inhalation of dust
6. Inhalation of dust
7. Outdoor inhalation of soil vapor
8. Indoor inhalation of soil vapor
9. Ingesting soil
10. Skin contact with dust.
11. Eating contaminated vegetables

B

Potential Receptors Plastic water supply pipes
Potential Exposure Pathways
1. Permeation of plastic supply pipes

C

Potential Receptors Buried Concrete (foundations/services)
Potential Exposure Pathways
1. Adverse effects on buried concrete.

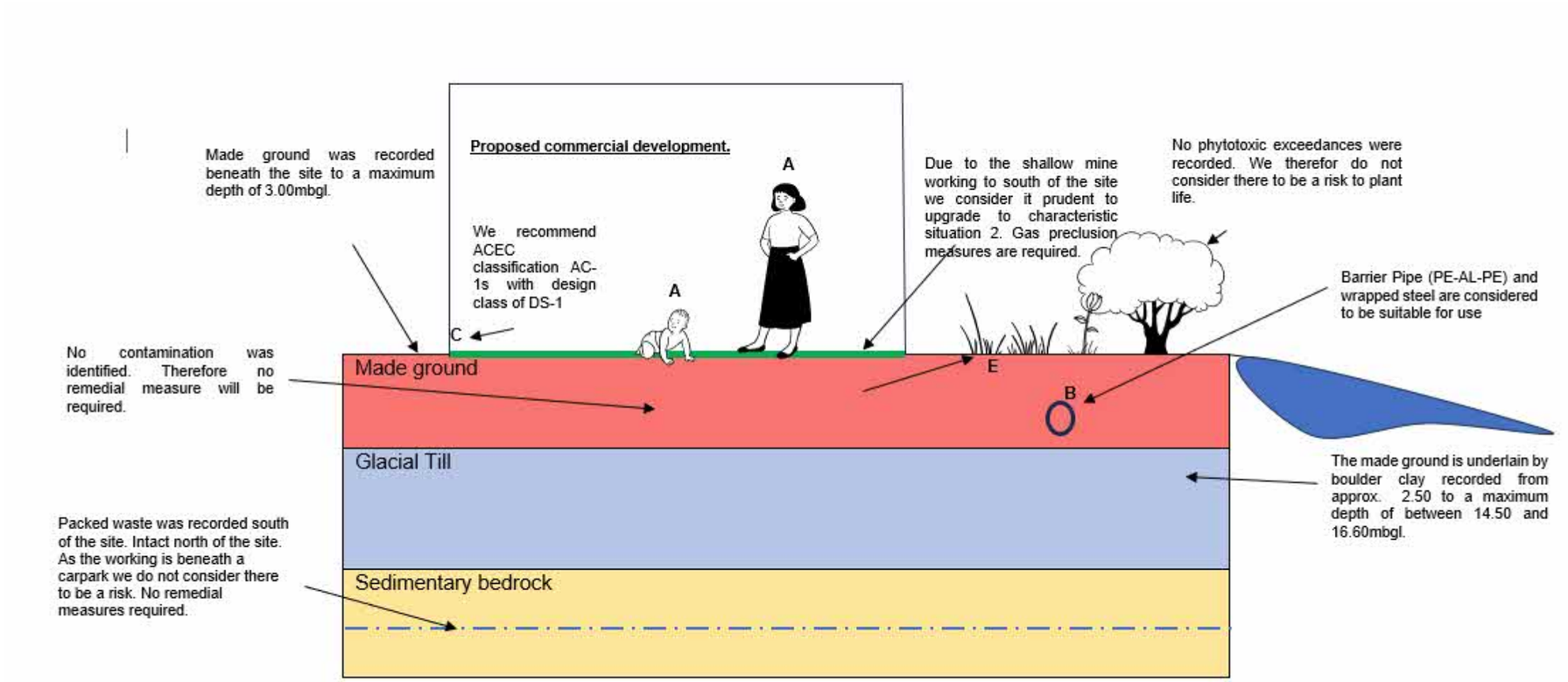
D

Potential Receptors Ground Water
Potential Exposure Pathways
1. Leaching of contaminants to groundwater
2. Migration of contaminants in ground water

E

Potential Receptors Plant Life
Potential Exposure Pathways
1. Direct contact with contaminated soils and ground water
2. Uptake of contaminants from the soil or groundwater into the plant

Post Development Conceptual site model.



Potential sources

A Potential Receptors (Site Users/Construction personal)
Potential Exposure Pathways
1. Outdoor ingestion of dust
2. Indoor ingestion of dust
3. Skin contact with indoor dust
4. Skin contact with outdoor dust
5. Outdoor inhalation of dust
6. Inhalation of dust
7. Outdoor inhalation of soil vapor
8. Indoor inhalation of soil vapor
9. Ingesting soil
10. Skin contact with dust.
11. Eating contaminated vegetables

B Potential Receptors Plastic water supply pipes
Potential Exposure Pathways
1. Permeation of plastic supply pipes

C Potential Receptors Buried Concrete (foundations/services)
Potential Exposure Pathways
1. Adverse effects on buried concrete.

D Potential Receptors Ground Water
Potential Exposure Pathways
1. Leaching of contaminants to groundwater
2. Migration of contaminants in ground water

E Potential Receptors Plant Life
Potential Exposure Pathways
1. Direct contact with contaminated soils and ground water
2. Uptake of contaminants from the soil or groundwater into the plant

Table 18: Site Specific risk assessment and remedial measures.

Pathway linkages identified in the ground Investigation				Predevelopment risk assessment			Post development risk assessment			
Source	Contaminants of concern recorded	Pathway	Receptor	Likelihood of Occurrence	Severity of Consequence	Risk Rating	Risk Management action Taken	Likelihood of Occurrence	Severity of Consequence	Risk Rating
	None identified	Direct contact and/ or Ingestion of soil contaminated	Human Health (including children playing)				No remedial measure required			
		Ingestion of soil from touching contaminated soil by digging or through eating contaminated vegetables.								
		Inhalation of wind generated dust with contaminated material								
		Tracking back of contaminated soil/dust from soft landscaped areas into home/commercial property								
		Inhalation of dust generating activities and or wind generated dust with contaminated material	Human Health (construction workers) Nearby residents.				No remedial measure required			
		Direct contact with contaminated soil through excavation								
		Uptake of asbestos from the made ground soils and or contaminated groundwater	Plant life in areas of soft landscaping				No remedial measure required			
		Leaching of contaminants to the ground water from the made ground soils	Groundwater - Superficial				We do not consider the site to be underlain by a pervasive shallow groundwater table.			
		Leaching of contaminants to the deeper ground water body.	Groundwater - Aquifer				No remedial measures required			
		Direct entry of contaminants into surface water via accidental spillage/leakage or from discharge pipework. Outfall of contaminated surface water	Surface Water Receptor – River				No remedial measure required			
	Ground/mine Gases (CH_4 and CO_2)	Inhalation of rising vapours or gases from unrecorded made ground deposition (indoors and outdoors)	Human Health	Ground Gas monitoring is ongoing. However we consider remedial measure will be required relating to characteristic situation 2.						
Radioactive soil or rocks	Radioactive decay of		Human Health (end users)				No remedial measures required.			

	uranium (radon gas)	Inhalation of rising radon gases/dust from the soil and rocks beneath the site (indoors & outdoors)	Human Health (construction workers)				No remedial measures are required.			

KEY 1 (Classification of Consequence)	
	Minor
	Mild
	Medium
	Severe

KEY 2 (Classification of probability)	
	Unlikely
	Low likelihood
	Likely
	High Likely Hood

KEY 3 (Risk Rating)	
	Very low risk
	Low Risk
	Moderate Risk
	High Risk
	Very High Risk

Risk Management During Site Work

During ground works, some simple measures may have to be put in place to mitigate the risk of contamination affecting the site workers and the environment. Most of the proposed measures represent good practice for the construction industry and include:

Informing the site workers of the contamination on site and the potential health effects from exposure.

Where appropriate, the provision of suitable PPE for workers who may be potentially impacted by working in areas of the contamination.

Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating, or drinking without washing their hands first and moving away from the work site to a designated safe zone with appropriate welfare facilities.

Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne.

Vigilance should apply in respect of the identification of any material suspected to comprise or include asbestos fibres, consultation being made, if necessary, with an appropriately licenced asbestos removal specialist.

Management of Unidentified Contamination Sources

There is the potential risk of encountering isolated areas of unrecorded contamination material, especially asbestos. Should such materials be encountered, further testing may be required to assess the risk to health and safety

Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material and potential contaminant under consideration, this could be either a skip or a lined area.

Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

13.0 Invasive Plant Survey

13.1 General

An invasive species survey was not requested by the client. We recommend an invasive species survey is undertaken by a specialist during the growing season.

14.0 Conclusion

14.1 General

Ardmore point undertook a site investigation to identify any contamination or ground related risks that have the potential to impact the proposed development

The ground conditions encountered were generally consistent with those anticipated in the published information. Consisting of predominantly three geological units; made ground; glacial till and sedimentary bedrock.

14.2 Contamination

The GQRA did not identified any contamination exceedances. No asbestos was identified. We therefore do not consider there to be a risk to human health

No phytotoxic exceedances were recorded. We do not consider there to be a risk to plant life.

14.3 Water Environment

We do not consider the shallow soils to adversely affect the water environments.

14.4 Ground Gas

Ground gas monitoring is ongoing. A ground gas risk assessment will be issued as an addendum to this report once all rounds are complete. However due to the mine workings present, we consider it prudent to upgrade to characteristic situation 2 where gas preclusion measures will be required.

Radon protection measures are not required.

14.5 Geotechnical Assessment

Foundation Design

The site investigation indicated the site to be underlain by made ground, sand and gravel and glacial till. Made ground deposits are a variable degree of compaction and not considered to be a suitable bearing horizon in their current condition.

As the superficial deposits are generally variable (i.e. loose sand or medium dense boulder clay), we consider vibro piling to rockhead to be the most viable solution for the building in the north. The natural bedrock is consider to provide a bearing capacity of 100kPa.

Once the development layout has been finalised, we would advise that discussions are held with us to ensure the pertinence of our recommendations.

The Built Environment

In accordance with the BRE Special digest 1:2005 'Concrete in Aggressive Ground', recommendations for concrete would be aggressive chemical environment (ACEC) classification AC-1s with design sulphate class of DS-1.

We consider a barrier pipe (PE-AL-PE), and a wrapped steel to be suitable for use along the proposed tract.

Road Construction

We recommend a 600mm capping layer rolled with a 13t vibrating drum roller is place beneath roads. Plate bearing tests should be undertaken after to confirm suitability after the initial site clearance.

Mining

R02 recorded 1.20m working described as packed waste between 19.20mbgl and 20.40mbgl. In order for the site to be classified as stable 12.00m of rockhead was required above the working. As rockhead is at 14.50mbgl, there is only 4.70m of rockhead above the working, we therefore consider there is insufficient rock overburden. Remedial measures will be required.

Mine stabilisation by drilling and grouting involves the drilling of a grid of treatment boreholes across the identified areas of instability and the subsequent injection of a cementaceous grout to fill in areas of voidage in the former mine-workings. Areas of open space would not be subjected to grouting works.

14.6 Consultations with Public Authorities

The measures proposed within the report are consistent with current conventional practices, we would recommend that approvals are received from the relevant departments of local authorities before any works are progressed.

We hope that this will meet your current requirements. However, please contact us if you require any other information.

Genna Stewart
Geo-environmental

Stuart Mitchell
Managing Director

15.0 References

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Position Statement WAT-PS-10-01, 'Assigning Groundwater Assessment Criteria for Pollutant Inputs', SEPA 2014

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Indicative Atlas of Radon in Scotland, Health Protection Agency, 2011

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NHBC Guidance: GUIDANCE ON EVALUATION OF DEVELOPMENT PROPOSALS ON SITES WHERE METHANE AND CARBON DIOXIDE ARE PRESENT (Boyle & Witherington 2007)

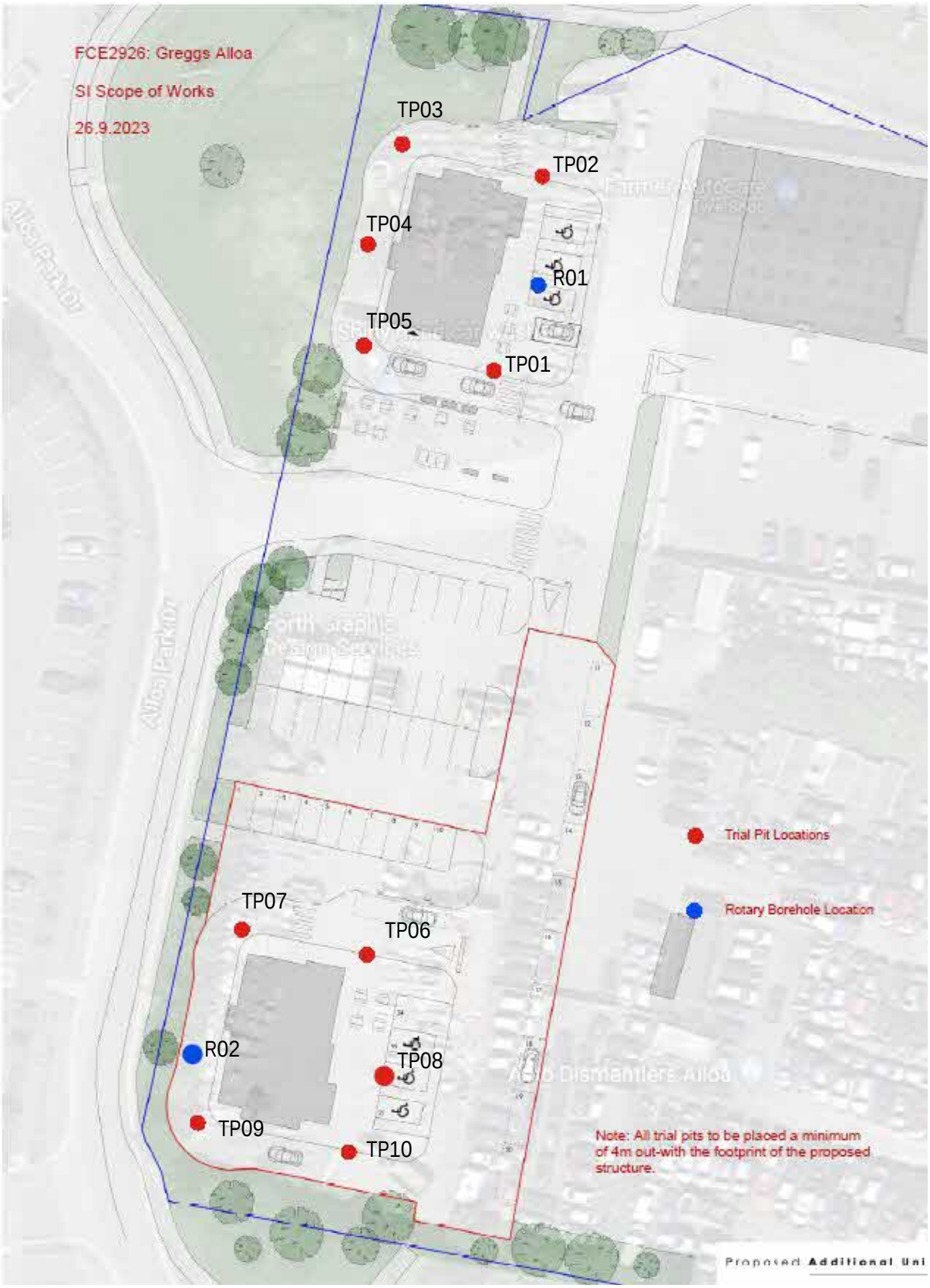
Sizer K, Creedy D and Sceal J. (1996) Methane and other gases from disused coal mines: the planning response – Technical report for the department of the environment – Wardell Armstrong – The Stationery Office (eds) – London (UK)

AP1916
Russell Yard
Alloa

Appendix A: Site Location Plan

Site Loca on Plan: Old Russells Yard, Clackmannan Road, Alloa FK10 4DA (Grid Reference: NS 899 927).

Appendix B: Borehole Plan


FCE2926: Greggs Alloa
SI Scope of Works
26.9.2023
TP03
TP02
TP04
R01
TP05
TP01
TP07
TP06
R02
TP08
TP09
TP10
Trial Pit Locations
Rotary Borehole Location
Note: All trial pits to be placed a minimum of 4m out-with the footprint of the proposed structure.

Appendix C: Trial Pit Logs


Well


Well


Well


Well


Well


Well


Well


Well


Well


Well


Well

Appendix D:

Rotary Borehole Logs


Well


Well

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend
				TCR	SCR	RQD				
	▼							23.50		
								24.00		
								24.20		
								25.00		
								30.00		
			Type/FI	TCR	SCR	RQD	D/R/(SPT)			


Well


Well

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend
				TCR	SCR	RQD				
								20.40		
								22.50		
								25.00		
								30.00		
			Type/FI	TCR	SCR	RQD	D/R/(SPT)			

Appendix E:

Laboratory Test Results

Stuart Mitchell
Ardmore Point Ltd☐
Innovation Centre
1 Ainslie Road
Hillington Park
Glasgow
G52 4RU

t: 0330 800 1060

e: stuart.mitchell@ardmorepoint.com

i2 Analytical Ltd.
40 Carron Pl,
East Kilbride,
Glasgow
G75 0YL

t: 01355202915
f: 01923237404
e: scotland@i2analytical.com

Analytical Report Number : 23-69225

Project / Site name:	Old Russells Yard Alloa	**Samples received on:**	16/11/2023
Your job number:	AP1916	**Samples instructed on/ Analysis started on:**	16/11/2023
Your order number:	AP1916	**Analysis completed by:**	27/11/2023
Report Issue Number:	1	**Report issued on:**	28/11/2023
Samples Analysed:	2 soil samples		

Signed: [redacted]

Ashleigh Cunningham
Customer Service Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-69225
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880602	2880603
Sample Reference				TP01	TP09
Sample Number				None Supplied	None Supplied
Depth (m)				1.00	1.00
Date Sampled				08/11/2023	09/11/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	50
Moisture Content	%	0.01	NONE	11	11
Total mass of sample received	kg	0.001	NONE	0.8	0.8
General Inorganics					
pH - Automated	pH Units	N/A	MCERTS	7.3	7.9
Electrical Conductivity	µS/cm	10	ISO 17025	150	210
Redox Potential	mV	-800	NONE	190.4	194.4
Phenols by GC-MS					
Phenol	mg/kg	0.2	ISO 17025	< 0.2	< 0.2
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	< 0.2	< 0.2
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	< 0.1	< 0.1
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3
2-Chlorophenol	mg/kg	0.1	MCERTS	< 0.1	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3
2-Nitrophenol	mg/kg	0.3	NONE	< 0.3	< 0.3
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	< 0.1	< 0.1
4-Methylphenol	mg/kg	0.2	NONE	< 0.2	< 0.2
Total Phenols					
Total Phenols (GC-MS)	mg/kg	1	NONE	< 1.0	< 1.0
Monoaromatics & Oxygenates					
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	18	17
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
p & m-xylene	µg/kg	5	MCERTS	6.9	16
o-xylene	µg/kg	5	MCERTS	< 5.0	8.2
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0
Petroleum Hydrocarbons					
Mineral Oil (C10 - C20) EH_CU_1D_AL	mg/kg	10	NONE	200	< 10
Mineral Oil (C21 - C40) EH_CU_1D_AL	mg/kg	10	NONE	54	18
TPH2 (C6 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0
VOCs					
Chloromethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Chloroethane	µg/kg	5	NONE	< 5.0	< 5.0
Bromomethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Vinyl Chloride	µg/kg	5	NONE	< 5.0	< 5.0
Trichlorofluoromethane	µg/kg	5	NONE	< 5.0	< 5.0
1,1-dichloroethene	µg/kg	5	NONE	< 5.0	< 5.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	5	NONE	< 5.0	< 5.0
Trans 1,2-dichloroethylene	µg/kg	5	NONE	< 5.0	< 5.0
1,1-dichloroethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
2,2-Dichloropropane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Chloroform	µg/kg	5	NONE	< 5.0	< 5.0
1,1,1-Trichloroethane	µg/kg	5	ISO 17025	< 5.0	< 5.0

Analytical Report Number: 23-69225
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880602	2880603
Sample Reference				TP01	TP09
Sample Number				None Supplied	None Supplied
Depth (m)				1.00	1.00
Date Sampled				08/11/2023	09/11/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
1,2-dichloroethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,1-Dichloropropene	µg/kg	5	ISO 17025	< 5.0	< 5.0
Cis-1,2-dichloroethene	µg/kg	5	ISO 17025	< 5.0	< 5.0
Carbontetrachloride	µg/kg	5	NONE	< 5.0	< 5.0
1,2-dichloropropane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Trichloroethene	µg/kg	5	ISO 17025	< 5.0##	< 5.0##
Dibromomethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Bromodichloromethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Cis-1,3-dichloropropene	µg/kg	5	ISO 17025	< 5.0	< 5.0
Trans-1,3-dichloropropene	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,1,2-Trichloroethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,3-Dichloropropane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Dibromochloromethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Tetrachloroethene	µg/kg	5	NONE	< 5.0	< 5.0
1,2-Dibromoethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Chlorobenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,1,1,2-Tetrachloroethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Styrene	µg/kg	5	ISO 17025	< 5.0	< 5.0
Bromoform	µg/kg	5	NONE	< 5.0	< 5.0
Isopropylbenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,1,2,2-Tetrachloroethane	µg/kg	5	ISO 17025	< 5.0	< 5.0
Bromobenzene	µg/kg	5	NONE	< 5.0	< 5.0
N-Propylbenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
2-Chlorotoluene	µg/kg	5	ISO 17025	< 5.0	< 5.0
4-Chlorotoluene	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,3,5-Trimethylbenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
Tert-Butylbenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,2,4-Trimethylbenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
Sec-Butylbenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,3-dichlorobenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
P-Isopropyltoluene	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,4-dichlorobenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,2-dichlorobenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
Butylbenzene	µg/kg	5	NONE	< 5.0	< 5.0
1,2-Dibromo-3-chloropropane	µg/kg	5	ISO 17025	< 5.0	< 5.0
1,2,4-Trichlorobenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0
Hexachlorobutadiene	µg/kg	5	NONE	< 5.0	< 5.0
1,2,3-Trichlorobenzene	µg/kg	5	ISO 17025	< 5.0	< 5.0

Sum of the above VOCs	µg/kg	5	NONE	< 5.0	< 5.0

VOCs TICs

VOCs TICs Compound Name		N/A	NONE	ND	ND
VOC % Match	%	N/A	NONE	-	-

SVOCs

Aniline	mg/kg	0.1	NONE	< 0.1	< 0.1
Phenol	mg/kg	0.2	ISO 17025	< 0.2	< 0.2
2-Chlorophenol	mg/kg	0.1	MCERTS	< 0.1	< 0.1
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	< 0.2	< 0.2
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2	< 0.2
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	< 0.1	< 0.1

Analytical Report Number: 23-69225
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880602	2880603
Sample Reference				TP01	TP09
Sample Number				None Supplied	None Supplied
Depth (m)				1.00	1.00
Date Sampled				08/11/2023	09/11/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2	< 0.2
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	< 0.1	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Hexachloroethane	mg/kg	0.05	ISO 17025	< 0.05	< 0.05
Nitrobenzene	mg/kg	0.3	MCERTS	< 0.3	< 0.3
4-Methylphenol	mg/kg	0.2	NONE	< 0.2	< 0.2
Isophorone	mg/kg	0.2	MCERTS	< 0.2	< 0.2
2-Nitrophenol	mg/kg	0.3	NONE	< 0.3	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	< 0.3	< 0.3
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3
4-Chloroaniline	mg/kg	0.1	NONE	< 0.1	< 0.1
Hexachlorobutadiene	mg/kg	0.1	MCERTS	< 0.1	< 0.1
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	< 0.1	< 0.1
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	< 0.1	< 0.1
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	< 0.2	< 0.2
2-Methylnaphthalene	mg/kg	0.1	NONE	< 0.1	< 0.1
2-Chloronaphthalene	mg/kg	0.1	MCERTS	< 0.1	< 0.1
Dimethylphthalate	mg/kg	0.1	MCERTS	< 0.1	< 0.1
2,6-Dinitrotoluene	mg/kg	0.1	NONE	< 0.1	< 0.1
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
2,4-Dinitrotoluene	mg/kg	0.2	NONE	< 0.2	< 0.2
Dibenzofuran	mg/kg	0.2	MCERTS	< 0.2	< 0.2
4-Chlorophenyl phenyl ether	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Diethyl phthalate	mg/kg	0.2	MCERTS	< 0.2	< 0.2
4-Nitroaniline	mg/kg	0.2	NONE	< 0.2	< 0.2
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Azobenzene	mg/kg	0.3	NONE	< 0.3	< 0.3
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	< 0.2	< 0.2
Hexachlorobenzene	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Carbazole	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Dibutyl phthalate	mg/kg	0.2	NONE	< 0.2	< 0.2
Anthraquinone	mg/kg	0.3	NONE	< 0.3	< 0.3
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Butyl benzyl phthalate	mg/kg	0.3	NONE	< 0.3	< 0.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Total SVOC	mg/kg	0.3	NONE	< 0.30	< 0.30

SVOCs TICs

Sample Deviation Report

Analytical Report Number: 23-69225
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880602	2880603
Sample Reference				TP01	TP09
Sample Number				None Supplied	None Supplied
Depth (m)				1.00	1.00
Date Sampled				08/11/2023	09/11/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
SVOCs TICs Compound Name		N/A	NONE	Naphthalene, substituted	ND
SVOC % Match	%	N/A	NONE	96	-
SVOCs TICs Compound Name		N/A	NONE	Heptadecane	-
SVOC % Match	%	N/A	NONE	95	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not Detected

Sample Deviation Report

Analytical Report Number : 23-69225
Project / Site name: Old Russells Yard Alloa

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2880602	TP01	None Supplied	1	Brown loam and sand with gravel.
2880603	TP09	None Supplied	1	Brown loam and sand with gravel and stones.

Analytical Report Number : 23-69225
Project / Site name: Old Russells Yard Alloa

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Phenols, speciated, in soil, by GCMS	Determination of speciated phenols in soil by extraction in dichloromethane and hexane followed by GC-MS.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Electrical conductivity of soil	Determination of electrical conductivity in soil by electrometric measurement.	In-house method	L031-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Redox Potential of soil	Determination of redox potential in soil by electrometric measurement.	In house method.	L084-PL	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS.Refer to CoA for analyte specific accreditation.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Tentatively identified compounds (SVOC) in soil	Determination of semi-volatile organic compounds total ion count in soil by extraction with dichloromethane and hexane followed by GC-MS followed by a full library scan.	In-house method based on USEPA 8270	L064-PL	D	NONE
TPH2 (Soil)	Determination of hydrocarbons C6-C10 by headspace GC-MS.	In-house method based on USEPA8260	L088-PL	W	NONE
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Tentatively identified compounds (VOC) in soil	Determination of volatile organic compounds total ion count in soil by headspace GC-MS followed by a full library scan.	In-house method based on USEPA8260	L073-PL	W	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260. Refer to CoA for analyte specific accreditation	L073B-PL	W	MCERTS
Mineral Oil (Soil) C10 - C40	Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L076-PL	D	NONE

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Sample Deviation Report

Analytical Report Number : 23-69225
Project / Site name: Old Russells Yard Alloa

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

- Quality control parameter has a high recovery (outside of limit); however the associated result is below the reporting limit, other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised

Sample Deviation Report

Analytical Report Number : 23-69225
Project / Site name: Old Russells Yard Alloa

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis.Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
TP01	None Supplied	S	2880602	c	Redox Potential of soil	L084-PL	c

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Analytical Report Number : 23-69228

Project / Site name:	Old Russells Yard Alloa	**Samples received on:**	16/11/2023
Your job number:	AP1916	**Samples instructed on/ Analysis started on:**	16/11/2023
Your order number:	AP1916	**Analysis completed by:**	27/11/2023
Report Issue Number:	1	**Report issued on:**	28/11/2023
Samples Analysed:	11 soil samples		

Signed: [redacted]

Ashleigh Cunningham
Customer Service Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-69228
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880619	2880620	2880621	2880622	2880623
Sample Reference				TP01	TP01	TP02	TP03A	TP04
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	1.70	1.00	0.50	1.00
Date Sampled				08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	61	51	< 0.1	51	33
Moisture Content	%	0.01	NONE	7.8	9	12	9.1	9.4
Total mass of sample received	kg	0.001	NONE	0.7	0.7	0.7	0.6	0.7
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	SPU	SPU	SPU	SPU	SPU

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	9.2	11.6	8.5	8	7.9
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	43	110	180	94	64
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalen	g/l	0.00125	MCERTS	0.0213	0.0538	0.0913	0.0469	0.0319
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalen	mg/l	1.25	MCERTS	21.3	53.8	91.3	46.9	31.9
Organic Matter (automated)	%	0.1	MCERTS	0.4	4	3.2	2.8	12

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	0.53	< 0.05	< 0.05	0.18
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.09
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.08
Phenanthrene	mg/kg	0.05	MCERTS	0.06	6.7	0.24	0.09	1.2
Anthracene	mg/kg	0.05	MCERTS	< 0.05	1.1	0.06	< 0.05	0.58
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	2.2	0.45	0.15	0.75
Pyrene	mg/kg	0.05	MCERTS	< 0.05	2.6	0.41	0.15	1.1
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.99	0.2	0.07	0.6
Chrysene	mg/kg	0.05	MCERTS	< 0.05	1.3	0.24	0.09	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	0.8	0.31	0.11	0.45
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	0.41	0.14	< 0.05	0.13
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.67	0.27	< 0.05	0.44
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.25	0.15	< 0.05	0.16
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.31	0.17	< 0.05	0.47

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80	17.7	2.64	< 0.80	6.23

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	3	9.2	5.4	9	3.7
Boron (water soluble)	mg/kg	0.2	MCERTS	< 0.2	1.3	0.4	0.2	1.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.3	0.4	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	14	22	21	27	24
Copper (aqua regia extractable)	mg/kg	1	MCERTS	16	47	69	50	45
Lead (aqua regia extractable)	mg/kg	1	MCERTS	7.1	19	47	41	19
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	13	20	19	26	36
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	22	60	120	120	30

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	< 5.0##	< 5.0##	< 5.0	< 5.0##	< 5.0##
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	9.4
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0#	< 5.0	< 5.0
p & m-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0#	< 5.0	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

Analytical Report Number: 23-69228
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880619	2880620	2880621	2880622	2880623
Sample Reference				TP01	TP01	TP02	TP03A	TP04
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	1.70	1.00	0.50	1.00
Date Sampled				08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	< 1.0	170	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	16	2800	< 2.0	< 2.0	3
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	41	5500	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	1200	16	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	NONE	63	9700	16	< 10	11
TPH-CWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPH-CWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	0.012
TPH-CWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	0.077
TPH-CWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	1.4	30	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	11	920	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	30	3000	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	12	1100	< 10	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	NONE	53	5000	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not Detected

Analytical Report Number: 23-69228
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880624	2880625	2880626	2880627	2880628
Sample Reference				TP05	TP06	TP07	TP08	TP09
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	1.00	0.50	0.50
Date Sampled				08/11/2023	09/11/2023	09/11/2023	09/11/2023	09/11/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	50	33	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	8.2	12	11	15	19
Total mass of sample received	kg	0.001	NONE	0.7	0.9	0.9	0.9	0.9
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	SCA	SCA	SCA	WEM	WEM

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8	8.7	7.8	8.2	7.8
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	62	61	96	160	47
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalen	g/l	0.00125	MCERTS	0.0312	0.0303	0.0479	0.0825	0.0234
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalen	mg/l	1.25	MCERTS	31.2	30.3	47.9	82.5	23.4
Organic Matter (automated)	%	0.1	MCERTS	11	0.7	1.3	0.6	1.7

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.33	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.06	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	0.1	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	1.3	< 0.05	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	0.37	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.53	< 0.05	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	0.72	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.41	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	0.39	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.35	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.08	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.3	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.1	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.38	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	5.43	< 0.80	< 0.80	< 0.80	< 0.80

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	3.3	5.9	5.3	10	12
Boron (water soluble)	mg/kg	0.2	MCERTS	1.4	0.2	1	0.2	0.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	21	29	24	35
Copper (aqua regia extractable)	mg/kg	1	MCERTS	49	33	37	50	12
Lead (aqua regia extractable)	mg/kg	1	MCERTS	8	7.4	8.4	23	13
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	42	26	32	21	25
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	29	45	69	50	59

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	17	< 5.0	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
p & m-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

Analytical Report Number: 23-69228
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880624	2880625	2880626	2880627	2880628
Sample Reference				TP05	TP06	TP07	TP08	TP09
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	1.00	0.50	0.50
Date Sampled				08/11/2023	09/11/2023	09/11/2023	09/11/2023	09/11/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	3.4	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	61	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	NONE	11	12	< 10	69	< 10
TPH-CWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPH-CWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.01	NONE	0.024	< 0.010	< 0.010	< 0.010	< 0.010
TPH-CWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPH-CWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not Detected

Analytical Report Number: 23-69228
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880629
Sample Reference				TP10
Sample Number				None Supplied
Depth (m)				0.50
Date Sampled				09/11/2023
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	25
Total mass of sample received	kg	0.001	NONE	0.8

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	IZJ

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.2
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	320
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalen	g/l	0.00125	MCERTS	0.162
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalen	mg/l	1.25	MCERTS	162
Organic Matter (automated)	%	0.1	MCERTS	5.2

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.11
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.18
Pyrene	mg/kg	0.05	MCERTS	0.17
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.09
Chrysene	mg/kg	0.05	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.06
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.07

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.7
Boron (water soluble)	mg/kg	0.2	MCERTS	3.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	22
Copper (aqua regia extractable)	mg/kg	1	MCERTS	40
Lead (aqua regia extractable)	mg/kg	1	MCERTS	65
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	66

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0
p & m-xylene	µg/kg	5	MCERTS	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0

Analytical Report Number: 23-69228
Project / Site name: Old Russells Yard Alloa
Your Order No: AP1916

Lab Sample Number				2880629
Sample Reference				TP10
Sample Number				None Supplied
Depth (m)				0.50
Date Sampled				09/11/2023
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.02	NONE	< 0.020
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.02	NONE	< 0.020
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.05	NONE	< 0.050
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	13
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	NONE	13

TPH-CWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.01	NONE	< 0.010
TPH-CWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.01	NONE	< 0.010
TPH-CWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.05	NONE	< 0.050
TPH-CWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	NONE	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not Detected

Analytical Report Number : 23-69228
Project / Site name: Old Russells Yard Alloa

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2880619	TP01	None Supplied	0.5	Brown loam and sand with gravel and stones.
2880620	TP01	None Supplied	1.7	Brown sand with gravel and stones.
2880621	TP02	None Supplied	1	Brown loam and clay with gravel and vegetation.
2880622	TP03A	None Supplied	0.5	Brown clay and sand with gravel and stones.
2880623	TP04	None Supplied	1	Brown clay and sand with gravel and stones.
2880624	TP05	None Supplied	1	Brown clay and sand with gravel and stones.
2880625	TP06	None Supplied	0.5	Brown loam and sand with gravel and stones.
2880626	TP07	None Supplied	1	Brown clay and sand with gravel and vegetation.
2880627	TP08	None Supplied	0.5	Brown sand with gravel and brick.
2880628	TP09	None Supplied	0.5	Brown clay and loam with gravel and vegetation.
2880629	TP10	None Supplied	0.5	Brown clay and loam with gravel and vegetation.

Analytical Report Number : 23-69228
Project / Site name: Old Russells Yard Alloa

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards. Refer to CoA for analyte specific accreditation.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260. Refer to CoA for analyte specific accreditation	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID. Refer to CoA for band specific accreditation.	In-house method with silica gel split/clean up.	L088/76-PL	D	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry

Analytical Report Number : 23-69228
Project / Site name: Old Russells Yard Alloa

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
FID	Flame Ionisation Detector				
GC	Gas Chromatography				
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))				
CU	Clean-up - e.g. by Florisil®, silica gel				
1D	GC - Single coil/column gas chromatography				
2D	GC-GC - Double coil/column gas chromatography				
Total	Aliphatics & Aromatics				
AL	Aliphatics				
AR	Aromatics				
#1	EH_2D_Total but with humics mathematically subtracted				
#2	EH_2D_Total but with fatty acids mathematically subtracted				
_	Operator - understore to separate acronyms (exception for +)				
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total				

- Data reported unaccredited due to quality control parameter failure associated with this result; other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised

- Quality control parameter has a high recovery (outside of limit); however the associated result is below the reporting limit, other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised

AP1916
Russell Yard
Alloa

Appendix F:

Chain of Custody

i2 SAMPLE CHAIN OF CUSTODY RECORD

No

Analytical i2 Environmental Science

7 Woodshots Meadow
Croxley Green Business Park
Watford
WD18 8YS

t: 01923 225404
f: 01923 237404

reception@i2analytical.com

Client:	Ardmore Point	Date samples dispatched:	sheet of
Address:	Hillington park innovation center, Ainslie Road, Hillington, Glasgow, UK	Samples delivered/collected by:	
client e-mail:	stuart.mitchell@ardmorepoint.com	Sampler I.d.	One project/ site per sheet please
Project/Site Name:	Old Russells Yard Alloa	Turnaround time/date results due: 7	
Project/Site Code:	AP1916		Client PO: AP1916
Contact Name:	Stuart Mitchell		
T	Fax:		

Please indicate the analysis required for each sample by marking the boxes

Lab Use	BH or TP or Sample ID	Depth (m)	Date sample taken	Time sample taken	S- soil, W - water, L - leachate, O - other	no. of containers	Suite E A	Suite E B	FULL WAC / 2 Stage	UKWIR	Topsoil 3882	Subsoil 3882	Leachate Suite A	Leachate Suite B						Sample Specific Notes/ Container types (Lab use Only)
	TP01	0.50			S	3		x												
	TP01	1.70			S	3		x												
	TP02	1.00			S	3		x												
	TP03A	0.50			S	3		x												
	TP04	1.00			S	3		x												
	TP05	1.00			S	3		x												
	TP06	0.50			S	3		x												
	TP07	1.00			S	3		x												
	TP08	0.50			S	3		x												
	TP09	0.50			S	3		x												
	TP10	0.50			S	3		x												
	TP01	1.00			S	3				x										
	TP09	1.00			S	3				x										

Total no. of samples: 13

Possible Hazard Identification

Non-Hazard ☐ Hazardous ☐ Unknown ☐

Special instructions / QC; requirements & comments:

avg. transport temp.

hours in transport

Sample disposal (a fee maybe assessed if samples are retained longer than 1 month) return to client ☐ disposal by lab ☐ archive for ☐

i2 QUOTE NO 802570.2

LAB USE ONLY

Data received: time: by:

Data instructed: time: by:

Laboratory notes

Appendix G:

Gas Monitoring Results

Gas & Groundwater Monitoring Results

Job Number:	AP1916
Job Name:	Russells Yard, Alloa
Monitored by:	GS
Address:	Old Russel Yard, Clackmannan Road, Alloa, FK10 4DA
Date:	18/11/2023

Background Readings:	Weather Conditions:	Dry
	Ground Conditions (dry/wet etc):	Dry
	Air Temperature	6
	Atmospheric Pressure mb (start):	1007
	Atmospheric Pressure mb (finish):	1007

Borehole No.	Time	O_2% v/v		CO_2% v/v		CH_4% v/v		H_2S ppm		CO ppm		LEL	Flow l/h		Depth of Well mBGL	GWL mBGL
		Lowest	Steady	Low	Steady	Low	Steady	Low	Steady	Low	Steady		Low	Steady		
R1	30 seconds	1.6	1.6	2.9	2.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	DRY	5.00
	1 minute	1.4	1.4	2.9	2.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
R2	30 seconds	17.2	17.2	0.0	0.0	-0.10	-0.10	0.00	0.00	15.00	15.00	0.00	0.00	0.00	DRY	5.00
	1 minute	17.2	17.2	0.0	0.0	-0.10	-0.10	0.00	0.00	15.00	15.00	0.00	0.00	0.00		
Remarks:	Note that the valves werent shut so conditions are not a true reflection of thie gas regime.															

Gas & Groundwater Monitoring Results

Job Number:	AP1916
Job Name:	Russells Yard, Alloa
Monitored by:	GS
Address:	Old Russel Yard, Clackmannan Road, Alloa, FK10 4DA
Date:	18/11/2023

Background Readings:	Weather Conditions:	Dry
	Ground Conditions (dry/wet etc):	Dry
	Air Temperature	6
	Atmospheric Pressure mb (start):	1019
	Atmospheric Pressure mb (finish):	1019

Borehole No.	Time	O_2% v/v		CO_2% v/v		CH_4% v/v		H_2S ppm		CO ppm		LEL	Flow l/h		Depth of Well mBGL	GWL mBGL
		Lowest	Steady	Low	Steady	Low	Steady	Low	Steady	Low	Steady		Low	Steady		
R1	30 seconds	2.2	2.2	3.0	3.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	DRY	5.00
	1 minute	2.3	2.3	2.9	2.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
R2	30 seconds	18.1	18.1	0.0	0.0	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	0.00	DRY	5.00
	1 minute	18.2	18.2	0.0	0.0	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	0.00		
Remarks:																

Gas & Groundwater Monitoring Results

Job Number:	AP1916
Job Name:	Russells Yard, Alloa
Monitored by:	GS
Address:	Old Russel Yard, Clackmannan Road, Alloa, FK10 4DA
Date:	07/12/2023

Background Readings:	Weather Conditions:	Dry
	Ground Conditions (dry/wet etc):	Dry
	Air Temperature	6
	Atmospheric Pressure mb (start):	1003
	Atmospheric Pressure mb (finish):	1003

Borehole No.	Time	O_2% v/v		CO_2% v/v		CH_4% v/v		H_2S ppm		CO ppm		LEL	Flow l/h		Depth of Well mBGL	GWL mBGL
		Lowest	Steady	Low	Steady	Low	Steady	Low	Steady	Low	Steady		Low	Steady		
R1	30 seconds	1.5	1.5	3.2	3.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	DRY	5.00
	1 minute	0.8	0.8	3.3	3.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
R2	30 seconds	18.5	18.5	0.0	0.0	0.00	0.00	0.00	0.00	10.00	10.00	<.<<	0.00	0.00	DRY	5.00
	1 minute	18.5	18.5	0.0	0.0	0.00	0.00	0.00	0.00	10.00	10.00	<.<<	0.00	0.00		
		.														
Remarks:																

AP1916
Russell Yard
Alloa

Appendix H:

CIRIA C552

Table 6.3 *Classification of consequence*

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied.
Medium	Chronic damage to Human Health ("significant harm" as defined in DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem. (note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR , 2000).	Concentrations of a contaminant from site exceed the generic, or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the *Draft Circular on Contaminated Land*, DETR, 2000). Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (eg foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

Table 6.4 *Classification of probability*

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term

These classifications are then compared to indicate the risk presented by each pollutant linkage. It is important that this classification is only applied where there is a possibility (which can range from high likelihood to unlikely) of a pollutant linkage existing.

This method can be applied with or without site investigation data and can be used to assess the results of either qualitative or quantitative assessment. **It is recommended that the amount of data and basis of classifications are made clear when reporting such an assessment**. It is often possible to undertake this risk evaluation following the Phase 1 stage of the risk assessment. If site investigation and further risk estimation are then undertaken the evaluation can be revised.

Once the consequence and probability have been classified, these can then be compared (see Table 6.5) to produce a risk category, ranging from "very high risk" to "very low risk". The actions corresponding with this classification is given in Table 6.6. A worked example is presented in Box 6.10.

Table 6.3 shows the classification of consequence. To classify the consequence it is important to bear in mind that the classification does not take into account the probability of the consequence being realised (this is considered in Table 6.4). Therefore, for a particular pollutant linkage it may be necessary to classify more than one consequence. For example, the risk from methane build-up in a building presents a risk of harm both to the building and to human health. Both would be classified as *severe*, but the probability, addressed in the next stage of this methodology, may vary (for example, the building may be unoccupied for most of the time, with only occasional visits – eg a pumping station).

The classification of *severe* relates to short-term (acute) risks only. The *medium* classification relates to chronic harm, which can be classed as "significant harm" (if the assessment is carried out for Part IIA purposes. The *mild* classification also relates to significant chronic harm but applies to less-sensitive receptors. The *minor* classification relates to harm which, while not considered "significant", may have a financial implication (eg phytotoxic effects of contaminants on development landscaping).

It is worth noting that, in theory, both a *severe* and *medium* classification can result in death. The differentiation between the two categories is that *severe* relates to a short-term risk whilst *medium* relates to a long-term risk. Therefore the classification of *severe* should indicate that urgent action is required (urgent action may also be required under the *medium* classification, but usually longer-term actions are sufficient).

The classification gives a guide as to the severity and consequence of identified risks when compared with other risk presented on the site. It is not possible to classify an identified risk as presenting "no-risk", rather "very low risk". This is important, as the acceptability of risk may depend on the viewpoint of the stakeholder concerned. It may be necessary to take action to deal with a risk even if classified as "very low", although these actions may not necessarily be required urgently.

Table 6.5 *Comparison of consequence against probability*

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	**Very high risk**	**High risk**	**Moderate risk**	Moderate/ low risk
	Likely	**High risk**	**Moderate risk**	Moderate/ low risk	Low risk
	Low likelihood	**Moderate risk**	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

Table 6.6 *Description of the classified risks and likely action required*

Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, if is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Box 6.10 *Example of risk evaluation*

A site is used for car parking. The surface is mainly hardstanding, but the quality is not sufficient to prevent infiltration of rainwater. Site investigation has shown that, underlying the hardstanding, the made ground and groundwater (minor aquifer) beneath the made ground contain raised concentrations of toxic metals. The site investigation also encountered several areas of fly-tipped wastes with very high cyanide content (enough to present short-term risks to human health). One such area, bordered by housing, is used for informal recreation, mainly by children.

Therefore the contaminant-pathway-receptor relationship can be summarised as below.

Contaminant	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Risk classification	Risk management action taken
Fly-tipped material with high cyanide content	Direct contact	Humans, mainly children playing on site	Severe	High likelihood	Very high	Immediate removal of fly-tipped material to suitable landfill facility
Toxic metals, for example arsenic and cadmium	Leaching to groundwater (minor aquifer)	Minor aquifer, no local abstractions	Medium	High likelihood	High	Further groundwater monitoring, including perimeter and removal of hotspots of contamination.
Toxic metals, for example arsenic and cadmium	Direct contact	Site workers and visitors during remediation	Medium	Likely	Moderate	Site health and safety plan made allowance for contamination. Site workers were supplied with personal protective equipment and damping down of the site during dry periods was undertaken during remediation.
Toxic metals, for example arsenic and cadmium	Dust	Site workers Residential properties next door to site Site workers and visitors during remediation	Medium	Likely	Moderate	It was considered that damping down of site was sufficient to break this pollutant linkage. Dust monitoring was undertaken on site and at site boundaries to prove this.

Note

The pollutant linkage for residential properties was not assessed in detail, as the measures to address the risk to site workers from contaminated dust were considered sufficient to protect nearby residents.

ardmore point

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