



Geo-Environmental Consultants

PHASES 8 & 9,

ALLOA

REPORT ON

SITE INVESTIGATIONS

DATE

February 2018

CLIENT

Allanwater Developments

Allanwater Developments

PHASES 8 & 9, ALLOA

Report on Site Investigations

Date of Issue: February 2018

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Project Reference: P16/483

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EXECUTIVE SUMMARY

Client	Allanwater Developments
Site	Phases 8&9, Alloa
Proposed Development	Residential housing
Project Objectives	<ul style="list-style-type: none"> ▪ To investigate the possible presence of ground contamination associated with the historical uses of the site and any potential associated risks. ▪ To investigate the ground conditions and provide recommendations on foundation and infrastructure design. ▪ To provide recommendations (if any) for additional works/remediation required.
Ground Conditions	<p>The ground conditions recorded during the investigation were generally consistent with the anticipated sequence of strata indicated by the desk study information.</p> <p>The soils were noted to comprise of topsoil, underlain by raised beach deposits of silty sandy CLAY, underlain by sandy SILT, and further underlain by glacial soils of sandy gravelly CLAY.</p> <p>Rockhead was encountered at depths of between 14.00 m and 16.00 m bgl.</p> <p>A pervasive ground water table was recorded within the sandy SILT at a depth of 3.0m bgl.</p>
Assessment of Risks to Human Health, the Water Environment and vegetation	<p>Within the shallow soils the GQRA has not identified any toxic metal or hydrocarbon contaminant exceedances.</p> <p>The shallow soils underlying the site are not considered to pose a risk to the water environment or vegetation.</p> <p>Topsoil analyses indicates that the topsoil on site is suitable for multi-purpose reuse however, it was noted that the topsoil was recorded to be low in organic content.</p>
Assessment of the Built Environment	<p>Recommended concrete (ACEC) Classification is AC-I with a Design Sulphate Class for the site of DS-I.</p> <p>UKWIR analyses indicates that Polyethylene water supply pipes can be used.</p>
Assessment of Ground Gas and Radon	<p>From the site characteristic hazardous gas flow rate, as calculated and based on a worst-case scenario, the ground gas regime has been classified as 'Characteristic Situation 1'. As such ground gas preclusion measures are not deemed necessary.</p> <p>Radon gas preclusion measures are not required.</p>
Foundation Considerations (Based on existing site levels)	<p>Weak raised beach deposits, which are unsuitable for traditional spread or deep trench foundations, were recorded to depths of up to 8.0m bgl. Therefore, we consider that a piled foundation solution should be employed, end-bearing either onto bedrock, at depths between 14.00 m and 16.00 m bgl or into the firm to stiff gravelly clay at depths of between 5.10m bgl and 8.00mbgl. These bearing horizons would provide an allowable bearing capacity of ≥ 100 kN/m².</p>
Mining	Historical mining is not considered a development constraint.

Invasive Plant Species	Invasive plant species have not been recorded within the site.
Flooding	The site is perceived to be at a moderate risk from flooding.
Service Information	No utilities are indicated on the site.

1.0 INTRODUCTION

1.1 Commission

1.1.1 Mason Evans Partnership (MEP) were commissioned by Allanwater Developments (the Client) to undertake ground investigation works at a site named as 'Phases 8 & 9, Alloa' in connection with the proposed development of the site (Drawing No PI 6/483/SI/R/F/01 and 02).

1.1.2 Mason Evans supervised ground investigations at the captioned site to determine the underlying ground conditions in relation to the proposed development of a new residential estate, with gardens and associated areas of hard/soft landscaping. The proposed development layout is shown in Drawing No PI 6/483/SI/R/F/03.

1.2 Investigation Proposals

1.2.1 The investigation proposals were outlined in our correspondence to the Client, dated August 2017. The intention of the investigation was to provide information on the following:

- Soil profile beneath the site.
- Chemical contamination conditions.
- Ground/Mine gas emissions.
- Geotechnical characteristics of the materials.
- Foundation bearing characteristics.
- Mining constraints.

1.3 Limitations

1.3.1 Our interpretations of the ground conditions are based on the information retrieved from trial pits and soil/mineral bores sunk within the site during recent intrusive investigations. While we have carried out interpretation of the ground conditions between the exploratory locations, it should be recognised that soil and groundwater conditions can vary from point to point. As such, ground conditions at variance with those indicated by the exploratory pits/bores may exist in areas not investigated.

1.3.2 It should be recognised that this report is prepared in accordance with current recommended practice and existing legislation. It is written in the context of a proposed residential development, with gardens and hard/soft landscaping. Should there be any alternative end-use, it would be prudent to consult us further to ensure the continued pertinence of the recommendations advised.



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client details:

ALLANWATER DEVELOPMENTS
 24B KENILWORTH ROAD
 BRIDGE OF ALLAN, FK9 4 DU

project title:

**ALLOA
 PHASES 8 AND 9**

drawing title:

SITE LOCATION PLAN

project no:
P16/483

drawing no:
P16/483/SI/R/F/01

revision:

date:
12.02.18

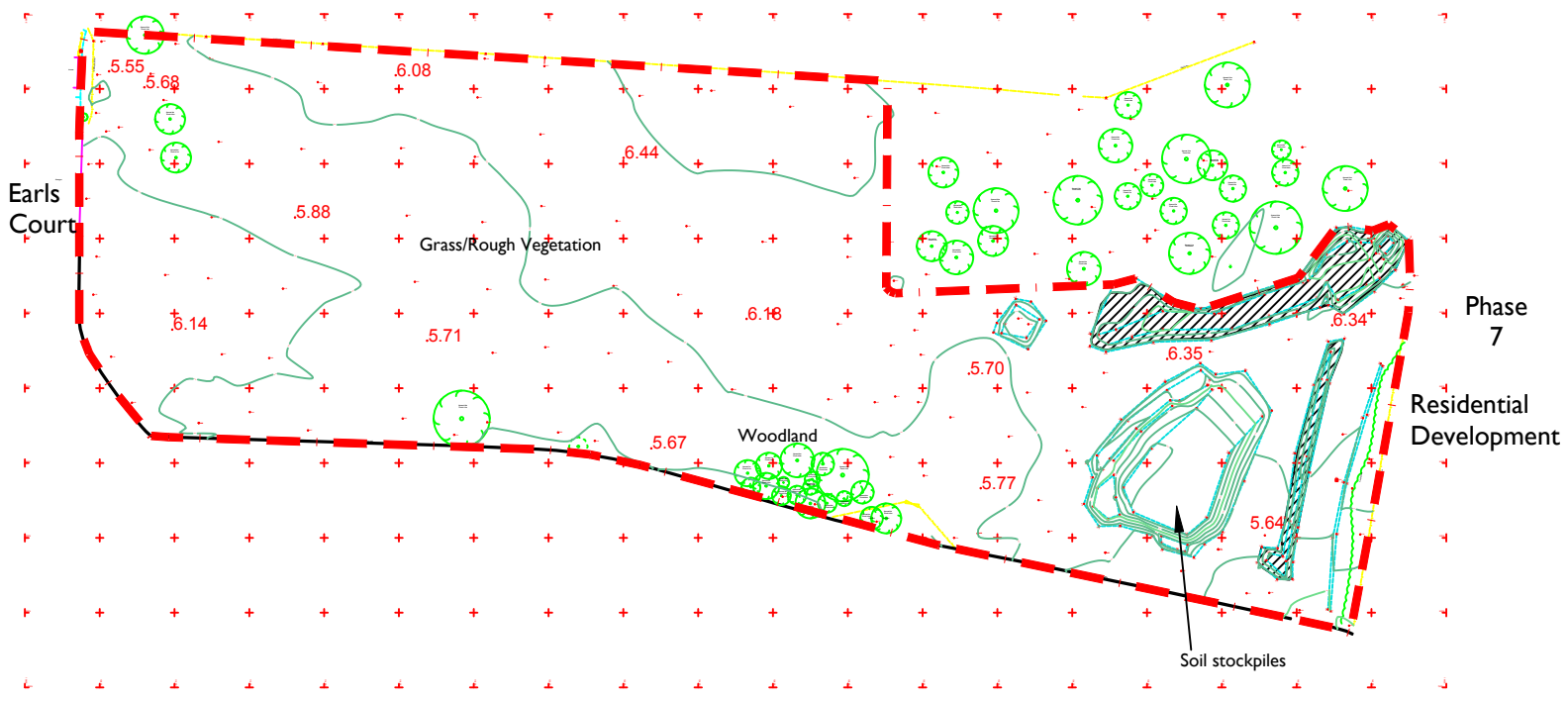
drawn by:
AC

approved by:
PB

scale:
1:50,000



Alloa Rugby Club



NOTES

- Site boundary
- ▨ Soil stockpile not within site during Mason Evans ground investigations

Note:
Topographic survey received from Allan Water Development (August 2017)

REV	DATE	DETAILS

ALLANWATER DEVELOPMENTS
24B KENILWORTH ROAD
BRIDGE OF ALLAN
FK9 4 DU

PROJECT TITLE

ALLOA
PHASES 8 AND 9

DRAWING TITLE

EXISTING SITE LAYOUT

DRAWN BY AC	CHK'D BY HoL	APP'D BY PB	DATE 12.02.18	SCALE 1:2000 @A4
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PROJECT No. P16/483	DRAWING No. P16/483/SI/R/F/02	REVISION
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SCHEDULE OF ACCOMMODATION - ALLOA 9

Morven (Mo)	2
Kinross (Ki)	2
Amochar (Aa)	8
Lomond (Lo)	3
Ochil (Oc)	3
Cullin (Cu)	3
Clairgorm (Ca)	2
Torrison (To)	1

SCHEDULE OF ACCOMMODATION - ALLOA 8

Morven (Mo)	8
Kinross (Ki)	6
Amochar (Aa)	13
Lomond (Lo)	5
Ochil (Oc)	8
Cullin (Cu)	5
Clairgorm (Ca)	5
Torrison (To)	3
TOTAL	53

NOTES

--- Site boundary

REV	DATE	DETAILS

ALLANWATER DEVELOPMENTS
248 KENILWORTH ROAD
BRIDGE OF ALLAN
FK9 4DU

PROJECT TITLE

ALLOA
PHASES 8 AND 9

DRAWING TITLE

PROPOSED DEVELOPMENT LAYOUT

DRAWN BY AC	CHK'D BY HoL	APP'D BY PB	DATE 12.02.18	SCALE Not to Scale
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PROJECT No. P16/483	DRAWING No. P16/483/SI/R/F/03	REVISION
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RESIDENTIAL DEVELOPMENT
ALLOA 8
ALLANWATER HOMES LTD

FEASIBILITY
SITE LAYOUT

SCALE: 1:500 DATE: 12.10.2016 BY: KR
FEASIBILITY REV: 1 DWG SIZE: A1



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2.0 SUMMARY OF DESK STUDY INFORMATION

2.1 General

2.1.1 A summary of the current site conditions as understood from the supplied survey information and site reconnaissance is included in Table 01. A site walkover was undertaken in August 2017 (included in Appendix 01), an Envirocheck Report (included in Appendix 02) was procured and a review of selected publicly available information was undertaken (included in Appendix 03). A summary of the findings of these researches are also included in the table below:

2.2 The Site

2.2.1 A summary of the existing site conditions is included in the table below:

TABLE 01 - Site Details and Review of Public Records

Site Name	Phases 8 & 9, Alloa
National Grid Ref	289166, 692029
Site Area	Total site area: Approx. 3.5 Ha
Topography	Noted to be generally flat lying (6 m AoD). The surface covering consisting predominantly of grass with several trees in the southern site area. A large soil stockpile occupies the eastern site area (approx. 3000m ² (refer to Drawing No P16/483/SI/R/F/02).
Current Usage	The site was unoccupied agricultural land at the time of site investigations.
Proposed Use	Development of a new residential (with gardens) estate (Drawing No. P16/483/SI/R/F/03)
Surface Water Bodies	There are no surface water features within the site boundaries. The nearest surface water body is the Black Devon located approximately 200 m to southeast of the site. In 2014 SEPA classified it as having an overall status of 'moderate' (Data sheets are included in Appendix 3). Given the relative distance of the Black Devon, we do not consider it to be a sensitive water receptor.
Groundwater	SEPA's datasheets on ground water indicate the site to be underlain by two groundwater bodies, 'Tullibody' and 'Alloa'. The water body 'Tullibody' was recorded in the northern site area, and in 2014 was given an overall status of 'Good', with a 'Good' overall flow rate and 'Good' water quality. The water body 'Alloa' was recorded in the southern site area, and in 2014 was given an overall status of 'poor', with a 'Good' overall flow rate and 'Poor' water quality. (Data sheets are included in Appendix 3).
Public Register Information	<p>-No discharge consents were registered on site, or within 250 m of the site. 5 no discharge consents are recorded within 500 m of the site, described as sewage effluent and surface water discharge.</p> <p>-No groundwater abstraction wells are noted within 1000 m of the site.</p> <p>-There is a recorded landfill site 490 m southwest of the site, recorded as being closed. The waste handled was not known.</p> <p>-There are 3 No recorded waste transfer sites recorded at 230 m of the site, handling household and commercial waste and controlled by Clackmannanshire Council.</p> <p>-There are no active trade entries within the site or within 250 m of the site. There is one listed within 500 m of the site – D&J Printers, located 270 m northwest and listed as being 'Inactive'.</p> <p>-There are no active fuel station entries within 500 m of the site, but 2 no within 1000m.</p>
Radon	The site is located within a low probability radon area where less than 1% of homes are considered to be above the action level.
Buried Services	A review of buried service plans has indicated that the site is generally clear of known buried services. Care should still be taken when excavating, as unrecorded buried services could exist within the site. A copy of available buried service plans is included in Appendix 04
Flooding	The site is perceived to be at a moderate risk of river flooding in the southern and western site area. Similarly, there is a moderate risk of surface water flooding close to the western site boundary. Refer to flood maps included in Appendix 03.
Invasive Plants	No vegetation or invasive plant species were recorded within the site as part of our walkover survey.

2.3 Site History

2.3.1 Information on the site's historical use was obtained through an inspection of available Ordnance Surveys maps dating from 1861 to the present day. A summary of the information is presented in the following table:

TABLE 02 - Summary of History (Ordnance Survey Map Records)

Ordnance Survey Map Edition	The Site	The Surrounding Area
1:10,560 – 1866 1:2,500 – 1865	<ul style="list-style-type: none"> The site was noted to be occupied agricultural land. 	<ul style="list-style-type: none"> A collection of buildings, named as 'Bowhouse' recorded to the immediate west of the site (estate/farm). Woodland/open space named as 'Alloa Park', recorded to the immediate north of site. Settlement of 'Alloa' recorded 500 - 1000 m northwest of the site, surrounding area predominantly agricultural. Within 'Alloa' mixed residential and industrial, including factory, foundries, works, ship yards and blacksmiths. Railline, aligned east to west, noted 900 m north of site.
1:10,560 – 1901 1:2,500 – 1900	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> Significant expansion to the settlement of 'Alloa' – mixed industrial and residential. New dock, associated with 'Alloa Harbour' recorded 300 m west of site. Further development and expansion to 'Bowhouse'. Recreational ground/estates recorded within 'Alloa Park'. Quarries and an old shaft recorded 1000 m east of the site.
1:10,560 – 1922 1:2,500 – 1924	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> Further industrial development to 'Alloa', including 'shafts' and works to the north, and Forthbank Shipbuilding Yard to the southwest of the site. 'Cauldron Aeroplane Factory' and 'Aerodrome' recorded 250 – 750 m south of the site.
1:10,560 – 1952	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> Residential development recorded 75 m west of the site. Shipyards and aeroplane factory no longer noted. 'Forth Bank Mine' recorded 450 m south of site, with associated rail link, aligned north to south.
1:10,000 – 1958 1:1,250 – 1961	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> Surrounding site area remained largely unchanged
1:10,000 – 1967	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> Significant residential development to the north and west of site. Warehouses developed 1000 m north of site. Mine to the south of site marked as being disused. Former shipyard and aeroplane factory now a number of small works.
1:10,000 – 1978	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> Former 'Alloa Park' had been developed for residential (180 m to 700 m north of site. Also, residential developed to the west of site. Rugby/football ground to the immediate north of site. Former Shipyards to the southwest had been developed to a sewage works.
1:10,000 – 1990/91	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> Surrounding site area remained generally unchanged with only some small-scale residential and educational developments.
1:10,000 – 1999	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> The surrounding site remained unchanged.
Present Day (2017)	<ul style="list-style-type: none"> The site remained unchanged. 	<ul style="list-style-type: none"> Residential development to the east and north east of the site, with the former 'Bowhouse' now individual residential properties.

2.3.2 Following a review of the developmental history of this site, based on information obtained from historical ordnance survey maps, we have concluded that the site has remained undeveloped since at least 1865, and as

such can be classified as 'greenfield' in nature (with the exception of the soil stockpile in the eastern site area).

2.3.3 Copies of historical Ordnance Survey maps are included in Appendix 02.

2.4 Published Geological Information

Superficial Deposits

2.4.1 The available published maps indicated that the majority of the natural soils to comprise post glacial 'Raised Beach' deposits' (i.e SILT and SAND) (Drawing No. PI6/483/SI/R/F/04). Following a review of the site history, and following a site walkover survey, we would anticipate TOPSOIL to be encountered across the site.

2.4.2 Several historical borehole records were available, located within the site and approximately 50 m northeast and south west of the site. These positions generally record the superficial geology to comprise topsoil deposits, underlain by a mixture of CLAY, SILT and SAND, often with shell fragments (i.e indicative of raised beach deposits), further underlain by boulder clay (glacial till).

2.4.3 The natural superficial deposits are recorded to extend from ground level to depths of between approximately 14.00 m to 21.00 m bgl, underlain by sedimentary bedrock.

2.4.4 Historical borehole information is included in Appendix 05.

Solid and Mining Geology

2.4.5 The underlying rock strata were indicated to consist of sedimentary rocks of the Middle Coal Measures below the southern site area which comprise a sequence of SANDSTONES, SILTSTONES, MUDSTONES and SEATROCKS, with several economic COAL seams and the Passage Group below the northern site area which comprise a sequence of coarse SANDSTONES and SEATEARTHS (Drawing No. PI6/483/SI/R/F/04).

2.4.6 The BGS Solid Geology map indicates that the *Upper 5 Foot Coal (1.32m)* outcrops in the southern site area, dips to the north below the southern site area and terminates against the *600 foot fault* which strikes through the site diagonally. In addition, the *Nine Foot Foot Coal (2.43m)* is indicated to out crop to the south of site and dips to the north below the site and terminates against the *600 foot fault*. The BGS indicate that stratigraphically there are 4 No. coal seams (in leaves) between the Upper 5 Foot Coal and the Nine Foot Coal, indicated to be between 0.35m to 1.04m in thickness.

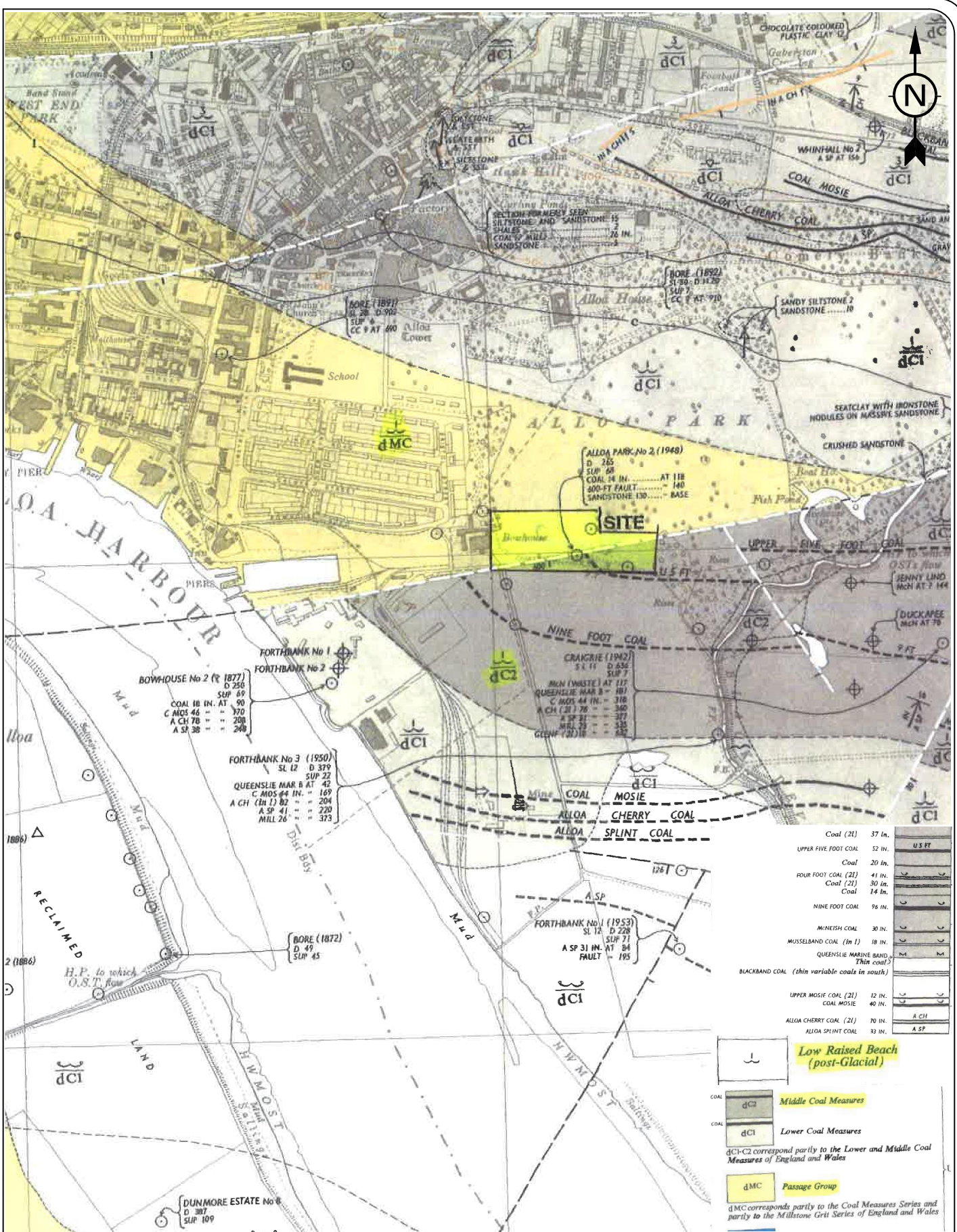
2.4.7 In February 2017 MEP received a report from The Coal Authority (refer to Appendix 06), which indicated that the site is in a surface area that could be affected by underground mining in 2 seams of coal at 120m depth, and last worked in 1953, but that any movement in the ground due to coal mining activity should have stopped by now.

2.4.8 Further research, utilizing the Coal Authority's online resources, indicate that the Coal Authority have records of underground mining below the area to the south of site in the Mosie Coal, Alloa Cherry Coal and Alloa Splint coal. These workings are indicated to terminate 100m to the south of site. The Coal Authority's online

resources indicates that the coal authority do not have records of workings at the level of the Upper Five Foot Coal or Nine foot coal that may underlie the site at shallow depths (refer Appendix 3).

- 2.4.9 The Coal Authority Report however also indicated that the site is in a surface area where the Coal Authority believe there is coal at or close to the surface and that this coal may have been worked at some time in the past. Therefore we considered there to be a moderate risk from mineral instability.
- 2.4.10 The Coal Authority indicate that there are no known coal mine entries within, or within 20m of, the boundary of the property.
- 2.4.11 A copy of the Coal Authority online resource information is included in Appendix 3.
- 2.4.12 In terms of mine gas emissions, The Coal Authority report notes 'no record of a mine gas emission require action', and as such we consider the risk of mine gas impacting the site to be low.
- 2.4.13 A review of the site history has not indicated the presence of historical quarrying activities within the site, or immediate surrounding area.
- 2.4.14 In conclusion, based on our researches we concluded that the site was at a low to moderate risk from mineral instability, associated with historical mining activities, and therefore mineral investigations were required.

Drg 04



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ALLANWATER DEVELOPMENTS

24B KENILWORTH ROAD

BRIDGE OF ALLAN, FK9 4 DU

project title:

ALLOA
PHASES 8 AND 9

drawing title:

SITE LOCATION PLAN

project no:
P16/483

drawing no:
P16/483/SI/R/F/04

revision:

date:
12.02.18

drawn by:
AC

approved by:
PB

scale:
1:10,560

Hydrogeology

- 2.4.15 Interpretation of the site hydrogeology required consideration of the general geological conditions. In this instance, the available information indicated the site to be potentially comprised of four geological units: made ground, post glacial beach deposits, glacial till and sedimentary bedrock. The typical permeability ranges of each of these strata are recorded in Table 03.

TABLE 03 –Typical Material Permeability

Material	Typical Permeability Range (m/sec)
Made Ground	Variable
Glacial Till	$10^{-2} - 10^{-9}$
Raised Beach Deposits	$10^{-4} - 10^{-10}$
Sedimentary Rock	10^{-2} to 10^{-8}

- 2.4.16 Minimal made ground deposits are expected below the site. Made ground deposits could potentially allow surface water infiltration. When this is coupled with the moderate to high infiltration and moderate to high permeability of the underlying natural granular deposits (silts and sands), it was considered possible that a shallow groundwater body could exist within the natural granular soils.
- 2.4.17 At present, surface run-off below the site would be low given that the site was surfaced predominantly by grass. Infiltration of surface water would therefore be expected to be high.
- 2.4.18 The potential for a deeper groundwater table below rockhead is moderate given the permeability range of the sedimentary strata. The presence of any potential deep groundwater table would be dependent on secondary porosity, such as fracturing; this would also control any potential movement between shallow and deep lying groundwater bodies.
- 2.4.19 The Scottish Environmental Protection Agency (SEPA) provides guidance in document WAT-PS-10-01 'Assigning Groundwater Assessment Criteria for Pollutant Inputs' (August 2014) for assessing contamination risks to groundwater and the water environment. It was also considered possible that groundwater within the superficial soils beneath the site could meet the minimum criteria to be classified as a water body i.e. an abstraction could achieve 10 m³ per day. Therefore, shallow groundwater is regarded as a potential sensitive receptor, although it is still considered unlikely that it would be utilised for abstraction.

2.5 Preliminary Conceptual Site Model

- 2.5.1 In order to fully evaluate the potential presence of contamination at the site, the study area must be considered in an environmental context taking account of its geology, topography, past and present land-use and any previous site investigation data. It is therefore advantageous to develop a 'Conceptual Site Model' as defined in the R & D Publication CLR11 issued by the Department for the Environment and Rural Affairs (DEFRA). The model then forms an integral part of the contamination assessment of the proposed development site.
- 2.5.2 Statutory guidance sets the definition of contaminated land within the context of the "suitable for use" approach. It is based on the principles of risk assessment, including the concept of a **pollutant linkage**

between a **source** contaminant and a **receptor**, by means of a **pathway**. This concept is considered further below. We would highlight that the approach, while perhaps rendering the site suitable for its current use, may provide inappropriate to a change in site designation or specific land use, arising from existing site conditions.

2.5.3 The presence of all three elements identifies a plausible pollutant linkage. An assessment of the potential sources, pathways and receptors constitutes a conceptual mode for the site.

2.6 **Source Characterisation**

2.6.1 The potential on-site sources of contamination identified by this desk study are:

- Localised unrecorded deposition of contaminated materials.
- Deposition of contaminated soils in the eastern site area (soil stockpile).

2.6.2 The potential off-site sources of contamination identified by this desk study are:

- Deposition of contaminated materials associated with construction of neighbouring residential developments.

2.6.3 The typical processes involved, and associated Contaminants of Concern (COC) are discussed and summarised in Table 04 overleaf.

TABLE 04: Contaminants of Concern

THE SITE	Industrial Activity/ Site Use	Potential Pathways	*Associated Potential Contaminants
CURRENT	<ul style="list-style-type: none"> Unrecorded deposition of contaminated materials. Deposition of contaminated soils in the eastern site area (soil stockpile). 	<ul style="list-style-type: none"> Contaminants transported from other areas. Spillages and leakages of contaminants. 	Metals: As, Cd, Cr, Ni, Zn, Cu, Hg, Pb Organics: Fuel oils, PAH, Phenol Miscellaneous: Asbestos Ground Gasses: CO ₂ , CH ₄
PREVIOUS	<ul style="list-style-type: none"> Unrecorded deposition of contaminated materials. 	<ul style="list-style-type: none"> Deposition of waste materials during construction and continued usage Spillage of contaminants. 	Metals: As, Cd, Cr, Ni, Zn, Cu, Hg, Pb Organics: Fuel oils, PAH, Phenol Miscellaneous: Asbestos Ground Gasses: CO ₂ , CH ₄
IMMEDIATE SURROUNDING AREA	Industrial Activity/ Site Use	Potential Pathways	Associated Potential Contaminants
CURRENT	<ul style="list-style-type: none"> Deposition of contaminated materials associated with construction of neighbouring residential developments. 	<ul style="list-style-type: none"> Spillages and leakages of contaminants. Contaminants transported from surrounding surface run-off. 	Metals: As, Cd, Cr, Ni, Zn, Cu, Hg, Pb Organics: Fuel oils, PAH, Phenol Miscellaneous: Asbestos Ground Gasses: CO ₂ , CH ₄
PREVIOUS	<ul style="list-style-type: none"> Deposition of contaminated materials associated with construction of neighbouring residential developments. 	<ul style="list-style-type: none"> Deposition of contaminated materials/wastes during construction /demolition. Spillage of and leakages of contaminants. Contaminants transported from surrounding surface run-off. 	Metals: As, Cd, Cr, Ni, Zn, Cu, Hg, Pb Organics: Fuel oils, PAH, Phenol Miscellaneous: Asbestos Ground Gasses: CO ₂ , CH ₄

*Considered unlikely following review of historical records and the site walkover.

2.7 Receptor Characterisation

2.7.1 Potential receptors at the site are defined on the basis of the site proposal, which will include the development of new residential properties with gardens and associated hard standing. The following receptors are considered relevant to this site:

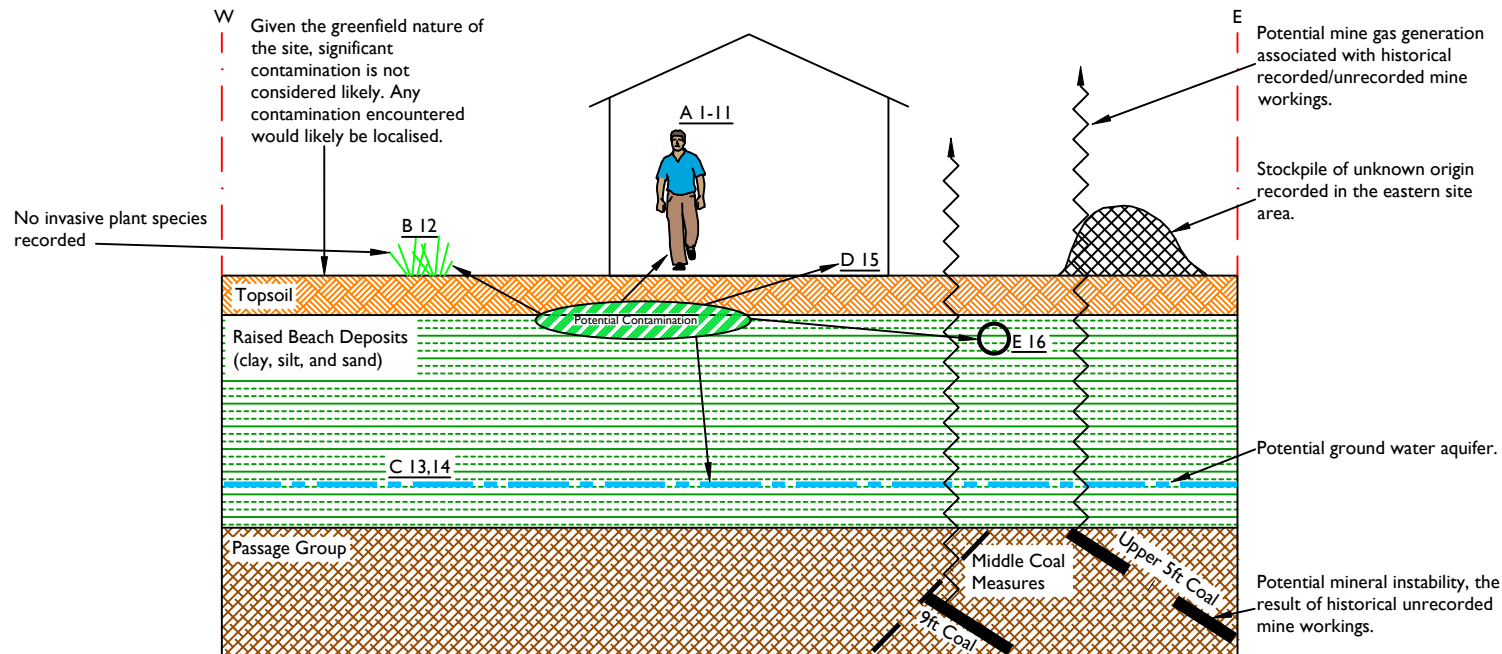
- Humans – site end users and construction works (outdoor),
- Humans – site end users (indoor),
- Buildings and services (including water supply pipes and buried concrete),
- Vegetation (plants in proposed gardens and soft landscaped areas),
- Water Environment (ground water).

2.8 Pathway Characterisation (Pollutant Linkages)

2.8.1 The pathways by which sensitive receptors may be exposed to potential sources of contamination, as determined by the proposed end use for the site are as follows:

1. Humans – site end users and construction workers (outdoor)
 - *Dermal (skin) contact with contaminated soil, fugitive dust and the absorption of any contaminants through the skin into the body.*
 - *Inhalation of soil dust or vapour.*
 - *Ingestion of soil by hand to mouth activity.*
2. Humans – site end users (indoor)
 - *Inhalation of any ground gas migrating into the buildings.*
 - *Inhalation of soil derived dust.*
 - *Ingestion of soil derived dust.*
3. Buildings
 - *Potential soil gas generated in the ground vertically migrating and pooling within the structure.*
 - *Contact with aggressive or acidic soils will affect the concrete design of the foundations.*
4. Services including the domestic water supply
 - *Direct contact with contaminated soil or groundwater.*
 - *Leaching of contaminants through the soil.*
 - *Service trenches acting as preferential migration pathways for contamination.*
 - *Permeation of plastic water supply pipes.*
5. Vegetation (plants in landscaped areas)
 - *Direct contact with contaminated soils and groundwater.*
 - *Uptake of contaminants from the soil or groundwater into the plant.*
6. Water Environment (ground water features)
 - *Leaching of contaminants from the soil to water environment.*
 - *Contaminant migration offsite in the water environment.*
 - *Direct entry of contaminants (e.g. spillage) into the water environment.*

2.8.2 The potential source-receptor-pathway linkages identified for this site are illustrated within our Preliminary Conceptual Site Model (Drawing No P16/483/SI/R/F/05) and on Tables 5A and 5B. Site investigations were required to confirm or otherwise the existence of such linkages in addition to providing further confirmation of the geological and geotechnical conditions.



Potential Source

- Localised made ground
- Mine gas

Potential Exposure Pathways

1. Outdoor ingestion of dust.
2. Indoor ingestion of dust.
3. Consumption of homegrown vegetables.
4. Ingestion of soil attached to vegetables.
5. Skin contact with outdoor soil.
6. Skin contact with indoor dust.
7. Outdoor inhalation of dust.
8. Indoor inhalation of dust.
9. Outdoor inhalation of soil vapour.
10. Indoor inhalation of soil vapour.
11. Inhalation of ground gases.
12. Contaminant uptake by vegetation.
13. Leaching of contaminants to the groundwater.
14. Contaminant migration in the groundwater.
15. Detrimental effects on buried concrete.
16. Permeation of plastic water supply pipes.

Potential Receptors

- A. Site users / construction personnel.
- B. Vegetation / fauna.
- C. Groundwater.
- D. Buried concrete (Service and foundations)
- E. Plastic water supply pipes.

NOTES

REV	DATE	DETAILS

ALLANWATER DEVELOPMENTS
24B KENILWORTH ROAD
BRIDGE OF ALLAN
FK9 4 DU

PROJECT TITLE

ALLOA
PHASES 8 AND 9

DRAWING TITLE

PRELIMINARY CONCEPTUAL
SITE MODEL

DRAWN BY AC	CHK'D BY HoL	APP'D BY PB	DATE 12.02.18	SCALES Not to Scale
PROJECT No. P16/483		DRAWING No. P16/483/SI/R/F/05		REVISION

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EVANS**

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TABLE 5A: Preliminary Qualitative Risk Assessment – On Site

Source	*COCs	Pathway	Receptors (s)	Assessment	Further Investigation Required
I. Localised areas of potentially contaminated made ground	Metals, semi-metals and non-metals: As, Cd, Cr, Ni, Zn, Cu, Hg, Pb Organics: Hydrocarbons, PAH, Fuel oil, Phenol Anions: Asbestos, Sulphate Ground gasses: CO ₂ , CH ₄	Dermal contact, ingestion, inhalation	Human – site workers Humans – end users (outdoor)	Spillage/leakage of contaminants impacting near surface soils. Contaminated materials may have been deposited within the site.	Yes
		Leaching through soil or direct migration	The water environment - groundwater	Contaminants may be leached and potentially mobilised from the soil by percolation and/or shallow groundwater movement.	Yes
		Direct contact, leaching through soil, groundwater migration	Buildings and services	Potential for aggressive chemical environments for concrete due to sulphate and acidic conditions. Presence of contaminants in soil that may permeate water supply pipes.	Yes
		Gas/vapour inhalation, vertical/lateral migration	Buildings and services Humans – end users (indoor)	Contamination may include gas/vapour producing materials or compounds that could vertically migrate into overlying buildings producing a potentially asphyxiating or explosive environment.	Yes
		Direct contact, uptake	Plants	Direct contact or uptake of contamination from the soil or groundwater could adversely affect any plants grown.	Yes
		Migration in the groundwater	Groundwater	Contaminants could impact the groundwater and migrate offsite.	Yes
		Point source discharge	Surface water	River Ayr located 20 m north of the site	Yes
		Diffuse source	Surface Water	No sensitive surface water receptors on site.	Yes

*Considered unlikely following review of historical records and the site walkover.

TABLE 5B: Preliminary Qualitative Risk Assessment – Off-Site

Source	*COCs	Pathway	Receptors (s)	Assessment	Further Investigation Required
I. Localised areas of potentially contaminated made ground	Metals, semi-metals and non-metals: As, Cd, Cr, Ni, Zn, Cu, Hg, Pb Organics: Hydrocarbons, PAH, Fuel oils, Phenols Anions: Asbestos, Sulphate Ground gasses: CO ₂ , CH ₄	Dermal contact, ingestion, inhalation	Human – site workers Humans – end users (outdoor)	Spillage/leakage of contaminants impacting near surface soils. Contaminated materials may have been deposited within the site.	Yes
		Leaching through soil or direct migration	The water environment - groundwater	Contaminants may be leached and potentially mobilised from the soil by percolation and/or shallow groundwater movement.	Yes
		Direct contact, leaching through soil, groundwater migration	Buildings and services	Potential for aggressive chemical environments for concrete due to sulphate and acidic conditions. Presence of contaminants in soil that may permeate water supply pipes.	Yes
		Gas/vapour inhalation, vertical/lateral migration	Buildings and services Humans – end users (indoor)	Contamination may include gas/vapour producing materials or compounds that could vertically migrate into overlying buildings producing a potentially asphyxiating or explosive environment.	Yes
		Direct contact, uptake	Plants	Direct contact or uptake of contamination from the soil or groundwater could adversely affect any plants grown.	Yes
		Migration in the groundwater	Groundwater	Contaminants could impact the groundwater and migrate offsite.	Yes
		Point source discharge	Surface water	River Ayr located 20 m north of the site	Yes
		Diffuse source	Surface Water	River Ayr located 20 m north of the site	Yes

*Considered unlikely following review of historical records and the site walkover.

3.0 SITE INVESTIGATIONS

3.1 General

3.1.1 The scope and location of works was provided by Allanwater Development (Client). Site works undertaken were implemented generally in accordance with BS10175:2011 and BS5930:2015.

3.1.2 The following investigation works were undertaken:

TABLE 06 – Site Investigations

Trial Pits	20 No. trial pits, excavated mechanically, extended to depths of up to 2.70 m and logged by a competent field geologist. Logs are included in Appendix 07.
Stockpile Sampling	3 No. trial pits were excavated into a soil stockpile (we understand from the adjacent residential development). Logs are included in Appendix 07.
Boreholes and Well Installations	11 No. soil boreholes were sunk from ground level to depths of up to 15.75 m bgl. Gas and groundwater monitoring wells were installed in 10 of the boreholes (11 No in total). Logs are included in Appendix 10.
Mineral Boreholes	6 No. mineral boreholes were sunk from ground level to depths of up to 35.00 m bgl. Logs are included in Appendix 08.
Chemical Testing	14 No. soil samples and 4 No. leachate samples were tested for a comprehensive range of potential contaminants. Soil chemical analysis results are included in Appendix 09.
Ground Water/Gas Monitoring	6 No. ground gas/water monitoring visits have been undertaken to date. Results are included in Appendix 10.
Geotechnical Testing	In-situ SPT tests were undertaken in all boreholes sunk on site. Geotechnical analyses were undertaken on selected soil samples. Results are included in Appendix 11.

3.1.3 The exploratory holes were intended to provide geotechnical and hydrogeological data of site areas associated with the proposed development, and to facilitate soil and water sampling for chemical contamination and geotechnical testing, where required.

3.1.4 Representative samples of made ground and underlying natural soils were obtained and tested for an appropriate suite of testing associated with the historical site usage.

3.1.5 Exploratory hole locations are indicated on Drawing No PI6/483/SI/R/F/06.