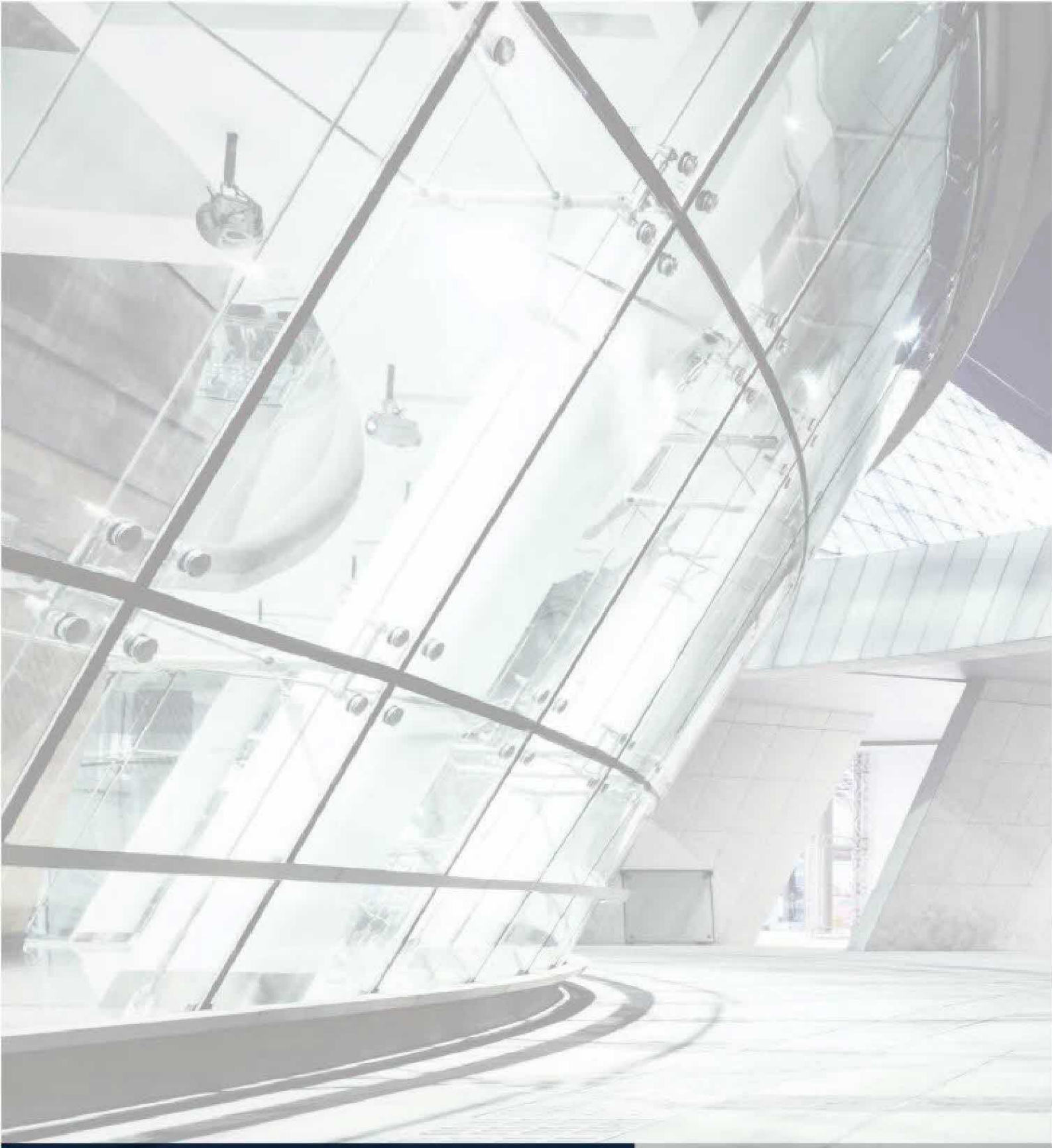

GROUNDTECH
CONSULTING

CDC SKEGNESS

GEO-ENVIRONMENTAL APPRASIAL

UNITED LINCOLNSHIRE HOSPITALS NHS TRUST

NOVEMBER 2023

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SUMMARY

Site Details		
Site Location	The site is located circa 0.5km north west of Skegness Town Centre and the site is approximately centred on National Grid Reference 555908, 363488.	
Site Area	The site is approximately 0.4ha and roughly rectangular in shape. Topography is generally level throughout. The majority of the site is occupied by mobile homes situated upon an associated hardstanding car park. Soft landscaping is evident in the north, west and east boundaries of the site where light vegetation around the perimeter is visible. The southern point connects the site to Old Wainfleet Road.	
Preliminary Risk Assessment		
History	The site historically was of industrial use as a brick works from at least 1888 and was likely demolished from 1966-1982. The surrounding area has experienced industrial use comprising hospitals, churches, tips, depots, garages and factories were of use within 250m of the site. The variety and use of the surrounding area correlates to the use of the site emphasising the history of extensive commercial and industrial activity within the surrounding area.	
Geology/Hydrogeology	The geology of the site is composed of Tidal Flat Deposits comprising clay and silt underlain by Ferriby Chalk formation. BGS data shows the site to have no geological faults. The superficial deposits of clay and silt are classified as an Unproductive Aquifer. The Ferriby Chalk formation is classified to be a Principal Aquifer. The soils are of high leach potential.	
Environmental Setting	The River Main Drain is present on site and has a failed a chemical rating. The Environment agency indicate the site is outside of the flood risk zone faces no threat of flooding.	
Pollution Linkage (PL) Assessment	Human Health	Made Ground is expected at the site and given the former land use a brick works and refuse tip with associated nearby contaminative sources, the risk to human health is considered to be Moderate to Low.
	Controlled Waters	Regarding Controlled Waters, there is a low risk relating to the migration and impaction of groundwater. The demolition of previous buildings located on the site have the potential to contaminate the soils beneath the site, impacting the groundwater from soil contamination. No significant sources of mobile contamination have been identified and the impermeable superficial deposits will restrict the migration of contaminants into the groundwater, resulting in a Low risk. No risk is considered to exist relating to surface waters.
	Permanent Ground Gas	The history of the site indicates Made Ground will be present beneath the site. The presence of a refuse tip landfill encroaching the northern section of site could result in the presence of deep Made Ground. Additional offsite sources of ground gases such as a backfilled pit and ponds have also been identified. A Moderate to High risk is present.
Ground Model		
Made Ground Soils	Made Ground was encountered in all exploratory holes from ground level to a maximum depth of 1.7m bgl. Grey tarmac surfaced all exploratory holes besides WS03 to a maximum depth of 0.2m. Light grey occasionally sandy gravel with constituents of chalk was encountered within all	

	exploratory holes from 0.1m to 1.7m bgl. Brown sandy gravel/gravelly sand with constituents of brick, metal, ceramic, chalk, slag, flint and occasional clinker was encountered from 0.5m to 1.0m bgl in WS01, WS02, PLT02 and PLT03.
Natural Soils	Natural strata was encountered in CP01, CP02, WS01, WS02, WS03 from a minimum depth of 0.5m to 1.7m bgl to a maximum depth of 12.5m bgl. Soft occasionally firm brown silty clay/clayey silt Tidal Flat Deposits were encountered in CP01, CP02, WS01 and WS03 from 0.5m to 12.5m. Firm to stiff brown sandy clay were encountered in CP01 and CP02 from a minimum depth of 12.5m to 16.0m bgl to a maximum depth 14.6m to 16.3m bgl (Ferriby Chalk Formation). Medium dense brown silty gravelly sand / sandy gravel with minor constituents of chalk and flint was encountered in CP01 and CP02 from 14.6 to 19.5m bgl and is considered to be weathered bedrock deposits (Ferriby Chalk Formation).
Bedrock	Ferriby Chalk Formation was encountered from 19.5m bgl in CP02. Structureless Chalk composed of slightly clayey gravel (Grade Dc) was encountered from 19.5m to 22.0m bgl. Structureless chalk composed of slightly sandy cobbles (Grade Dc) was encountered from 22.0m to 22.5m bgl.
Groundwater	Groundwater was encountered in CP01, CP02, WS01, WS02 and WS03 from 1.5m bgl to 4.0m bgl.
Ground Engineering Assessment	
Foundations	The most suitable and cost beneficial type of pile is considered to be a driven pile. Driven piles are the most effective solution to minimise the potential impacts of varying ground conditions on the proposed structure. The pile foundations should be designed to transmit loads from the structure to the ground safely and avoiding the differentiated settlement in the clay and silt.
Highways	Five plate load tests were conducted on the natural strata beneath the site at depths of between 0.4m and 0.5m bgl. CBR values of 3.4% to 25.6% are likely to be achieved in undisturbed natural soils. Plate load results undertaken within gravelly ashy sand did not meet the design criteria for highway construction. As a minimum the subgrade should be proof rolled prior to construction.
SuDS	The use of SuDS drainage within the natural ground is not feasible at the site due to the presence of shallow groundwater and cohesive soils which are capable of low soil infiltration rates.
Constraints	Shallow groundwater and poor/variable soils are the main limitation. Groundwater being encountered from 1.5m bgl to a maximum depth of 4.0m bgl resulted in instability of the exploratory holes. Furthermore, the variations of clay and silt formations within the site creates differentiated settlement resulting in a constraint for construction. The site is in a medium UXO risk and a detailed UXO risk assessment is recommended to confirm risk. At present, UXO supervision is required for all intrusive surveys. The former cutting/refuse tip could be a source of deep Made Ground and additional investigation is required to delineate the position of the pit.
GQRA and Revised (PL) Assessment	
Human Health	Regarding site users coming into contact with contaminated soils on soils, Geo-environmental testing has not recorded any elevated Contaminants of Concern based on the site being developed commercially. A source of volatiles has not been identified onsite and no visual or olfactory evidence of hydrocarbon/volatile contamination has been identified. However, as a nearby source has been

	identified a watching brief should be undertaken as part of the enabling works and construction phase. Relating to contamination on the subject site affecting adjacent site users. No mobile contamination has been identified onsite or through the geo-environmental testing. A source or pollution linkage has not been identified. Made Ground is present beneath the site to a maximum depth of 1.7m, geo-environmental testing identified no risk from contaminants to the water supply pipes therefore, a linkage hasn't been identified however a local water company risk assessment is recommended to confirm risk.
Permanent Ground Gas	Made Ground is present beneath the site to a maximum depth of 1.7m besides this, no concentrations of methane, or hydrogen sulphide were detected. Gas monitoring visits identified no risks to human health. No evidence of gas migration from the former refuse tip/cutting has been identified.

Final Appraisal

The following further work is required to progress to the construction phase:

- Completion of gas monitoring programme
- Issue gas assessment
- Further investigation to delineate the extent of the former cutting/refuse tip
- Detailed Foundation design
- Tree Survey by qualified arboriculturist
- Confirmation of recommendations made in this appraisal with regulators

TABLE OF CONTENTS

Plans		
Plan Reference	Revision	Title
GRO-23133-P01	-	Project Location Plan
GRO-23133-P02	-	Preliminary Findings and Constraints Plan
GRO-23133-P03	-	Illustrative Preliminary Conceptual Site Model (CSM)
GRO-23133-P04	-	Exploratory Hole Location Plan
GRO-23133-P05	-	Generalised Ground Model
GRO-23133-P06	-	Revised Illustrative Conceptual Site Model (CSM)

1.0 INTRODUCTION

1.1 Project Objectives

Groundtech Consulting Limited have been instructed by CCS Consulting on behalf of United Lincolnshire Hospitals NHS Trust to undertake a Geo-Environmental Appraisal for a site at Old Wainfleet Road in Skegness.

The objectives of the Preliminary Risk Assessment were to establish the sites environmental and geotechnical background in order to generate a Conceptual Site Model to identify any potential constraints and linkages which may affect the redevelopment of the site.

A main investigation was undertaken in accordance with BS 5930:2020, BS 10175:2017, BS 8576:2013 and Eurocode 7 to revise the CSM and quantify the level of risk identified in the PRA. The Appraisal has been prepared in accordance with current UK Legislation and to discharge Land Quality pre-commencement planning conditions.

The report has been undertaken to fulfil the requirements of a preliminary risk assessment in accordance with current LCRM risk assessment guidance.

1.2 Proposed Development

The proposed development is of commercial end use comprising of a clinical diagnostics centre with associated hardstanding car parking and soft landscaping.

Proposed Development

1.3 Limitations

This Preliminary Risk Assessment is based on information obtained from a number of sources, and the information is assumed to be correct.

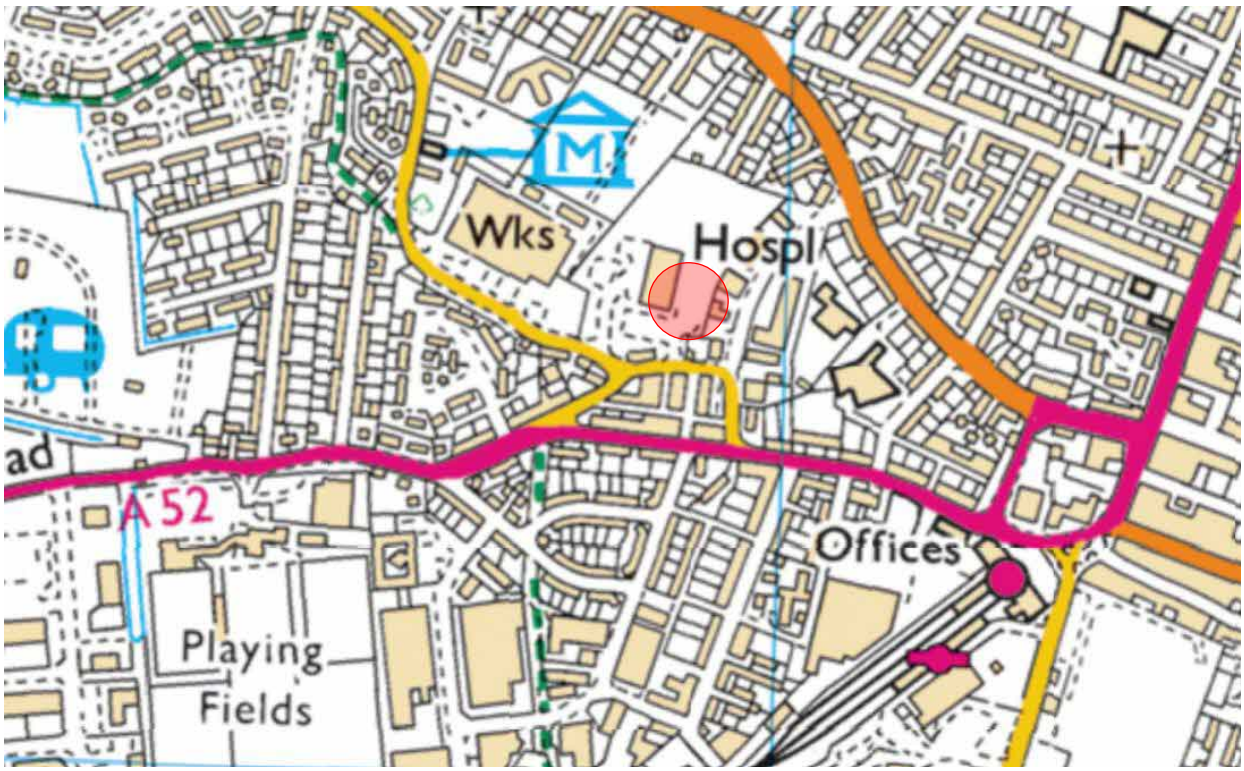
Other conditions may exist on the site that have not been taken into account in this assessment as they are outside the scope of works. Groundtech Consulting are not responsible for these circumstances that are not outlined in the report.

The assessment has been prepared for the exclusive use of the client. No third parties may rely on or reproduce the contents of the report without the written permission of Groundtech Consulting Limited. If any unauthorised third party comes into possession of the report they rely on it at their own risk and Groundtech Consulting Limited will not be obliged to provide a duty of care.

2.0 SITE SETTING

2.1 Location

The site is located circa 0.5km north west of Skegness Town Centre as shown on the Project Location Plan GRO-23133-P01. The site is approximately centred on National Grid Reference 555908, 363488.



Project Location

Access to the site is gained off Old Wainfleet Road to the south of the site.

2.2 Site Description

The site is approximately 0.4 hectares in area and roughly rectangular in shape, the topography is generally level throughout.

Site Features

The majority of the site is occupied by a hardstanding car park associated with the adjacent warehouse building to the west of the site boundary.

At the time of the investigation, the site was being utilised as a storage area for mobile housing units with several mobile homes stored across the site. HGVs were noted to be frequently accessing the site through the southern entrance from Old Wainfleet Road to collect and deposit the mobile units.

There is a mobile above ground fuel tank on site in the west situated near to the warehouse.

Sparse areas of soft landscaping in the form of are present along the extreme northern, eastern and western site boundaries, with overgrown weeds and foliage visible.

Site Boundaries and Surrounding Area

The site is bound by palisade fencing to the south where the site is accessed from Old Wainfleet Road. The western boundary is bound by the warehouse building to the west and the north boundary by further palisade fencing.

The site is surrounded by following features/land uses:

North	-	Grassed over field and woodland
East	-	Commercial buildings and associated car parking
South	-	Old Wainfleet Road followed by housing
West	-	Warehouse building and associated car parking

Site photographs are presented in Appendix 2 and relevant features are recorded on the Preliminary Development Constraints Plan GRO-23133-P02.

3.0 ENVIRONMENTAL SETTING

3.1 Site History

Available historical maps have been obtained, a list of dates and scale are listed in the table below:

Scale	Date
1:1,250	1966, 1966/69, 1973, 1973/74, 1982/86, 1987/89, 1994, 1989/94, 1992/94, 1994/95, 1993/9, 2003
1:2,500	1889, 1932, 1965/66
1:10,000/10,560	1887, 1905/06, 1938, 1946/48, 1951/55, 1968/70, 1982, 1991/92, 2001, 2010, 2023

The plans were examined and potential issues have been identified and summarised in the table below:

Date	Site	Surrounding Area
1887	Building located at centre of site and outbuilding at southern boundary associated with brick works.	Kilns associated with brick works c.5m east and c.10m west. There is a body of water immediately north of the site. Additionally, there are two ponds c.50m south west and c.90m south east. Buildings associated with brickworks are located on site and in the surrounding area. Surrounding areas are predominantly fields and roads, and residential housing is immediately south of the site.
1906	Cutting present on northern site boundary towards pit further north.	Unspecified Pit c.5m north and c.100m north west. Kilns to east no longer present and brick works building c.100m west demolished. Ponds c.50m south west and 90m south east no longer present, possibly backfilled.
1932	Brick works no longer indicated on site, associated buildings partially demolished.	Residential development c.100m north.
1946/48	No significant change.	Unspecified pit immediately north increasing in size. Residential and commercial expansion to south. Warehouse building constructed c.100m west. Pit c.100m north west increasing in size.
1951/55	No significant change.	Warehouse building constructed immediately west.
1966/69	Former brick works building expanded. Outbuilding to south demolished and residential housing encroaching southern boundary. Refuse Tip immediately north encroaching site. Buildings associated with works present in south western area.	Pit immediately north indicated as a refuse tip. Pit c.100m north west no longer present, possibly backfilled. Works immediately west, c.85m and c.100m south west. Engineering works c.100m west. Garages c.120m south west and c.150m south. Factory c.150m south. Depot c.75m east. Residential expansion to south.
1973/74	Building partially demolished on northern area.	Depot to immediate east of the site. Factory c.5m east. Warehouse constructed c.60m east.

1982/86	Building on site completely demolished and site predominantly hardsurfaced. Refuse Tip no longer indicated.	Additional depots c.10m east and 50m north east. Allotment gardens c.100m north west. Works c.135m west. Electricity substation c.110m west. Factory 150m south demolished and replaced with housing.
1987/89	No significant change.	Refuse tip no longer indicated. Factory c.5m east no longer indicated. Electricity substation c.10m south east.
1994	Minimal change.	Residential expansion occurred directly south of the site and great commercial land use to the south west and east. An additional depot and warehouse is developed c.100m east.
2023	The site is hardsurfaced and currently utilised a storage yard for a mobile homes dealership.	Three petrol stations have been constructed within 500m south west. Building for medical care has been constructed c.150m north east.

The historical plans are presented in Appendix 3.

3.2 Geology

The following British Geological Survey (BGS) records and other available information were inspected to accurately determine the geology underlying the site:

1:50,000 Scale Geological Sheet 116, Skegness - Solid and Drift Edition.
BGS Records

Made Ground

Made Ground is not indicated to be present beneath the site on the available geological plans. However, the presence of Made Ground is anticipated due to the historical land use as a brick works and general redevelopment.

Superficial Deposits

The site is indicated to be underlain by Tidal Flat Deposits which typically comprises of clay and silt.

Geological Map – Bedrock & Superficial Geology

Solid Geology

The bedrock is of the Ferriby Chalk Formation.

No faults are shown on or within an influencing distance of the site.

BGS Records

BGS records immediately east of the site indicate Made Ground to a maximum depth of 0.9m bgl underlain by very soft silty organic Clay with occasional pockets of Sand to depths of between 10.3m and 11.2m bgl. This was underlain by stiff gravelly Clay with chalk pebbles to a maximum depth of 13.6m bgl, overlying medium dense gravel of chalk flint to 15.3m bgl. Weathered Chalk was encountered in a single borehole between depths of 15.3m and 16.8m bgl. Hard white chalk was encountered from depths of between 15.3m and 16.8m bgl to hole termination depth. Additionally, black clayey peat was recorded in a borehole adjacent to the site from the depth of 2.5m to 2.9m bgl.

The BGS records are presented in Appendix 4.

3.3 Hydrogeology

The superficial deposits in this area are classified by the Environment Agency as an Unproductive Aquifer. These are drift deposits typically with a low permeability that have negligible significance for water supply or river base flow.

The bedrock is classified as a Principal Aquifer. This is geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers.

The soils beneath the site are of a high leaching potential.

The site is in a Source Protection Zone, Zone III, Total Catchment (the area needed to support the discharge from the protected groundwater source).

There are no groundwater abstraction points within 1km of site, three historical abstraction licences are present within 2km of site associated with laundry use and throughflow for a lake and pond. There are no potable water abstractions within 2km of site.

3.4 Hydrology

The nearest named watercourse is the Main Drain River located approximately 640m west of site.

Environment Agency information indicates that the site is outside a flood risk zone and is not at risk of flooding.

The risk of flooding from rivers and seas (RoFRaS) is classified as Low.

Six surface water abstraction points are present within 2000m of the site with the nearest active point being present 1853m south west pertaining to spray irrigation.

3.5 Environmental Consultations

A request has been submitted to the Contaminated Land Officer at Skegness Council for information pertaining to the site. This information will be forwarded on receipt.

An environmental consultation has been conducted through Groundsure, which accesses British Geological Survey and Environment Agency databases. The complete EnviroInsight Report can be found in Appendix 5, a summary of the more relevant points are presented in the table below.

Record	<250m	250 – 500m	Description
Authorised Processes	3	2	No Part A authorisations have taken place within 500m of the site. Five part B authorisations have been granted within a 500m radius. The nearest is a historic permit located 14m north east associated with the respraying of road vehicles. The closest active permit is 219m north east pertaining to dry cleaning.
Pollution Incidents	-	-	-
Landfill and Waste Treatment	3	1	A refuse tip has historically been present on the northern boundary of site. A historic landfill was is also indicated 3m north east of site associated with the household waste at the former brick works.
Discharge Consents	0	1	Only discharge consent is 439m south relating to sewage discharges.
Petrol Filling Stations	1	2	The closest is c.248m south east and is actively used.
Current industrial Uses	16	0	A motoring garage for second-hand vehicles is present 1m east of the site and a vehicle repair and servicing garage is located 8m north east. An electricity substations is located 7m south east of the site and 155m south west.

3.6 Radon

The new radon map launched by UKHSA in December 2022 has been examined which defines areas requiring radon protective measures. The probability is 1% and 3% and CDC Skegness is not in an area requiring radon protection measures in foundations in accordance with BRE Report 211 8Radon – Guidance on protective measures for new dwellings92015 Edition.

The radon data in the Groundsure report is supplied by the BGS/Public Health England and is the definitive map of Radon Affected Areas in Great Britain and Northern Ireland and estimates that less than 1% of properties are affected by radon which confirms that no radon protection measures are required. The dataset is intended for use at 1:50,000 scale and was derived from both geological assessments and indoor radon measurements (more than 560,000 records). A minimum 50m buffer should be considered when searching the maps, as the smallest detectable feature at this scale is 50m. The findings of this section should supersede any estimations derived from the Indicative Atlas of Radon in Great Britain (1:100,000 scale).

3.7 Coal Authority Consultation

The site is outside the area of a designated coalfield, the Law Society and Coal Authority state a mining search is not required.

3.8 Unexploded Ordnance (UXO)

Zetica bomb risk maps indicate the site is of a moderate UXO risk. A preliminary UXO risk assessment has been commissioned and is presented in Appendix 6, a summary of the findings is presented below.

During WWII, the site was situated within the Urban District of Skegness, which according to official Home Office bombing statistics sustained an overall low density bombing campaign, across a district of 3,862 acres. The exact location of bombing in relation to the site could not be determined at the preliminary stage.

Information at this preliminary stage suggests both Lincoln Road to the north and Alexandra Road to the south received bombings.

Given the findings of the preliminary report, further research is recommended in the form of a Detailed UXO Risk Assessment in accordance with CIRIA guidelines. This was recommended in order to better assess the wartime conditions within and around the proposed area of works. Further research would involve the acquisition of any available written local bombing records, WWII-era aerial photography and other archival material.

Prior to, or in lieu of, a Detailed Assessment, it is recommended that appropriate UXO Risk Mitigation Measures are provided for intrusive works proposed.

4.0 CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

4.1 Introduction

The potential level of risk posed by contaminants in soil and/or groundwater will be influenced by the type and concentration of the contamination at source, the likelihood of exposure occurring, the potential pollution linkages and the likely chronic or acute effects on the receptors.

A contaminant is defined as a substance that has the potential to cause harm, a risk is considered to exist if such a substance is present at sufficient concentrations to cause harm and if a pathway is present a receptor could be exposed to the contaminant.

Section 4.0 compiles the information from the previous sections to assemble a Conceptual Site Model to inform the risk assessment process. The potential sources identified on the site and off the site that are within influencing distance are assessed to determine if pollution linkages exist and an unacceptable risk is posed to human health and controlled waters. The assessment has been carried out on a qualitative basis and aims to produce a complete and comprehensive Preliminary Conceptual Site Model; the potential pollution linkages are displayed on GRO-23133-P03 Illustrative Preliminary CSM.

Three potential types of impacts exist for a site and all three need to be considered in the qualitative preliminary risk assessment:

Impacts from sources on the subject site.
Impacts to the surrounding area from the subject site.
Impacts to the subject site from the surrounding area.

4.2 Potential Contamination Sources

Onsite Sources and Associated Contaminants of Concern (CoC)

From the information obtained during the preliminary risk assessment there are a number of onsite sources of contaminants which may affect the redevelopment of the site for commercial end use.

The former buildings which have been demolished are a potential source of Made Ground which may contain general contaminants including heavy metals, Polycyclic Aromatic Hydrocarbons (PAHs), asbestos and permanent ground gases.

A fuel tank located on the west boundary of the site could be a potential source of Total Petroleum Hydrocarbons (TPH) contaminants.

The Refuse Tip bordering the north boundary could result in leachate contamination and landfill gases affecting the proposed development. The Tidal Flat deposits are also considered to be a risk of ground gases.

Brick Works being present on site will potentially cause a range of contaminants as set out in the table below sourced from the DoE Industry Profile.

Industry Profile	Associated Contaminants of Concern	Required Testing
Ceramics and cement (brick and artificial stone works)	Heavy metals, metal oxides, hexavalent chromium, asbestos, ash, hydrocarbons, plasticisers, cement dusts, flue gas dusts.	Metals, sulphate, Total Petroleum Hydrocarbons (TPH CWG), speciated Polycyclic Aromatic Hydrocarbons (PAHs) and asbestos.

The current presence of a fuel tank on site could cause hydrocarbon contamination to the site.

Offsite Sources and Associated Contaminants of Concern (CoC)

There are a number of potential off-site sources of contamination that could impact the redevelopment of the site and include:

- Pit/refuse tip immediately north
- Factory 5m east
- Electricity substations 7m south east and 116m west
- Multiple brick works within a 150m radius of the site and an engineering works c.100m west
- Allotment gardens c.100m north west
- Garages c.130m south west and c.150m south and additionally, a garage 8m west respraying vehicles
- Kilns c.5m east and c.10m west
- Potentially backfilled ponds 50m south west and 90m south east
- Landfill with household waste

The pit/refuse tip to the north of the site is indicated to have been subject to household waste landfill. It is therefore a potential source of permanent ground gases such as carbon dioxide and methane.

The possible backfilling of ponds 50m south west and 90m south east could also be possible sources of ground gases.

Kilns 5m east and 10m west could be potential sources of heavy metals, speciated PAHs, ash, clinker and ground gases.

The end product of the factory 5m east is unknown but could be a source of general contamination.

The potential use of depots and vehicle use at them could be sources of fuel derived hydrocarbons, PAHs, SVOCs, VOCs and heavy metals. The garages are a potential source of hydrocarbons, fuels and oils.

The electricity substations are a source of PolyChlorinated Biphenyls (PCBs) which were formally used in transformers as a cooling agent.

The allotment gardens to the north west are a potential source of herbicides, pesticides and fertilisers.

Engineering works are indicated c.100m west in addition to multiple other works within a 150m radius of the site. Depending on the nature of the engineering works, it could be a source of metals and insulation materials such as asbestos, bitumen and PCBs. Unspecified works could be sources of a variety contaminants depending on the use and construction of the works that existed.

4.3 Pollution Linkages

The definition of a pollution linkage is a medium which allows a contaminant to impact a receptor. Potential pollution linkages have been recognized for the commercial development from the identified contamination sources that exist.

At this stage the contaminants identified above are considered to potentially pose an unacceptable risk human health and controlled waters through the following pollution linkages:

- Direct soil and dust ingestion
- Dermal contact with soil both indoor and outdoors
- Indoor air inhalation from soil and vapour

Outdoor inhalation of soil and vapour
Migration and accumulation of ground gas into internal spaces
Impaction of groundwater from soil contamination (diffuse and point)
Impaction of groundwater from groundwater plume
Migration of soil and groundwater contamination impacting surface waters

4.4 Receptors

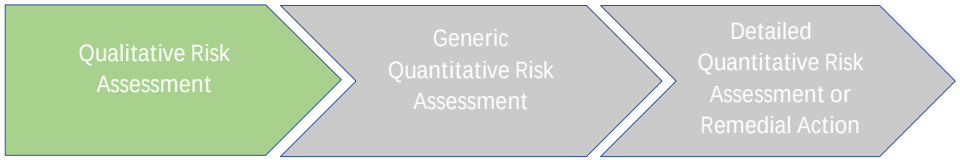
Receptors generally fall into the categories of human health or controlled waters within the river basin system. The recognized receptors are listed below:

Site end users
Adjacent Site Users
Aquifers bedrock and superficial
Nearby unnamed watercourses & Main Drain River
Clean potable water supply pipe

4.5 Preliminary Conceptual Site Model (CSM)

The information obtained from the consultations and summarised in Section 2.0 and 3.0 has been used to compile a Preliminary CSM. Using Source-Pathway-Receptor assessment criteria that is applicable in the UK, a risk assessment has been completed to determine if a plausible pollution linkage exists between the identified contaminants and receptors. The risk classification has been estimated in accordance with the CIRIA C552 assessment criteria outlined in Appendix 7.

Human Health Pollution Linkage Assessment



The table below represents the first stage in the land quality risk assessment process - the Qualitative Risk Assessment.
In order for a development site to be deemed 8suitable for use9the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

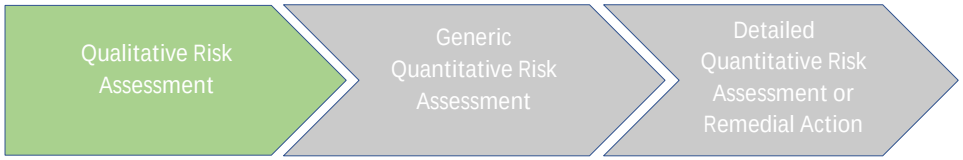
Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
PL1	Contaminated Soils	Ingestion of soil and dust. Dermal contact with soil.	Unlikely to Low Likelihood	Medium	Moderate to Low	Pollution Linkage 1 refers to proposed site users coming into contact with contaminated soils on the site. Historically, a brick works was present on site and associated kilns were situated in the immediate vicinity. These are a potential source of metals, speciated PAHs, asbestos, ash and clinker. In addition, all buildings that have been historically present on site have since been demolished. Demolition Made Ground may therefore be present beneath the site which could be contaminated with heavy metals, speciated PAHs and asbestos. An unspecified works has been present immediately west of site and a factory was recorded immediately east. Depending on the nature of these industrial activities, they could be a source of metals, PAHs, fuels/oils and asbestos which may have migrated onto site. The vehicle repair garage 8m north east of site is a source of PAHs, VOCs, SVOCs, metals and fuels/oils which may have migrated to the site.

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
						The onsite AST is a source of heavy metals and fuels/oils if leakage has occurred and the soils have been impacted. Due to the age of the electricity substation 7m south, it is not considered to be a source of PCBs. All the remaining sources of contamination are present at significant distance from site to allow for attenuation. The proposed development is of commercial end use comprising of a clinical diagnostics centre with associated hardstanding car park spaces. The majority of the site will therefore encompass a hardstanding cover. However, proposed development plans indicate areas of soft landscaping are set to be incorporated into the development. A pollution linkage is therefore considered to exist between the contaminated Made Ground soils beneath the site and site end users.
PL2	Contaminated Soils	Inhalation of vapour.	Unlikely to Low Likelihood	Medium to Severe	Moderate to Low	Pollution linkage 2 refers to vapours migrating into confined spaces within the proposed development. The AST is a source of fuels/oils which may present a vapour risk if the soils have been impacted. The tank has been identified above hardsurfacing and intrusive investigation is required to determine if the soils have been impacted. The respraying of vehicles works c.8m north east is a source of vapours which may have migrated onsite site. A possible pollution linkage is present.

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
PL3	Contaminated Soils	Inhalation of soil dust by adjacent site users.	Unlikely	Medium	Low	Pollution Linkage 3 relates to contamination on the subject site affecting adjacent site users. No significant sources of mobile contamination have been identified on site and the surrounding land use is generally industrial, therefore a pollution linkage is not considered to exist.
PL4	Contaminated Soils	Attacking potable water supply pipe.	Unlikely	Medium	Moderate	Pollution Linkage 4 refers to the possible contaminants permeating potable water pipes and consumption by the future site end users of the tainted water supply. Possible deep Made Ground is likely present beneath the site at installation depth due to the historical presence of brick works and refuse tip in north. A potential risk has been identified.
PL5	Ground Gas	Migration and accumulation of ground gas in internal spaces.	Likely	Medium to Severe	Moderate to High	Made Ground is likely present beneath the site due to the historical presence of brick works and refuse tip/landfill. The refuse tip is indicated in the northern section of site and could be a potential source of ground gases such as carbon dioxide and methane. Tidal Flats are also considered to be a potential source. The backfilled ponds and pit c.100m north of site may be a source of ground gases depending on the cohesive nature of the superficial deposits inhibiting migration.

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
						An intrusive Ground Investigation comprising the installation of ground gas monitoring wells is recommended to confirm the gas risk. The site is not within an area requiring Radon precautions within foundations.

Controlled Waters Pollution Linkage Assessment



The table below represents the first stage in the land quality risk assessment process – Qualitative Risk Assessment.

In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
PL6	Contaminated Soils	Impaction of groundwater from soil contamination (diffuse and point). Impaction of groundwater from groundwater plume.	Unlikely	Medium	Low	Historically, the site has been utilised as a brick works up until 1932 and associated kilns were present to the immediate east and north west of the site. No significant sources of mobile contamination have been identified onsite. Geological maps indicate that the site is underlain by Tidal Flat Deposits (Unproductive Aquifer) and the bedrock is the Ferriby Chalk Formation (Principal Aquifer). The site is in a total catchment Source Protection Zone on site, this is related to the chalk bedrock. There are no potable water abstractions within 2km. No significant sources of mobile contamination have been identified through the PRA and the anticipated significant depth of impermeable superficial deposits will restrict the downwards migration of any contaminants of concern into the groundwater present within the bedrock. No plausible pollution linkage has been identified.

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
PL7	Contaminated Soils	Migration of soil and groundwater contamination impacting surface waters.	Unlikely	Medium	Low	The nearest named watercourse is the Main Drain River. No significant sources of mobile contamination have been identified on site and the receptor is considered to be a significant distance from site to allow for natural attenuation. No risk to surface waters is considered to exist.

5.0 SCOPE OF INVESTIGATION AND RATIONALE

5.1 Project Objectives

The aim of the fieldwork was to:

Determine the stratification beneath the site.
Maintain watching brief for visual and olfactory evidence of contamination.
Obtain samples using methodology in current guidance for contamination analysis.
Identify realistic pollution linkages to groundwater.
Obtain relevant geotechnical parameters for preliminary foundation design to address both ULS and SLS conditions.
Determine if targeted supplementary investigation in areas of concern is required and for remedial design.
Determine the modulus of subgrade reaction (k value) and CBR values
Install monitoring standpipes for gas and groundwater monitoring.
Assess the identified pollution linkages in the CSM.

5.2 Scope of Works

The following scope of works was completed between the dates of 13th September and 18th of September 2023.

2 No. Cable Percussive boreholes (CP01 and CP02) were drilled to a maximum depth of 22.5m bgl.
3 No. Windowless sample boreholes (WS01 to WS03) were drilled to a maximum depth of 4.0m bgl.
5 No. Plate load tests (PLT1 to PLT5) were undertaken at a depth of 0.4 to 0.5m bgl.
UXO Supervision & Clearance for the exploratory holes.

The exploratory hole locations are presented on Groundtech Plan GRO-23133-P04 and the exploratory hole logs are in Appendix 8.

The exploratory holes were positioned to establish the stratification beneath the site and target any areas of concern as summarised in the table below:

Location	Target Rationale
CP01 to CP02, WS01 to WS03	Proposed development footprint
CP01	Refuse Tip/Landfill//Pit
CP02	Above ground Storage Tank (AST)
PLT01 to PLT05	Proposed access road and car parking

The exploratory holes were logged by a suitably experienced geo-environmental engineer in general accordance with the following current guidance:

British Standards Institution 8Code of Practice for Site Investigations9BS 5930:2020
British Standards Institution <Geotechnical investigation and testing – Identification and classification of soil= BS EN ISO 14688:2018
BS EN ISO 14689:2002 <Geotechnical investigation and testing – Identification and classification of rock=.

5.3 Soil Sampling

During the intrusive investigation, representative samples were taken at regular intervals, changes of strata and where evidence of contamination existed. Laboratory analysis was scheduled on the samples obtained.

The samples obtained are summarised in the table below:

Soil Sample	Number
Environmental Sample	25
Disturbed Sample	52
Undisturbed U100 Sample	2

The samples have been obtained in accordance with current environmental and geotechnical guidance. The sampling plan has been designed obtain samples from all required strata using the correct methodology.

Disturbed samples of soil for geo-environmental testing were placed in the correct sampling containers as required by the laboratory in accordance with their MCERTS and UKAS Accreditation. Transportation was arranged in a timely manner and the samples were at the correct temperature.

The sample locations and depths are recorded on the exploratory logs.

5.4 Geo-Environmental Testing

To inform the Generic Quantitative Risk Assessment, the following geo-environmental testing was scheduled to assess the risk from contamination on the site. The testing is based on the potential sources identified in the PRA and observations during the Ground Investigation.

Contaminant of Concern (CoC)	Matrix	Number
Arsenic, cadmium, chromium (total and hex), copper, nickel, mercury, lead, zinc, selenium, organic matter, sulphate and pH.	Soil	8
Speciated Polycyclic Aromatic Hydrocarbons (PAHs)	Soil	8
Asbestos	Soil	8

The Geo-Environmental Laboratory Testing Results are presented in Appendix 9.

Representative disturbed samples were obtained for all soil types encountered. Selected samples were scheduled for testing at an approved laboratory in accordance with BS 1377 8Method of Test for Soils for Civil Engineering Purposes91990. The following tests were scheduled:

British Standard	Test Method	Number
Part 2	Water Content	7
Part 2	Plasticity Index Analysis	7
Part 2	Determination of Particle Size Distribution (PSD)	6
Part 2	Sedimentation analysis using pipette method	6
Part 3	pH Value	5
Part 3	Water Soluble Sulphate Content	5
Part 7	Determination of Undrained Shear Strength in Triaxial Compression	2

The Geotechnical Laboratory Testing Results are presented in Appendix 10.

5.5 Ground Gas Monitoring

Gas monitoring installations were constructed in the boreholes. The standpipes consisted of high-density polyethylene (HDPE) pipe - a bentonite seal was placed around the plain pipe and a clean gravel pack was placed around the slotted pipe. A summary of the installation construction is presented in the table below:

Location	Depth (m bgl)	Response Zone (m bgl)	Targeted Strata	Reason
CP01	12.00	3.0 – 12.0	Natural Silt/Clay	Ground Gas
CP02	12.00	3.0 – 12.0	Natural Silt/Clay	Ground Gas
WS01	4.00	1.0 – 4.0	Natural Silt/Clay	Ground Gas
WS02	4.00	1.0 – 4.0	Natural Silt/Clay	Ground Gas
WS03	4.00	1.0 – 4.0	Natural Silt/Clay	Ground Gas

Permanent gas and flow rate monitoring was carried out using GFM 436 infrared gas monitor with integral electronic flow analyser. The measurements taken are listed below:

Oxygen (O_2), carbon dioxide (CO_2) and methane (CH_4) as the percentage volume in air (%v/v).
Hydrogen sulphide (H_2S) and carbon monoxide (CO) as the percentage volume in air (%v/v).
Lower Explosive Limit (%LEL) of methane.
Atmospheric and borehole pressure, including pressure trend.
Flow measurements (l/hr).
Weather and ground surface conditions.

Both peak and steady state conditions were monitored to understand the behaviour of the permanent ground gas, the steady state conditions were recorded by allowing the gas monitor to run for a minimum of 3 minutes.

Permanent gas and groundwater monitoring results are presented in Appendix 11.

6.0 GROUND MODEL

6.1 Made Ground

Made Ground was recorded in all exploratory holes from ground level to 1.7m bgl. The surfacing of site generally comprised tarmac from ground level to depths of between 0.1m and 0.15m bgl. Topsoil surfacing was encountered locally to WS03 in the eastern section of site to a maximum depth of 0.2m bgl.

Exploratory Hole Locations

Two main Made Ground populations were encountered beneath the surfacing and is described below:

1. Light grey occasionally sandy gravel with constituents of chalk was encountered within all exploratory holes from depths of between 0.1m bgl and 0.2m bgl to depths of between 0.4m bgl and 1.7m bgl.

2. Brown sandy gravel/gravelly sand with constituents of brick, metal, ceramic, chalk, slag, flint and occasional clinker was recorded within WS01, WS02, PLT02 and PLT03 from depths of between 0.5m and 0.6m bgl to a maximum depth of 1.0m bgl.

6.2 Natural Ground

The natural strata encountered generally confirmed the published geological records. Three main natural stratification encountered during the investigation and are described below:

1. Soft, occasionally firm brown silty CLAY/clayey SILT was encountered in CP01 to CP02 and WS01 to WS03 from depths of between 0.5m and 1.7m bgl to a maximum depth of 12.5m bgl. (Tidal Flat Deposits).

2. Firm to stiff brown sandy CLAY was present within CP01 and CP02 at depths of between 12.5m to 16.0m bgl to depths of between 14.6m and 16.3m bgl. (Ferriby Chalk Formation).

3. Medium dense brown silty gravelly SAND/sandy GRAVEL with minor constituents of chalk and flint was recorded within CP01 and CP02 from a minimum depth of 14.6m bgl to a maximum depth of 19.5m bgl. (Ferriby Chalk Formation).

6.3 Bedrock

Bedrock was encountered during this investigation from a minimum depth of 19.5m bgl in CPO1 and CP02, and comprised the following:

Structureless CHALK composed of slightly clayey gravel (Grade Dc) was encountered within CP02 from 19.5m bgl to 22.0m bgl.

Structureless CHALK composed of slightly sandy cobbles (Grade Dc) was present within CP02 from 22.0m bgl to 22.5m bgl.

6.4 Groundwater

Groundwater strikes were observed in all exploratory boreholes, a summary of the groundwater strikes are presented below:

Exploratory holes	Depth Struck	Seepage/Strike	Strata
WS01	2.7m	Strike	Clayey Silt
WS02	2.4m	Strike	Silty Clay
WS03	3.1m	Strike	Silty Clay
CP01	3.1m	Strike	Clayey Silt
CP02	2.5m	Strike	Clayey Silt

6.5 Watching Brief

A watching brief was maintained during the Ground Investigation for visual and olfactory evidence of contamination.

No olfactory evidence of contamination, slag and clinker was observed in PLT02 and PLT03 between 0.5m and 0.55m bgl.

6.6 Excavation Stability

Evidence of pit side collapse was not encountered during the excavation of the trial pits. However, collapsing of the weak cohesive soils was encountered during the drilling of the boreholes and casing was required for the cable percussive boreholes.

6.7 Excavation Progress

From 3.0m bgl, excavation became difficult and slow due to encountering groundwater within the window sample boreholes and cable percussion boreholes. In the cable percussion boreholes, drilling became slower due to the presence of medium dense gravelly Sand/ sandy Gravel at a minimum depth of 14.6m bgl.

7.0 GROUND ENGINEERING

7.1 Geotechnical Testing Results

Comparison of water content and the value of 0.4 times the Liquid Limit in accordance with BRE Digest 412 'Desiccation in Clay Soils' suggests significant desiccation has taken place when 0.4 times the Liquid Limit is greater than the actual water measured water content. This is a rudimentary method but also a good guide.

Results of the plasticity testing and the volume change potential of the Clay is summarised in the table below:

Reference	Depth (m bgl)	Modified PI	Volume Change Potential	Desiccated
CP01	1.8	37	Moderate	No
CP01	6.5	39	Moderate	No
CP01	12.5	26	Moderate	No
CP02	1.0	38	Moderate	No
CP02	2.0 – 2.45	40	Moderate	No
CP02	6.5	34	Moderate	No
CP02	12.5	16	Low	Yes

Quick undrained triaxial testing was carried out on two samples of natural undisturbed clay, the results of the triaxial testing are summarised in the table below:

Reference	Depth (m bgl)	Undrained Shear Strength (kPa)	Relative Strength
CP02	2.0	39	Low
CP02	14.0	181	Very High

Particle Size Distribution (PSD) and sedimentation testing was undertaken on six samples of the natural cohesive soils taken from CP01 and CP02 from depths of between 1.0m and 14.0m bgl. The material was classified as slightly sandy clayey SILT, locally silty CLAY and is presented on the exploratory hole logs.

7.2 Assessment Background

The ground engineering investigation has been undertaken to formulate an accurate ground model to undertake preliminary foundation design. The ground model has been constructed with a moderate to high level of confidence and has evolved from the information obtained by the PRA.

The existing site is a gated tarmac surfaced car park currently utilised as a storage area for mobile housing units. The proposed development is commercial end use comprising of a clinical diagnostics centre with an associated hardstanding car parking and soft landscaping.

Ground Conditions

The site was predominantly surfaced with tarmac to a maximum depth of 0.2 underlain by Made Ground which generally comprised light grey occasionally sandy gravel with constituents of chalk with a maximum thickness of 1.55m. The superficial deposits reached a maximum depth of 14.7m bgl and consisted of clayey Silt, locally silty clay. The underlying bedrock comprised medium dense brown silty gravelly Sand/sandy Gravel followed by structureless weathered chalk (Grade Dc).

Groundwater was present from a minimum depth of 1.5m bgl to a maximum depth of 3.5m bgl.

Limitations

The main development constraint is the deep soft clayey Silt locally silty Clay deposits encountered from a minimum depth of 0.5m bgl to maximum depth of 12.5m bgl, which recorded low SPT N values of between 1 and 4. As a result of the low SPT values, traditional shallow foundations are not considered a feasible option for the proposed commercial development and alternative foundations solutions such as piles and raft are to be considered.

Furthermore, the variable ground conditions preclude the use of shallow foundations due to the potential of differential settlement. The shallow groundwater would also reduce the feasibility of shallow foundations due to the risk of collapse. It is therefore recommended that alternative deeper foundations solutions such as piles are utilised.

The former cutting along the northern site boundary should be investigated and delineated to confirm it does not encroach onto the proposed development. The cutting was formerly associated with the brick works and later utilised as a household landfill waste tip.

The site lies within a medium UXO risk and this should be communicated to all groundworkers before commencement of the construction phase. A detailed UXO risk assessment is recommended to determine if UXO supervision is required, until this has been acquired, UXO supervision is required for future groundworks onsite.

7.3 Geotechnical Parameters

The geotechnical test results have been evaluated to derive geotechnical parameters for the soils underlying the site. A generalised ground model GRO-23133-P05 is presented on Appendix 12 to provide a generalised ground model for the site.

Characterization of the geotechnical parameters above has been undertaken to select a characteristic value, which is a cautious estimate of the value affecting the occurrence of the limit state. The characteristic values are provided below:

Soft silty Clay	-	undrained shear strength of 11.5kPa for ULS conditions based on direct laboratory measurements.
Soft clayey Silt	-	undrained shear strength of 10kPa for ULS conditions based on correlation of SPT 8N9Value of 2.
Stiff slightly sandy Clay	-	undrained shear strength of 180kPa for ULS conditions based on direct laboratory measurements.
Medium dense gravelly Sand	-	characteristic SPT 8N9 value of 18 has been measured and by correlation a ϕ9value of 33° has been selected for ULS conditions.
Medium dense Gravel	-	characteristic SPT 8N9 value of 18 has been measured and by correlation a ϕ9value of 33° has been selected for ULS conditions.
Residually weathered Chalk	-	characteristic SPT 8N9 value of 38 has been measured and by correlation a ϕ9value of 38° has been selected for ULS conditions.

7.4 Preliminary Foundation Design

Traditional shallow foundations are not considered to be feasible for the proposed development due to the varying ground conditions which include soft clayey Silt, locally silty Clay. In addition, relatively shallow groundwater and instability have been encountered within the boreholes close to foundation excavation depth which could rise with seasonal variation.

A raft solution is also likely to exceed total settlement tolerances, and is not considered a viable option. Therefore, the most suitable foundation options include pile foundations.

Pile Foundations

If a pile foundation solution is preferred, preliminary design by calculation has been carried out using due skill and care using the global factor of safety method.

The most suitable and cost beneficial type of pile is considered to be a driven pile. A piling contractor should be consulted to confirm driven piles are suitable due to the depth of poor performing Tidal Deposits and the proposed end bearing strata. Furthermore, consideration will need to be given to the neighbouring buildings to the east and west during the installation of the piles. There are options to reduce the vibration if required, such as bottom driven piles and this should be discussed with a piling contractor. In addition, if concrete piles do not offer the lateral support through the soft clayey silt locally silty clay, prestressed or steel piles should be considered.

Design by Calculation

The preliminary design by calculation is based on the following ground model:

Made Ground to 1.7m bgl
Soft clayey Silt locally silty Clay to 12.5m bgl
Stiff Clay to 14.7m bgl
Medium dense gravelly sand/sandy gravel of Chalk to 18m bgl

For a single driven concrete pile 225mm in diameter and 18m in length end bearing in the natural medium dense gravely Sand/sandy Gravel of chalk, an allowable load of 270kN has been calculated. If greater loads are associated with the proposed development, consideration should be given to larger diameter piles or pile groups, a pile 400mm in diameter would provide an allowable load of 600kN. Greater loads can also be achieved using CFA piles if considered a suitable pile type by the contractor. This design should be confirmed with the preferred piling contractor.

At this stage, the loadings are not available. Pile caps should be constructed and a reinforced ring beam spanned between each pile cap to support the loadings from the walls and floor slab.

Detailed pile design should be undertaken by an experienced piling contractor and should take into account finished levels. The ground conditions indicate downdrag may be an issue, this scenario may occur where surcharging of the ground causes soft Clay/Silt to settle relative to the pile.

An appropriate working platform should be constructed in accordance with BR470 guidance.

The piled foundations should be designed to transmit loads from the structure to the ground safely and avoiding the differentiated settlement of the Clay and Silt.

Design Validation

Static load testing on working piles is recommended as a minimum to validate the design for ULS and SLS conditions in accordance with Eurocode 7. The piles are likely to be driven to set using pile driving formulae,

restriking of the piles should be undertaken after any pore water pressure has been given time to dissipate and the set confirmed through dynamic testing in advance of the static load testing validation.

The piling type, length, depth of reinforcement and design should be discussed with a specialist piling contractor. They can then undertake the detailed design including drawings and specifications to provide fitness for purpose design.

All piling work should be carried out in accordance with BS EN 12699:2015 8Execution of special geotechnical works. Displacement piles9

Construction Recommendations

The recommendations in this appraisal are preliminary and the detailed design should be developed in advance and during the construction phase. If the ground conditions or groundwater regime encountered during the construction phase differ significantly to the conditions encountered during the Ground Investigation, work should cease and Groundtech Consulting contacted for further advice.

During the construction phase, supervision by a suitably qualified geotechnical engineer should be on a continuous basis to check the design assumptions are correct and construction conforms to design in accordance with EC7. Supervision should include inspections, Control Ground Investigations and monitoring by a suitably qualified geotechnical engineer.

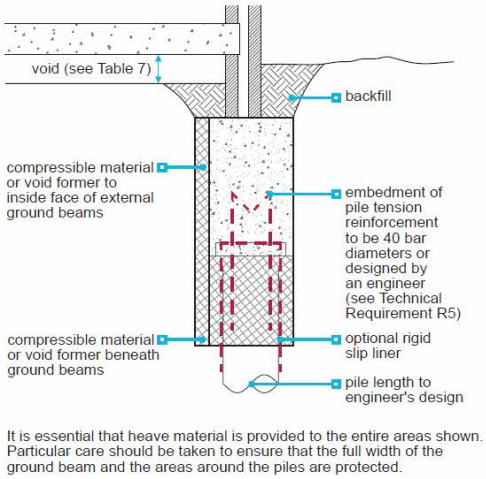
7.5 Building Near Trees

Where foundation excavations encounter cohesive strata in the vicinity of existing, proposed or recently removed trees, foundations should be adjusted in full accordance with NHBC Standards Chapter 4.2. Several mature trees are present in a woodland north of the site.

All foundations should be deepened below roots of greater than 5mm diameter during excavations for footings.

A survey of all trees and hedges on the site and within 30m of the site boundary should be undertaken to identify tree species, locations and heights. This information will be required in order to assess the effects of trees on the cohesive strata.

A typical example of heave precautions for piled foundations has been taken from appropriate guidance is displayed below:



Typical example of heave precautions for a piled foundation.

7.6 Floor Slab

Greater than 600mm of Made Ground soils are consistently present beneath the site, a suspended floor slab is recommended for this foundation solution.

7.7 Construction

The cable percussive boreholes indicate that instability of excavations is anticipated within the soft silty Clay/ clayey Silt. Instability of the Made Ground is also a possibility and should be considered in the groundworks method statements.

Tracked high specification plant is recommended to maintain the build programme. Breaking equipment may also be required locally to penetrate the surfacing.

Groundwater encountered at depths of between 2.4m and 3.1m has resulted in instability of the boreholes during the investigation and require further consideration within the construction phases. Dewatering of foundation excavation is considered unlikely.

7.8 Concrete Classification

Made Ground

Water soluble sulphate testing was undertaken on 5 samples of the Made Ground. The range of soluble sulphate (SO_4) recorded is 25.9mgl/l to 51.8 mg/l. Associated pH values ranged between 8.43 and 9.23 indicating slightly alkaline conditions.

For a dataset of between five and nine results, the mean of the highest two of the sulphate test results should be taken as the characteristic value and the mean of the lowest 20% of pH results are to be used. For the Made Ground, a characteristic water soluble sulphate concentration of 45.86mg/l and a pH value of 8.43 have been selected.

Natural Strata

Water soluble sulphate testing was undertaken on 8 samples of the natural strata. The range of soluble sulphate (SO_4) recorded is 17.6mg/l to 223.5mg/l. Associated pH values ranged between 7.81 and 9.30 indicating slightly alkaline conditions.

The site contains static groundwater. This is because the natural strata is of Clay and Silt compositions. Therefore, migration of groundwater is limited because of the impermeability of the superficial deposits.

The results of laboratory pH and sulphate content indicate that ACEC Class AC-1s and sulphate class DS-1 conditions prevail in accordance with BRE Special Digest 1 <Concrete in aggressive ground= 2005. The specific concrete mixes (the Design Concrete Class) to be used on site will be determined by the site-specific concrete requirements in terms of the durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any need for Additional Protective Measures (APM) detailed in Part D of BRE Special Digest 1 with further guidance in Pt E and F.

7.9 Highway Design

Five plate load tests were conducted on the natural strata beneath the site at depths of between 0.4m and 0.5m bgl. Plate load test results are presented in Appendix 13.

Location	Depth (m bgl)	Strata	Plate Diameter (mm)	CBR Value (%)	K762 (kN/m2 /mm)
PLT01	0.4	Made Ground: Sandy Gravel of chalk	455	17.1	75.0
PLT02	0.5	Made Ground: Gravelly ashy sand	455	3.4	29.4
PLT03	0.5	Made Ground: Gravelly ashy sand	455	4.6	35.0
PLT04	0.4	Made Ground: Sandy Gravel of chalk	455	7.3	45.9
PLT05	0.4	Made Ground: Sandy Gravel of chalk	455	25.6	94.5

The plate load tests results within the sandy gravel of chalk indicate that the CBR values recorded meet the design criteria of 5%. However, the plate load test results undertaken within the gravely ashy sand do not meet the design criteria. As a minimum the subgrade should be proof rolled prior to construction. If the formation level is within the gravelly ashy sand encountered at a minimum depth of 0.5m bgl, some reengineering of the subgrade is required prior to highway construction to achieve the required design CBR value.

The soils are considered to frost susceptible due to the fines content, highway construction should be a minimum thickness of 450mm to mitigate against the risk.

7.10 Sustainable Urban Drainage System (SuDS)

The use of SuDS drainage within the natural ground is not feasible at the site due to the presence of shallow groundwater and cohesive soils which are capable of low soil infiltration rates.

8.0 LAND QUALITY

8.1 Geo-Environmental Testing Results - Soils

Thirteen samples of Made Ground and natural strata have been tested for a range of relevant Contaminants of Concern. In accordance with LCRM, a Generic Quantitative Risk Assessment (GQRA) has been undertaken to determine the significance of the concentrations as derived through Geo-Environmental testing.

The GQRA process comprises the comparison of the actual concentrations measured on site with Generic Assessment Criteria (GACs) for the protection of human health.

The GACs used for the assessment of soil concentrations have been derived using the CLEA model. The GACs used are listed below:

Soil Guideline Values (SGVs) which demonstrate minimal risk.
LQM/CIEH S4ULs which use the same toxicological data as the SGVs but different exposure criteria.
C4SLs which demonstrate low risk.

In deriving the GACs for use on Brownfield sites we have assumed a 1% Soil Organic Matter unless the results indicate otherwise.

The proposed development is of commercial end use comprising of a clinical diagnostics centre with an associated hardstanding car park and soft landscaping. We have therefore undertaken the GQRA on the basis that the proposed development site falls under the commercial land-use scenario as defined in SR3 (EA, 2009b).

The strata or sources of contamination targeted by the laboratory testing scheduled is summarised in the table below:

Strata	Number of Samples Tested	Locations
Granular Made Ground (Population 1)	5	PLT01, CP01, CP02, WS02, WS03,
Natural ground	3	CP01, CP02, WS03

A summary of the Geo-Environmental Testing results is presented below and the GQRA screening values are presented in Appendix 14:

Metals				
Contaminant	Range (mg/kg)	Screening value (mg/kg)	Exceedances	Locations
Arsenic	0.9 - 22.5	640	-	-
Cadmium	<0.1 - 0.1	190	-	-
Chromium	2.0 - 49.9	8600	-	-
Hexavalent Chromium	<0.3	33		-
Copper	5.0 - 18.0	68000	-	-
Lead	<5.0 - 23.0	2300	-	-
Mercury	<0.1	26	-	-
Nickel	2.7-41.8	1800	-	-
Selenium	<1	13000	-	-
Zinc	11 - 85	730000	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)				

Contaminant	Range (mg/kg)	Screening value (mg/kg)	Exceedances	Locations
Naphthalene	<0.04 - 0.41	190	-	-
Acenaphthylene	<0.03	83000	-	-
Acenaphthene	<0.05	84000	-	-
Fluorene	<0.04	63000	-	-
Phenanthrene	<0.03 - 0.25	22000	-	-
Anthracene	<0.04 - 0.06	52000	-	-
Fluoranthene	<0.03 - 0.39	23000	-	-
Pyrene	<0.03 - 0.29	54000	-	-
Benzo(a)anthracene	<0.04 - 0.20	170	-	-
Chrysene	<0.02 - 0.21	350	-	-
Benzo(b)fluoranthene	<0.05 - 0.27	44	-	-
Benzo(k)fluoranthene	<0.05 - 0.10	120		
Benzo(a)pyrene	<0.04 - 0.20	35	-	-
Indeno(123cd)pyrene	<0.04 - 0.14	500	-	-
Dibenzo(ah)anthracene	<0.04	3.5	-	-
Benzo(ghi)perylene	<0.04 - 0.15	3900	-	-
Others				
Organic Matter	<0.2%-6.4			
pH	7.81-9.3			

Asbestos Screen			
Position	Depth (m bgl)	Result	Quantification
PLT01	0.2	None Detected	n/a
WS02	0.5	None Detected	n/a
WS03	0.2	None Detected	n/a
WS03	0.6	None Detected	n/a
CP01	0.5	None Detected	n/a
CP01	2.0	None Detected	n/a
CP02	0.5	None Detected	n/a

8.2 Generic Quantitative Risk Assessment – Soils

The site was previously a brick works until 1982 when it was demolished with associated buildings and kilns surrounding. A former refuse pit was indicated to encroach the northern boundary.

An electricity substation is present 7m south east of the site which is a source of PCBs which were historically used as coolant agents in the transformers. The PCBs are indicated to be highly localised, and the substation was constructed in 1987 which was post usage of PCBs.

The vehicle repair and respraying garage present in 8m north east of the site is a source of volatiles. The only visual evidence of contamination was recorded in the granular Made Ground of PLT02 and PLT03 in the southern section of site. Furthermore, no olfactory evidence was recorded during the Ground Investigation and no visual evidence of hydrocarbon/volatile contamination was noted.

Made Ground was encountered to a maximum depth of 1.7m bgl and was generally granular with minor constituents of chalk, metal, ceramic, brick and rare clinker.

Heavy Metals

Geo-Environmental testing on the soils has indicated that there are no elevated heavy metal contaminants based on the site being developed with a clinical diagnostics centre.

Speciated Polycyclic Aromatic Hydrocarbons (PAHs)

Using the commercial screening values, no elevated concentrations of speciated PAHs have been recorded. Laboratory testing undertaken indicated that there was no vapour risk from volatile contaminants.

Asbestos

Asbestos testing was undertaken in five samples of the granular Made Ground and three samples of the underlying natural strata.

Asbestos has been detected in any of the samples screened.

Constraints

The extreme northern section of the site at the position of the former cutting/refuse tip was inaccessible at the time of the investigation. Additional investigation should be undertaken to determine the presence of the former refuse tip and associated deep Made Ground should be delineated.

8.3 Permanent Ground Gases

Three of the four ground gas monitoring visits have been carried out to date between 27th September and 23rd October 2023.

No concentrations of methane (CH_4) have been recorded within any of the standpipes. Detectable levels of carbon dioxide (CO_2) were recorded within the installations up to a maximum level of 2.9% v/v along with depleted oxygen (O_2) concentrations of 16.0% v/v.

In addition, no positive gas flow rates have been detected during the monitoring visit.

The atmospheric pressure was 1004mb to 1010mb and the monitoring was complete during periods of falling and steady rising pressure.

Groundwater was recorded in the standpipes at depths of between 0.49m to 1.31m bgl during the visit and were consistently recorded above the response zone of the standpipes. The shallow groundwater may restrict gas migration, however, is it indicative of the groundwater regime beneath the site.

Characterisation of the Gas Screening Value

Based upon the results recorded to date, in accordance with CIRIA Report C665, the risk to the site from ground gases has been assessed by converting the results to gas screening values (GSVs), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates. In addition, individual <hazardous gas flow rates= (Qhg) have been derived for each monitoring point. As no levels of methane have been recorded, a GSV for carbon dioxide only has been calculated.

$$\text{GSV (l/hr)} = \text{max borehole flow rate (l/hr)} \times \text{max gas concentration (\%)}$$

For this interim assessment, the maximum recorded concentration of carbon dioxide of 2.9% v/v has been used. No positive gas flow rates have been detected, therefore the limit of detection of the gas analyser of 0.1 l/hr has been used to calculate the GSV - this is worst case scenario.

Carbon Dioxide GSV = 0.029 (2.9%) x 0.1 = 0.0029 l/hr

In order to assess the ground gas regime beneath the site and the need to incorporate ground gas precautions, guidance was taken from CIRIA C665 8Assessing risks posed by hazardous ground gases to buildings9 Based on the site being developed as a Clinical Diagnostic Centre, the Wilson and Card method has been used to carry out the assessment.

When considering the results in accordance with CIRIA C665 (Section A Development and Table 8.5 – Modified Wilson and Card Classification) it can be seen that the GSV values for carbon dioxide are below the assessment GSV of 0.07 l/hr and falls within Characteristic Situation 1 therefore, gas protection measures are not required. The presence of shallow groundwater above the response zone of the standpipes may restrict the migration of ground gases however this is indicative of the site conditions. Furthermore, no significant ground gas concentrations or flows were recorded in the wells with groundwater in the response zone.

Characteristic Situation 1

The proposed development is classified as a Building Type C in accordance with BS 8485:2015 and the site falls in CS1 in accordance with Table 2 of the above guidance and no gas protection measures are required. The above recommendations are to be confirmed on completion of the monitoring programme.

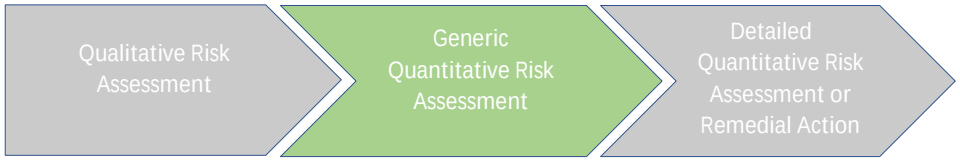
Radon

The site is not located in an area requiring radon protective measures.

8.4 Revised Pollution Linkage Assessment

The CSM has been revised based on the Ground Investigation and testing using Source-Pathway-Receptor assessment criteria that is applicable in the UK, a risk assessment has been completed to determine if a plausible pollution linkage exists between the identified contaminants and receptors. An illustrative CSM is provided on GRO-23133-P06.

Human Health Pollution Linkage Assessment



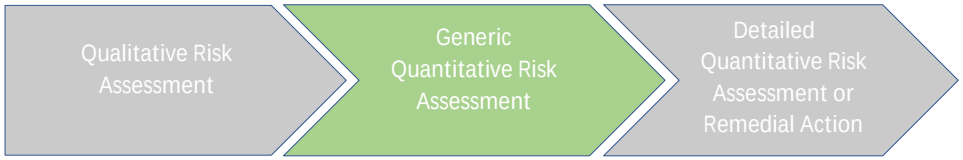
The table below represents the second stage in the land quality risk assessment process - the Generic Quantitative Risk Assessment.
In order for a development site to be deemed 8suitable for use9the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					Generic Quantitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
PL1	Contaminated Soils	Ingestion of soil and dust. Dermal contact with soil.	Unlikely to Low Likelihood	Medium	Low	Pollution Linkage 1 refers to proposed site users coming into contact with contaminated soils on the site. Historically, buildings associated with the surrounding brick works were present on site and associated kilns were situated in the immediate vicinity. Made Ground of light grey sandy gravel with constituents of chalk was encountered in all exploratory holes from 0.1m to 1.7m bgl. Geo-environmental testing has not recorded any elevated Contaminants of Concern based on the site being developed commercially. Visual evidence of contamination was noted in the form of slag in PLT03. Asbestos has not been detected within any of the seven samples screened. No contamination has been recorded through laboratory testing and the site is to be predominantly covered in hardsurfacing. As no source of contamination has been identified, no viable pollution linkage is considered to exist.

Conceptual Site Model						Generic Quantitative Risk Assessment
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
PL2	Contaminated Soils	Inhalation of vapour.	Unlikely	Medium to Severe	Low	Pollution linkage 2 refers to vapours migrating into confined spaces within the proposed development. Laboratory testing has not detected any volatile PAHs above the vapour saturation limit. No visual or olfactory evidence of hydrocarbon or volatile contamination was noted during the investigation. The risk is Low however a watching brief should be undertaken during groundworks for visual or olfactory evidence of hydrocarbon/volatile contamination.
PL3	Contaminated Soils	Inhalation of soil dust by adjacent site users.	Unlikely	Medium	Low	No mobile contamination has been identified by the Ground Investigation and environmental testing. In addition, the surrounding land use is generally commercial and industrial and not considered sensitive receptors. As a source has not been identified, no pollution linkage exists.
PL4	Contaminated Soils	Attacking potable water supply pipe.	Unlikely	Medium	Low	Made Ground is present beneath the site to a maximum depth of 1.7m and is therefore present at installation depth. No organic contamination has been recorded beneath the site. Furthermore, geo-environmental testing identified minimal concentrations of PAHs within the Made Ground and a risk to potable water pipes is not considered to exist.

	Conceptual Site Model				Generic Quantitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
					Low	It is recommended that proposed potable water supply pipes are installed within the natural ground where possible. A local water company risk assessment required to confirm selection of water supply pipe when the route of the pipe is known. A source or pollution linkage has not been identified.
PL5	Ground Gas	Migration and accumulation of ground gas in internal spaces.	Likely	Medium to Severe		Made Ground is present beneath the site is of a maximum depth of 1.7m besides this, no concentrations of methane, or hydrogen sulphide were detected. Gas monitoring visits identified no risks to human health. Interim gas monitoring results place the site within CS1 and gas precaution measures will not be required for the site. This will be confirmed or otherwise on completion of the monitoring. The site is not within an area requiring Radon precautions within foundations.

Controlled Waters Pollution Linkage Assessment



The table below represents the first stage in the land quality risk assessment process – Qualitative Risk Assessment.

In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
PL6	Contaminated Soils	Impaction of groundwater from soil contamination (diffuse and point). Impaction of groundwater from groundwater plume.	Unlikely	Medium	Low	Historically, the site has been utilised as a brick works up until 1932 and associated kilns were present to the immediate east and north west of the site. No significant sources of mobile contamination have been identified onsite. The site is in a total catchment Source Protection Zone on site, this is related to the chalk bedrock. There are no potable water abstractions within 2km. Made Ground was encountered beneath the site to a maximum depth of 1.7m bgl and generally comprised sandy gravel of chalk with minor constituents of brick, ceramics, glass and clinker. Geological maps indicate that the site is underlain by Tidal Flat Deposits (Unproductive Aquifer) and the bedrock is the Ferriby Chalk Formation (Principal Aquifer). No mobile contamination has been recorded beneath the site and the geology underlying the site comprises a clay layer which will inhibit the downwards migration of contaminants to the aquifer.

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
					Low	The proposed development is commercial end use and will have a new drainage system installed which will considerably reduce infiltration and leaching of potential contaminants. No plausible pollution linkage has been identified.
PL7	Contaminated Soils	Migration of soil and groundwater contamination impacting surface waters.	Unlikely	Medium		The nearest named watercourse is the Main Drain River. No significant sources of mobile contamination have been identified on site and the receptor is considered to be a significant distance from site to allow for natural attenuation. No risk to surface waters is considered to exist.

8.5 Outline Remedial Strategy

Based on the results of the investigation, no specific remedial measures are required with respect to contaminated soils or groundwater.

Where hardsurfacing is present, this will effectively act as a cover system. A nominal depth of suitably clean topsoil should be placed in proposed soft landscaping areas.

Interim ground gas monitoring results place the site within CS1 and gas precaution measures will not be required within the proposed development. The full assessment will determine the level of precautions on completion of the gas monitoring programme. In addition, no radon precaution measures are required.

Watching Brief and Regulatory Compliance

A watching brief should be in place during ground works and construction, specifically in the area of the former refuse tip. If previously unidentified contamination is encountered, work should cease in that area and Groundtech Consulting contacted for advice.

Regulatory compliance should be obtained pre-commencement to avoid delays during the construction. phase which will have cost implications.

Additional Ground Investigation is required in the area of the former cutting/refuse tip in the northern section of the site to delineate the extent of the pit.

8.6 Asbestos in Soils

Asbestos has not been detected in any of the seven samples screened, no specific asbestos control measures are required at this stage.

8.7 Health and Safety - Construction and Ground Workers

During the reclamation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. The risk to construction and ground workers is assessed in the table below:

PL Ref	Potential Source	Pollution Linkage	Likelihood	Severity	Level of Risk
PL8	Made Ground	Ingestion, direct contact, inhalation of dusts.	Unlikely	Medium	Low

No elevated contaminants of concern have been recorded and the risk to construction workers is low, Made Ground has been encountered across the site. Standard PPE and welfare facilities will be sufficient to mitigate the risks. Ground workers should be made aware of the risks through a site induction and via information on noticeboards.

General guidance on these matters is given in the Health and Safety Executive (HSE) document <Protection of Workers and the General Public during the Redevelopment of Contaminated Land=. In summary, the following measures are suggested to provide a minimum level of protection:

All ground workers should be issued with the relevant protective clothing, footwear and gloves. These protective items should not be removed from the site and personnel should be instructed as to why and how they are to be used.
Hand-washing and boot-washing facilities should be provided.

Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.
Good practices relating to personal hygiene should be adopted on the site.
The contractor shall satisfy the Health and Safety Executive with regard to any other matters concerning the health, safety and welfare of persons on the site.

8.8 Waste Classification by Assessment

We have reviewed the testing results and inputted them into the HazWasteOnline model which allows users to code and classify waste as defined in the EWC (European Waste Catalogue 2002) based on EC Regulation 1272/2008 on the Classification, labelling and packaging of substances and mixtures (CLP) and latest Environment Agency guidance (WM3 <Guidance on the classification and assessment of waste (1st edition 2015)-Technical Guidance=).

This is a useful tool as waste producers have the legal responsibility to classify any waste they produce.

Four samples of Made Ground and 4 samples of natural strata were tested to assess whether they contained any contaminants in the hazardous range when screened against assessment criteria within WM3. The results are in the Waste Classification Report presented in Appendix 15.

Based on the assessment tool the Made Ground and natural soils have been classified as Non-Hazardous.

8.9 Waste Acceptance Criteria (WAC) Results

Waste Acceptance Criteria was outside the scope of this investigation and the guidance given below is general.

The Landfill Directive (Directive 1999/31/EC on the landfilling of waste) led to the establishment of a methodology for classifying wastes. Wastes can only be accepted at a landfill if they meet the relevant Waste Acceptance Criteria (WAC) for that type of landfill. There are three different WAC, these are for:

Inert waste
Non-Hazardous waste
Hazardous waste

Wastes should first be classified based on their total concentrations as detailed in the previous section. WAC testing is then required if the end disposal route is a landfill.

The possibility of automatic inert classification of the natural soils should be explored in accordance with Section 4.3 of the EA guidance document. The Council Decision includes a list of wastes in Section 2.1.1 of the document that are assumed to be inert and therefore acceptable at a landfill for inert waste without testing, this is the case if:

They are single stream waste of a single waste type (although different waste types from the list may be accepted together if they are from a single source)
and
There is no suspicion of material or substances such as metals, asbestos, plastics, chemicals, etc to an extent which increases the risk associated with the waste sufficiently to justify contamination and they do not contain other their disposal in other classes of landfill.

If any organic contaminated material is encountered during the construction phase, it is possible that this may be classified as hazardous and testing should be undertaken at that time.

Materials should segregate and where necessary sufficient time is allowed to further classify the material properly, including discussion with landfill sites and waste transfer stations to find the best disposal route. It is recommended that where possible that the soils could be recycled at a suitable local waste treatment plant or transfer station rather than a landfill disposal route.

The reuse of soils on the site this should be done in accordance with the CL:AIRE <Development Industry Code of Practice for the Definition of Waste= (CL:AIRE CoP). Any re-use scheme should be designed to minimise disposal costs.

After a cut and fill balance plan/volume calculation has been carried out, a U1 and T5 exemption could be registered. This will allow the use of the following soils without a waste permit or under Dow CoP MMP:

1,000 tonnes (c. 600m^3) of non-hazardous soil
5,000 tonnes (c. 3,000m^3) of natural sand and gravels.
50,000 tonnes (c. 25,000m^3) of bituminous material to be used in roadways.
5,000 tonnes (c. 3,000m^3) of crushed concrete/stone.

9.0 FINAL APPRAISAL

9.1 Land Quality

The site and nearby area have historically been of industrial and commercial use. The site has been occupied by bricks works since 1887 until 1992. Surrounding land use has been industrial with works and a factory being constructed by 1973. Currently an electricity substation is present circa 10m south east. Two garages are within 150m of the site having been constructed in 1966.

The Made Ground was generally consistent throughout the site. Tarmac surfaced all exploratory holes besides WS03 to a maximum depth of 0.2m bgl. Light grey occasionally sandy gravel with constituents of chalk was encountered in all exploratory holes from a minimum depth of 0.1m to a maximum depth of 1.7m bgl. Brown sandy gravel/gravelly sand with constituents of brick, metal, ceramic, chalk, slag, flint and occasional clinker was encountered in WS01, WS02, PLT02 and PLT03 from 0.5m to 1.0m bgl.

Based on the site being developed with a clinical diagnostics centre, no elevated Contaminants of Concern have been recorded by the Geo-Environmental testing. No asbestos was detected within samples tested.

As no exceedances have been recorded and no significant visual or olfactory contamination was noted, no source of contamination is present and the risk to human health is Low and no remedial measures are required. In addition, the site is to be predominantly underlain byhard surfacing which will break the pathway to end site users.

A source of volatiles has not been identified onsite and no visual or olfactory evidence of contamination was noted, the risk of the inhalation of vapour on site is Low. However, a watching brief for volatile contamination should be undertaken during ground works.

Significant mobile contamination has not been encountered as part of the Ground Investigation and the risk to controlled waters is Low.

Gas monitoring results has classified the site as CS1 and no ground gas precautions are necessary. Additionally, the location of the site means no radon precautions are required.

The Made Ground and shallow natural soils underlying the site have been classified as Non-hazardous for waste disposal purposes.

9.2 Ground Engineering

Piled foundations are the most suitable option end bearing in the in the sandy Gravel/gravelly Sand deposits. The piles are required due to the poor and variable shallow ground conditions, and the high groundwater table.

Suspended floor slabs are required to be compatible with the pile foundation solution. In addition, Made Ground has typically been recorded greater than 600mm.

The results of laboratory pH and sulphate content indicate that ACEC Class AC-1s and sulphate class DS-1.

The risk of flooding from rivers and seas (RoFRaS) is classified as Low.

Additional investigation is required to delineate the extent of the former cutting/refuse tip that is indicated to encroach onto the northern boundary of site.

There is a medium risk from UXO on the site and this should be communicated to all groundworkers before commencement of the construction phase. A detailed UXO risk assessment is recommended, UXO supervision is required for future groundworks onsite unless a detailed risk assessment indicates otherwise.

9.3 Required Further Work

The following further work is considered necessary to progress the site to construction phase:

- Completion of gas monitoring programme
- Issue gas assessment
- Further investigation to delineate the extent of the former cutting/refuse tip
- Detailed Foundation design
- Tree Survey by qualified arboriculturist
- Confirmation of recommendations made in this appraisal with regulators

10.0 RELEVANT INDUSTRY REFERENCES

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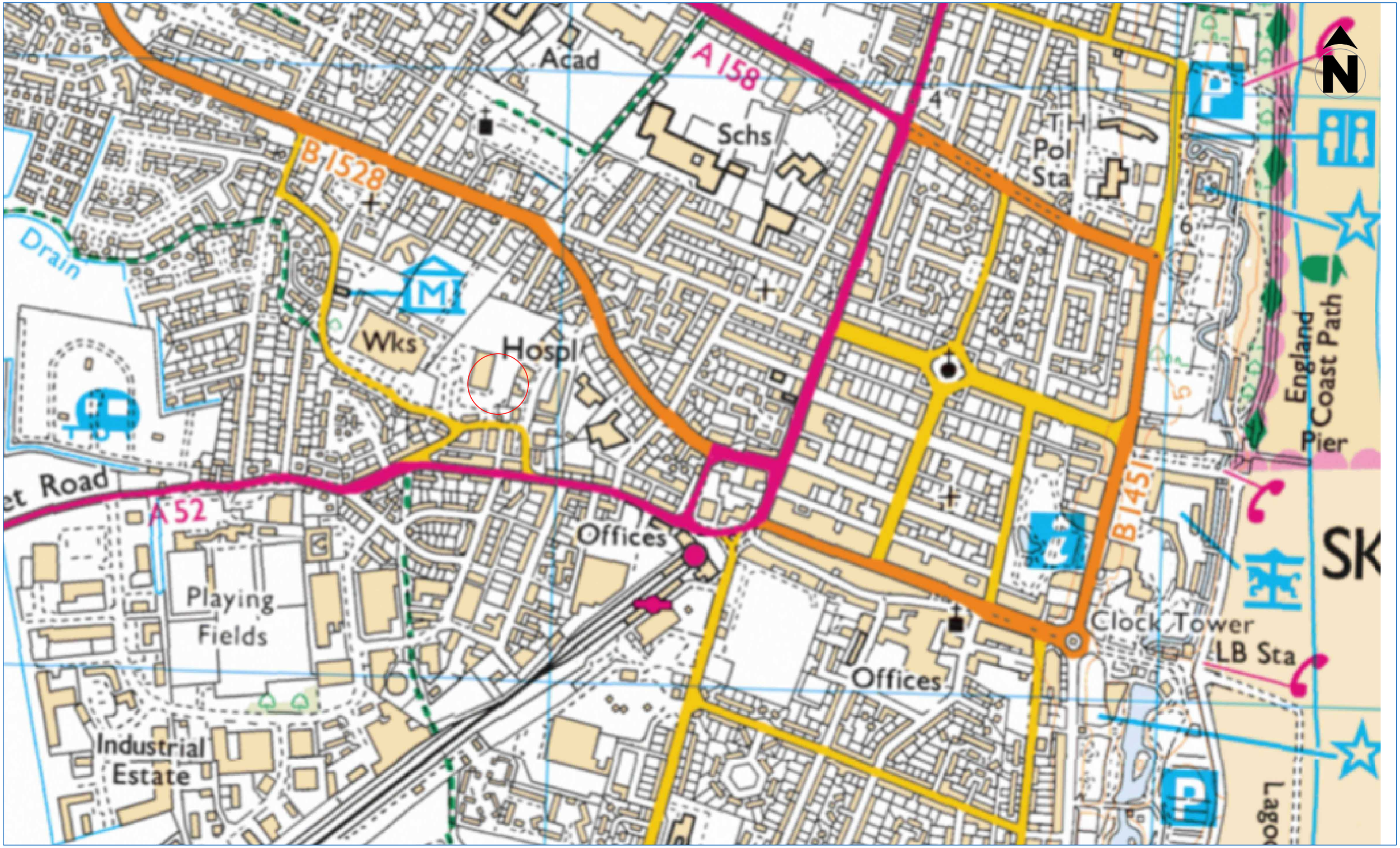
APPENDIX 1 - Plans



GROUNDTECH CONSULTING

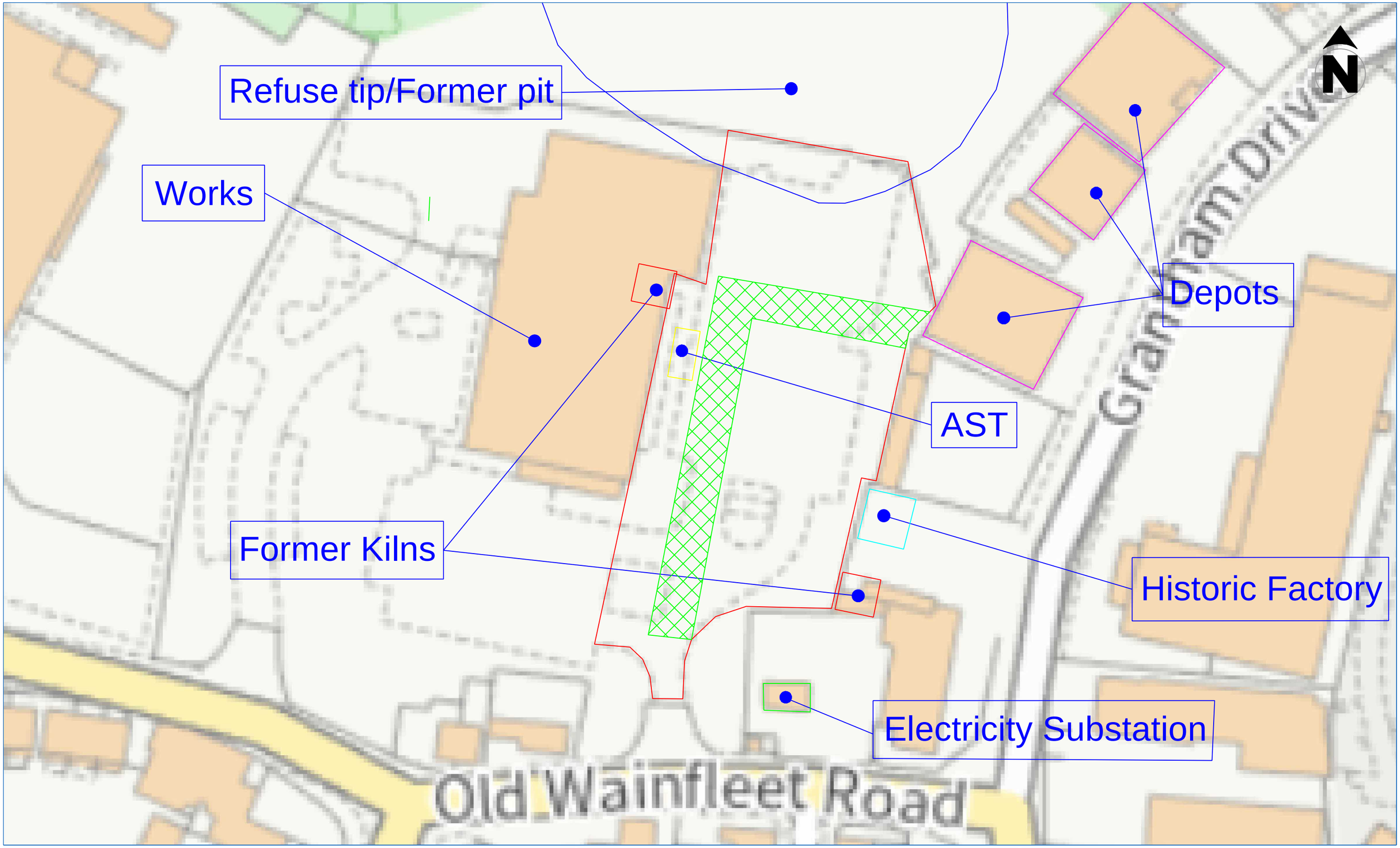
CLIENT	UNITED LINCOLNSHIRE HOSPITALS NHS TRUST
PROJECT TITLE	CDC SKEGNESS
PLAN TITLE	PROJECT LOCATION PLAN
DATE	SEPTEMBER 2023
SCALE	NTS
PLAN NUMBER	GRO-23133-P01

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

Site Location



GROUNDTECH CONSULTING

CLIENT	UNITED LINCOLNSHIRE HOSPITALS NHS TRUST
PROJECT TITLE	CDC SKEGNESS
PLAN TITLE	PRELIMINARY DEVELOPMENT CONSTRAINTS PLAN
DATE	SPETEMBER 2023
SCALE	NTS
PLAN NUMBER	GRO-23133-P02

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

Site Boundary

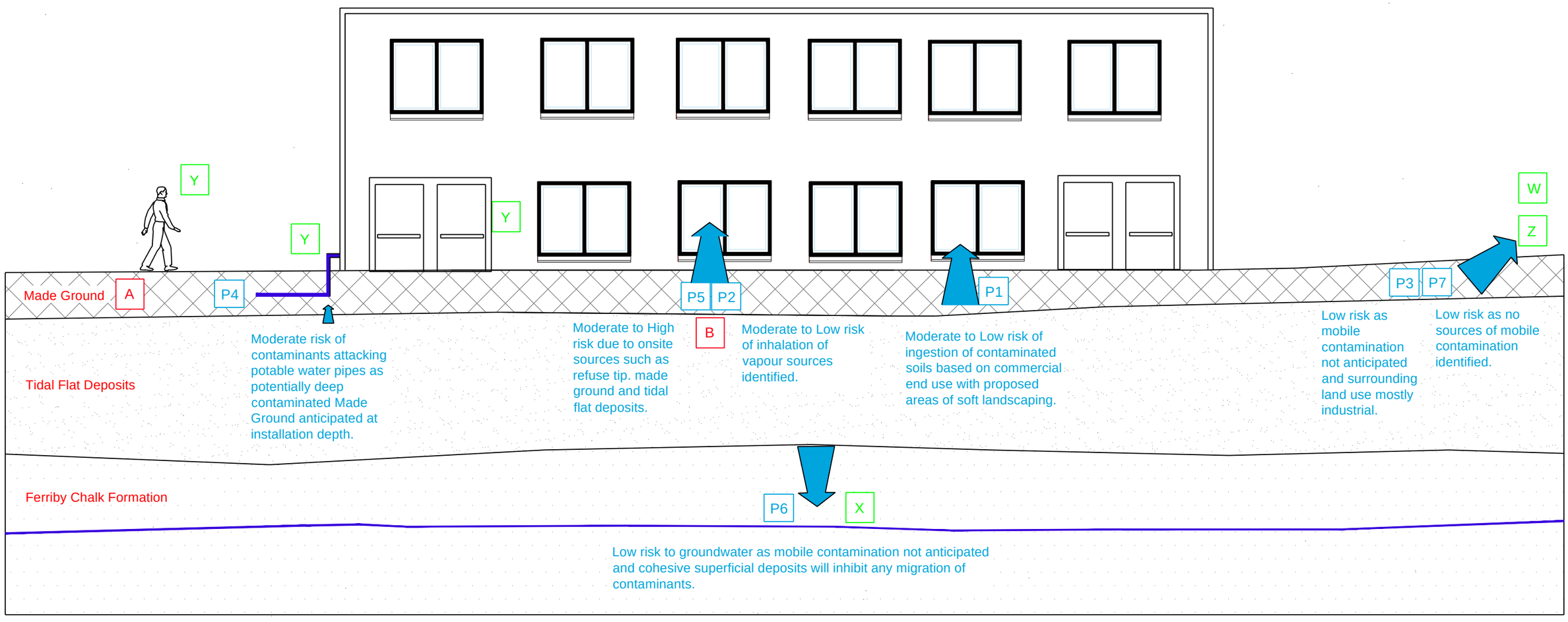
Position of former buildings associated with brick works

SOURCES
A. Contaminated soils / Made Ground. B. Ground gas.

POLLUTION LINKAGES
P1. Ingestion of soil and dust. P2. Inhalation of vapour. P3. Inhalation of soil dust by adjacent site users. P4. Attacking of potable water supply pipe. P5. Migration and accumulation of ground gas in internal places. P6. Impaction of groundwater from soil contamination. P7. Migration of soil and groundwater contamination impacting surface waters.

RECEPTORS
W. Main Drain River X. Groundwater within the Principal bedrock Aquifer. Y. Site end users. Z. Adjacent site users.

Proposed Skegness CDC Development



GROUNDTECH CONSULTING

CLIENT	UNITED LINCOLNSHIRE HOSPITALS NHS TRUST
PROJECT TITLE	CDC SKEGNESS
PLAN TITLE	ILLUSTRATIVE PRELIMINARY CSM
DATE	SEPTEMBER 2023
SCALE	NTS
PLAN NUMBER	GRO-23133-P03

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

GROUNDTECH CONSULTING

CLIENT	UNITED LINCOLNSHIRE HOSPITALS NHS TRUST
PROJECT TITLE	CDC SKEGNESS
PLAN TITLE	PROPOSED EXPLORATORY HOLES PLAN

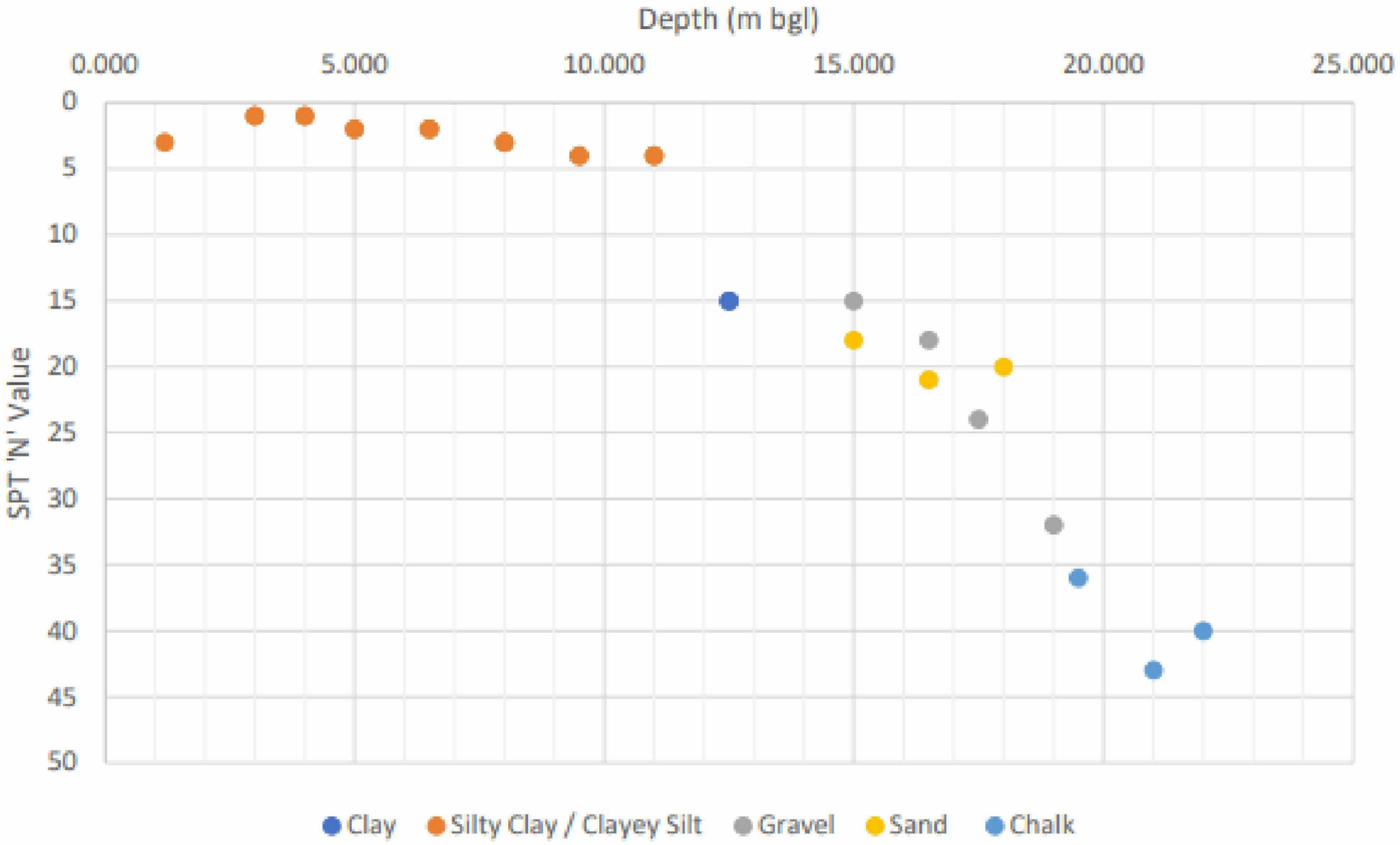
DATE	SEPTEMBER 2023
SCALE	NTS
PLAN NUMBER	GRO-23133-P04

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

- Site Location
- Windowless sample borehole location
- Cable percussion borehole location
- Plate load test location



GROUNDTECH CONSULTING

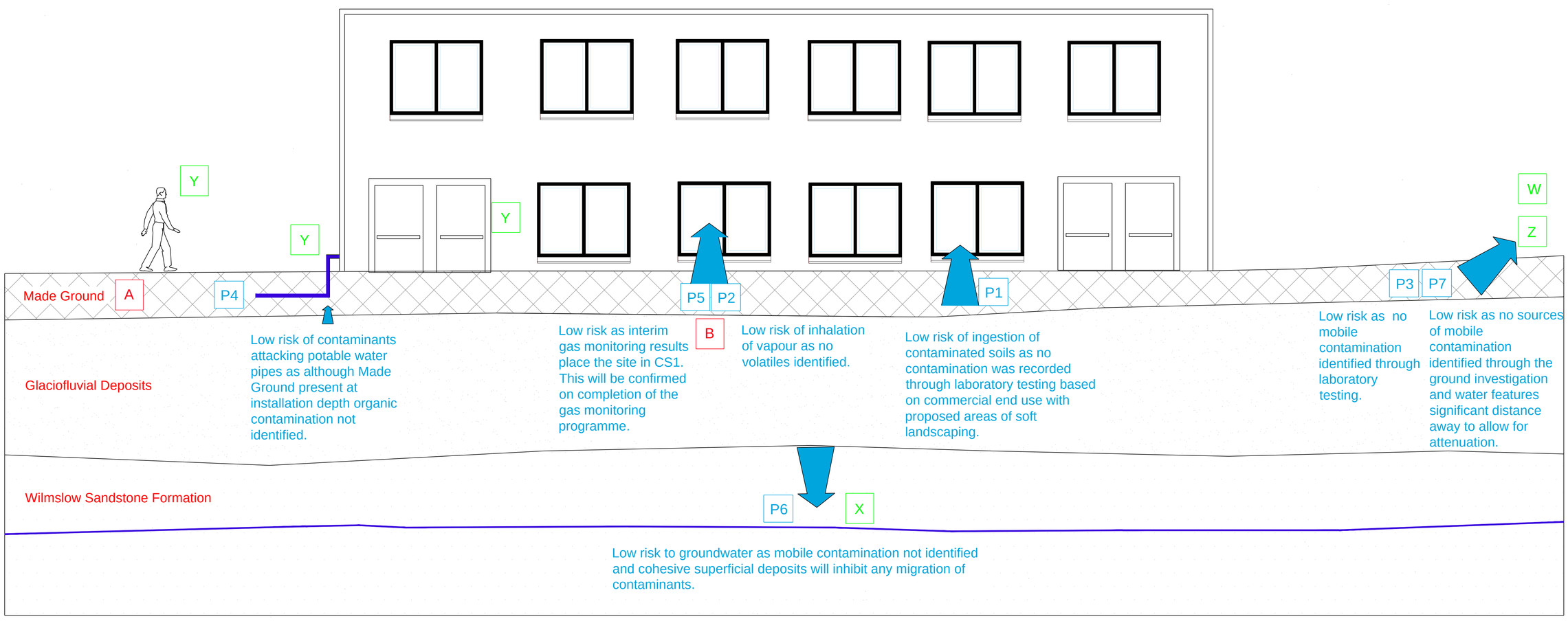
CLIENT	UNITED LINCONSHIRE HOSPITALS NHS TRUST
PROJECT TITLE	CDC SKEGNESS
PLAN TITLE	GENERALISED GROUND MODEL
DATE	OCTOBER 2023
SCALE	NTS
PLAN NUMBER	GRO-23133-P05

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

SOURCES	POLLUTION LINKAGES	RECEPTORS
A. Contaminated soils / Made Ground. B. Ground gas.	P1. Ingestion of soil and dust. P2. Inhalation of vapour. P3. Inhalation of soil dust by adjacent site users. P4. Attacking of potable water supply pipe. P5. Migration and accumulation of ground gas in internal places. P6. Impaction of groundwater from soil contamination. P7. Migration of soil and groundwater contamination impacting surface waters.	W. Main Drain River X. Groundwater within the Principal bedrock Aquifer. Y. Site end users. Z. Adjacent site users.



GROUNDTECH CONSULTING

CLIENT	CCS CONSULTING
PROJECT TITLE	CDC SKEGNESS
PLAN TITLE	ILLUSTRATIVE REVISED CSM
DATE	OCTOBER 2023
SCALE	NTS
PLAN NUMBER	GRO-23133-P06

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

APPENDIX 2 - Site Photographs

Photograph 1 – AST on western site boundary.

Photograph 2 – North west facing view of the site.

Photograph 3 – CP02 Location.

Photograph 4 – North east corner of site obstruction.

Photograph 5 – Northern site boundary.

Photograph 6 – Mobile housing units stored in eastern section of site.