



e3p

Phase I & II Geoenvironmental Site Assessment
North Manchester Golf Club

Reference: 14-807-R1-2
Date: January 2022



PHASE I & II GEOENVIRONMENTAL SITE ASSESSMENT

North Manchester Golf Club,
Manchester Old Road,
Middleton,
Manchester M24 4PE

Prepared for:
Duchy Homes



Report Ref: 14-807-R1-2
Date Issued: January 2022

North Manchester Golf Club

Phase II Geoenvironmental Site Assessment
January 2022

E3P

Taylor Road
Trafford Park
Urmston
M41 7JQ

+ 44 (0) 161 707 9612
<https://e3p.co.uk/>

Registered in England
CRN: 807255262

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DATE	July 2021	January 2022	
PREPARED BY	Jamie Craig	G. Calvert	
QUALIFICATIONS	MESci	BSc (Hons), FGS	
CHECKED BY	R. Hodnett	R. Hodnett	
QUALIFICATIONS	BSc (Hons), FGS	BSc (Hons), FGS, MEnvSc	
AUTHORISED BY	M. Dyer	A Edgar	
QUALIFICATIONS	BSc (Hons), FGS, AIEMA, MEnvSc, CEnv	BSc, MSc, PIEMA, MEnvSc, CEnv	



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EXECUTIVE SUMMARY

Site Address	Land at North Manchester Golf Club, Manchester Old Road, Middleton, Manchester M24 4PE.	
Grid Reference	E 385870, N 405470.	
Site Area	Ca. 8.1 Ha.	
Proposed Development	E3P understands that Duchy Homes are considering the proposed acquisition and future redevelopment of a parcel of land at North Manchester Golf Club, Middleton, Greater Manchester for low rise residential housing with associated adopted estate roads and utility infrastructure. The planning application also includes the demolition of the existing club house and construction of a new one in its place in the north of the main development area of the site, along with a driving range further north within the current golf course.	
Current Site Use	The subject site comprises of two irregular shaped parcels of land located to the north of Manchester Old Road, Middleton and is currently part of a wider golf course. The main sector of the site (southern sector) comprises an area of golf course comprising maintained grassland. The north-eastern sector of this area of the site is occupied by overgrown, rough scrub vegetation and semi mature and mature trees. A drainage ditch was also identified. A raised grassed bund is present in the east of the sector separating the golf course from the area of overgrown vegetation. The northern part of the sector is occupied by an area of informal gravel hardstanding car parking, the current golf course club house, greenkeepers maintenance shed/storage and driveway to the site. The current clubhouse is two storey and of brick construction. The northern sector of the site, in which a new driving range is to be constructed, is part of the wider golf course and generally comprises trees and overgrown vegetation.	
Site History	A review of historic Ordnance Survey Historical Mapping confirms that the north of the southern sector of the site formerly comprised Rhodes House and associated buildings, which now exists as the golf club house. A pond was present as part of the gardens to Rhodes House from 1848 up until 1955 where it is assumed to have been infilled. The southern and central sections of this sector, along with the northern sector where the proposed driving range is to be located, have remained undeveloped. A sand pit was identified in the east of the southern sector of the site from 1992 until 2000 however this is considered to be a feature of the golf course rather than an area of infilling.	
Environmental Setting	Drift Geology	Majority of the site: Glaciofluvial Sheet Deposits - SAND and GRAVEL. Northern sector: Hummocky (moundy) Glacial Deposits – SAND and GRAVEL.
	Bedrock Geology	Pennine Lower Coal Measures Formation (MUDSTONE, SILTSTONE, SANDSTONE) and Blenfire Rock (SANDSTONE).
	Faults	Minor fault located in the south western sector of the site in a north-west to south-east trajectory. Downthrow on the western side.



	Hydrogeology	Secondary A aquifer (drift) overlying Secondary A aquifer. Secondary undifferentiated superficial aquifer noted in the northern sector. Closest groundwater abstraction point 817 m east of the site.
	Hydrology	Onsite streams and ditches have been identified, with reservoirs noted between the two parcels on site. a point has been noted 22m north of the southern sector of the site. Reservoirs have been noted between 30-90m south of the site.
	Flood Risk	Unaffected by flooding from rivers.
Natural Landform and Geomorphology	The site generally slopes southwards towards Manchester Old Road along the southern border. However, a change in gradient is located between the car park and the golf course to the south but also to the wooded/overgrown area to the east/north-east. The golf course has local undulations which may be man-made however the areas surrounding the club house and car parking appears to have been made level to facilitate the construction of the golf course club house and associated car parking. It is considered that Manchester Old Road was cut into the natural drift deposits, and therefore the site requires a retaining wall along the southern boundary rather than the site being upfilled. It is considered that the subject site has undergone little to no development in regards to alteration of the natural landform.	
Previous Reports	E3P has previously completed a Phase I and II Geoenvironmental Site Assessment for the site (Report Ref: 10-665-R1, dated September 2015) on behalf of Countryside Properties. The key findings of the previous site investigation reports are summarised within this report.	
Utility Locations	A gas main, sludge main and electricity infrastructure are present within the site boundary. The LV electricity cable was traced during the ground investigation and is located within the bund structure located in the southern sector of the site. The gas main is present north of the bund running in a south-east to north-west trajectory. The sludge main is located in the central area of the site.	
Landfill Sites and Ground Gases	A BGS recorded landfill is present 28 m east of the subject site. There are two historical landfills located 27 m south-west and 29 m east of the site. There are three entries within the Envirocheck Report for potentially infilled land (non-water) associated with the unknown filled ground (pit, quarry etc). There are two entries for potentially infilled land (water) for unknown filled ground (pond, marsh, river, stream, dock etc). No waste treatment sites have been identified within 500 m of the subject site.	
Radon	Unaffected – no special precautions required.	
Coal Mining/Land Stability	The site is located within an area that may be affected by coal mining. E3P has completed a desk-based coal mining risk assessment which has indicated that there is a low risk of unrecorded coal mining at shallow depth for the subject site.	
Hazardous Installations	No hazardous installations that could potentially prejudice the proposed construction of highly sensitive residential dwellings have been identified within influencing distance of the subject site.	



GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation within the Duchy Homes residential development area comprising: ✿ 11 x mechanically excavated trial pits; ✿ 5 x window sample boreholes; ✿ 2 cable percussive boreholes; ✿ 6 x Dynamic Cone Penetrometers; ✿ 1 x Hand Dug Pit; and, ✿ Construction of environmental monitoring installations.
Ground Conditions	MADE GROUND Made Ground deposits were encountered in five exploratory hole locations (WS104, TP101, TP102, TP103 and HDP101) to a maximum proved depth of 1.10m bgl. Made Ground deposits within TP101 and TP102 generally comprised a reworked topsoil of a black slightly clayey sand with frequent rootlets overlying a brown orange medium clayey medium sand. These materials were subsequently underlain with a blackish brown very clayey medium sand. The reworked topsoil was also identified within TP103. Within HDP101 Made Ground comprised a reworked topsoil as above, overlying Made Ground sand deposits as per the above. Made Ground deposits in WS104 comprised a blackish grey slightly clayey sand with occasional brick fragments and was considered to be associated with the former pond in this area of the site. TOPSOIL Natural topsoil deposits were identified within 14 exploratory hole locations to depths of between 0.20-0.30m bgl. The topsoil deposits are comprised of a black slightly clayey medium SAND with frequent rootlets. DRIFT Drift deposits were encountered within all exploratory locations to a maximum depth of 20.45 m bgl. Drift deposits generally comprised a brown slightly clayey medium SAND overlying a loose to medium dense brown very gravelly, slightly clayey medium SAND with gravel and cobbles of sandstone, mudstone and limestone to a maximum depth of 5.60 m bgl. Within TP103/SA101 a light brown slightly clayey medium SAND was encountered to a maximum depth of 2.10 m bgl, while in WS104 a brownish grey very silty, slightly clayey fine SAND was encountered, which was considered likely to be silt materials associated with the base of the former infilled pond. Within WS101 a grey slightly clayey, very gravelly medium SAND with gravel of sandstone, mudstone and limestone were overlying the brown slightly clayey medium SAND. However, the underlying SAND identified fragments of coal. SAND deposits were noted to be very loose or loose within WS101, WS102, WS103, WS104, WS105, CP101 and CP102 at depths of between 1.20m and 5.45mbgl.



Ground Conditions	Underlying the gravelly medium SAND deposits, which were encountered within CP101 and CP102 from 5.60mbgl and 5.50mbgl respectively was a very stiff high strength brown sandy CLAY.
	SOLID The bedrock geology was not encountered as part of the ground investigation.
	Historic BGS boreholes in the surrounding area have identified that bedrock is likely to be present beneath the site at circa 45.00m bgl.
	GROUNDWATER Groundwater was encountered as strikes at depths between 0.50m and 1.80 m bgl. Granular deposits were noted to be saturated where the groundwater was encountered.

CONTAMINATED LAND ASSESSMENT

Human Health	A Tier 1 Human Health Risk Assessment has been undertaken using the chemical analysis results of the soils and comparing to the relevant Tier I criteria. The assessment has not identified any elevated levels of contaminants of concern. However, within the previous ground investigation completed by E3P, elevated concentrations of asbestos, lead, arsenic, Benzo(b)Fluoranthene, Benzo(a)Pyrene and Dibenzo(a,h)Anthracene were identified. Asbestos was identified in TP102 within Made Ground deposits however this location is outside of the proposed red line boundary. The elevated concentrations of lead, arsenic, Benzo(b)Fluoranthene, Benzo(a)Pyrene and Dibenzo(a,h)Anthracene were located within Made Ground topsoil and SAND deposits within WS107 at 0.20m and TP110 at 1.80m. The risk to chronic human health associated with the elevated concentrations on inorganic heavy metals and non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in proposed private gardens, landscaping and public open space where Made Ground or impacted soils are present, to remove any potential for direct exposure to impacted soils. Made Ground deposits have been identified on-site; should these remain on site a cover system should be installed within all gardens. Alternatively, a hotspot removal may be required. Topsoil deposits are deemed suitable for re-use on-site with the exception of deposits within WS107 in the 2016 E3P site investigation. These deposits should undergo a hotspot removal, where the area of impact should be delineated, excavated and segregated from natural topsoil deposits and placed in an area of low sensitivity on site. Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. Further, post-demolition and site clearance investigations are required in the north and northeast of the site to confirm the findings of this initial assessment as and when full and unrestricted access is available.
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Controlled Waters	The Tier 1 comparison for groundwater and leachate has identified elevated concentrations of heavy metals and PAHs in WS104 and WS105. Elevated concentrations in WS104 were attributed to leachate analysis; supplementary groundwater sampling in this location did not identify any elevated concentrations and as such, there is not considered a risk to controlled waters at this location. Groundwater samples from WS105 identified elevated concentrations of heavy metals and PAHs against both DWS and EQS screening values. An m-BAT assessment has been completed in regards to the identified elevated copper, nickel and zinc concentrations, which determined only the first round of monitoring in WS105 had RCR values exceeding copper and zinc. The Pb screening tool identified WS105 to be bioavailable within the first monitoring visit but not the second. The elevated concentrations are considered to be anomalous in this location; the same is considered for PAHs as there is no significant source on-site and the borehole was not located within Made Ground deposits. It is possible the source of the elevated concentrations in WS105 are attributed to chemicals utilised as part of the golf course maintenance. The site is underlain by granular drift deposits to circa 5.50 m bgl which is turn underlain by low permeability cohesive deposits to depths greater than 20.00 m bgl. The presence of this underlying cohesive drift stratum will offer significant protection to the underlying aquifer and minimise vertical migration in respect to this controlled water receptor. The nearest surface water feature is a small stream/ditch 15m west of the site, and reservoirs 20 m south of the site. Roads are present between the site and the surface water features which will act as a barrier but also a greater source of contaminants to the surface water features than the site itself. It is unlikely any of the identified contaminants would migrate to the surface water features due to the roads acting as a barrier to stop any migration. The path of the stream/ditch on-site is currently unknown but it does not appear to be linked to any other watercourses. The heavy metals and PAHs are likely low mobility and therefore are unlikely to migrate to the surface water receptors. It should also be noted the site is currently uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore any leaching potential. Further groundwater monitoring is recommended within WS105 and down-gradient to confirm the low risk to controlled waters.
Ground Gas	An infilled pond has been identified on-site and off-site landfills within proximity to the site which may be a source of Made Ground, alluvial deposits or contain deeper organic soils with putrescible matter which may be subject to decay-producing low levels of hazardous ground gases such as carbon dioxide and methane. Carbon dioxide and methane have associated asphyxiation and explosive risks, respectively. Off-site landfills are unlikely to affect the site due to the proximity to the site.



Ground Gas Cont.	An off-site landfill has been identified in close proximity to the subject site circa 28m south-east of the site. However, based on Groundsure LIDAR data and available contours it is likely infilling operations were over 50 m from the subject site and therefore the risk to the site is considered to be low. Within the previous site investigation completed by E3P in 2015, ground gas monitoring was completed across the site with WS109 and WS110 situated in the south/south-east of the site targeting any occurrences of migrating ground gases from the off-site landfill. In addition, WS101 from the 2015 E3P Ground Investigation was located in the south-west of the site which would note any presence of ground gases originating from the former landfill 27m south-west of the site. No elevated concentrations of carbon dioxide or methane were identified within any of the E3P 2015 monitoring wells, and as such it can be concluded that ground gases from the off-site landfill are not migrating to the subject site. Ground gas monitoring suggests the site can be zoned for the installation of CS1/Green and CS2/Amber 1 protection measures, as isolated areas of elevated ground gas concentrations have been identified on-site and as such, protective measures will be required to any proposed plots in areas classified as CS2/Amber 1. Zoning of the site should be agreed upon with the Local Authority prior to construction.
Potable Water Infrastructure	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

GEOTECHNICAL ASSESSMENT

Underground Obstructions	No underground obstructions were encountered during the ground investigation. Underground obstructions are anticipated beneath the current golf course club house which will require grubbing out in their entirety during the remediation and enabling works. However significant utility infrastructure is present within the subject site, which includes a large sludge main, electricity line and a gas main. These underlying services will need to be taken into consideration prior and during the development of the subject site.
Allowable Bearing Pressure	The underlying SAND deposits have been assessed as being very loose to medium dense with a net ABP in the order of 9.13–219 kN/m². Cohesive drift deposits have been encountered at depths greater than 5.00 m bgl. where they have been assessed as being very stiff with an ABP between 167-308 kN/m².
Foundation Options	The site has been noted to be underlain by loose SANDS which are partially saturated and therefore will result in the reduction in the calculated safe ABP by 50%. The most viable solution for the subject site would be to re-engineer the loose sands with VSC to support a shallow strip foundation using a bottom feed. Consideration of the proximity to sensitive infrastructure will be required. In the area of infilled pond in the northeastern sector of the site, an allowance for a driven piled foundation solution is required Consideration of the use of VSC in plots in the proximity of the sensitive service infrastructure on-site should be considered which may require a driven piled foundation, raft foundations or use of a gravel trench to limit vibrations.



Foundation Options Cont.	It should be noted that instability of excavations, water ingress and saturated soils would preclude the use of strip and trench fill foundations. It is recommended that further investigative works are undertaken once the Himalayan Balsam and trees are cleared from the north-eastern and eastern sector of the site, so a further geotechnical investigation can be undertaken to advise on the foundation solution in this area.
Building Floor Slabs	It is considered that for the majority of substructures, the underlying stratum would be granular in nature and have less than 600 mm of infilled ground and in those areas, a suspended floor slab would not be required. However, where there are CLAY deposits or an excess of 600 mm of infill a suspended floor slab will be required.
Heave Precautions	The majority of the site is underlain by granular stratum that is not subject to volumetric instability as a result of fluctuations in moisture content. However, if shallow clay deposits are encountered, it is important to consider the depth of the founding stratum, location of trees and the need for any heave precautions where there is no sub-floor void.
Soakaway Drainage	The site is predominantly underlain by circa 1.00–5.00 m of high permeability gravelly SANDS. Three BRE365 Permeability Tests have been undertaken where a good infiltration rate has been calculated. However, a high water table was observed during the ground investigation with saturated SANDs present and therefore the use of soakaway drainage may be limited. The granular drift deposits are likely to offer a certain amount of soakage potential; however, the construction of sustainable drainage is likely to be difficult due to the stability of the natural granular material, especially after periods of heavy rain. Additionally, consideration must be given to the construction of the soakaways due to the site being elevated above the adopted highway to the south of the site by circa 1.00m. However, the application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – Soakaway Design.
Sulphate Assessment	Concrete classification will be DS1 AC1s.
CBR Design %	Granular soils can be re-engineered to ensure 5% within the subgrade during favourable climatic conditions. Natural clay soils will provide a CBR in the order of 3–5% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade.
Cut/Fill	Development levels are unknown at this time; however, some cut-and-fill works will be required to prepare the development platform. Where levels change, especially in areas of upfill and VSC or a raft is proposed, the site derived material will need to be engineered and compacted to ensure >95% of the Max Dry Density. Also note that in favourable climatic conditions, compaction can be achieved. However, in wetter times, stabilisation agents may be required.
Civil Engineering Excavations	The E3P Intrusive Ground Investigation has not identified the presence of weathered/competent bedrock at a shallow depth, the presence of which would impede the excavation materials to form sewerage and drainage infrastructure and foundations.



Civil Engineering Excavations Cont.	Saturated soils and a high water table have been encountered which have caused instability within trial pits. Dewatering for deep drainage construction may be required.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: <i>Waste Classification – Guidance on the classification and assessment of waste</i> .

RECOMMENDATIONS

Based on the findings of the geoenvironmental site assessment, the following additional works are recommended to be completed in due course:

- ✿ Treatment and removal of Himalayan Balsam.
- ✿ Further investigation within areas previously inaccessible.
- ✿ Delineation of the former infilled pond.
- ✿ Arboricultural survey.
- ✿ Settlement Analysis for earthworks design.
- ✿ Geotechnical earthworks strategy (infrastructure).
- ✿ Remediation and enabling works strategy.
- ✿ Construction phase Surface Water Management Plan.



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DRAWING LIST

14-807-001 - Site Location Plan
14-807-002 - Proposed Development Plan
14-807-003 - Historical Features Plan
14-807-004 - Site Features Plan
14-807-005 - Exploratory Hole Location Plan
14-807-006 - Depth of Made Ground Plan
14-807-007 - Depth of Topsoil Plan
14-807-008 - Depth to Founding Strata Plan
14-807-009 – Concept Foundation Zoning Plan
14-807-010 - Conceptual Site Model
14-807-015 – Development Constraints Plan



1.3. OBJECTIVES

The objectives of the geoenvironmental assessment are as follows:

- ✦ Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified.
- ✦ Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors.
- ✦ Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs.
- ✦ Provide recommendations regarding future works required.

1.4. SCOPE OF WORKS

The scope of work includes the following elements:

- ✦ Design of suitable intrusive ground investigation;
- ✦ Window sample probeholes with, and construction of, environmental monitoring installations;
- ✦ Deep cable percussive boreholes;
- ✦ Mechanically excavated trial pits;
- ✦ BRE365 permeability tests;
- ✦ In-situ geotechnical testing;
- ✦ Chemical and geotechnical laboratory analysis;
- ✦ Groundwater monitoring and sampling;
- ✦ Ground gas monitoring;
- ✦ Contamination risk assessment and conceptual site model;
- ✦ Geotechnical assessment and interpretation; and
- ✦ Factual and interpretive reporting.

1.5. LIMITATIONS

The limitations of this report are presented in Appendix I.

1.6. CONFIDENTIALITY

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



2. SITE SETTING

2.1. SITE DETAILS

Site Address	Land at North Manchester Golf Club, Manchester Old Road, Middleton, Manchester M24 4PE
National Grid Reference	E 385870, N 405470.
Site Area	Ca. 8.1 Ha

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

A site location map is presented in Appendix III as Drawing 14-807-001.

2.2. CURRENT SITE USE

E3P has undertaken a site walkover of the entire site and a description of the key findings is summarised in Table 2.1.

TABLE 2.1 SITE DESCRIPTION

Occupancy/Use	The subject site comprises two irregular shaped parcels of land located to the north of Manchester Old Road, Middleton and is currently part of a wider golf course. The main sector of the site (southern sector) comprises an area of golf course comprising maintained grassland. The north-eastern sector of this area of the site is occupied by overgrown rough scrub vegetation and semi mature and mature trees. A drainage ditch was also identified. A raised grassed bund is present in the east of the sector separating the golf course from the area of overgrown vegetation. The northern part of the sector is occupied by an area of informal gravel hardstanding car parking, the current golf course club house, greenkeepers maintenance shed/storage and driveway to the site. The current clubhouse is two storey and of brick construction. The northern sector of the site, in which a new driving range is to be constructed, is part of the wider golf course and generally comprises trees and overgrown vegetation.	
Surface Cover (%)	Buildings	10%
	Hardstand	10%
	Soft Cover	80%
Structures	The current golf club house and greenkeepers maintenance shed / storage are present in the north of the main site area. A golf net is present in the east of the site.	
Access	Access to the site can be gained from the A576 Manchester Old Road, located south of the subject site. A private road enters the site from the south and borders the western edge of the southern sector of the subject site. Pedestrian access to the site can also be gained from an open access point in the south eastern corner.	



Slope	The site generally slopes southwards towards Manchester Old Road along the southern border. However, a change in gradient is located between the car park and the golf course to the south but also to the wooded/overgrown area to the east. An additional change in gradient is located between the car parking and wider golf course in the north of the main development area. The golf course has local undulations, and the areas surrounding the club house and car parking appears to have been made level to facilitate the construction of the property.
Retaining Structures	A retaining wall runs the full length of the site along the southern boundary through a range of heights between 0.40 and 1.00m. The retaining wall is higher in the western section of the southern boundary and reduces in height eastwards. A much larger retaining wall exists off the north east corner of the club house of around 1.5-2.0m, retaining the steep slope in the north down into the car park.
Vegetation/Ecology	Mature and semi mature trees are present along the site boundary and sporadically within the site. Mature trees line the access road along the western boundary of the southern sector of the site. Rough scrub vegetation is located in the north eastern sector of the proposed residential development area. Dense areas of Himalayan Balsam have also been identified within this area. The proposed driving range development area comprises a series of mature trees and overgrown vegetation(woodland). A habitat survey will be required to support the planning application.
Hazardous Material Storage	No above-ground storage tanks (ASTs) or underground storage tanks (USTs) were observed at the site during the preliminary site walkover. Due to the previously undeveloped nature of the site, it is unlikely that hazardous materials storage will have occurred on the site.
Asbestos-Containing Material (ACM)	No evidence of ACM was noted during the site walkover and during the site investigation. However due to the lack of investigation for the infilled area in the north eastern sector of the site and the likelihood of significant Made Ground deposits, the presence of ACM can not be ruled out at this time. Additionally due to the age of the buildings on-site ACM may be present within the building fabric.
Polychlorinated Biphenyls (PCBs)	There is no equipment identified that may contain PCBs within the site boundary
Waste Storage	Potentially hazardous waste streams are unlikely to be generated at the site and none were observed during the preliminary site inspection.
Drainage	A large sludge main is present on site, running from the north west across the site to the south east corner of the site. Within the south of the site a wooden chamber was identified assumed to be associated with drainage infrastructure on site.



2.3. SURROUNDING AREA

The surrounding area land uses are summarised in Table 2.2.

TABLE 2.2 SURROUNDING LAND USES

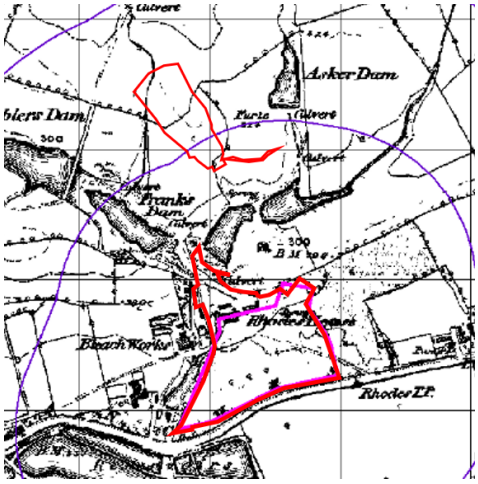
DIRECTION	LAND USE
North	Golf Course
East	Residential units / Golf Course
South	Manchester Old Road, woodland, reservoirs and River Irk
West	Residential units / Golf Course

3. SITE HISTORY

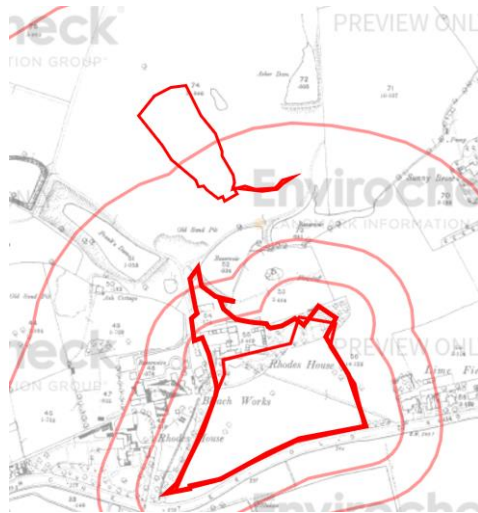
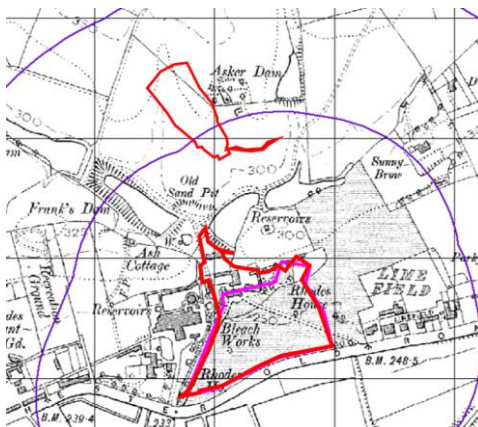
3.1. ON-SITE HISTORICAL DEVELOPMENT

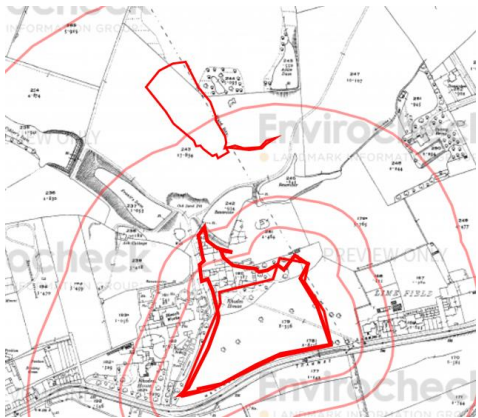
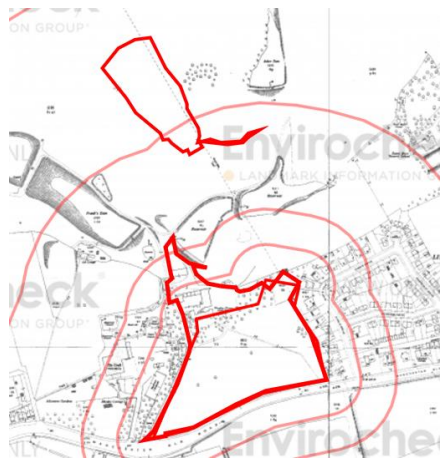
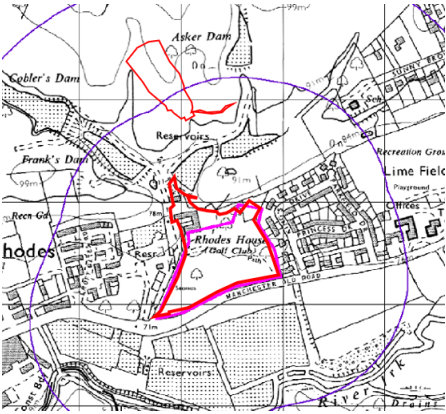
A review of historical mapping and historical aerial imagery pertinent to the site is summarised in Table 3.1. In addition, historical site features are presented on Drawing No 14-807-003 in Appendix III.

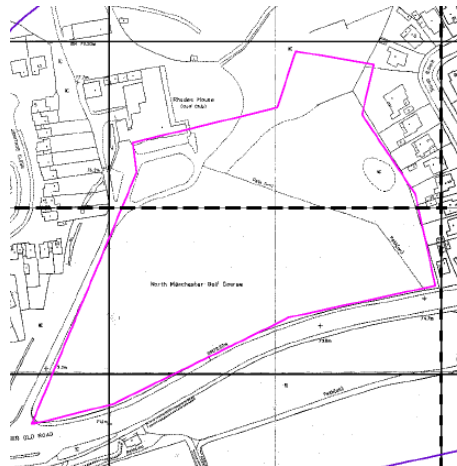
TABLE 3.1 HISTORICAL DEVELOPMENT

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1848 1:10,560	Both sectors of the site appear to comprise open grassland with a number of trees present. A track running is present in a south east to north west trajectory crossing the central sector of the southern sector of the site, used for access from Manchester Old Road for Rhodes House. The north western and north eastern sector of the southern sector of the site appears to be occupied by the gardens of Rhodes House with a possible pond feature; along with the edge of buildings. Rhodes House is present in the north of the southern sector of the site. A track and culvert appears to be present to the north of the buildings.	



MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1893 1:2,500	A building is present in the north of the southern sector of the site. No significant changes to the site.	
1909 1:2,500	The gardens in the northeast of the site have undergone alteration. No other significant changes to the site.	
1910 1:10,560	Contour lines are noted across the central area of the southern sector of the site and in the centre of the northern sector of the site.	

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1932 1:2,500	No significant changes to the site.	
1955 1:2,500	Within the southern sector, the track is now noted as a footpath with a new entrance to the site now present on the western boundary of the site and in the north-western corner of this sector. A number of trees are now present in the northern area of the sector, with the pond feature no longer present. The site now appears to be used as a golf course. A building associated with Rhodes House is no longer present. The remainder of the site appears to be unchanged.	
1977 1:10,000	No significant changes.	

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1992 1:1,250	A possible sand pit is now present in the eastern sector of the site, however, this feature is likely to be associated with the golf course. Within the northern sector of the site, no significant changes have been noted.	
2000 Google Earth	Sand Pit is no longer present. No significant changes to the site.	
2021 Google Earth	No significant changes to the site.	



3.2. OFF-SITE HISTORICAL DEVELOPMENT

A review of potentially contaminative uses identified on historical Ordnance Survey maps within a 250 m radius of the site is summarised in Table 3.2.

TABLE 3.2 SURROUNDING HISTORICAL DEVELOPMENT

SURROUNDING FEATURE	DISTANCE	DATES	DIRECTION
Old Sand Pit <i>Then no longer present</i>	10m	Pre 1893 – Pre 1955 Pre 1955 - Present	North of southern sector.
Reservoir <i>Then landfill</i>	25m	Pre 1893 – Pre 1967 Pre 1967 – Pre 1974	South East
Reservoir <i>Then landfill</i>	25m	Pre 1893 – Pre 1984 Pre 1984 – Pre 1992	South West
Bleach Works with associated reservoirs <i>Then no longer present</i>	30 m	Pre 1848–Pre 1955 Pre 1955 - Present	West
Filter Beds <i>Then a Tank identified</i> <i>Then identified as disused Reservoir</i> <i>Then becomes housing</i>	40m	Pre 1909–Pre 1922 Pre 1922–Pre 1955 Pre 1955–Pre 1984 Pre 1984- Present	West
Reservoir <i>Then a Gasometer is added</i> <i>Then a Tank is identified within Reservoir as being disused</i> <i>Then becomes housing</i>	45-90m	Pre 1893- Pre 1909 Pre 1909-1955 1955- Pre 1965 1965- Present	West
Electricity Substation	72m	Pre 1955 - Present	East
Old Sand Pit <i>Then no longer present</i>	120m	Pre 1893 – Pre 1909 Pre 1909 - Present	North West of southern sector
Cobblers Dam <i>Then 'Disused' / no longer present</i>	150 m	Pre 1848 – Pre 1999 Pre 1999 - Present	South-West of northern sector
Sand Pit <i>Then no longer present</i>	154m	Pe 1909 – Pre 1987 Pre 1987 - Present	South-East
Sand Pit <i>Then no longer present</i>	233m	Pre 1910 – Pre 1956 Pre 1956 - Present	South-West
Calico Print Works <i>Then Rhodes Print Works</i> <i>Then Works</i> <i>Then Business Park</i>	250 m	Pre 1894–Pre 1965 Pre 1965 – Pre 1984 Pre 1984 -Pre 2006 Pre 2006 - Present	South West



3.3. PLANNING HISTORY

E3P has undertaken a review of online planning records held by Rochdale Borough Council and the results are summarised in Table 3.3.

TABLE 3.3 SUMMARY OF PLANNING RECORDS

REFERENCE	DATE	DESCRIPTION	DECISION
16/01123/FUL	September 2016	Erection of 65 dwellings including the demolition of the existing buildings on site, and the erection of a replacement club house (including pro-shop and function room), erection of greenkeepers store and the relocation of the existing practice area with associated engineering, drainage and landscaping together with the construction of a replacement car park.	Refused
02/D39655	Jan/Feb 2002	Installation of a prefabricated single storey building.	Grant subject to conditions.
01/D38436	Jan/Apr 2001	Erection of storage building	Grant subject to conditions

3.4. PREVIOUS REPORTS

E3P has previously completed a Phase I and II Geoenvironmental Site Assessment for the site (Report Ref: 10-665-R1, dated September 2015) on behalf of Countryside Properties. The works were completed in the proposed residential and golf club house redevelopment area.

The key findings of the previous site investigation reports are summarised below and where necessary data used to support the E3P geoenvironmental site assessment:

- ✳ The preliminary Tier I Human Health risk assessment has identified the presence of marginally elevated non-volatile PAHs compounds and asbestos within the shallow Made Ground deposits across the northeast portion of the site. Additionally, elevated lead and arsenic have been detected within the shallow topsoil in close proximity to the chipping green. Due to the presence of PAHs and heavy metals within Made Ground deposits, plots in these areas will require the installation of a 600mm chemically suitable cover system.
- ✳ Within the southern sector (majority of the site) in areas in which no Made Ground was identified garden cover systems are not required within properties in this area.
- ✳ It is considered that the site can be zoned into an area as Characteristic Situation 2 (Amber 1) (north and south east), with the remaining area of the site as Characteristic Situation 1 (Green). However, zoning the site for gas protection measures will require approval by the Local Authority
- ✳ The Tier 1 controlled waters contaminant risk assessment did not identify any viable pollutant linkage and as such the risk is deemed to be low.
- ✳ The majority of the site is underlain by granular SAND and GRAVEL deposits with localised



deeper deposits of very stiff high strength brown CLAY.

-  The target founding stratum is variable in consistency and strength with loose to medium dense granular soils underlying the majority of the subject site at the depths where a traditional spread foundation would normally bear. The presence of damp soils and unstable granular stratum would preclude excavation for deeper Trench Fill type solutions to support a shallow reinforced strip footing. In due consideration of the identified ground conditions, it is considered that the most economic foundation solution would be to undertake a process of Ground Improvement by Vibro Stone Columns to ensure a uniform safe ABP of circa 125kN/m² with uniform settlement characteristics in the shallow stratum (circa 600mm bgl). Ultimately there will be localised areas of a site this size where it will be uneconomic to be re-engineered using a Vibro ground improvement due to the depth and nature of Made Ground and potential presence of external features such as trees and infrastructure. It will therefore be necessary to utilise a pile foundation for circa 10-20% of the proposed dwellings.



4. ENVIRONMENTAL SETTING

4.1. GEOLOGY AND HYDROGEOLOGY

The British Geological Survey (BGS) map for the site, (1:50,000, Solid and Drift editions) and online records indicate the site is underlain by the geological sequence presented in Table 4.1.

TABLE 4.1 SUMMARY OF UNDERLYING GEOLOGY

GEOLOGICAL UNIT	CLASSIFICATION	DESCRIPTION	AQUIFER CLASSIFICATION
Drift – majority of the site	Glaciofluvial Sheet Deposits – Devensian	SAND and GRAVEL	Secondary A aquifer
Drift – northern sector	Hummocky (moundy) Glacial Deposits	SAND and GRAVEL	Secondary Undifferentiated
Solid – majority of site	Pennine Lower Coal Measures Formation	MUDSTONE, SILTSTONE AND SANDSTONE	Secondary A aquifer
Solid – south-west	Blenfire Rock	SANDSTONE	Secondary A aquifer

TABLE 4.2 FAULTING

LOCATION	DESCRIPTION
South west of site	Direction - North West to South East. Downthrow on western side.

The Envirocheck report indicates that the site is not located within a groundwater source protection zone. Furthermore, there is one groundwater abstraction point within 1 km of the site; Robert McBride Limited is located 817m east of the site utilised for manufacturing, however the licence is noted to be revoked. There are two surface water abstraction points on the wider North Manchester Golf Club site 107m north of the residential development area of the site.

4.2. NATURAL LANDFORM AND GEOMORPHOLOGY

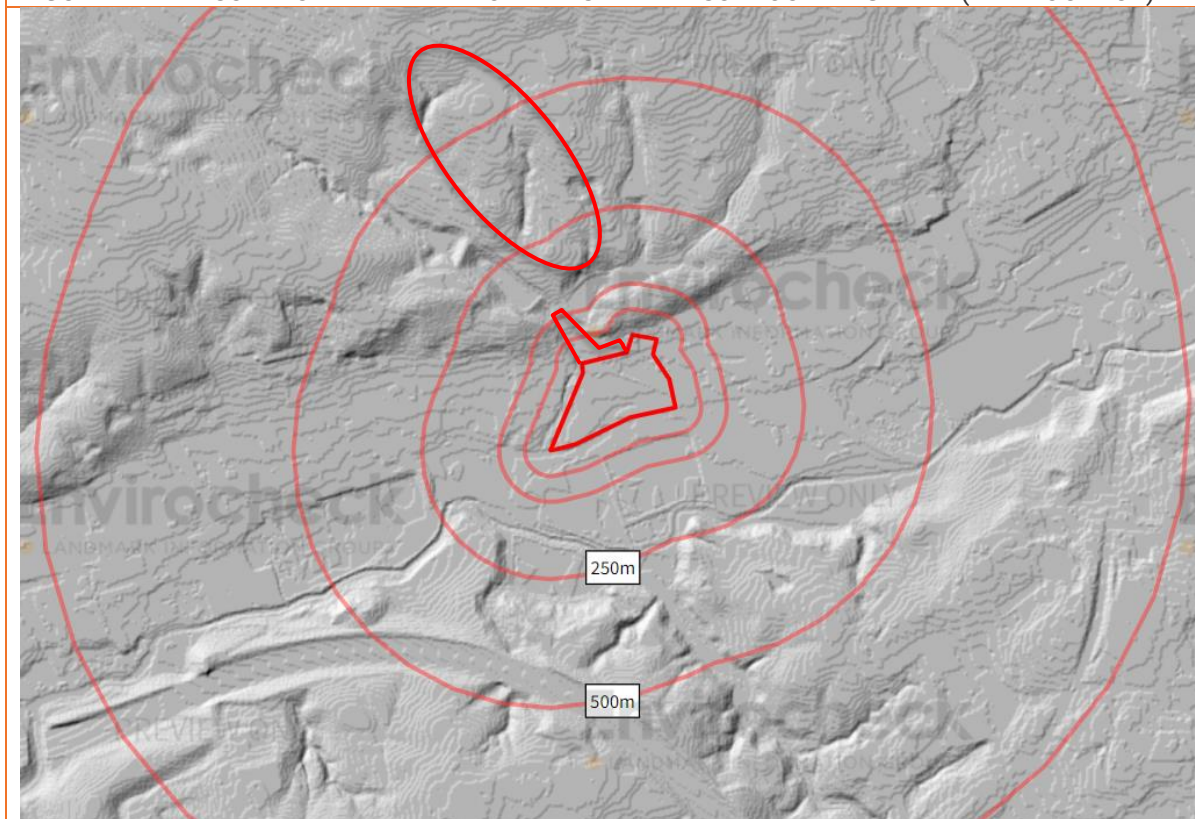
Based on the initial geological assessment, a review of available topographic data and pertinent mapping, E3P has undertaken a preliminary geomorphological assessment of the landform and its possible mechanism for formation.

The site generally slopes southwards towards Manchester Old Road along the southern border. However, a change in gradient is located between the car park and the golf course to the south but also to the wooded/overgrown area to the east/north-east. The golf course has local undulations which may be man-made however the areas surrounding the club house and car parking appears to have been made level to facilitate the construction of the golf course club house and associated car parking.

It is considered that Manchester Old Road was cut into the natural drift deposits, and therefore the site requiring a retaining wall along the southern boundary rather than the site being upfilled. It is considered that the subject site has underwent little to no development in regards to alteration of the natural landform.



FIGURE 4.1 SURFACE LIDAR DATA OF THE SITE AND SURROUNDING AREA (ENVIROCHECK)



4.3. GEOTECHNICAL DATA

Geotechnical data presented within a commercially available environmental database is summarised in Table 4.3.

TABLE 4.3 SUMMARY OF GEOTECHNICAL DATA

HAZARD	DESIGNATION
Shrink-Swell Clay	No hazard
Landslides	Very Low
Ground Dissolution	No hazard
Compressible Ground	No hazard
Collapsible Deposits	Very Low
Running Sand	Very Low

4.4. COAL MINING

The Envirocheck report states the site is in an area that may be affected by coal mining.

A Coal Authority (CA) mining report was obtained (Ref:51002462756001) dated 16th April 2021.

The CA operates a risk-based approach to the assessment of potential instability issues associated with future development of land located within the predefined CA consultation areas. This risk-based approach subdivides the potential risk into “low” and “high” risk categories.

The risk categories can be defined as:



Low-Risk Sites – Deemed to be land where coal mining has taken place, however it was at such depth not to pose a risk to new development and it therefore contains no known recorded risks and as such no further assessment is required.

For low-risk sites, the CA categorically states:

If your proposed development is within the Development Low Risk Area there is no need for you to submit any coal mining information with your planning application and The Coal Authority will not be consulted by the LPA. The LPA will include our Standing Advice as an informative note within the decision notice.

High-Risk Sites – Deemed to be landholdings located within an area known to contain legacy risks that include:

- ✳ Mine entries (shaft or adit);
- ✳ Shallow coal workings (recorded and probable);
- ✳ Workable coal seam outcrops;
- ✳ Mine gas sites and areas;
- ✳ Recorded coal-mining-related hazards;
- ✳ Geological features (fissures and break lines); and
- ✳ Former surface mining sites (sometimes using historic opencast extraction methods).

4.5. COAL MINING INFORMATION

Prior to the enactment of the Coal Mines Regulation Act (1872), which came into force on the 1st January 1883, there was no statutory requirement to record the extent of abandoned mine workings and as such the CA has no knowledge of extensive workings throughout the UK Coal Fields where shallow workings are present at a depth that could result in a subsidence event in the future (through successive cavitation) associated with failure of support mechanism.

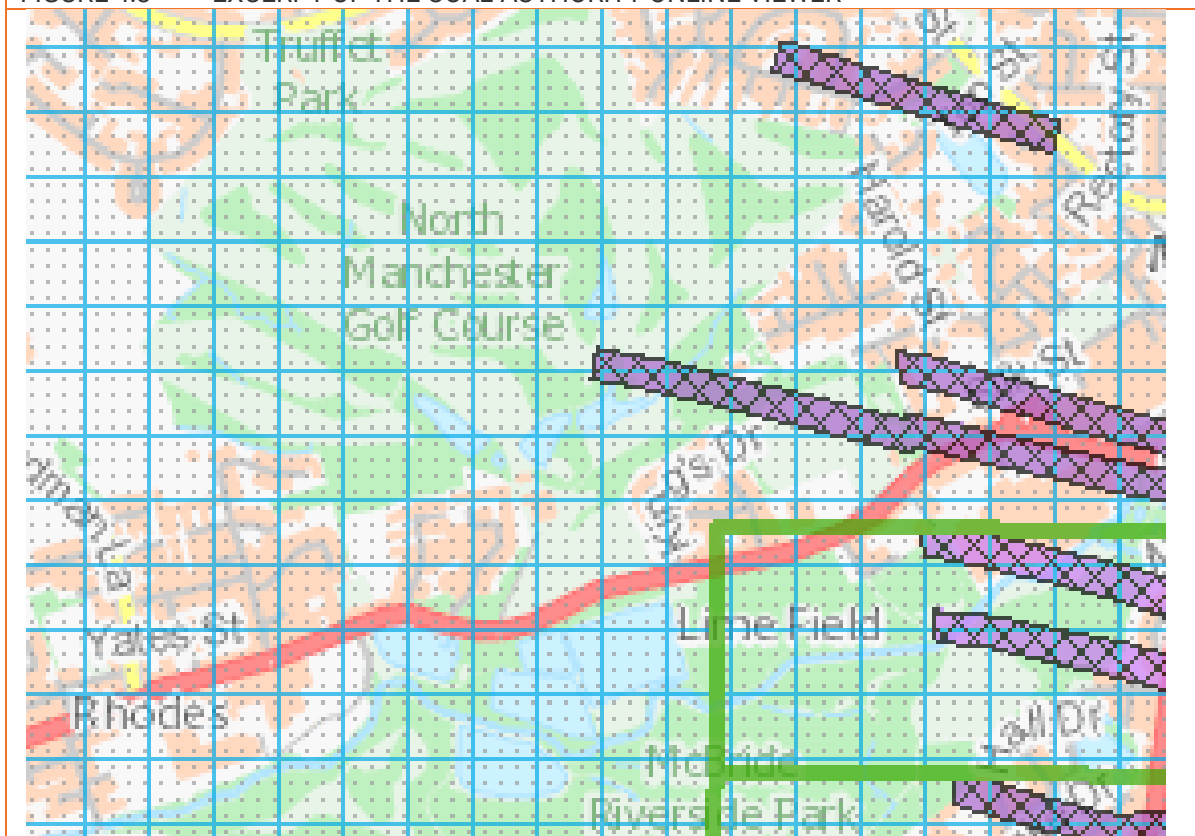
To determine if a site may have unrecorded or recorded coal mine workings requires the consideration of a wide range of information and E3P has completed a review of relevant information in relation to potential coal mining activities.

In the first instance, E3P has reviewed the Coal Authority Online Viewer and an excerpt of this is presented in Figure 4.3. This map shows that the site does not lie within a development high risk area. Furthermore, there are coal seams to the north of the residential development area, located to the east of the proposed driving range. No previous shallow mining or mining operations have taken place within the boundaries of the residential development area site boundary.

The area of development high risk and coal outcrop is considered to be to the east of the driving range.



FIGURE 4.3 EXCERPT OF THE COAL AUTHORITY ONLINE VIEWER



As the site is within an area affected by Coal Mining E3P have consulted with the Coal Authority who have provided a Consultant Coal Mining Report for the site (Ref:51002462756001).

Table 4.4 provides a summary of pertinent coal mining information with this report. It should be noted that the information provided herein from the Coal Authority is focused upon the Duchy Homes development boundary.

TABLE 4.4 COAL MINING INFORMATION

SOURCES OF INFORMATION	SUMMARY
Known Past Underground Mining	No past mining recorded.
Probable Unrecorded workings	None recorded.
Spine Roadways at Shallow Depth	No spine roadway recorded at shallow depth.
Mine Entries within 100m of the site	None recorded within 100 metres of the enquiry boundary.
Mine Abandonment plans	Mine abandonment plans are available from the Coal Authority however are not considered required for this assessment.
Known outcrops	No outcrops recorded.
Faults / Fissures	A fault is present across the south west of the site in a north-west to south-east orientation.
Opencast mines	None recorded within 500 metres of the enquiry boundary.



SOURCES OF INFORMATION	SUMMARY
Coal Authority Managed Tips	None recorded within 500 metres of the enquiry boundary.
Remediated Sites	None recorded within 50 metres of the enquiry boundary.
Coal Mining Subsidence	The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994. There is no current Stop Notice delaying the start of remedial works or repairs to the property. The Coal Authority is not aware of any request having been made to carry out preventive works before the coal is worked under section 33 of the Coal Mining Subsidence Act 1991.
Mine Gas	None recorded within 500 metres of the enquiry boundary
Mine Water	None recorded within 500 metres of the enquiry boundary.
Future Underground Mining	None recorded.
Coal Authority Development Advice	No action required.
British Geological Survey Mapping	The 1:10,000 geological mapping for the area shows no outcrops or worked seams within the site boundary.
Review of Coal Authority Archive	No CA archives/mine abandonment plans are made available.
Historical Ordnance Survey Mapping	A review of the 1:10,000 Ordnance Survey mapping from circa 1850, which has records of mine workings that predate the Mining & Regulation Act of 1872, has not identified any historical evidence of coal extraction within 500 m of the subject site.
Historical Site Investigations	E3P has not been provided with any historic site investigation reports.

4.5.1. COAL AUTHORITY PLAN

The Coal Authority plan referenced: MR-LARGE-PLOT-51002462756001-1618565109871 shows that no coal seams are present within the subject site or in close proximity.



FIGURE 4.4 COAL AUTHORITY PLAN FOR THE SITE



Note: The boundary has been extended by E3P to that in which has been provided by the Coal Authority.

4.6. COAL MINING RISK ASSESSMENT

This risk assessment comprises a desk-based review of all available information on coal mining issues that are relevant to the application site deemed to be located within a high-risk area. This includes:

- ✿ Interpretation of information to identify and assess the risks to the proposed development from coal mining legacy, including the cumulative impact of issues;
- ✿ Setting out appropriate mitigation measures to address the coal mining legacy issues affecting the site, including any necessary remedial works and/or demonstrate how coal mining issues have influenced the proposed development; and
- ✿ Demonstrating to the local planning authority that the application site is, or can be made, safe and stable to meet the requirements of national planning policy with regard to development on unstable land.

The coal mining risk assessment is summarised in Table 4.5.

TABLE 4.5 SUMMARY OF COAL MINING RISK ASSESSMENT

COAL MINING RISK ASSESSMENT	YES/NO	RISK ASSESSMENT
Recorded Underground Coal Mining at Shallow Depth (< 30 m)	No	Very Low
Recorded Underground Coal Mining at Shallow Depth (> 30 m)	No	Very Low
Evidence of Unrecorded Surface Extraction of Coal Outcrop	No	Very Low
Unrecorded Underground Coal Mining at Shallow Depth (< 30 m)	No	Very Low



COAL MINING RISK ASSESSMENT	YES/NO	RISK ASSESSMENT
Mine Entries (Shaft/Adits)	No	Very Low
Coal Mining Geology – Fractures/Fissures	No	Very Low
Recorded Gas Emissions	No	Very Low
Recorded Mining Surface Hazard	No	Very Low
Surface Mining (Opencast)	No	Very Low/Low

Based on the evidence provided, a low risk of unrecorded coal mining at shallow depth has been identified for the subject site.

4.7. RADON RISK POTENTIAL

The Envirocheck report indicates the site is situated in an area where less than 1% of homes are above the “Action Level” and that the BGS reports that full radon protective measures are not necessary in the construction of new dwellings or extensions.

4.8. PRELIMINARY GEOTECHNICAL ASSESSMENT

Based on the desk-study information, the following geotechnical assessment has been made:

- ✳ Trees are present along boundaries of the site, which due to the potential presence of cohesive drift deposits, will result in proposed foundations requiring deepening within their influence. Assessment must be undertaken as to the plasticity of the clay and its associated reaction to heave and/or cracking.
- ✳ The infilled pond located in the north-western sector of the residential development area of the site may give rise to geotechnical issues due to the potential of soft/unsuitable materials being utilised to backfill.
- ✳ Should areas of significant depths of Made Ground be identified, materials will require grubbing out to the base and backfilled with geotechnically suitable material.
- ✳ Existing buildings will require demolition, the materials from which may be utilised to create a 6F2 material with use in the development platform on site. The foundations from these features will also require grubbing out to the base and potentially further testing required to validate the material beneath the structures.
- ✳ The site is locally undulating with topographical variances against Manchester Old Road and in the north-east and north of the residential development and golf course club house area of the site. In order to construct low-rise residential development, some earthworks will be required to create a level developable platform.

4.9. HYDROLOGY

Surface water features within 250 m of the subject site are summarised in Table 4.6.

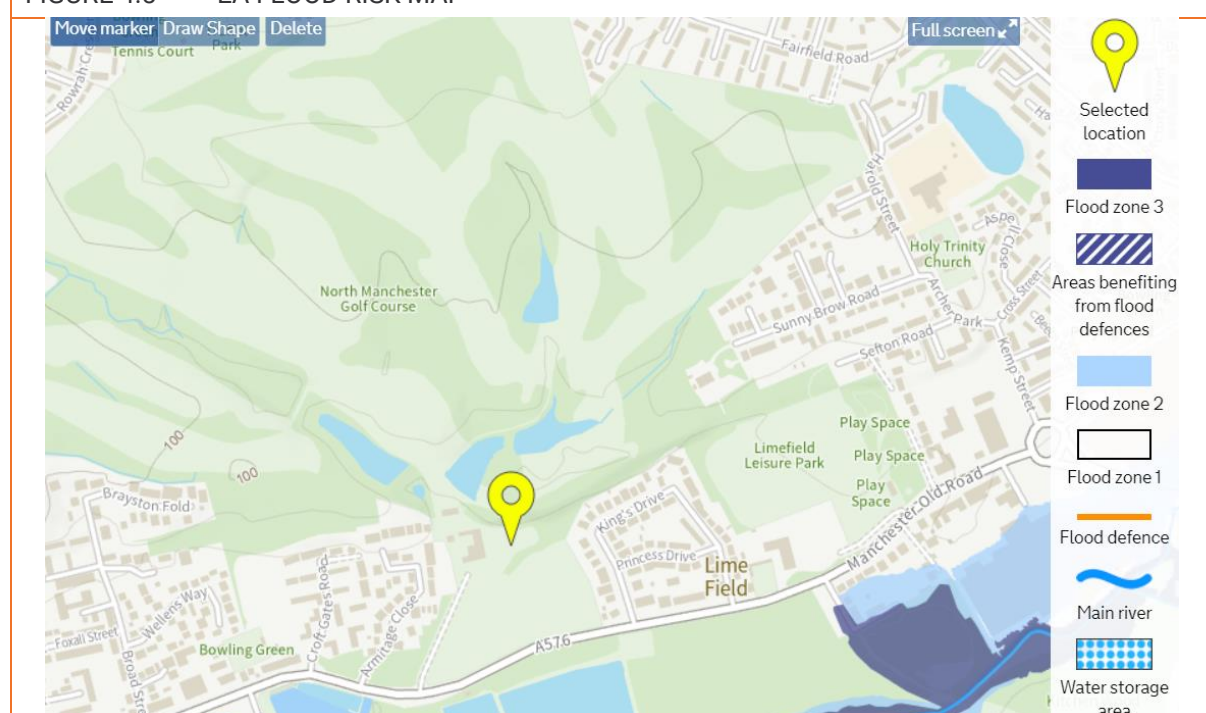


TABLE 4.6 SURFACE WATER FEATURES

SURFACE WATER FEATURE	QUALITY	DISTANCE (m)	DIRECTION
Unnamed Stream/Ditch	Unknown	On-site	North-East
Unnamed Stream/Ditch	Unknown	On-site	North-West
Unnamed Reservoir	Unknown	On Golf Course site.	Between northern and southern development parcels
Unnamed Reservoir	Unknown		
Pond	Unknown	22m	North of southern development area.
Unnamed Reservoirs	Unknown	30-90 m	South
Franks Dam Reservoir	Unknown	70 m	Northwest of southern development area.
River Irk	River Quality E	155 m	South

The site is located within a currently defined "Flood Risk Zone 1"; defined as land assessed as having less than 1 in 1,000 annual probability of river or sea flooding (< 0.1%), and as such is considered to be unaffected by river flooding. In addition, the Envirocheck report states there is a potential for groundwater flooding to occur at the surface. The Environment Agency (EA) Flood Risk Map for the site is presented as Figure 4.5.

FIGURE 4.5 EA FLOOD RISK MAP



Source - <https://flood-map-for-planning.service.gov.uk/>



Based on the local topography and the location of surface watercourses it is considered likely that shallow groundwater, if present, will flow in a southerly direction, following the topographical gradient towards The River Irk to the south of the site.

4.10. INDUSTRIAL LAND USES

The site is located within a predominantly residential area therefore there are no active entries within the trade directory for industrial land uses within 250m of the subject site.

4.11. SENSITIVE LAND USES

The closest residential properties are located adjacent to the eastern boundary of the site, and are in close proximity to the western boundary.

The site is located within a Nitrate Vulnerable Zone associated with the River Irk.

16m south of the site is Alkrington Woods which is designated as a Local Nature Reserve.

No other environmentally sensitive land uses have been identified within close proximity to the site.

4.12. SITE SENSITIVITY ASSESSMENT

The site is assessed to be located within a "High" sensitivity setting as discussed within Table 4.7.

TABLE 4.7 SITE SENSITIVITY ASSESSMENT

SENSITIVITY PROFILE	DISCUSSION	RATING
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not located within a Groundwater Source Protection Zone or Drinking Water Safeguard Zone.	Low
Distance to the Closest Groundwater Abstraction Point	Closest groundwater abstraction point is located 817m east of the site associated with manufacturing.	Moderate
Aquifer Classification in Superficial Drift Deposits	Secondary Aquifer – A / Secondary Undifferentiated	Low-Moderate
Aquifer Classification in Bedrock	Secondary Aquifer - A	Moderate
Is the Site Underlain by Low-Permeability Drift to Depths in Excess of 10 m?	The underlying superficial deposits are likely to comprise gravelly sands with high permeability characteristics which may lead to migration of possible pollutants to the underlying Secondary A Aquifers.	High
Is the Site Located Within 50 m of a Surface Watercourse?	Unnamed streams and ditches are present on-site. A pond is present circa 22m north of the southern development area, with two reservoirs present between the northern and southern development parcels.	High
Sensitive Land Uses	Residential properties are in close proximity to the site. A local nature reserve is circa 16m south of the site.	High
OVERALL SITE ENVIRONMENTAL SENSITIVITY		High



5. CONSULTATIONS

5.1. LANDFILL SITES AND WASTE TREATMENT SITES

There are three registered landfill sites recorded within 250 m of the subject site;

- ✳ A BGS recorded landfill site is located 28 m east of the subject site, however the Envirocheck states there is no threat to groundwater or surface water;
- ✳ A historical landfill site is located 27 m south-west of the subject site, at a former reservoir where deposited wastes included inert waste. No input dates have been provided.
- ✳ A historical landfill is located 29 m east of the subject site, named as land off Manchester Old Road. The landfill received inert, industrial, commercial, household and special waste including liquid sludge. The landfill inputted wastes between December 1967 and September 1974.

There are three entries within the Envirocheck Report for potentially infilled land (non-water) associated with the unknown filled ground (pit, quarry etc). The closest is located adjacent to the northern boundary of the southern development area, with two further entries located between 139 m and 238 m south of the site dated 1984. Additionally, there are two entries for potentially infilled land (water) for unknown filled ground (pond, marsh, river, stream, dock etc) between 58 m and 218 m from the site dated 1910.

No waste treatment sites have been identified within 500 m of the subject site.

5.2. REGULATORY DATABASE

The information summarised in Table 5.1 has been obtained from a commercially available environmental database. The summary table only includes records from within 250 m of the subject site and is not otherwise detailed in the report.

TABLE 5.1 SUMMARY OF ENVIRONMENTAL DATA

RECORD	ENTRIES WITHIN 250 m	DETAILS
Contaminated Land Register Entries and Notices	0	None Identified
Authorised Industrial Processes (IPC/IPPC/LAPPC)	1	LAPPC is located 127 m east of the subject site, in relation to Middleton Service Station.
Fuel Stations Entries	1	Rhodes Service Station is located 207 m east of the subject site. noted to be obsolete.
Licensed Radioactive Substances	0	None Identified
Enforcements, Prohibitions or Prosecutions	0	None Identified
Discharge Consents	9	The closest discharge consent is located 179 m south-west of the site operated by Littleborough Urban District Council and is noted to be lapsed. 7 entries are present between 201 m and 227 m south-west of the site. A Discharge consent operated by Bernstein Group PLC is located 230m south-west of the site.

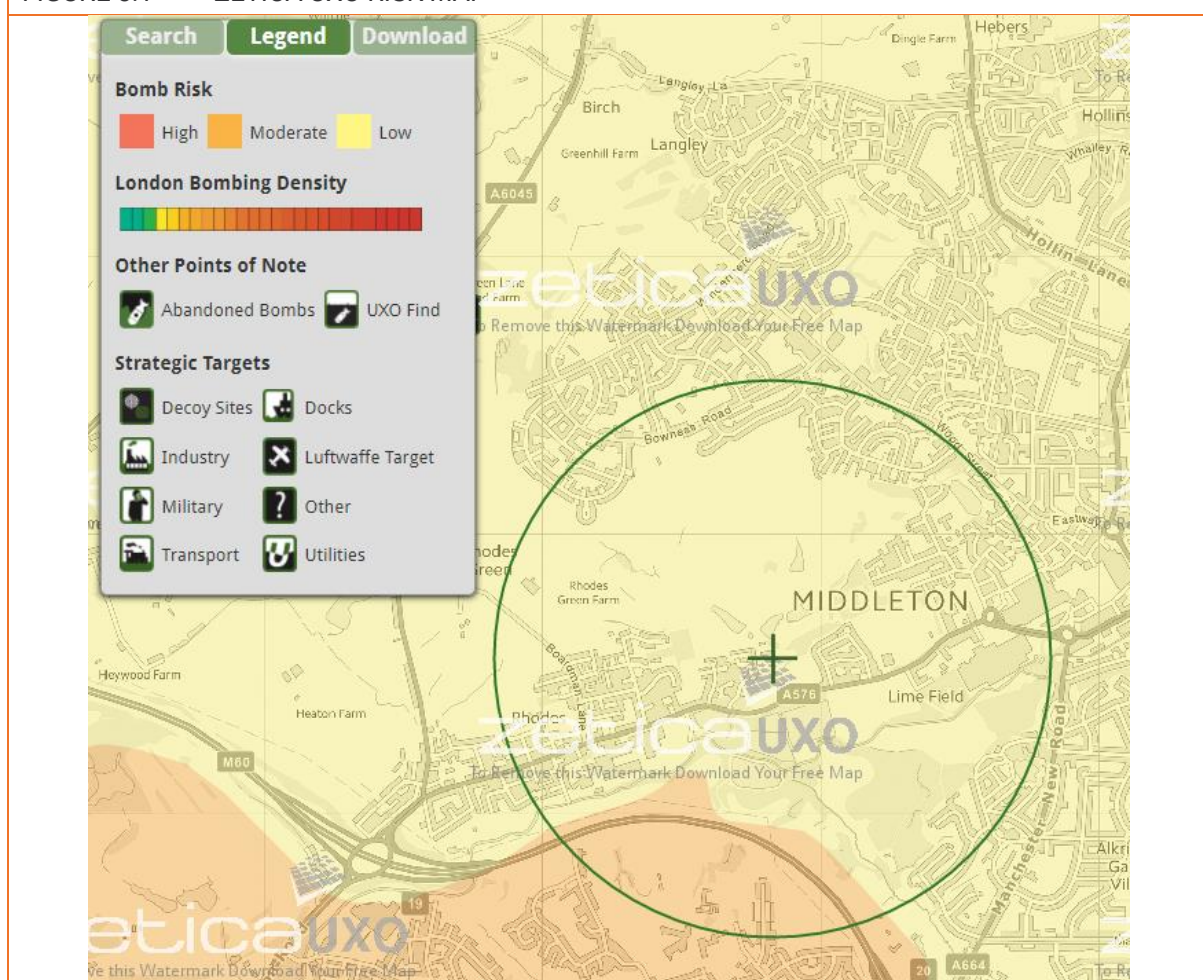


RECORD	ENTRIES WITHIN 250 m	DETAILS
Pollution Incidents	6	6 pollution incidents have been identified between 45 m and 156 m from the site and are all noted to be Category 3 minor incidents. All entries are related to the Irk catchment area and pollutants include chemicals, inert materials, oils diesel and sewage debris/litter.
Consents Issued Under the Planning (Hazardous Substances) Act 1990	0	None Identified
Control of Major Accident Hazard (COMAH) Sites	0	None Identified

5.1. UNEXPLODED ORDNANCE

The regional unexploded bomb risk map from Zetica (2014) indicates that the site is in an area at low risk from possible unexploded ordnance (UXO) resulting from the Second World War. The Zetica UXO Risk Map is presented as Figure 5.1.

FIGURE 5.1 ZETICA UXO RISK MAP



Source - <https://zeticauxo.com/downloads-and-resources/risk-maps/>



5.2. INITIAL CONCEPTUAL SITE MODEL

In accordance with EA LCRM (2019) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), E3P has developed an initial conceptual site model (CSM) to identify potential contamination sources, migration pathways and receptors within the study area. This is summarised in Table 5.2.

ON-SITE SOURCES OF CONTAMINATION

The following potential on-site sources of contamination have been identified:

- ✳ Potentially infilled pond features located in the northeast of the southern sector of the site;
- ✳ Possible chemical contamination originating from the maintenance of the golf course, such as localised fuel spillages and pesticide use; and,
- ✳ Possible Made Ground deposits associated with the demolition of buildings and subsequent development and levelling of the car parking area.

OFF-SITE SOURCES OF CONTAMINATION

The following potential off-site source of contamination have been identified:

- ✳ Bleach works located on the western boundary of the site;
- ✳ Landfill sites surrounding the subject site;
- ✳ Printworks located to the south-west of the subject site; and,
- ✳ Infilled pits.



TABLE 5.2 INITIAL CONCEPTUAL SITE MODEL

SOURCE	PATHWAY	RECEPTOR
Human Health		
Heavy Metals, PAHs Associated With Made Ground and Ground Maintenance.	Dermal Contact and Ingestion. Consumption of Homegrown Produce.	Construction Workers. Residential End Users.
Discussion: Limited Made Ground, considered a source of heavy metals and non-volatile PAHs, is anticipated on-site given the largely undeveloped nature of the site. However, Made Ground associated with former construction, development and levelling in the southern sector of the site is anticipated. An infilled pond on-site has been identified and may be a source of deeper Made Ground and potentially heavy metals and PAHs. Spillages from machines associated with the golf course on site are unlikely however still possible. Heavy metals associated with chemicals utilised for golf course maintenance may be present on site. Intrusive ground investigation is required to assess the presence of any Made Ground on site which could be a potential source of heavy metals and non-volatile PAHs. Should Made Ground be present it may be a potential source of these determinants and these may pose a short term risk to construction workers who may come into contact with impacted soils during earthworks. All construction works must be undertaken using the appropriate Personal Protective Equipment (PPE) to remove this potential risk. Future residential users may come into contact with impacted soils within any garden and landscaped areas. If impacted soils are identified then localised remediation or an appropriate cover system, designed in accordance with BRE465 (Cover Systems for Land Regeneration), will remove the exposure pathway and therefore risk to future residential site users.		
Volatile Hydrocarbon Compounds Associated with Industrial Equipment Used For Ground Maintenance.	Volatilisation/Accumulation. Vapour Inhalation.	Construction Workers. Residential End Users.
Assessment Sources of volatile contamination are considered unlikely due to the largely undeveloped nature of the site. Leakages/spillages of volatile contamination associated with maintenance of the golf course are considered possible, however, these are unlikely and if present will be localised. Off-site a former bleach works was present to the west of the subject site. Sodium hypochlorite is diluted with water with the addition of detergents or soap to make bleach or disinfectant. There is no current hazardous materials storage as the area has been redeveloped into housing. It is known historically that a sodium hypochlorite solution (bleach) was stored in the adjacent bleach works. The infilled bleach pits and above ground storage tanks located on the land to the west of the site is a potential source of bleach solution, although this is thought to be a very low risk as it is likely the tanks were pumped dry and cleaned prior to backfilling. Furthermore, any historical spills in the bleaching room may be a potential source of bleach solution. The risk to the subject site is considered to be low as the site has been redeveloped into housing so has likely gone under remediation. Intrusive ground investigation is required to assess the presence of any Made Ground on site which could be a potential source of volatile contaminants.		
Asbestos-Containing Materials (ACMs) within Made Ground	Fibre/Dust Inhalation.	Construction Workers. Residential End Users. Third-Party Property.
Assessment: The presence of ACM within the building fabric of the existing structures to be demolished and underlying Made Ground cannot be discounted. Furthermore, ACM may be present within the infilled pond on-site. Asbestos containing material may be presented within any localised Made Ground; but given the predominantly undeveloped nature of the site; the wide-spread presence of any asbestos or contaminants is not anticipated.		



SOURCE	PATHWAY	RECEPTOR
ACM poses a risk through fibre and dust inhalation and if present may pose a risk to construction workers during any future earthworks/demolition, should dust be generated during those works. Intrusive ground investigation is required to assess the presence of any Made Ground on site which could be a potential source of ACM. Risks from ACM can be mitigated through the development of a detailed enabling works strategy following guidance and protocol specified within the Control of Asbestos Regulations (2012) and industry best practice as detailed in CIRIA733 (Asbestos in Soil and Made Ground: A guide to understanding risk). Construction works completed with PPE and provision of welfare.		
Hazardous Ground Gases		
Methane and Carbon Dioxide Associated with Possible On-Site Fill Material, Infilled Pond and Off-Site Landfill.	Inhalation. Accumulation.	Construction Workers. Residential End Users.
Assessment: An infilled pond has been identified on site and former landfills within proximity to the site which may be a source of Made Ground, alluvial deposits or contain deeper organic soils with putrescible matter which may be subject to decay-producing low levels of hazardous ground gases such as carbon dioxide and methane. Carbon dioxide and methane have associated asphyxiation and explosive risks, respectively. Ground gas monitoring will likely be required to assess any potential gas production from infilled features. Should a ground gas risk be identified to end users, the risks can be mitigated through the adoption of suitable control measures within the building construction using guidance presented within CIRIA 665 (Assessing Risk Posed by Hazardous Ground Gases to Buildings) and BS8485 (Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments).		
Controlled Waters		
Hydrocarbon and Volatile Compounds Associated Course Maintenance, Infilled Pond and Localised Made Ground.	Vertical/Lateral Migration.	Streams/Ditches, Reservoirs Secondary A Aquifer
Discussion: Limited sources of volatile contamination are anticipated on-site due to the largely undeveloped nature of the site. Leakages/spillages associated with ground maintenance of the golf course is a possible source of volatile contamination. Minimal mobile contaminants are anticipated to be present associated with underlying Made Ground; if present they are likely to be localised. Drift deposits are considered to comprise permeable sand deposits which will not afford much protection to the Secondary A Aquifer. Surface water features are in close proximity to the site. A controlled water risk assessment will be required following groundwater monitoring.		
Buildings and Infrastructure		
pH and Sulphate associated with Made Ground deposits located on site	Corrosion of Concrete.	Foundations/Concrete.
Discussion: Elevated levels of pH and Sulphates could be present within Made Ground deposits located on site possibly proving detrimental to the foundations of the proposed development.		



SOURCE	PATHWAY	RECEPTOR
Ecology		
Heavy metals and PAHs in Made Ground	Lateral Migration.	Streams/Ditches/ Reservoirs
Discussion: Heavy metal and PAH contamination is considered possible which may be taken up by flora in soft landscaping/gardens.		



6. GROUND INVESTIGATION

6.1. GENERAL OVERVIEW

A ground investigation has been designed based on the findings of the desk study, with exploratory holes advanced to target specific potential contaminant sources summarised in Table 6.1. The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed between the 15th and 16th March 2021, and only covers the area of land proposed to be redeveloped into low rise residential properties for Duchy Homes. The works are summarised in Table 6.1.

6.2. LIMITATIONS OF THE INVESTIGATION

-  Access was limited to the area in the northeastern sector of the site due to the presence of Himalayan Balsam.
-  Access in the central-eastern area of the site was limited due to the presence of a LHP gas main and electricity infrastructure.
-  Access in the area of soft landscaping in front of the club house could not be investigated due to the presence of live services.



6.3. SCOPE OF INVESTIGATION

TABLE 6.1 SUMMARY OF FIELDWORK

POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	MONITORING WELLS RESPONSE ZONE (m bgl)
General Ground Conditions of Deeper Soil Horizons	CP101	Cable Percussive Borehole	20.45	N/A
	CP102		20.45	N/A
General Ground Conditions Including the Presence/Nature of Made Ground in the Vicinity of the Former Pond.	WS104	Window Sample Probehole	4.45	1.00–3.00
General Ground Conditions Including the Presence/Nature of Made Ground in the North-Eastern Sector of the Site.	HDP101	Hand Dug Pit	1.10	N/A
	WS103	Window Sample Probehole	3.45	0.50–1.00
General Ground Conditions Including the Presence/Nature of Made Ground or Topsoil Deposits Within the Golf Course	WS101	Window Sample Probehole	5.45	0.50–1.50
	WS102		4.45	N/A
	WS105		3.45	1.00–1.75
	TP101-TP102, TP104-TP109	Mechanically Excavated Trial Pit	2.20	N/A
General Ground Conditions and Soakaway Potential Assessment	TP103 / SA101	BRE365 Permeability Tests	2.00	N/A
	TP110 / SA102		1.80	
	TP111 / SA103		1.60	

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples, spatially distributed to offer the maximum site coverage whilst also being advanced to target specific contaminant sources. Soakaway testing was also completed in three of these trial pits for the purposes of assessing soakaway potential.

Window sample probeholes were advanced to undertake in-situ detailed geotechnical testing, obtain environmental samples and install groundwater and ground gas monitoring wells.

A series of cable percussive boreholes were advanced to circa 20.45m bgl to investigate deep ground conditions, undertake in-situ geotechnical testing and obtain geotechnical samples.

A hand dug pit was placed within the north eastern sector of the site to investigate ground conditions and collect samples for environmental and geotechnical analysis.

The sampling locations are illustrated in Drawing 14-807-005 (Appendix III). The ground conditions encountered are indicated on the logs, which are provided in Appendix V.

Return visits were made to monitor installations for groundwater level and gas concentrations. In addition, selected wells were purged and samples of groundwater recovered for chemical analysis.



6.4. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix V and presented in Table 7.3 and discussed in Section 9.

6.5. PERMEABILITY TESTS

Three soakaway tests were undertaken (SA101, SA102 and SA103) in order to assess the likely permeability of the underlying strata to determine the potential suitability for soakaway drainage within the proposed development. The results are presented in Table 7.6 and the test certificates are included within Appendix IX.

6.6. LABORATORY ANALYSIS

Selected soil samples were submitted for a range of chemical analysis comprising:

-  Metals.
-  pH, total sulphate, water-soluble sulphate (2:1 extract).
-  Sulphide.
-  Cyanide.
-  Phenols.
-  Total and speciated polycyclic aromatic hydrocarbons (PAHs).
-  Asbestos identification and quantification.
-  Speciated and banded total petroleum hydrocarbon (TPH).

I2 Analytical undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 8.

Selected samples were submitted to PSL Laboratory where the following geotechnical tests were undertaken:

-  Consolidation (OED)
-  Particle Size Distribution (PSD)

Laboratory analysis sheets are included in Appendix XI and are summarised in Section 7.



7. GROUND AND GROUNDWATER CONDITIONS

7.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 7.1.

TABLE 7.1 SUMMARY OF STRATA

HOLE	DEPTH TO STRATUM (m bgl)			
	MADE GROUND	TOPSOIL	SAND	CLAY
CP101	-	0.00–0.30	0.30–5.60	5.60–20.45
CP102	-	0.00–0.30	0.30–5.50	5.50–20.45
WS101	-	0.00–0.20	0.20–5.45	-
WS102	-	0.00–0.30	0.30–4.45	-
WS103	-	0.00–0.30	0.30–3.45	-
WS104	0.00–1.10	-	1.10–4.45	-
WS105	-	0.00–0.30	0.30–3.45	-
TP101	0.00–1.00	-	1.00–2.20	-
TP102	0.00–1.00	-	1.00–2.10	-
TP103/SA101	0.00–0.21	-	0.21–2.00	-
TP104	-	0.00–0.30	0.30–1.90	-
TP105	-	0.00–0.25	0.25–1.90	-
TP106	-	0.00–0.25	0.25–2.00	-
TP107	-	0.00–0.20	0.20–1.80	-
TP108	-	0.00–0.30	0.30–1.80	-
TP109	-	0.00–0.30	0.30–1.80	-
TP110/SA102	-	0.00–0.30	0.30–1.80	-
TP111/SA103	-	0.00–0.30	0.30–1.60	-
HDP101	0.00–0.90	-	0.90–1.10	-

7.2. MADE GROUND

Made Ground deposits were encountered in five exploratory hole locations (WS104, TP101, TP102, TP103 and HDP101) to a maximum proven depth of 1.10m bgl.

Made Ground deposits within TP101 and TP102 generally comprised a reworked topsoil of a black slightly clayey sand with frequent rootlets overlying a brown orange medium clayey medium sand. These materials were subsequently underlain with a blackish brown very clayey medium sand. The reworked topsoil was also identified within TP103.

Within HDP101 Made Ground comprised a reworked topsoil as above, overlying Made Ground sand deposits as per the above.



Made Ground deposits in WS104 comprised a blackish grey slightly clayey sand with occasional brick fragments and was considered to be associated with the former pond in this area of the site.

A Depth of Made Ground Plan is presented as Drawing 14-807-006 in Appendix III.

7.3. TOPSOIL

Natural topsoil deposits were identified within 14 exploratory hole locations to depths of between 0.20-0.30m bgl. The topsoil deposits comprised of a black slightly clayey medium SAND with frequent rootlets.

7.4. DRIFT DEPOSITS

Drift deposits were encountered within all exploratory locations to a maximum depth of 20.45mbgl.

Drift deposits generally comprised a brown slightly clayey medium SAND overlying a loose to medium dense brown very gravelly, slightly clayey medium SAND with gravel and cobbles of sandstone, mudstone and limestone to a maximum depth of 5.60mbgl.

Within TP103/SA101 a light brown slightly clayey medium SAND was encountered to a maximum depth of 2.10 m bgl, while in WS104 a brownish grey very silty, slightly clayey fine SAND was encountered, which was considered likely be silt materials associated with the base of the former infilled pond.

Within WS101 a grey slightly clayey, very gravelly medium SAND with gravel of sandstone, mudstone and limestone was overlying the brown slightly clayey medium SAND. However the underlying SAND identified fragments of coal.

SAND deposits were noted to be very loose or loose within WS101, WS102, WS103, WS104, WS105, CP101 and CP102 at depths of between 1.20m and 5.45mbgl.

Underlying the gravelly medium SAND deposits, which were encountered within CP101 and CP102 from 5.60mbgl and 5.50mbgl respectively was a very stiff high strength brown sandy CLAY.

7.5. SOLID GEOLOGY

The bedrock geology was not encountered as part of the ground investigation.

Historic BGS boreholes in the surrounding area have identified that bedrock is likely to be present beneath the site at circa 45.00m bgl.

7.6. GROUNDWATER

Groundwater strikes were encountered as strikes. The depth of the strikes are shown on the exploratory hole records in Appendix V and are summarised in Table 7.2.

TABLE 7.2 SUMMARY GROUNDWATER STRIKES

LOCATION	DEPTH TO STRIKE (m)	NOTES
TP105	0.80	Water Strike – Saturated sands
TP106	1.00	Water Strike – Saturated sands
TP107	1.60	Water Strike – Saturated sands
TP108	1.80	Water Strike – Saturated sands



LOCATION	DEPTH TO STRIKE (m)	NOTES
TP109	1.60	Water Strike – Saturated sands
WS101	1.50	Water Strike – Saturated sands
WS102	0.50	Water Strike – Saturated sands
WS103	1.00	Water Strike – Saturated sands
WS104	1.50	Water Strike - Slow ingress
WS105	1.75	Water Strike – Saturated sands
CP102	1.00	Water Strike

7.7. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has not been identified during the site investigation.

7.8. SOIL CONSISTENCY

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 7.3.

7.9. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation.

In a number of trial pit locations the side stability was unstable due to the presence of loose sands and water strikes. The SAND deposits were noted to be saturated where water strike were present. Deeper excavations were prone to collapse due to the presence of damp granular soils with little stability.

Window sample probeholes were noted to collapse due to loose SAND deposits.

The presence of water reduces the inherent strength of granular deposits through the increase in hydrostatic pore pressure.



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TABLE 7.3 STANDARD/CONE PENETRATION TEST RESULTS

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS101	1.2	SAND	13	12.76	Medium Dense	N/A	N/A	N/A	127.56
WS101	2	SAND	18	16.44	Medium Dense	N/A	N/A	N/A	164.44
WS101	3	SAND	6	5.22	Loose	N/A	N/A	N/A	52.18
WS101	4	SAND	16	13.52	Medium Dense	N/A	N/A	N/A	135.18
WS101	5	SAND	25	20.74	Medium Dense	N/A	N/A	N/A	207.41
WS102	1.2	SAND	8	7.85	Loose	N/A	N/A	N/A	78.50
WS102	2	SAND	0	0.91	Very Loose	N/A	N/A	N/A	9.13
WS102	3	SAND	13	11.31	Medium Dense	N/A	N/A	N/A	113.05
WS102	4	SAND	26	21.97	Medium Dense	N/A	N/A	N/A	219.66
WS103	1.2	SAND	13	12.76	Medium Dense	N/A	N/A	N/A	127.56
WS103	2	SAND	8	7.31	Loose	N/A	N/A	N/A	73.08
WS103	3	SAND	9	7.83	Loose	N/A	N/A	N/A	78.27
WS104	1.2	SAND	8	7.85	Loose	N/A	N/A	N/A	78.50



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BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS104	2	SAND	19	17.36	Medium Dense	N/A	N/A	N/A	173.57
WS104	3	SAND	10	8.70	Loose	N/A	N/A	N/A	86.97
WS104	4	SAND	16	13.52	Medium Dense	N/A	N/A	N/A	135.18
WS105	1.2	SAND	11	10.79	Medium Dense	N/A	N/A	N/A	107.94
WS105	2	SAND	7	6.39	Loose	N/A	N/A	N/A	63.95
WS105	3	SAND	8	6.96	Loose	N/A	N/A	N/A	69.57
CP101	1.2	SAND	18	17.66	Medium Dense	N/A	N/A	N/A	176.62
CP101	2	SAND	15	13.70	Medium Dense	N/A	N/A	N/A	137.03
CP101	3	SAND	16	13.91	Medium Dense	N/A	N/A	N/A	139.14
CP101	4	SAND	9	7.60	Loose	N/A	N/A	N/A	76.04
CP101	5	SAND	8	6.64	Loose	N/A	N/A	N/A	66.37
CP101	6.5	CLAY	20	16.33	N/A	High strength	Very Stiff	81.64	167.85
CP101	8	CLAY	25	20.24	N/A	High strength	Very Stiff	101.18	208.03
CP101	9.5	CLAY	27	21.76	N/A	High strength	Very Stiff	108.80	223.70
CP101	11	CLAY	29	22.43	N/A	High strength	Very Stiff	112.14	230.55



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CP101	12.5	CLAY	29	21.19	N/A	High strength	Very Stiff	105.94	217.81
CP101	14	CLAY	30	20.78	N/A	High strength	Very Stiff	103.91	213.63
CP101	15.5	CLAY	35	23.05	N/A	High strength	Very Stiff	115.27	236.99
CP101	17	CLAY	40	25.11	N/A	High strength	Very Stiff	125.56	258.15
CP101	18.5	CLAY	50	29.98	N/A	High strength	Very Stiff	149.88	308.15
CP101	20	CLAY	50	28.67	N/A	High strength	Very Stiff	143.36	294.75
CP102	1.2	SAND	15	14.72	Medium Dense	N/A	N/A	N/A	147.19
CP102	2	SAND	10	9.14	Loose	N/A	N/A	N/A	91.35
CP102	3	SAND	8	6.96	Loose	N/A	N/A	N/A	69.57
CP102	4	SAND	9	7.60	Loose	N/A	N/A	N/A	76.04
CP102	5	SAND	11	9.13	Loose	N/A	N/A	N/A	91.26
CP102	6.5	CLAY	23	18.78	N/A	High strength	Very Stiff	93.88	193.03
CP102	8	CLAY	26	21.05	N/A	High strength	Very Stiff	105.23	216.35
CP102	9.5	CLAY	27	21.76	N/A	High strength	Very Stiff	108.80	223.70
CP102	11	CLAY	31	23.97	N/A	High strength	Very Stiff	119.87	246.45
CP102	12.5	CLAY	33	24.11	N/A	High strength	Very Stiff	120.55	247.85
CP102	14	CLAY	34	23.55	N/A	High strength	Very Stiff	117.76	242.12
CP102	15.5	CLAY	41	27.01	N/A	High strength	Very Stiff	135.03	277.62



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BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
CP102	17	CLAY	42	26.37	N/A	High strength	Very Stiff	131.84	271.05
CP102	18.5	CLAY	50	29.98	N/A	High strength	Very Stiff	149.88	308.15
CP102	20	CLAY	50	28.67	N/A	High strength	Very Stiff	143.36	294.75

NOTES

* The Allowable Bearing Pressure (ABP) should be considered indicative.

The interpretation of in situ mass undrained shear strength (cu) data from SPT Blow Count (N) results and the influence of the Plasticity Index (PI) was reported in Standard Penetration Test in Insensitive Clays and Soft Rocks. Stroud (1974). The standard penetration test and the engineering properties of glacial materials subsequently. Stroud and Butler (1975) and (1989).

Allowable bearing pressure on sands. Soil Mechanics in Engineering Practice Terzaghi, K. & Peck, R.B. 1996.



7.10. CONSOLIDATION

A series of undisturbed samples of Glacial Till were submitted for oedometer analysis. Oedometer analysis was completed using remoulded samples. The results are provided in Table 7.4.

TABLE 7.4 OEDOMETER CONSOLIDATION RESULTS

LOCATION	DEPTH (m)	SAMPLE TYPE	MOISTURE CONTENT (%)	OEDOMETER CONSOLIDATION		
				PRESSURE RANGE (kPa)	M _v (m ² /MN)	C _v (m ² /year)
CP101	6.50-6.95	TUB	13	0-134.5	0.382	38.482
				134.5-269	0.119	20.736
				269-538	0.081	14.278
				538-1076	0.048	7.034
				1076-134.5	0.021	8.499
CP101	9.50-9.95	TUB	13	0-194.5	0.220	39.161
				194.5-389	0.071	12.952
				389-778	0.038	3.334
				778-1556	0.024	2.080
				1556-194.5	0.007	3.280
CP102	12.50-12.95	TUB	15	0-254.5	0.114	30.943
				254.5-509	0.075	19.774
				509-1018	0.049	10.837
				1018-2036	0.029	2.079
				2036-254.5	0.017	1.740
CP102	14.00-14.45	TUB	15	0-284.5	0.100	23.654
				284.5-569	0.050	9.263
				569-1138	0.034	4.957
				1138-2276	0.021	2.518
				2276-284.5	0.007	2.129
CP102	18.50-18.95	TUB	17	0-374.5	0.141	32.648
				374.5-749	0.062	6.797
				749-1498	0.030	3.562
				1498-2996	0.018	1.539
				2996-374.5	0.010	2.092

When considered at over-burden pressure with an additional load of 134-2996 kPa the coefficient of volume compressibility (M_v) ranged from 0.007 m²/MN up to 0.382 m²/MN. The material is considered to be very low to high compressibility.



The rate at which settlement is likely to occur is determined by the coefficient of consolidation (C_v). As shown in Table 7.4, the coefficient ranges from 1.539 m^2/yr to 39.161 m^2/yr . The rate at which settlement will occur is increased by the presence of sand within the Glacial Till and it is likely that settlement will occur over a period of months to years.

7.11. PARTICLE SIZE DISTRIBUTION

Particle Size Distribution Tests have been undertaken on selected samples of granular material via wet sieve to obtain information on the soil fractions. The results are included in Table 7.5. The full results can be found in Appendix XI.

TABLE 7.5 SUMMARY OF PARTICLE SIZE DISTRIBUTION TEST RESULTS

LOCATION	DEPTH (m)	SOIL FRACTION (%)			
		COBBLES	GRAVEL	SAND	SILT/CLAY
TP101	0.70 (Natural)	0	10	73	17
TP104	1.80 (Natural)	0	59	34	7

7.12. SOIL INFILTRATION

In-situ BRE 365 Soakaway tests were undertaken over a 48 hour period within trial pits completed as SA101, SA102 and SA103.

The results are presented in Table 7.6 below and the test certificates are included within Appendix IX.

TABLE 7.6 BRE365 SOAKAWAY TESTING RESULTS

LOCATION	DEPTH (m)	MATERIAL	TEST NO.	SOIL INFILTRATION RATE (m/s)
SA101	2.00	Slightly clayey SAND	Test No.1	6.00E-05
			Test No.2	3.13E-05
			Test No.3	3.02E-05
SA102	1.80	Slightly clayey very gravelly SAND	Test No.1	6.63E-05
			Test No.2	4.85E-06
			Test No.3	3.32E-05
SA103	1.60	Slightly clayey SAND / Slightly clayey very gravelly SAND	Test No.1	2.26E-05
			Test No.2	2.80E-05
			Test No.3	3.02E-05

Soil infiltration was taken over the wetted area from between 75% and 25% of the effective depth. All tests showed granular drift deposits to have good soakaway potential.

Therefore, considering the significant volumes of permeable SAND drift deposits on the site, it is considered that soakaway drainage may be suitable for the proposed development. However, the application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – *Soakaway Design*.



7.13. CALIFORNIA BEARING RATIO

The California bearing ratio (CBR) for the soils were measured using an in-situ TRL probe. The results are summarised in Table 7.7.

The result sheets are included in Appendix VIII and the locations are shown on Drawing 14-807-005 (Appendix III). CBR results have been averaged from the blow counts across the strata tested and any abnormally high blow counts ignored as these are likely to be from larger granular material and so represent anomalies.

TABLE 7.7 SUMMARY OF DCP RESULTS

LOCATION	DEPTH (m)	STRATA	IN-SITU OR LAB TEST	CBR (%)
DCP101	0.43–0.86	Very gravelly SAND	In-Situ	8.11
DCP102	0.66–0.84	Very gravelly SAND	In-Situ	11.04
DCP103	0.55–0.86	Very gravelly SAND	In-Situ	10.46
DCP104	0.34–0.59	Very gravelly SAND	In-Situ	14.92
DCP105	0.58–0.79	Slightly clayey SAND	In-Situ	22.17
DCP106	0.49–0.86	Gravelly SAND	In-Situ	2.54

It should be noted that the reported CBR results were obtained from soils in a highly undisturbed state. If, however, the topsoil and surface cover is removed during periods of wetter climatic condition, the formation will soften, reducing the CBR.

7.14. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 7.8), shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

TABLE 7.8 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
TP101	0.90	0.0062	7.1	DS-1, AC-1s
TP102	0.25	0.016	6.5	DS-1, AC-1s
TP106	0.10	0.019	5.6	DS-1, AC-1s
TP108	0.20	0.021	5.6	DS-1, AC-1s
WS101	0.50	0.0044	7.5	DS-1, AC-1s
WS102	1.00	0.0046	7.7	DS-1, AC-1s
WS103	1.00	0.0085	7.8	DS-1, AC-1s
WS104	1.00	0.032	6.4	DS-1, AC-1s
WS104	1.50	0.014	8.1	DS-1, AC-1s
HP101	0.80	0.019	8.4	DS-1, AC-1s



8. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

8.1. DEVIATING SAMPLES

Deviating samples were to be avoided during the ground investigation by using best practice sampling procedures including use of appropriate sampling containers and adhering to the laboratory holding times for each contaminant analysis undertaken. The following is noted regarding sample deviations:

8.2. HUMAN HEALTH RISK ASSESSMENT

At Tier 1 stage, the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM/CIEH S4UL (S4UL3267).

The results of this comparison have been summarised within Table 8.1.



TABLE 8.1 SUMMARY OF INORGANIC AND HYDROCARBON TOXICITY ASSESSMENT FOR A RESIDENTIAL END USE

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
Arsenic	mg/kg	37	16	25	N/A	1	No Further Action
Cadmium	mg/kg	17	16	<0.2	N/A	1	No Further Action
Chromium (VI)	mg/kg	6.1	16	< 4.0	N/A	1	No Further Action
Lead	mg/kg	200	16	140	N/A	1	No Further Action
Mercury	mg/kg	1.2	16	< 0.3	N/A	3	No Further Action
Nickel	mg/kg	180	16	19	N/A	1	No Further Action
Selenium	mg/kg	250	16	< 1.0	N/A	1	No Further Action
Copper	mg/kg	2400	16	51	N/A	1	No Further Action
Zinc	mg/kg	3700	16	120	N/A	1	No Further Action
Cyanide – Total	mg/kg	791	16	< 1.0	N/A	1	No Further Action
Phenols – Total	mg/kg	210	16	< 1.0	N/A	1	No Further Action
Asbestos	Fibres	NFD	16	NFD	N/A	3	No Further Action
Naphthalene	mg/kg	2.3	16	<0.05	N/A	4	No Further Action
Acenaphthylene	mg/kg	170	16	<0.05	N/A	2	No Further Action
Acenaphthene	mg/kg	210	16	0.38	N/A	1	No Further Action
Fluorene	mg/kg	170	16	0.23	N/A	1	No Further Action
Phenanthrene	mg/kg	95	16	2.6	N/A	2	No Further Action
Anthracene	mg/kg	2400	16	0.57	N/A	2	No Further Action
Fluoranthene	mg/kg	280	16	3.5	N/A	2	No Further Action
Pyrene	mg/kg	620	16	3.5	N/A	2	No Further Action
Benzo(a)Anthracene	mg/kg	7.2	16	1.9	N/A	2	No Further Action
Chrysene	mg/kg	15	16	1.4	N/A	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	2.6	16	1.9	N/A	2	No Further Action
Benzo(k)Fluoranthene	mg/kg	77	16	0.8	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	2.2	16	1.8	N/A	2	No Further Action
Indeno(123-cd)Pyrene	mg/kg	27	16	0.78	N/A	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.24	16	<0.05	N/A	2	No Further Action
Benzo(ghi)Perylene	mg/kg	320	16	0.94	N/A	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	16	< 1.0	N/A	4	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	16	< 0.1	N/A	4	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	16	< 0.1	N/A	4	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	74	16	<2.0	N/A	4	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	140	16	<4.0	N/A	4	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	260	16	21	N/A	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	1100	16	15	N/A	1	No Further Action



Notes

PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical / Lateral Migration; PL6 = Corrosion of concrete; PL7=Tainting of water supply; PL8 = Uptake by plants

Abbreviations: GAC = general assessment criteria, n = number of samples, MC = maximum concentration; Loc of Ex = location of exceedance; NFD = no fibres detected.

* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 1 values for aromatic compound for the non-volatile fractions (C12-C35). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

Referring to Table 8.1, the results of this direct comparison indicates that the data does not exceed the screening criteria for a residential end use for any contaminants.

HUMAN HEALTH RISK ASSESSMENT AND MITIGATION

Chemical analysis have not identified elevated levels of contaminants of concern within the most recent E3P site investigation.

Within the previous ground investigation completed by E3P, elevated concentrations of asbestos, lead, arsenic, Benzo(b)Fluoranthene, Benzo(a)Pyrene and Dibenzo(a,h)Anthracene were identified. Asbestos was identified in TP102 within Made Ground deposits however this location is outside of the proposed red line boundary. The elevated concentrations of lead, arsenic, Benzo(b)Fluoranthene, Benzo(a)Pyrene and Dibenzo(a,h)Anthracene were located within Made Ground topsoil and SAND deposits within WS107 at 0.20m and TP110 at 1.80m.

In relation to these exceedances, the following can be determined:

✳ The main exposure pathways based on the Tier I exceedances are:

- Soil ingestion;
- Dermal contact and ingestion; and,
- Consumption of homegrown vegetables.

All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils and consumption of homegrown vegetables. The risk to chronic human health associated with the elevated concentrations on inorganic heavy metals and non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in proposed private gardens, landscaping and public open space where Made Ground or impacted soils are present, to remove any potential for direct exposure to impacted soils. Made Ground deposits have been identified on-site; should these remain on site a cover system should be installed within all gardens. Alternatively a hotspot removal may be required.

The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy.

Topsoil deposits are deemed suitable for re-use on site with the exception of deposits within WS107 in the 2016 E3P site investigation. These deposits should undergo a hotspot removal, where the area of impact should be delineated, excavated and segregated from natural topsoil deposits and placed in an area of low sensitivity on site.



Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this.

8.3. CONTROLLED WATERS RISK ASSESSMENT

E3P has undertaken a controlled waters risk assessment for the site based on the consideration of the conceptual site model and the sensitive receptors which are summarised in Table 8.2.

TABLE 8.2 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground Potential Made Ground deposits associated with the infilled pond in the north eastern sector of the site could be a potential source of contamination to controlled waters.		High
Pathway		
Vertical Migration Due to the majority of the site being underlain by granular deposits, vertical migration of contaminants is likely to occur as a result of the high permeability of the drift deposits, however low permeability cohesive deposits are present circa 5.50m bgl which will prevent vertical migration into the underlying aquifer.		Moderate
Lateral migration Lateral migration of contaminants is considered possible due to the presence of granular deposits across the site.		High
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary A aquifer	High
Aquifer Classification in Bedrock	Secondary A aquifer	High
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not located within a source protection zone or drinking water safeguard zone.	Low
Distance to the Closest Groundwater Abstraction Point	The closest groundwater abstraction point is located 817m east of the site utilised for manufacturing.	Moderate
Is the Site Located Within 50 m of a Surface Watercourse?	A ditch is present in the north-east of the site however it does not appear to be linked to any other watercourses. The nearest off-site surface water feature is a stream/ditch 15 m west of the subject site, with three ponds/reservoirs between 20 m and 186m south of the site. the River Irk is 157 m south of the site.	High



The ICSM developed within the context of the site setting has identified the following viable pollutant pathways, which would be the downward migration of potentially mobile phase-soluble contaminants to the underlying aquifer and the lateral migration towards the stream/ditch to the west of the site which feeds into the River Irk and the reservoirs to the south of the subject site.

To ensure a robust appraisal of the identified risk to controlled waters, E3P has identified the sources of potential contamination that represent a risk to controlled waters from the initial CSM, we have then assessed the availability of ground investigation data in the form of analysis of the solid phase (soil) and dissolved phase within the perched groundwater or aquifer. The results of this assessment are presented in Table 8.3.

TABLE 8.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

CONTAMINANT	ASSESSMENT RATING	DISCUSSION
BTEX > 1 mg/kg	The soil data analysis has not identified any detectable concentrations of TPH C5 to C6 that might otherwise be indicative of VOC impact.	None
Total VOC > 1 mg/kg		
Total SVOC > 1 mg/kg	No potential sources of PCB have been identified	None
C5-C10 > 5 mg/kg	All concentrations are below the laboratory LOD.	None
C10-C12 > 10 mg/kg	All concentrations are below the laboratory LOD.	None
C12-C16 > 50 mg/kg	All concentrations are below the laboratory LOD.	None
Phenols > 2 mg/kg	All concentrations are below the laboratory LOD.	None
Naphthalene > 2 mg/kg	All concentrations are below the laboratory LOD.	None
Total PAH > 10 mg/kg	Total PAH concentrations above 10 mg/kg have been identified within TP101 at 0.20 mg/kg and TP101 at 0.90 mg/kg.	Further Discussion
PCB > 1 mg/kg	No potential sources of PCB have been identified	None
Heavy metals > 500 mg/kg	Concentrations of heavy metals have not been identified on site above 500 mg/kg.	None

The Tier I assessment has included a comparison of leachate analysis from samples of the Made Ground and groundwater samples to drinking water standards and environmental quality standards (EQS).

Two rounds of monitoring have been completed within WS105 on the 22nd March and 17th May 2021 due to elevated concentrations identified during the initial monitoring visit.

These are presented in Table 8.4.



TABLE 8.4 COMPARISON OF LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1,2,3}	DWS ^{3,4,5}	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA					
Arsenic	µg/l	50	10	1	3.5	N/A	No Further Action
Cadmium	µg/l	0.08-0.25	5	1	< 0.08	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	1	< 5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	1	1.4	N/A	No Further Action
Copper	µg/l	1	2000	1	20	WS104	Further Action
Total Cyanide	µg/l	1	50	1	< 1.0	N/A	No Further Action
Lead	µg/l	1.2	10	1	2.8	WS104	Further Action
Mercury	µg/l	–	1.0	1	< 0.5	N/A	No Further Action
Nickel	µg/l	4	20	1	3.9	N/A	No Further Action
Selenium	µg/l	–	10	1	< 4.0	N/A	No Further Action
Zinc	µg/l	10.9	–	1	15	WS104	Further Action
pH	6–9			1	7.2	N/A	No Further Action
Naphthalene	µg/l	2	10*	1	< 0.01	N/A	No Further Action
Anthracene	µg/l	0.1	10*	1	< 0.01	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	1	< 0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	1	< 0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	1	< 0.01	N/A	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	1	< 0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	10*	1	< 0.01	N/A	No Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	1	< 0.01	N/A	No Further Action



DETERMINAND	UNIT	EQS 1, 2, 3	DWS 3,4,5	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA					
TPH C5-C6 (benzene)	µg/l	10	1	1	< 1.0	N/A	No Further Action
TPH C6-C8 (toluene)	µg/l	74	700	1	< 1.0	N/A	No Further Action
TPH C8-C10 (ethyl benzene)	µg/l	20	300	1	< 1.0	N/A	No Further Action
TPH C10-C12 (xylene)	µg/l	30	500	1	< 10	N/A	No Further Action
TPH C12-C16	µg/l	2	90 ⁵	1	< 10	N/A	No Further Action
TPH C16-C35	µg/l	50#	90 ⁵	1	< 10	N/A	No Further Action
TPH C5-C6	µg/l	–	15000	1	< 1.0	N/A	No Further Action
TPH C6-C8	µg/l	–	15000	1	< 1.0	N/A	No Further Action
TPH C8-C10	µg/l	–	300	1	< 1.0	N/A	No Further Action
TPH C10-C12	µg/l	–	300	1	< 10	N/A	No Further Action
TPH C12-C16	µg/l	–	300	1	< 10	N/A	No Further Action
TPH C16-C21	µg/l	–	300**	1	< 10	N/A	No Further Action
TPH C21-C35	µg/l	–	300**	1	< 10	N/A	No Further Action
Tetrachloroethylene	µg/l	0.4	10	-	-	-	No Further Action
Trichloroethylene	µg/l	10	10	-	-	-	No Further Action
Trichlorobenzene	µg/l	0.4	–	-	-	-	No Further Action
Trichloromethane	µg/l	2.5	–	-	-	-	No Further Action
Dichloromethane	µg/l	20	200	-	-	-	No Further Action
Carbon Tetrachloride	µg/l	12	3	-	-	-	No Further Action
Vinyl Chloride	µg/l	–	0.3	-	-	-	No Further Action



TABLE 8.5 COMPARISON OF GROUNDWATER ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1, 2, 3}		NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER		LOCATION OF EXCEEDANCE	ASSESSMENT
		AA	DWS 3,4,5					
					22/03/2021	17/05/2021		
Arsenic	µg/l	50	10	3	74.6	10.3	WS105 (22/03/21 & 17/05/2021)	Further Action
Cadmium	µg/l	0.08-0.25	5	3	0.98	0.06	WS105 (22/03/21)	Further Action
Chromium (VI)	µg/l	3.4	–	3	<5.0	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	3	5.4	2.9	WS105 (22/03/21)	Further Action
Copper	µg/l	1	2000	3	210	10	WS105 (22/03/21 & 17/05/21)	Further Action
Total Cyanide	µg/l	1	50	3	<1.0	3.6	WS105 (17/05/21)	Further Action
Lead	µg/l	1.2	10	3	460	0.9	WS105 (22/03/21)	Further Action
Mercury	µg/l	–	1.0	3	<0.05	<0.05	N/A	No Further Action
Nickel	µg/l	4	20	3	26	2.8	WS105 (22/03/21)	Further Action
Selenium	µg/l	–	10	3	63	71	WS105 (22/03/21 & 17/05/21)	Further Action
Zinc	µg/l	10.9	–	3	97	1.8	WS105 (22/03/21)	Further Action
pH	6–9			3	6.9-8.1	7.4	N/A	No Further Action
Naphthalene	µg/l	2	10*	3	<0.01	0.26	N/A	No Further Action
Anthracene	µg/l	0.1	10*	3	<0.01	0.29	WS105 (17/05/21)	Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	3	<0.01	2.4	WS105 (17/05/21)	Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	3	<0.01	1.1	WS105 (17/05/21)	Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	3	<0.01	1.9	WS105 (17/05/21)	Further Action



DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS _{3,4,5}	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER		LOCATION OF EXCEEDANCE	ASSESSMENT
		AA			22/03/2021	17/05/2021		
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	3	<0.01	0.69	WS105 (17/05/21)	Further Action
Fluoranthene	µg/l	0.0063	10*	3	<0.01	4.2	WS105 (17/05/21)	Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	3	<0.01	0.72	N/A	No Further Action
TPH C5-C6 (benzene)	µg/l	10	1	3	< 1.0	< 1.0	N/A	No Further Action
TPH C6-C8 (toluene)	µg/l	74	700	3	< 1.0	< 1.0	N/A	No Further Action
TPH C8-C10 (ethyl benzene)	µg/l	20	300	3	< 1.0	< 1.0	N/A	No Further Action
TPH C10-C12 (xylene)	µg/l	30	500	3	< 10	< 10	N/A	No Further Action
TPH C12-C16	µg/l	2	90 ⁵	3	< 10	< 10	N/A	No Further Action
TPH C16-C35	µg/l	50#	90 ⁵	3	< 10	< 10	N/A	No Further Action
TPH C5-C6	µg/l	–	15000	3	< 1.0	< 1.0	N/A	No Further Action
TPH C6-C8	µg/l	–	15000	3	< 1.0	< 1.0	N/A	No Further Action
TPH C8-C10	µg/l	–	300	3	< 1.0	< 1.0	N/A	No Further Action
TPH C10-C12	µg/l	–	300	3	< 10	< 10	N/A	No Further Action
TPH C12-C16	µg/l	–	300	3	< 10	< 10	N/A	No Further Action
TPH C16-C21	µg/l	–	300**	3	< 10	11	N/A	No Further Action
TPH C21-C35	µg/l	–	300**	3	< 10	13	N/A	No Further Action
Tetrachloroethylene	µg/l	0.4	10	3	< 1.0	< 1.0	N/A	No Further Action
Trichloroethylene	µg/l	10	10	3	< 1.0	< 1.0	N/A	No Further Action



DETERMINAND	UNIT	EQS 1, 2, 3	DWS 3,4,5	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER		LOCATION OF EXCEEDANCE	ASSESSMENT
		AA			22/03/2021	17/05/2021		
Trichlorobenzene	µg/l	0.4	–	3	< 1.0	< 1.0	N/A	No Further Action
Trichloromethane	µg/l	2.5	–	3	< 1.0	< 1.0	N/A	No Further Action
Dichloromethane	µg/l	20	200	3	< 1.0	< 1.0	N/A	No Further Action
Carbon Tetrachloride	µg/l	12	3	3	< 1.0	< 1.0	N/A	No Further Action
Vinyl Chloride	µg/l	–	0.3	3	< 1.0	< 1.0	N/A	No Further Action

Notes

Solubility <0.01µg/l

AA – Annual Average

MAC- Maximum Admissible Concentration

* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water

** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
3. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
4. WHO Guidelines for Drinking Water Quality. Third edition (2004)



8.3.1. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data exceeds the EQS and DWS values for the following inorganic compounds:

-  Arsenic
-  Cadmium
-  Chromium (III)
-  Copper
-  Lead
-  Nickel
-  Total Cyanide
-  Selenium
-  Zinc
-  Anthracene
-  Benzo(b)fluoranthene
-  Benzo(k)fluoranthene
-  Benzo(a)pyrene
-  Indeno (123-cd)pyrene
-  Fluoranthene

In relation to the exceedances identified through the leachate analysis completed in WS104, these were isolated occurrences from Made Ground deposits. Copper exceeded EQS but not DWS, lead exceeded EQS but not DWS and Zinc exceeded the EQS threshold, and it should be noted a DWS screening value isn't available for this determinant.

Where leachate analysis has been undertaken, this can overstate the risk and is not wholly representative of the site characterisation, therefore reliance should be on groundwater sampling. Groundwater monitoring at this location did not identify any exceedances of determinants and as such there is not considered a controlled waters risk at this location.

In relation to the remaining exceedances, Table 8.6 provides a summary.



TABLE 8.6 SUMMARY OF ELEVATED CONTAMINANTS IN GROUNDWATER

CONTAMINANT	WS105 (µg/l)	
	Contaminant Source	
	Unknown Contaminant Source	
	Monitoring Date: 22/03/21	Monitoring Date: 17/05/21
Arsenic	74.6	10.3
Cadmium	0.98	-
Chromium (III)	5.4	-
Copper	210	10
Total Cyanide	-	3.6
Lead	460	-
Nickel	26	-
Selenium	63	71
Zinc	97	-
Anthracene	-	0.29
Benzo[b]fluoranthene	-	2.4
Benzo[k]fluoranthene	-	1.1
Benzo(a)pyrene	-	1.9
Indeno(123-cd)pyrene	-	0.69
Fluoranthene	-	4.2

8.3.2. M-BAT ASSESSMENT

Due to exceedances in groundwater samples for copper, nickel and zinc, an m-BAT assessment has been completed to assess the bioavailability of the metals with respect to surface water receptors (stream/ditch, reservoirs and River Irk). The chemical values from the groundwater analysis have been input into the assessment.

Where the Risk Characterisation Ratio (RCR) is greater than 1, this indicates the bioavailable concentration is above the EQS and the receptor is therefore at risk.

The following locations exceed the RCR:

1. WS105 (22/03/2021 – First Monitoring Visit)
 - Copper (144.12)
 - Zinc (1.09)

The m-BAT assessment has confirmed that copper, zinc and nickel are above the EQS and are considered bioavailable in the above locations on the site, due to the RCR values being above 1, however, analysis of groundwater from the second monitoring visit within WS105 did not identify any bioavailable concentrations of copper or zinc. Nickel was noted to not have a RCR above 1 within either samples from WS105. The elevated concentrations within the first visit in WS105 are considered to be anomalous results.

In light of the above assessment, E3P do not consider the site to pose an unacceptable level of risk to surface waters for copper, zinc and nickel. It should also be noted the site is currently uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore leaching potential.



8.3.3. FINAL PB SCREENING TOOL

Lead is not included in the M-BAT tool as it is not a full bioavailable EQS, however, a separate assessment using the Pb screening tool has been completed for lead. The DOC concentrations for WS105 sample during the first visit is above the threshold for the assessment and as such 20mg/L has been utilised. The assessment confirms that there is a risk within WS105 (First monitoring visit) as the concentrations exceed the site specific PNEC and the risk characterisation ratio is more than 1.0. However the second sample obtained from WS105 did not note an exceedance of the PNEC or RCR. As with the mBAT tool it is considered that the initial sample from WS105 is an anomaly and given the latest sample is not elevated in concentration or within the Pb screening tool, E3P do not consider the site to pose an unacceptable level of risk to surface waters for lead.

8.3.4. OTHER HEAVY METAL COMPOUNDS

Arsenic, cadmium, chromium (III), total cyanide and selenium have also been noted to be exceeding within groundwater samples from WS105. It should be noted that cadmium and chromium (III) were only noted to be exceeding on the first groundwater sampling round in WS105, and as such are considered anomalous results.

Arsenic was noted to be 74.6µg/l on the first monitoring visit, reducing to 10.3 µg/l on the second visit. The later sample only marginally exceeded the DWS but did not exceed the EQS.

Total cyanide did not exceed thresholds during the first monitoring visit but marginally exceeded the EQS screening value in the second monitoring visit. The DWS was not noted to be exceeded on either visit.

Selenium concentrations were identified at 63 µg/l on the first visit within WS105 and 71 µg/l during the second round of monitoring.

8.3.5. PAHS

Elevated PAH concentrations were identified within the second round of monitoring completed within WS105. The concentrations identified exceeded the EQS screening value but not the DWS.

8.3.6. DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

Historically the site has been subject to very little development, with the only area undergoing significant development is concentrated in the northern area of the site. This was in the form of historic gardens with a pond (now infilled) and the club house which is currently still present on site, with associated buildings on the site boundary previously demolished.

All leachate analysis showed elevations in relation to EQS standards primarily focused on WS104. Soil analysis for this borehole did not indicate any elevation in contaminants so it is highly likely that the results for leachate analysis have been exaggerated due to the aggressive nature of leachate testing. Groundwater analysis in this location did not identify any elevated concentrations of determinants and therefore the elevated concentrations identified in the leachate analysis are not considered to pose a risk to controlled water receptors.

The results of groundwater sampling showed elevated concentrations of heavy metals and PAHs within WS105. Two rounds of groundwater monitoring were completed within this location due to the initial elevated concentrations identified.



In regard to the heavy metals and PAHs identified within WS105 there is not considered to be a significant source on the subject site. WS105 was set within granular drift deposits where no Made Ground deposits were identified within the borehole during the site investigation. The elevated concentrations are considered to be anomalous results as groundwater samples in WS104 located within Made Ground did not identify any elevated concentrations of determinants. Additionally, no elevated concentrations of determinants have been identified within the soil analysis.

It is considered that the PAHs and Heavy Metals identified may be attributed to chemicals or weed killers utilised to maintain the golf course.

The site is underlain by granular drift deposits to circa 5.50m bgl which is turn underlain by low permeability cohesive deposits to depths greater than 20.00m bgl. The presence of this underlying cohesive drift stratum will offer significant protection to the underlying aquifer and minimise vertical migration in respect to this controlled water receptor.

The nearest surface water feature is a small stream/ditch in the north-east of the site, with another stream/ditch 15m west of the site, and reservoirs 20m south of the site. Roads are present between the site and the off-site surface water features which will act as a barrier but also a greater source of contaminants to the surface water features than the site itself. It is unlikely any of the identified contaminants would migrate to the surface water features due to the roads acting as a barrier to stop any migration. The path of the stream/ditch on-site is currently unknown but it does not appear to be linked to any other watercourses. The heavy metals and PAHs are likely low mobility and therefore are unlikely to migrate to the surface water receptors.

It should also be noted the site is currently uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore any leaching potential.

It is recommended further groundwater monitoring is completed within WS105 and down-gradient monitoring wells to confirm the above. There is considered a low risk to controlled waters from the subject site.

8.4. GROUND GAS

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report 665 – *Assessing risks posed by hazardous ground gases to buildings* (2007). However, it is recommended that the full ground gas assessment and recommended protection measures are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

8.5. INVESTIGATION RATIONALE

The ICSM has identified that the underlying Made Ground associated with the former infilled pond and former development in the north of the site, along with off-site landfills, may represent a potential source of ground gas generation. Based on the identification of these sources, E3P has determined that the site represents a low ground gas source generation potential.

Within the context of the proposed residential end use and ground gas generation potential, the gas assessment requires that 6 visits are required over 3 months, with at least two sets of readings at low or falling atmospheric pressure as set out within CIRIA 665 Tables 5.5a and 5.5b.

The spacing requirements for monitoring wells are detailed within CIRIA 665 Table 4.2, which indicates that for low gas hazard sites (Made Ground with limited degradable material, organic clay of limited thickness) and a high sensitivity development, nominal well spacing should be between 25 m and 50 m.



TABLE 8.7 GROUND GAS MONITORING LOCATION RATIONALE

LOCATION	GROUND GAS SOURCE	DEPTH OF MONITORING WELL (m)
WS101	Natural Ground / Deeper Groundwater Well	0.50–1.50
WS103	Natural Ground / Deeper Groundwater Well	0.50–1.00
WS104	Natural Ground / Deeper Groundwater Well / Potential Pond Deposits	1.00–3.00
WS105	Natural Ground / Deeper Groundwater Well	1.00–1.75

8.6. MONITORING METHODOLOGY

Concentrations of methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) were measured using a calibrated infra-red gas analyser (GFM435) with gas flow rates were measured using an integrated flow meter.

Gas measurements were recorded for a minimum of 60 seconds at each location, at which point the maximum concentration of CH₄ and CO₂, together with the lowest concentration of O₂ were recorded. The results of the ground gas monitoring are presented in Table 8.9.

CIRIA C665 and NHBC Report No 10627-R01 provide assessments for carbon dioxide and methane based upon gas screening values (GSVs) utilising flow rates and concentrations. The site-based GSVs for steady state methane and carbon dioxide are based upon the following equation:

$$GSV = \frac{\text{concentration (by vol)}}{100} \times \text{flowrate (1 / hr)}$$

The GSVs within CIRIA C665 are based upon all buildings other than standard residential houses. The NHBC GSVs are based upon standard residential houses with precast concrete floors (block and beam). The CIRIA 665 report author (Steve Wilson) since provided further clarification regarding which guidance should be adopted for residential houses that have suspended cast in-situ concrete floor slab: for the avoidance of doubt, it was confirmed that the GSVs within the CIRIA 665 guidance should be adopted. The thresholds for GSVs based upon NHBC and CIRIA guidance are provided within Table 8.8.

TABLE 8.8 RESIDENTIAL THRESHOLDS FOR GAS SCREENING VALUES (GSV) IN ACCORDANCE WITH CIRIA C665 AND NHBS REPORT NO 10627-R01 – RESIDENTIAL END USE

CIRIA – NO SUBFLOOR VOID		NHBC – SUBFLOOR VOID		
CLASSIFICATION	GSV (METHANE AND CARBON DIOXIDE)	CLASSIFICATION	GSV (METHANE)	GSV (CARBON DIOXIDE)
CS1	< 0.07	Green	< 0.13	< 0.76
CS2	< 0.70	Amber 1	< 0.63	< 1.60
CS3	< 3.5	Amber 2	< 1.60	< 3.10
CS4	< 15	Red	> 1.60	> 3.10
CS5	< 70	N/A	N/A	N/A
CS6	> 70	N/A	N/A	N/A



8.6.1. SUMMARY OF MONTIORING RESULTS

Table 8.9 presents the complete ground gas and groundwater monitoring results.



TABLE 8.9 SUMMARY OF GROUND GAS MONITORING RESULTS

WELL	DATE	CH ₄ INITIAL (%V/V)	CH ₄ STEADY (%V/V)	CH ₄ GSV (l/hr)	CO ₂ INITIAL (%V/V)	CO ₂ STEADY (%V/V)	CO ₂ GSV (l/hr)	O ₂ (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	21/04/21	0.10	0.10	0.0001	2.40	2.40	0.0024	18.30	1013	Rising	0.10	0.50–1.50	1.40	DRY
	14/05/21	0.10	0.10	0.00013	1.90	1.90	0.0025	18.70	1010	Steady	0.13		1.40	DRY
	28/05/21	0.10	0.10	0.00052	3.80	3.80	0.0198	15.50	1018	Steady	0.52		1.40	DRY
	11/06/21	0.10	0.10	0.00026	3.40	3.40	0.0088	16.20	1010	Rising	0.26		1.40	DRY
	22/06/21	0.10	0.10	0.00013	3.20	3.20	0.0042	16.40	1012	Steady	0.13		1.40	DRY
	02/07/21	0.10	0.10	0.0001	2.20	2.20	0.0022	18.80	1011	Falling	0.10		1.38	DRY
WS103	21/04/21	0.10	0.10	0.0001	1.30	1.30	0.0013	19.20	1013	Rising	0.10	0.50–1.00	1.20	DRY
	14/05/21	0.10	0.10	0.00052	1.10	1.10	0.00572	19.40	1010	Steady	0.52		1.20	DRY
	28/05/21	0.10	0.10	0.00052	2.00	2.00	0.0104	17.80	1018	Steady	0.52		1.18	DRY
	11/06/21	0.10	0.10	0.00026	1.90	1.90	0.0049	18.20	1010	Rising	0.26		1.18	DRY
	22/06/21	0.10	0.10	0.00013	2.10	2.10	0.0027	17.40	1012	Steady	0.13		1.20	DRY
	02/07/21	0.10	0.10	0.0001	0.90	0.90	0.0009	19.80	1011	Falling	0.10		1.17	DRY
WS104	21/04/21	4.10	4.10	0.0041	4.60	4.60	0.0046	0.20	1013	Rising	0.10	1.00–3.00	2.86	1.57
	14/05/21	2.90	2.90	0.00754	3.90	3.90	0.01014	0.50	1010	Steady	0.26		2.85	1.61
	28/05/21	3.90	3.90	0.03081	4.70	4.70	0.0371	0.70	1018	Steady	0.79		2.92	1.58
	11/06/21	3.40	3.40	0.01768	4.20	4.20	0.0218	0.80	1010	Rising	0.52		2.90	1.60
	22/06/21	2.90	2.90	0.02552	3.20	3.20	0.0282	1.20	1012	Steady	0.88		2.91	1.68
	02/07/21	3.00	3.00	0.003	5.60	5.60	0.0056	0.70	1011	Falling	0.10		2.90	1.95
WS105	21/04/21	0.10	0.10	0.00026	1.70	1.70	0.00442	19.30	1013	Rising	0.26	1.00–1.75	1.25	1.10



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WELL	DATE	CH ₄ INITIAL (%V/V)	CH ₄ STEADY (%V/V)	CH ₄ GSV (l/hr)	CO ₂ INITIAL (%V/V)	CO ₂ STEADY (%V/V)	CO ₂ GSV (l/hr)	O ₂ (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS105	14/05/21	0.10	0.10	0.00052	1.90	1.90	0.00988	19.10	1010	Steady	0.52	1.00–1.75	1.25	1.14
	28/05/21	0.10	0.10	0.00039	0.60	0.60	0.0023	19.80	1018	Steady	0.39		1.28	DRY
	11/06/21	0.10	0.10	0.00052	0.80	0.80	0.0042	19.70	1010	Rising	0.52		1.27	DRY
	22/06/21	0.10	0.10	0.00035	1.20	1.20	0.0042	18.90	1012	Steady	0.35		1.26	DRY
	02/07/21	0.10	0.10	0.00026	0.90	0.90	0.0023	19.90	1011	Falling	0.26		1.26	DRY

NOTES

NHBC Traffic Light System		Typical Max CH ₄ Concentration	GSV CH ₄	Typical Max CO ₂ Concentration	GSV CO ₂
	Amber 1	1	0.16-0.63	5	0.78-1.56
	Amber 2	5	0.63-1.56	10	1.56-3.13
	Red	20	1.56+	30	3.13+

Values in **BOLD** exceed Amber 1 Thresholds

Values in **BLUE** denote water above monitoring well



8.6.2. SOURCES OF GROUND GAS

The Phase I report and subsequent ground investigation has identified the following potential sources of ground gas:

- ✳ Made Ground deposits with former demolition and construction works;
- ✳ Infilled pond materials;
- ✳ Off-site landfills.

8.6.3. GROUNDWATER

WS101 was noted to be dry during all monitoring visits. WS103 and WS105 were noted to be dry during five and four monitoring visits respectively.

Within the remaining monitoring wells, groundwater levels generally decreased over the monitoring period.

8.6.4. GAS FLOW

During the monitoring a positive flow was noted in all monitoring wells. The measure of positive flow is considered to be due to ground gas concentrations as monitoring wells were largely noted to be dry, or with minimal groundwater identified where levels generally decreased.

8.6.5. GAS CONCENTRATIONS

Methane has been recorded at concentrations ranging from 0.10 % v/v (Limit of Detection (LOD)) to a maximum concentration of 4.10 % v/v (WS104). Methane was noted to be elevated within WS104 during all monitoring visits. No other elevated methane concentrations have been detected in the monitoring completed.

Carbon dioxide concentrations were recorded within all the monitoring wells at concentrations ranging between 0.60 % v/v and 5.60 % v/v (WS104). Elevated concentrations of carbon dioxide were only identified within WS104 on one occasion and appear to be associated with loose silty clayey SAND deposits likely associated with the former pond identified in this part of the site.

8.6.6. GAS ASSESSMENT

In accordance with the methodology outlined with the CIRIA publication C665, E3P have utilised the results of the ground gas monitoring surveys to calculate a tentative gas screening value (GSV). The GSVs for the monitoring positions are summarised in Table 8.10.

TABLE 8.10 GAS RISK PROFILE AND LOCATION

LOCATION	MAX CH ₄ (% v/v)	GSV (l/hr)	MAX CO ₂ (% v/v)	GSV (l/hr)	CLASSIFICATION
WS101	0.10	0.00052	3.80	0.0198	Green/CS1
WS103	0.10	0.00052	2.10	0.0104	Green/CS1
WS104	4.10	0.03081	5.60	0.0371	Amber 1/CS2



LOCATION	MAX CH ₄ (% v/v)	GSV (l/hr)	MAX CO ₂ (% v/v)	GSV (l/hr)	CLASSIFICATION
WS105	0.10	0.00052	1.90	0.0099	Green/CS1

The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area.

Ground gas monitoring suggests that the site can be predominantly classified as CS1, and in these areas it is considered that gas protection measures will not be required. However, WS104 in the north-east of the site has been identified as Amber 1 / CS2 and properties in this area will require specialist ground gas mitigation measures. WS104 was set within slightly clayey very silty SAND deposits which are considered to be associated with the degradation of historically filled material related to the former pond in this area. This material will have largely degraded due to the age of infilling therefore the potential for a prolonged and persistent gas source is reduced. Amber 1 / CS2 protection measures may be considered a conservative approach.

The E3P Geoenvironmental Site Investigation completed in 2015, identified areas of the site that were characterised as CS2 / Amber 1 and therefore requiring ground gas mitigation measures.

An off-site landfill has been identified in close proximity to the subject site circa 28m south-east of the site. However, based off Groundsure LIDAR data and available contours its likely infilling operations were over 50 m from the subject site and therefore the risk to the site is considered to be low. Within the previous site investigation completed by E3P in 2015, ground gas monitoring was completed across the site with WS109 and WS110 situated in the south/south-east of the site targeting any occurrences of migrating ground gases from the off-site landfill. In addition, WS101 from the 2015 E3P Ground Investigation was located in the south-west of the site which would note any presence of ground gases originating from the former landfill 27m south-west of the site. No elevated concentrations of carbon dioxide or methane were identified within any of the E3P 2015 monitoring wells, and as such it can be concluded that ground gases from the off-site landfill are not migrating to the subject site.

When combining the monitoring data from both phases of ground investigation it is possible that the site can be zoned into areas falling under Amber 1 / CS2 and those under Green / CS1. The zoning of the site should be agreed with the Local Planning Authority prior to construction.

Ground gas protection measures in accordance with Amber 1 / CS2 will require construction in line with BS8485 (2015)+A1(2019) as detailed herein.



8.7. RESIDENTIAL BUILDING GAS RISK MITIGATION

British Standard BS8485 (2015)+A1(2019) provides two types of residential property that require assessment. These building types are:

-  **Type A Building** – Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms are present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
-  **Type B Building** – Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small- to medium-sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.

Based on the ground gas risk assessment and the proposed Type A Building, it is envisaged that a point score of 3.5 will be required for affected properties, as summarised in Table 8.11.

TABLE 8.11 BS 8485 (2015) POINTS REQUIRED FOR TYPE A AND TYPE B BUILDINGS

CHARACTERISTIC SITUATION	NHBC TRAFFIC LIGHT SYSTEM	MINIMUM GAS PROTECTION SCORE (POINTS)	
		HIGH SENSITIVITY	
		TYPE A BUILDING	TYPE B BUILDING
1	Green	0	0
2	Amber 1	3.5	3.5
3	Amber 2	4.5	4
4	Red	6.5	5.5
5	N/A	N/A	6.5
6	N/A	N/A	N/A

Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, for example, high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system such as in institutional and/or fully serviced contractual situations.

The requisite 3.5 points must be achieved by installation of a suitable combination of measures detailed in Table 8.12.



TABLE 8.12 SUMMARY OF GROUND GAS MITIGATION MEASURES – BS8485 (2015)+A1(2019)

GAS PROTECTION SCORES FOR THE STRUCTURAL BARRIER		SCORE ^A
Floor and Substructure Design		
Precast Suspended Segmental Subfloor (Beam and Block)		0
Cast In-Situ Ground-Bearing Floor Slab (With Only Nominal Mesh Reinforcement)		0.5
Cast In-Situ Monolithic Reinforced Ground-Bearing Raft or Reinforced Cast In-Situ Suspended Floor Slab With Minimal Penetrations		1 or 1.5 ^B
Basement Floor and Walls Conforming to BS 8102:2009, Grade 2 Waterproofing^C		2
Basement Floor and Walls Conforming to BS 8102:2009, Grade 3 Waterproofing^C		2.5
^A) The scores are conditional on breaches of floor slabs, etc. being effectively sealed. ^B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2). ^C) The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product (see C.3, Note 4).		
PROTECTION ELEMENT SYSTEM	SCORE	COMMENTS
Gas protection scores for ventilation protection measures		
(a) Pressure Relief Pathway – Usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building.		0.5 Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is 0.
(b) Passive Subfloor Dispersal Layer – Media used to provide the dispersal layer are:  Clear void;  Polystyrene void former blanket;  Geocomposite void former blanket;  No-fines gravel layer with gas drains; and  No-fines gravel layer.	Very good performance	2.5
	Good performance	1.5
(c) Active Dispersal Layer – Usually comprising fans with active abstraction (suction) from a subfloor dilution layer with roof-level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers.		1.5 to 2.5 This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents.



		Active ventilation should always be designed to meet at least "good performance".
(d) Active Positive Pressurisation – Provided by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.	1.5 to 2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".
(e) Ventilated Car Park – Floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park.	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to Buildings Regulations 2000, Approved Document F [9].
PROTECTION ELEMENT SYSTEM	SCORE	COMMENTS
Gas Protection Score for the Gas-Resistant Membrane		
Gas-resistant membrane meeting all of the following criteria: ☛ Sufficiently impervious to the gases with a methane gas transmission rate < 40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); ☛ Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; ☛ Sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); ☛ Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre-reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools); ☛ Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and ☛ Verified in accordance with CIRIA C735.	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.4 mm thickness (equivalent to 370 g/m² for polyethylene) reinforced membrane (virgin polymer) meets the performance criteria opposite. If a membrane is installed that does not meet all the criteria opposite, then the score is 0.

This table should be read in conjunction with the notes presented in BS 8485 (2015)+A1 (2019)



8.8. POTABLE WATER SUPPLY

This section provides a summary of the site investigation data with reference to the selection of potable water supply pipework. The assessment is made with reference to the UK Water Industry Research (UKWIR) publication "Guidance on the selection of Water Supply Pipes to be used in Brownfield Sites"

TABLE 8.13 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

Contaminant Group	PE-threshold (mg/kg)	Concentrations at <u>Current</u> pipeline depth (mg/kg)
Total VOC	0.5	N/A
Total BTEX And MTBE	0.1	N/A
Total SVOCs (Excluding PAH and those substances marked with an *)	2	N/A
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.2
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	<6
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	<12
Phenols (From SVOC Analysis)*	2	N/A
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	NA
Ethers*	0.5	NA
Nitrobenzene*	0.5	NA
Ketones*	0.5	NA
Aldehydes*	0.5	NA
Amines	Fail	NA
Other Consideration		
Are there any exceedances of the PE threshold outside of the pipeline depth?	None identified.	
Is free product present in soil and groundwater?	None identified.	
Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?	None identified.	
Will soils impacted with above determinands likely be utilised elsewhere on site?	None identified.	
Will soils be imported to site as part of any future earth works	It is likely 6F2 materials will be required as part of the construction of roads on site. The importation of materials may affect the WIR Risk Assessment which should be updated after completion.	

Notes - Pipe line depth normally between 0.75m–1.35m

Based on the assessment of current site conditions it is likely that PE pipe will be suitable at the proposed development. However, an updated UKWIR risk assessment should be completed following the completion of remediation and enabling works as conditions may vary to those currently on-site.



8.9. CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 8.14 has been prepared for the site.

TABLE 8.14 CONCEPTUAL SITE MODEL

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL1 PL2	Made Ground	Dermal contact. Dermal contact and ingestion.	Future site users. Off-site receptors.	Likely	Low	Low
Discussion: Soil analysis has not identified any samples exceeding the screening criteria for a residential end use. Previous site investigation completed by E3P identified elevated concentrations of asbestos, lead, arsenic, Benzo(b)Fluoranthene, Benzo(a)Pyrene and Dibenzo(a,h)Anthracene. Recommendation: Areas in which Made Ground and elevated concentrations have been identified will require the installation of an appropriate cover system to be clearly defined within the Site Remediation & Enabling Works Strategy, however industry best practice (as outlined within BRE 465) will require a minimum 600mm deep certified clean cover. The clean certified cover system will remove any possible pathways of direct contact for future site users. Construction works should be completed with PPE and provision of welfare to ensure exposure and direct contact with impacted materials is at a minimum. A hotspot should be completed in the vicinity of the impacted topsoil in order to retain as much topsoil as possible as part of the final development. A hotspot removal may also be required in areas of impacted soils; however remaining Made Ground deposits will require a cover system.						
PL3	ACM in Made Ground	Inhalation of dust.	Future site users. Buildings. Off-site land users.	Low Likelihood	Low	Low
Assessment: No asbestos containing material was identified for the subject site. However due to site access restrictions in relation to the area of the infilled pond and north-eastern sector of the site, ACM's could possibly be present in the Made Ground deposits in this area. However due to the presence of invasive species in this area intrusive works could not be carried out to give a full scope of possible contamination in this area.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
Recommendation: Further investigation of area of infilled and overgrown land in north eastern sector of the subject site.						
PL4	Volatile Contaminants such as hydrocarbons or solvents	Inhalation of vapours. Migration through permeable strata and preferential pathways.	Future site users. Off-site receptors.	Low	None	Low
Assessment: No volatile compounds were detected within the soils analysis. Recommendation: N/A						
PL4	Methane, carbon dioxide (potentially infilled features on and within 250 m of the site)	Inhalation of gas. Migration through permeable strata and preferential pathways. Explosion in confined spaces.	Future site users. Buildings. Off-site land users.	Likely	Moderate	Low
Assessment: An infilled pond has been identified on site and off-site landfills within proximity to the site which may be a source of Made Ground, alluvial deposits or contain deeper organic soils with putrescible matter which may be subject to decay producing low levels of hazardous ground gases such as carbon dioxide and methane. Carbon dioxide and methane have associated asphyxiation and explosive risks, respectively. Ground gases associated with the off-site landfills are not considered to affect the site as previous monitoring has not identified any elevated concentrations of ground gases in the south-west or south-east of the subject site. Ground gas monitoring suggests the site can be zoned for the installation of CS1/Green and CS2/Amber 1 protection measures, as isolated areas of elevated ground gas concentrations have been identified on-site and as such, protective measures will be required to any proposed plots in areas classified as CS2/Amber 1.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
Recommendation: Localised areas of CS2/Amber 1 mitigation measures required. Zoning of the site to be agreed with the Local Authority.						
PL5	Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds	Surface runoff. Migration through permeable strata and preferential pathways. Perched waters migration.	Groundwater (Secondary A aquifer). Surface Water (Stream/ditches and Reservoirs).	Low	None	Low
Assessment: The Tier 1 comparison for groundwater and leachate has identified elevated concentrations of heavy metals and PAHs in WS104 and WS105. Elevated concentrations in WS104 were attributed to leachate analysis; supplementary groundwater sampling in this location did not identify any elevated concentrations and as such there is not considered a risk to controlled waters at this location. Groundwater samples from WS105 identified elevated concentrations of heavy metals and PAHs against both DWS and EQS screening values. A m-BAT assessment has been completed in regards to the identified elevated copper, nickel and zinc concentrations, which determined only the first round of monitoring in WS105 had RCR values exceeding for copper and zinc. The Pb screening tool identified WS105 to be bioavailable within the first monitoring visit but not the second. The elevated concentrations are considered to be anomalous in this location; the same is considered for PAHs as there is no significant source on site and the borehole was not located within Made Ground deposits. It is possible the source of the elevated concentrations in WS105 are attributed to chemicals utilised as part of the golf course maintenance. The site is underlain by granular drift deposits to circa 5.50m bgl which is turn underlain by low permeability cohesive deposits to depths greater than 20.00m bgl. The presence of this underlying cohesive drift stratum will offer significant protection to the underlying aquifer and minimise vertical migration in respect to this controlled water receptor. The nearest surface water feature is a small stream/ditch on-site, with another stream/ditch 15m west of the site, and reservoirs 20m south of the site. Roads are present between the site and the surface water features which will act as a barrier but also a greater source of contaminants to the surface water features than the site itself. It is unlikely any of the identified contaminants would migrate to the surface water features due to the roads acting as a barrier to stop any migration. The path of the stream/ditch on-site is currently unknown but it does not appear to be linked to any other watercourses. The heavy metals and PAHs are likely low mobility and therefore are unlikely to migrate to the surface water receptors.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
It should also be noted the site is currently uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore any leaching potential. Recommendation: Further groundwater monitoring within WS105 and down-gradient to confirm the low risk to controlled waters.						
PL6	Sulphate (Made Ground)	Sulphate attack on concrete.	Building structure.	Low	None	None
Assessment: Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 7.8), shows that the soils at the site meet Class DS- 1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE Special Digest 1 (2005). Recommendation: Concrete should be designed in accordance with the chemical testing results.						
PL7	Organic contaminants such as hydrocarbons, solvents	Ingestion of tainted water supply.	Future site users. Water pipes.	Low	None	None
Assessment: Low probability as no contamination was identified at anticipated pipeline depth (0.75–1.35 m). Recommendation: Based on the assessment of current site conditions it is likely that polyethylene pipe will be required at the proposed development. However; final pipeline selection will need to be confirmed with a UKWIR risk assessment post remediation and enabling works.						
PL8	Phytotoxic contaminants (Made Ground)	Direct Contact (plant uptake).	Flora.	Low	None	None
Assessment: Low probability as no contamination was identified which may be taken up by flora in soft landscaping/gardens.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
Recommendation: No action required.						

Main exposure pathways:

PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical / Lateral Migration; PL6 = Corrosion of concrete; PL7=Tainting of water supply; PL8 = Uptake by plants;



9. GEOTECHNICAL ASSESSMENT

9.1. PROPOSED DEVELOPMENT

E3P understands that Duchy Homes are considering the proposed acquisition and future redevelopment of a parcel of land at the North Manchester Golf Club, Middleton for low rise residential housing with associated adopted estate roads and utility infrastructure. This will include the demolition and reconstruction of the golf clubhouse in the north of the site.

9.2. SUMMARY OF GROUND CONDITIONS

MADE GROUND

Made Ground deposits were encountered in five exploratory hole locations (WS104, TP101, TP102, TP103 and HDP101) to a maximum proven depth of 1.10m bgl.

Made Ground deposits within TP101 and TP102 generally comprised a reworked topsoil of a black slightly clayey sand with frequent rootlets overlying a brown orange medium clayey medium sand. These materials were subsequently underlain with a blackish brown very clayey medium sand. The reworked topsoil was also identified within TP103.

Within HDP101 Made Ground comprised a reworked topsoil as above, overlying Made Ground sand deposits as per the above.

Made Ground deposits in WS104 comprised a blackish grey slightly clayey sand with occasional brick fragments and was considered to be associated with the former pond in this area of the site.

A Depth of Made Ground Plan is presented as Drawing 14-807-006 in Appendix III.

TOPSOIL

Natural topsoil deposits were identified within 14 exploratory hole locations to depths of between 0.20-0.30m bgl. The topsoil deposits comprised of a black slightly clayey medium SAND with frequent rootlets.

DRIFT DEPOSITS

Drift deposits were encountered within all exploratory locations to a maximum depth of 20.45mbgl.

Drift deposits generally comprised a brown slightly clayey medium SAND overlying a loose to medium dense brown very gravelly, slightly clayey medium SAND with gravel and cobbles of sandstone, mudstone and limestone to a maximum depth of 5.60mbgl.

Within TP103/SA101 a light brown slightly clayey medium SAND was encountered to a maximum depth of 2.10 m bgl, while in WS104 a brownish grey very silty, slightly clayey fine SAND was encountered, which was considered likely be silt materials associated with the base of the former infilled pond.



Within WS101 a grey slightly clayey, very gravelly medium SAND with gravel of sandstone, mudstone and limestone was overlying the brown slightly clayey medium SAND. However the underlying SAND identified fragments of coal.

SAND deposits were noted to be very loose or loose within WS101, WS102, WS103, WS104, WS105, CP101 and CP102 at depths of between 1.20m and 5.45mbgl.

Underlying the gravelly medium SAND deposits, which were encountered within CP101 and CP102 from 5.60mbgl and 5.50mbgl respectively was a very stiff high strength brown sandy CLAY.

SOLID

The bedrock geology was not encountered as part of the ground investigation.

Historic BGS boreholes in the surrounding area have identified that bedrock is likely to be present beneath the site at circa 45.00m bgl.

GROUNDWATER

Groundwater was encountered as strikes at depths between 0.50m and 1.80mbgl. Granular deposits were noted to be saturated where groundwater was encountered.

9.3. SITE PREPARATION

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the *Manual of Contract Documents for Highway Works (MCHW)*. This should include the following:

- ✦ Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
- ✦ Demolition of all existing buildings and removal of all concrete hardstanding.
- ✦ Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.
- ✦ Diversion of utility infrastructure where required.

9.4. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the net safe allowable bearing pressure (ABP) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 9.1.



TABLE 9.1 SUMMARY OF ABP

GRANULAR SOILS			
Description	Depth (Range m bgl)	Relative Density	Allowable Bearing Pressure (kN/m ²)
SAND (1 location)	2.00-2.45	Very Loose	9.13
SAND	1.20-5.45	Loose	52-91
SAND	1.20-5.45	Medium Dense	107-219
COHESIVE SOILS			
Description	Depth (range m bgl)	Undrained Shear Strength (Cu) (kN/m ²)	Allowable Bearing Pressure (kN/m ²)
Very Stiff CLAY	6.50-20.45	81–149	167–308

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target stratum has been identified as the underlying medium dense SANDs or very stiff CLAY deposits.

However, given the significant topographical variances on the site, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to remove the any buried obstructions and cut/fill the site to provide suitable development platform levels.

The site is underlain by predominantly medium dense sands at a shallow depth which overlie loose stratum. The deeper soil profiles have been noted to be saturated by the underlying groundwater which will result in the reduction in the calculated safe ABP by 50% as is demonstrated by the significant decrease in the calculated SPT N Value at depth. Careful consideration must be given to side wall support during the construction of foundations.

Due to the underlying loose SANDs to circa 5.00mbgl, it is considered that the most economical foundation solution for the site would be to reengineer the underlying loose SANDs using Vibro Stone Columns (VSC) to support a doubly reinforced shallow strip foundation. Due to saturated SANDs on site, the VSC should be completed using a bottom feed solution to ensure the structural integrity of the stone column.

Consideration must also be taken in regards to the gas and sludge main present on site. Vibrations resulting from installation of the VSC foundation solution may cause potential damage to this sensitive infrastructure; and as such the VSC contractor may require to install a trench to limit vibrations or a driven piled or engineered raft solution may be required in the vicinity of the sensitive infrastructure.

An allowance for a driven piled foundation solution should be considered in the vicinity of the pond in the north-east of the site which should be delineated as part of any future works on site. WS104 was placed in proximity to this historic feature, however due to site access limitations, was not able to fully prove the existence of deep Made Ground deposits. However infilled water features have the potential to contain unconsolidated and soft peat, clays and silts or Made Ground.

Due to groundwater ingress and instability of granular matrices, strip or trench fill foundations are unlikely to be suitable.



To determine if VSC is viable at the subject site, E3P has completed a Ground Improvement Design Risk Matrix that is summarised in Table 9.2.

TABLE 9.2 GROUND IMPROVEMENT DESIGN RISK MATRIX

RISK ITEM	COMMENT	PASS/FAIL
Soft clays with an undrained shear strength less than 30 kN/m²	CLAY soils have been assessed as being firm to stiff with Cu > 80 kN.	PASS
Ground with peat layers close to foundation level or the base of the stone column, or where intermediate layers of peat are thicker than 200 mm, either as a single layer or the sum of the thicknesses of individual layers throughout the length of the stone column	None Identified.	PASS
Voided filled ground, e.g. old water tanks, pottery, glass bottles, concrete rubble or brick fill of unsuitable grading	Made Ground beneath the north-eastern sector will require removal and processing to render the site suitable for VSC. The existing buildings substructure will also require excavation and processing into a graded aggregate suitable for vibro treatment.	PASS – on completion of enabling works
Loose or non-engineered fill not previously subject to rising or fluctuating water levels saturation	None identified.	PASS
Filled ground still settling or expected to settle under its own weight or due to the effects of surcharging/upfilling where there is a high organic content or where decay is continuing	None identified	PASS
Fill, containing degradable material where organic material forms more than 15% of fill by volume	None identified.	PASS
Clays with a plasticity index greater than 40%	None identified.	PASS
Highly sensitive soils liable to collapse or remoulding	None identified.	PASS
Cohesive soils with trees in influencing distance	None identified.	PASS
Overall Risk Rating and Suitability for Vibratory Ground Improvement		PASS

It is recommended that further investigative works are undertaken once the Himalayan Balsam and trees are cleared from the north-eastern and eastern sector of the site, so further geotechnical investigation can be undertaken to advise on the foundation solution in this area.



Although unlikely given the depth of the natural cohesive deposits, foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally in accordance with the requirements of NHBC standards for a where plots will be founded within cohesive drift. It is recommended that at working drawing stage a foundation schedule is prepared for the development taking account of the soil and the locations of trees.

9.5. GROUND FLOOR SLABS

Current building control regulations require that where infilled ground is present to depths in excess of 600 mm, or where the substratum is variable in terms of the structure and settlement potential, or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.

In this instance, it is considered that for the majority of substructures, the underlying stratum would be granular in nature and have less than 600 mm of infilled ground and in those areas a suspended floor slab would not be required. However, where there are CLAY deposits or an excess of 600 mm of infill a suspended floor slab will be required.

Where a cast in-situ suspended slab is utilised with no subfloor void, appropriate compressible material (heave precautions) will be required in the construction of the substructure.

9.6. HEAVE PRECAUTIONS

The site has been proven to be underlain by granular soils to circa 5.00m bgl, which are not susceptible to volumetric instability thus heave precautions will not be required for the subject site.

Clay soils are present on site however these are largely at depths unlikely to result in any volumetric instability of the shallow soils.

If the proposed development levels are to be cut / reduced to within influence of the cohesive soils it will be necessary to ensure that due consideration is given to the need for the heave precautions.

9.7. HIGHWAYS CONSTRUCTION

A programme of remediation and enabling works will be required to remediate the proposed road subgrade in accordance with the requirements of the Manual of Contract Documents for Highway Works Volume 1 Specification For Highway Works (Series 600-Earthworks) for a method compaction.

It is considered that the material can be re-engineered using method compaction to achieve a CBR in excess of 5% if works are completed in favourable climatic conditions.

9.8. DRAINAGE

The presence of Made Ground across the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.



The site is predominantly underlain by circa 1.00–5.00 m of high permeability gravelly SANDS. Three BRE365 Permeability Tests have been undertaken where a good infiltration rate has been calculated. However a high water table was observed during the ground investigation with saturated SANDs present and therefore the use of soakaway drainage may be limited.

The granular drift deposits are likely to offer a certain amount of soakage potential; however the construction of sustainable drainage is likely to be difficult due to the stability of the natural granular material, especially after periods of heavy rain. Additionally, consideration must be given to the construction of the soakaways due to the site being elevated above the adopted highway to the south of the site by circa 1.00m.

However, the application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – Soakaway Design.

9.9. CONCRETE DURABILITY

Based upon the results of the chemical analyses it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE *Special Digest 1* (2005).

9.10. EXCAVATIONS

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation. However, in a number of trial pit locations the side stability was unstable due to the presence of loose sands and water strikes resulting in saturated granular deposits. Window sample probeholes were noted to collapse due to loose SAND deposits.

Excavations should be feasible in the near surface with normal plant, however in the areas with high water table indicated, groundwater pumping may be required to form excavations.

Although the majority of excavations were determined to be stable, site works were completed in a period of little to no rainfall and as such it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97.

If local pumping of groundwater is required during the advancement of excavations for the proposed foundations then consideration should be given to the potential for dewatering gravels in the surrounding areas that may cause structural damage to building substructures in close proximity to the site.



TABLE 9.3 CIVIL ENGINEERING EXCAVATION RISK MATRIX

RISK ITEM	PRESENT	COMMENT
Running Sands	No	No running sand has been identified.
Minor Water Ingress	Yes	Minor water ingress will require localised dewatering/sump pumping during the construction of site drainage infrastructure. Ingress of water into foundation excavation will potentially flood foundation excavations, limiting the viability of spread foundations to be constructed. Dewatering for deep drainage construction may be required.
Shallow Bedrock	No	No shallow bedrock was observed for the subject site.

9.11. CONSTRUCTION ACTIVITY AND INSPECTION

The following activities and inspections should be incorporated in to the site works:

- Due to the variability of the soils at the site, it is recommended that sufficient allowance is made for the inspection of formations and sub-formations to foundations and pavement construction.
- Excavations where access is required should be subject to a risk assessment from a competent person and, where appropriate, mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 should be utilised.
- It is considered that dewatering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond.
- Where access to confined spaces is required, appropriate mitigation measures should be addressed within the construction stage health and safety plan. Particular account should be taken of the gas results.
- The presence of potential contamination and mitigation measures should be addressed as part of the construction stage health and safety plan and should include measures to design out the risks, reduce their impact and, finally, to include the use of personnel protective equipment (PPE).



9.12. GEOTECHNICAL RISK REGISTER

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of contaminated soils		N/A	10	No elevated concentrations of determinants were identified in the most recent phase of site investigation however the area that could not be investigated in the north-eastern sector of the site is likely to have significant Made Ground deposits with contaminated soils present. Previous site investigation works have identified elevated concentrations of determinants. Any unsuitable material will require removal and replacement with a geotechnically suitable fill subject to the required engineering specification for the development.
Bedrock		N/A	0	Shallow bedrock has not been identified during the site investigation.
Cohesive Stratum overlying shallow Bedrock (<3.00m)		N/A	0	The site is underlain by granular drift deposits to a depth of circa 5.00m bgl, which is in-turn underlain by CLAY deposits to depths in excess of 20.00mbgl. Bedrock was not encountered in the ground investigation.
Obstructions		N/A	0	No obstructions were identified during the ground investigation. Underground obstructions are likely to be present beneath the existing buildings on site which will require grubbing out in their entirety to create a suitable development platform. Any trees to be removed from the north-eastern sector of the site will require complete removal.
Artificially levelled and filled platforms		All	100	The site appears to have been levelled and artificially upfilled for the prior land use as a golf course in the northern sector of the site in the vicinity of the car park.
Retaining walls		N/A	0	A retaining wall is present along the southern boundary of the site against Manchester Old Road.



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POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Trench collapse		All	100	Mechanically excavated trial pits and window sample probeholes have been noted to collapse at the point in which groundwater is encountered. Loose sands have also been identified. Deep excavations will be prone to collapse and will require suitable support during excavation.
Mature trees		On site	20	A number of mature trees are present throughout the subject site. A tree survey is required; however, given the granular nature of shallow drift deposits heave precautions are not deemed necessary.
Volume change potential clay		N/A	0	CLAY deposits were not encountered within the upper 5.00m.
Peat		N/A	0	None identified.
Running sands		On site	20	None identified.
Ground dissolution		N/A	N/A	Data searches indicate no hazard.
Concrete design		On site	100	Chemical analysis indicates that the site meets DS-1, AC-1s concrete classification.
Low-permeability ground		N/A	0	Drift deposits on site have been proven to be predominantly high permeability sands. BRE 365 Soakaway permeability tests have been carried out and indicate a good drainage potential. However the design should take into consideration the high water table on site and the site being at a higher elevation than the adjacent Manchester Old Road.
Services/sensitive structures		On site	50	Utility plans and site observations have identified a LHP gas main, electricity infrastructure and a waste water pipeline present within the site boundary. The location of this sensitive infrastructure will need to be taken into consideration in relation to the final design of the development.



North Manchester Golf Club

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POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Abnormal foundation solutions		On site	100	The site has been noted to be underlain by loose SANDS which are saturated. The most viable solution for the subject site would be to re-engineer the loose sands with VSC to support a shallow strip foundation using a bottom feed. Consideration of the proximity to sensitive infrastructure will be required. In the area of infilled pond in the north eastern sector of the site an allowance for a driven piled foundation solution is required.
Areas not investigated		On site	10	The area of soft landscaping in front of the existing club house was not investigated due to the presence of services in this area, with investigation in the north eastern area limited due to the presence of Himalayan Balsam. Additionally, access in the central eastern area of the site was limited due to the presence of a LHP gas main and electricity infrastructure.
Surface water features		N/A	0	No surface water features were observed on site.
Current ponds to be filled		N/A	0	No ponds to be filled on site.
Historically infilled pond		On site	10	A former infilled pond is present in the north-east of the site which will require delineation as part of any remediation and enabling works. A driven piled foundation solution is likely to be required in this area.
Mining		N/A	0	The site is not considered to be affected by underground shallow mining.
Slope		N/A	0	The site slightly slopes in a southerly direction. A slope stability assessment is not considered to be required.



9.13. FURTHER WORKS

Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

-  Treatment and removal of Himalayan Balsam.
-  Further investigation within areas previously inaccessible.
-  Delineation of former infilled pond.
-  Plot-specific foundation schedule (upon receipt of the final development levels).
-  Arboricultural survey.
-  Geotechnical earthworks strategy (infrastructure).
-  Remediation and enabling works strategy.
-  Construction Phase Surface Water Management Plan.



10. CONCLUSIONS AND RECOMMENDATIONS

10.1. CONTAMINATED LAND ASSESSMENT

Human Health	A Tier 1 Human Health Risk Assessment has been undertaken using the chemical analysis results of the soils and comparing to the relevant Tier I criteria. The assessment has not identified any elevated levels of contaminants of concern. However, within the previous ground investigation completed by E3P, elevated concentrations of asbestos, lead, arsenic, Benzo(b)Fluoranthene, Benzo(a)Pyrene and Dibenzo(a,h)Anthracene were identified. Asbestos was identified in TP102 within Made Ground deposits however this location is outside of the proposed red line boundary. The risk to chronic human health associated with the elevated concentrations on inorganic heavy metals and non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in proposed private gardens, landscaping and public open space where Made Ground or impacted soils are present, to remove any potential for direct exposure to impacted soils. Made Ground deposits have been identified on-site; should these remain on site a cover system should be installed within all gardens. Alternatively, a hotspot removal may be required. Topsoil deposits are deemed suitable for re-use on site with the exception of deposits within WS107 in the 2016 E3P site investigation. These deposits should undergo a hotspot removal, where the area of impact should be delineated, excavated and segregated from natural topsoil deposits and placed in an area of low sensitivity on site. Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. Further post-demolition and site clearance investigations are required in the north and north east of the site to confirm the findings of this initial assessment as and when full and unrestricted access is available.
Controlled Waters	The Tier 1 comparison for groundwater and leachate has identified elevated concentrations of heavy metals and PAHs in WS104 and WS105. Elevated concentrations in WS104 were attributed to leachate analysis; supplementary groundwater sampling in this location did not identify any elevated concentrations and as such there is not considered a risk to controlled waters at this location.



**Controlled Waters
Cont.**

Groundwater samples from WS105 identified elevated concentrations of heavy metals and PAHs against both DWS and EQS screening values. A m-BAT assessment has been completed in regards to the identified elevated copper, nickel and zinc concentrations, which determined only the first round of monitoring in WS105 had RCR values exceeding for copper and zinc. The Pb screening tool identified WS105 to be bioavailable within the first monitoring visit but not the second. The elevated concentrations are considered to be anomalous in this location; the same is considered for PAHs as there is no significant source on site and the borehole was not located within Made Ground deposits. It is possible the source of the elevated concentrations in WS105 are attributed to chemicals utilised as part of the golf course maintenance.

The site is underlain by granular drift deposits to circa 5.50m bgl which is then underlain by low permeability cohesive deposits to depths greater than 20.00m bgl. The presence of this underlying cohesive drift stratum will offer significant protection to the underlying aquifer and minimise vertical migration in respect to this controlled water receptor.

The nearest surface water feature is a small stream/ditch 15m west of the site, and reservoirs 20m south of the site. Roads are present between the site and the surface water features which will act as a barrier but also a greater source of contaminants to the surface water features than the site itself. It is unlikely any of the identified contaminants would migrate to the surface water features due to the roads acting as a barrier to stop any migration. The path of the stream/ditch on-site is currently unknown but it does not appear to be linked to any other watercourses. The heavy metals and PAHs are likely low mobility and therefore are unlikely to migrate to the surface water receptors.

It should also be noted the site is currently uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore any leaching potential.

Further groundwater monitoring is recommended within WS105 and down-gradient to confirm the low risk to controlled waters.



Ground Gas	An infilled pond has been identified on site and off-site landfills within proximity to the site which may be a source of Made Ground, alluvial deposits or contain deeper organic soils with putrescible matter which may be subject to decay producing low levels of hazardous ground gases such as carbon dioxide and methane. Carbon dioxide and methane have associated asphyxiation and explosive risks, respectively. An off-site landfill has been identified in close proximity to the subject site circa 28m south-east of the site. However, based off Groundsure LIDAR data and available contours its likely infilling operations were over 50 m from the subject site and therefore the risk to the site is considered to be low. Within the previous site investigation completed by E3P in 2015, ground gas monitoring was completed across the site with WS109 and WS110 situated in the south/south-east of the site targeting any occurrences of migrating ground gases from the off-site landfill. In addition, WS101 from the 2015 E3P Ground Investigation was located in the south-west of the site which would note any presence of ground gases originating from the former landfill 27m south-west of the site. No elevated concentrations of carbon dioxide or methane were identified within any of the E3P 2015 monitoring wells, and as such it can be concluded that ground gases from the off-site landfill are not migrating to the subject site. Ground gas monitoring suggests the site can be zoned for the installation of CS1/Green and CS2/Amber 1 protection measures, as isolated areas of elevated ground gas concentrations have been identified on-site and as such, protective measures will be required to any proposed plots in areas classified as CS2/Amber 1. Zoning of the site should be agreed with the Local Authority prior to construction.
Potable Water	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

10.2. GEOTECHNICAL ASSESSMENT

No significant obstructions were encountered during the ground investigation. However due to the inaccessibility of the north eastern sector and the likelihood of the presence of Made Ground deposits due to the infilled features in this area, the presence of obstructions cannot be ruled out especially in the vicinity of the current golf club house. Further investigation will be required in this area when the area becomes accessible.

Due to the existing variances in the site topography, a phase of cut-and-fill enabling works will be required in order to create a proposed development platform suitable for a residential development. During a phase of cut-and-fill enabling works to create a developable platform, all below-ground obstructions if present will require grubbing out to the base of the Made Ground to enable the construction of proposed plots.

The site has been noted to be underlain by loose SANDS which are saturated. The most viable solution for the subject site would be to re-engineer the loose sands with VSC to support a shallow strip foundation using a bottom feed. Consideration of the proximity to sensitive infrastructure will be required. In the area of infilled pond in the north eastern sector of the site an allowance for a driven piled foundation solution is required.



Consideration of the use of VSC in plots in proximity of the sensitive service infrastructure on site should be considered which may require a driven piled foundation, raft foundations or use of a gravel trench to limit vibrations.

The underlying SAND deposits have been assessed as being very loose to medium dense with a net ABP in the order of 9.13-219 kN/m².

Cohesive drift deposits have been encountered at depths greater than 5.00mbgl. where they have been assessed as being very stiff with an ABP between 167-308 kN/m².

END OF REPORT



APPENDIX I LIMITATIONS

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



APPENDIX II

GLOSSARY

TERMS

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



North Manchester Golf Club

Phase I & II Geoenvironmental Site Assessment

January 2022

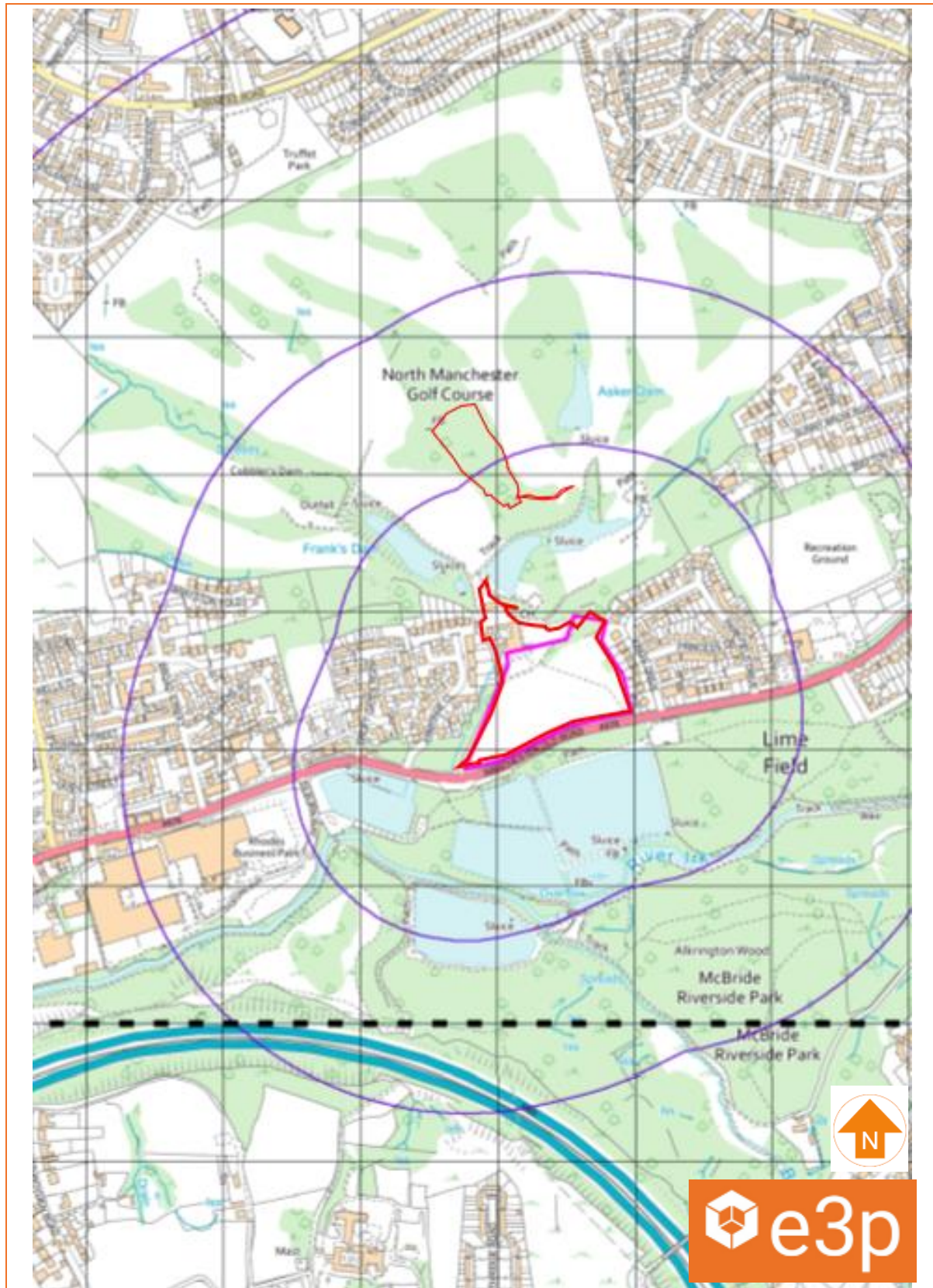
MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance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



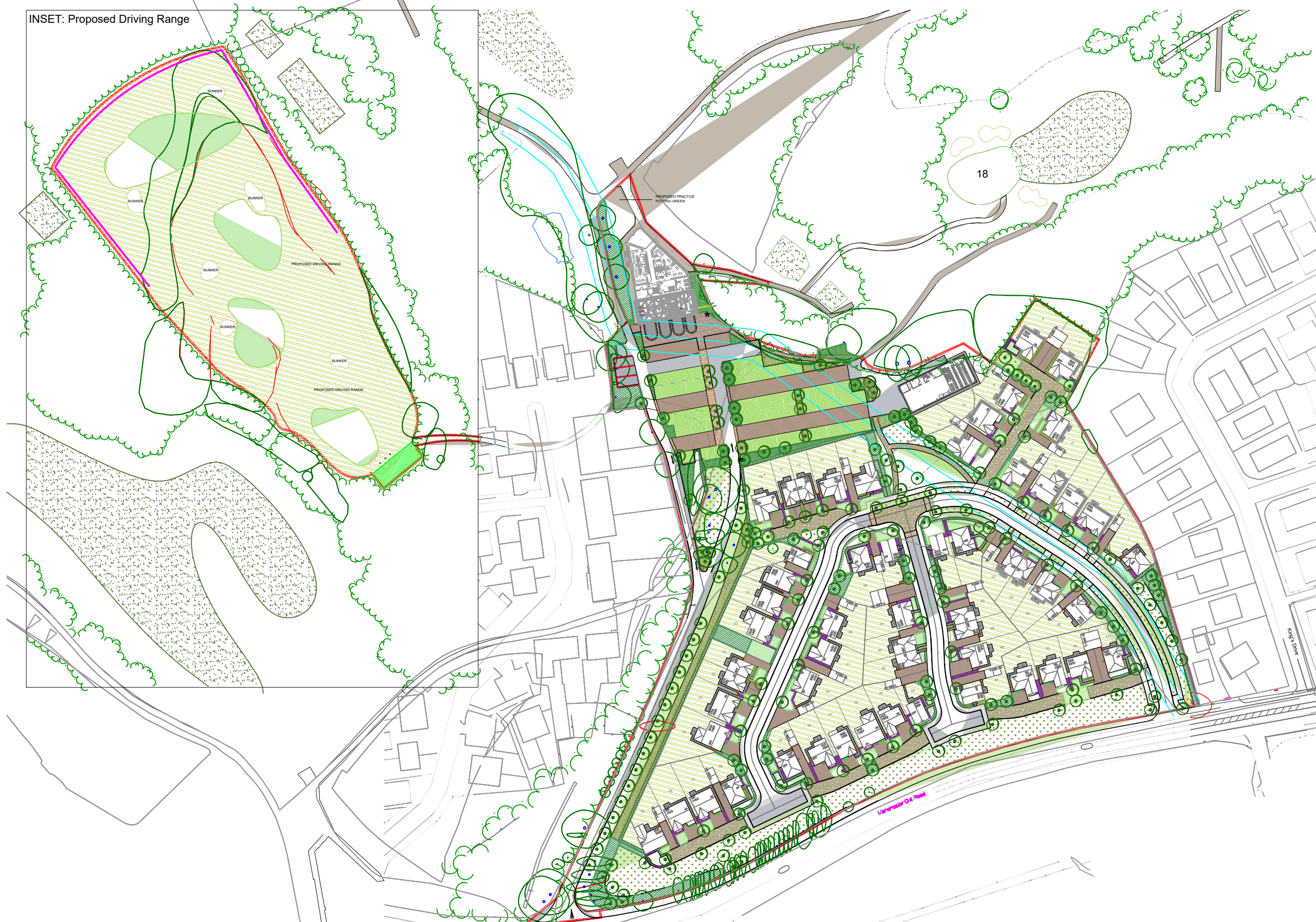
APPENDIX III

DRAWINGS

DRAWING 14-807-001 – SITE LOCATION PLAN



INSET: Proposed Driving Range



Notes:				
P1	REVD	24.01.2022	EB	BH
P1	REVC	11.11.2022	HM	GC
P1	REVB	16.07.2021	LM	BH
P1	REVA	02.06.2021	EB	BH
Phase	Issue	Date	Drawn	Checked

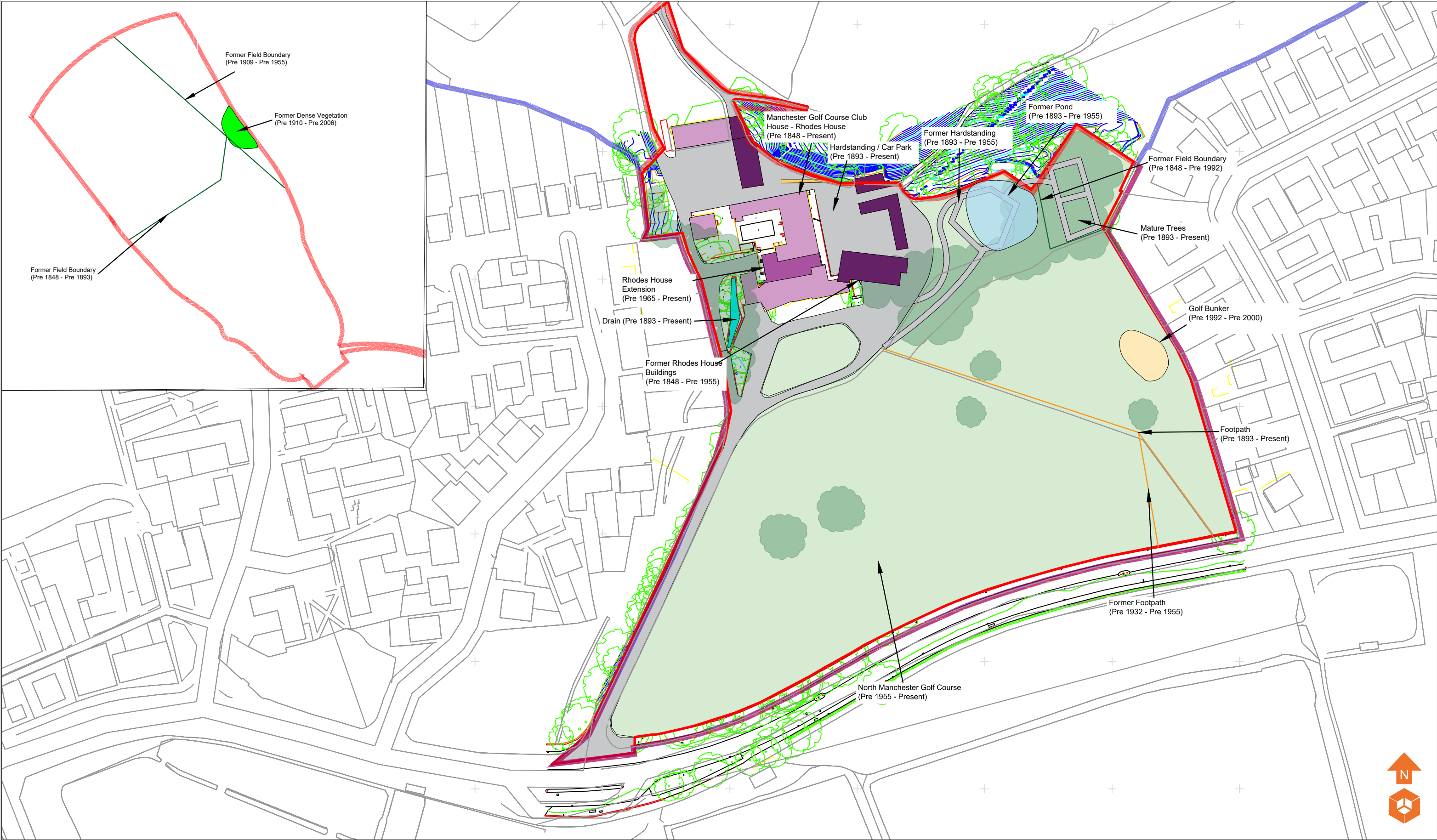
Client:	Duchy Homes
Job Title:	North Manchester Golf Club

Job No:	14-807
Drawing No:	002
Date:	24.01.2022
Scale:	NTS @ A3
Drawing Title:	Proposed Development Plan



Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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Historical Features

- Footpath (Pre 1893 - Present)
- Former Field Boundary (Pre 1848 - Pre 1992)
- Former Rhodes House Buildings (Pre 1893 - Pre 1955)
- Manchester Golf Course Club House Extension (Pre 1965 - Present)
- Manchester Golf Course Club House / Rhodes House (Pre 1848 - Present)
- North Manchester Golf Course (Pre 1955 - Present)
- Drain (Pre 1893 - Present)
- Mature Trees (Pre 1893 - Present)
- Hardstanding (Pre 1893 - Present)
- Golf Bunker (Pre 1992 - Pre 2000)
- Former Dense Vegetation (Pre 1910 - Pre 2006)

Notes:

P1	REVE	25.01.2022	EB	BH
P1	REVC	24.01.2022	EB	BH
P1	REVB	12.01.2022	HM	GC
P1	REVA	16.07.2021	LM	BH
P1		10.03.2021	EB	BH
Phase	Issue	Date	Drawn	Checked

Client:

Duchy Homes

Job Title:

North Manchester
Golf Club

Job No:

14-807

Drawing No:

003

Date:

25.01.2022

Scale:

NTS @ A3

Drawing Title:

Historical
Features Plan

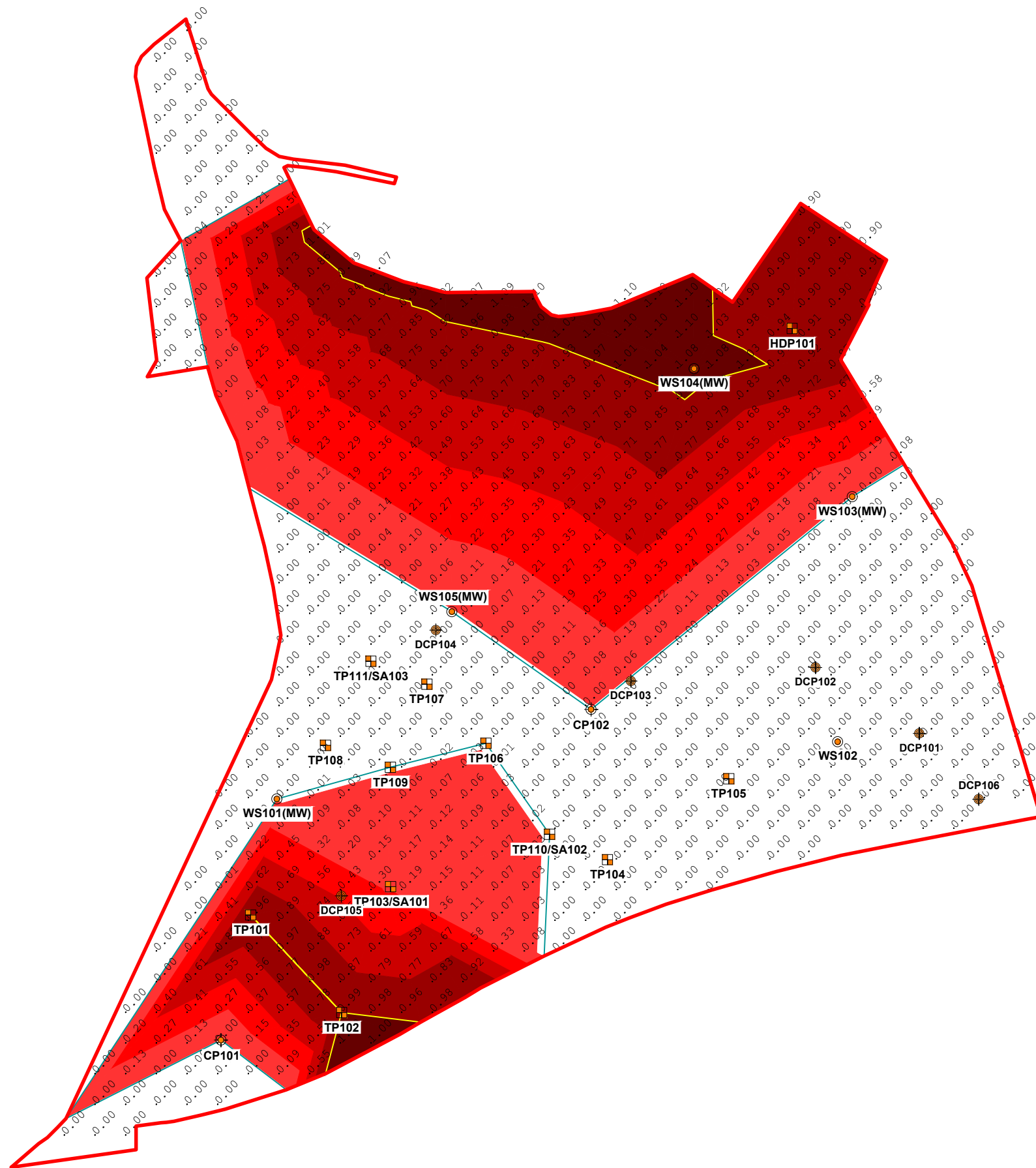


Environmental Engineering
Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
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Location Symbols					Notes:	Client: Duchy Homes	Job No: 14-807	Date: 12.01.2022	 Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk																																		
 WS101	Approximate Window Sample Probehole Location						Drawing No: 005	Scale: NTS @ A3																																			
 WS101(MW)	Approximate Window Sample Probehole with Install Location				<table><tr><td>P1</td><td>REVF</td><td>12.01.2022</td><td>EB</td><td>BH</td></tr><tr><td>P1</td><td>REVE</td><td>16.07.2021</td><td>LM</td><td>BH</td></tr><tr><td>P1</td><td>REVD</td><td>08.07.2021</td><td>EB</td><td>BH</td></tr><tr><td>P1</td><td>REVC</td><td>21.05.2021</td><td>HM</td><td>BH</td></tr><tr><td>P1</td><td>REVB</td><td>28.04.2021</td><td>LM</td><td>BH</td></tr><tr><td>P1</td><td>REVA</td><td>20.04.2021</td><td>LM</td><td>BH</td></tr><tr><td>Phase</td><td>Issue</td><td>Date</td><td>Drawn</td><td>Checked</td></tr></table>	P1	REVF	12.01.2022	EB	BH	P1	REVE	16.07.2021	LM	BH	P1	REVD	08.07.2021	EB	BH	P1	REVC	21.05.2021	HM	BH	P1	REVB	28.04.2021	LM	BH	P1	REVA	20.04.2021	LM	BH	Phase	Issue	Date	Drawn	Checked	Job Title: North Manchester Golf Club	Drawing Title: Exploratory Hole Location Plan	The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.
P1	REVF	12.01.2022	EB	BH																																							
P1	REVE	16.07.2021	LM	BH																																							
P1	REVD	08.07.2021	EB	BH																																							
P1	REVC	21.05.2021	HM	BH																																							
P1	REVB	28.04.2021	LM	BH																																							
P1	REVA	20.04.2021	LM	BH																																							
Phase	Issue	Date	Drawn	Checked																																							
 TP101	Approximate Trial Pit Location																																										
 TP101	Approximate Hand Dug Pit Location																																										
 SA101	Approximate Soakaway Test Location																																										
 CP101	Approximate Cable Percussive Borehole Location																																										
 DCP101	Approximate Dynamic Cone Penetrometer Test Location																																										



- Location Symbols**
- Approximate Window Sample Probehole Location
 - Approximate Window Sample Probehole with Install Location
 - Approximate Trial Pit Location
 - Approximate Hand Dug Pit Location
 - Approximate Soakaway Test Location
 - Approximate Cable Percussive Borehole Location
 - Approximate Dynamic Cone Penetrometer Test Location

- Made Ground Depth (m)**
- Depth of Made Ground 0.00 - 0.24m
 - Depth of Made Ground 0.25 - 0.49m
 - Depth of Made Ground 0.50 - 0.74m
 - Depth of Made Ground 0.75 - 0.99m
 - Depth of Made Ground >1.00m

Notes:				
P1	REVC	12.01.2022	EB	BH
P1	REVB	16.07.2021	LM	BH
P1	REVA	02.06.2021	EB	BH
Phase	Issue	Date	Drawn	Checked

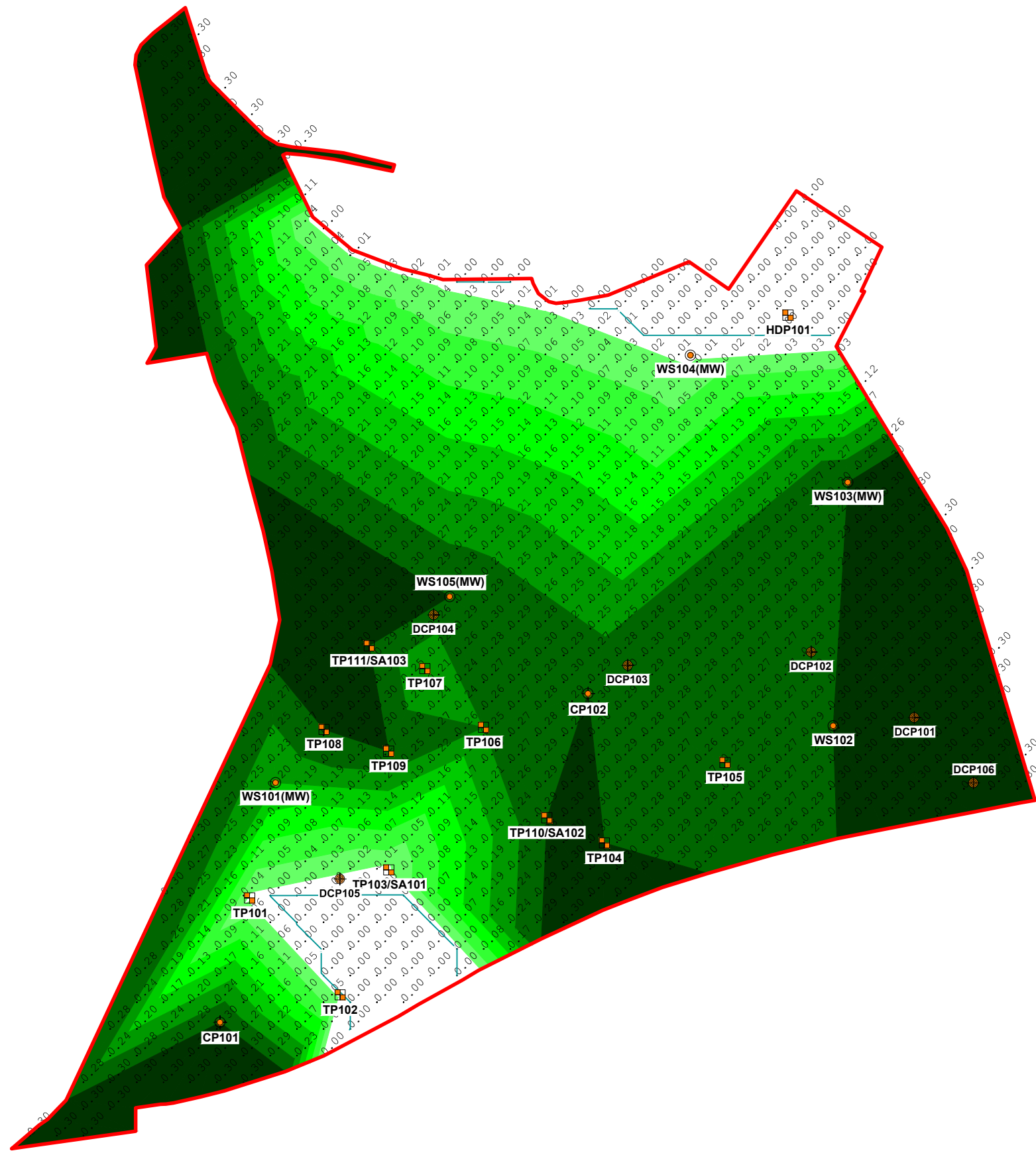
Client:	
Duchy Homes	
Job Title:	
North Manchester Golf Club	

Job No:	14-807	Date:	12.01.2022
Drawing No:	006	Scale:	NTS @ A3
Drawing Title:		Depth of Made Ground Plan	

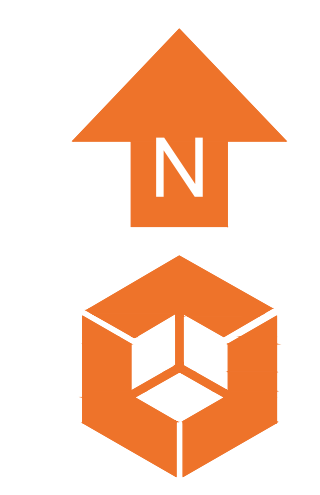
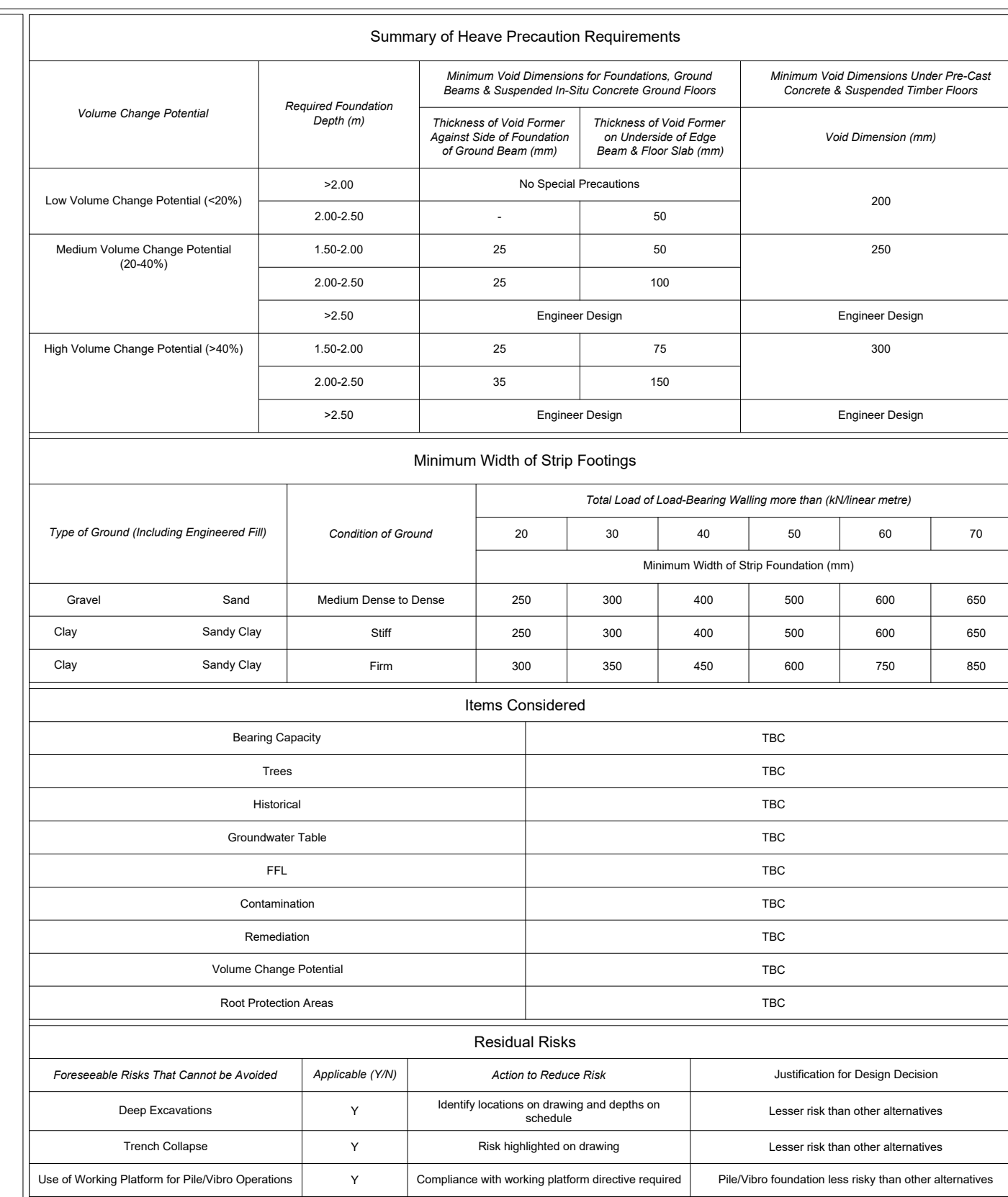


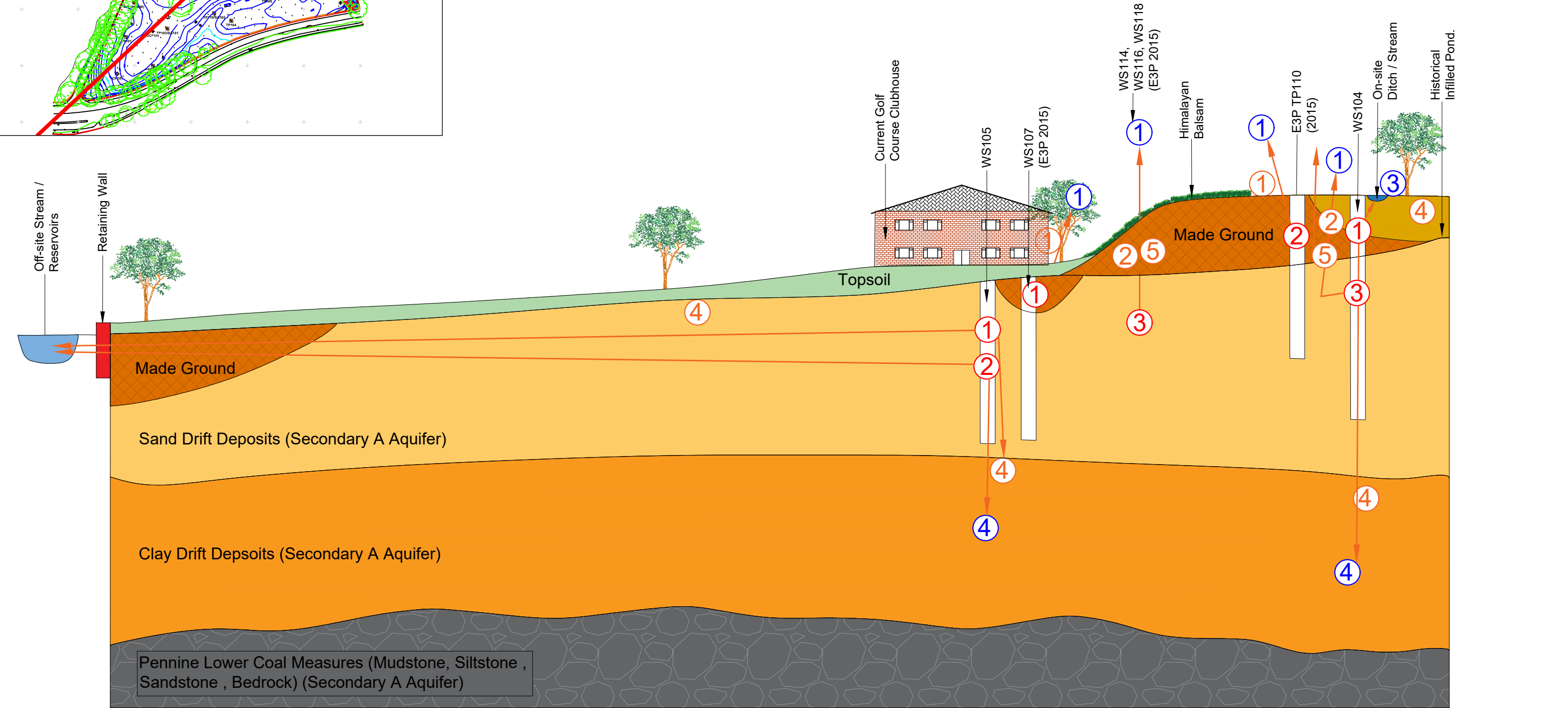
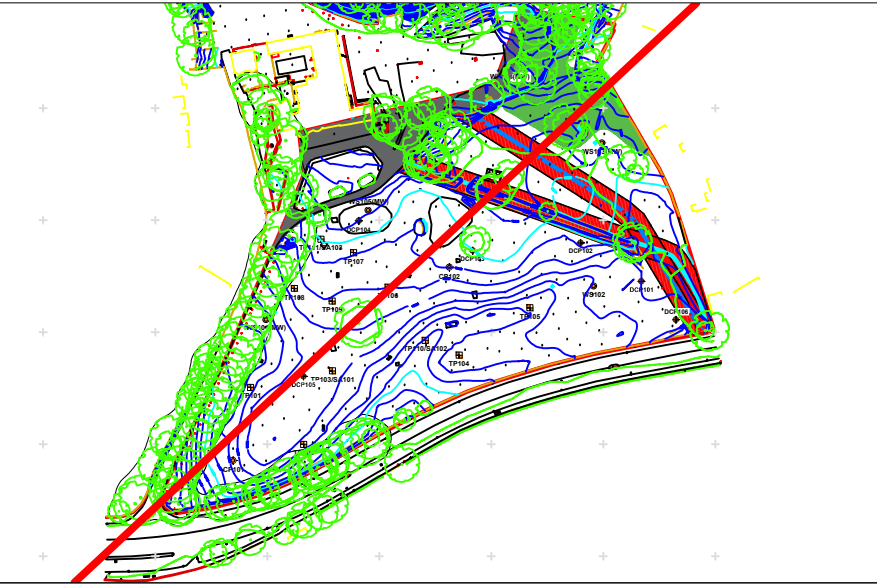
Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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Location Symbols			Topsoil Depth (m)			Notes:					Client:		Job No:		Date:		Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk	
WS101 Approximate Window Sample Probehole Location			 Depth of <i>Topsoil</i> 0.00 - 0.04m			P1 REVC 12.01.2022 EB BH P1 REVB 16.07.2021 LM BH P1 REVA 02.06.2021 EB BH Phase Issue Date Drawn Checked					14-807		12.01.2022					
WS101(MW) Approximate Window Sample Probehole with Install Location			 Depth of <i>Topsoil</i> 0.05 - 0.09m								Drawing No:		Scale:					
TP101 Approximate Trial Pit Location			 Depth of <i>Topsoil</i> 0.10 - 0.14m								007		NTS @ A3					
TP101 Approximate Hand Dug Pit Location			 Depth of <i>Topsoil</i> 0.15 - 0.19m			North Manchester Golf Club					Drawing Title:		Depth of <i>Topsoil</i> Plan		The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.			
SA101 Approximate Soakaway Test Location			 Depth of <i>Topsoil</i> 0.20 - 0.24m															
CP101 Approximate Cable Percussive Borehole Location			 Depth of <i>Topsoil</i> 0.25 - 0.29m															
DCP101 Approximate Dynamic Cone Penetrometer Test Location			 Depth of <i>Topsoil</i> >0.30m															





Geology Key

- Made Ground
- Topsoil
- Infilled Pond
- Sand Drift Deposits
- Clay Drift Deposits
- Pennine Lower Coal Measures
- Retaining Wall
- Off-Site Stream / Reservoirs
- On-Site Ditch / Stream

Sources

- ① Heavy Metals
- ② PAHs (non-volatile)
- ③ Hazardous Ground Gas

Receptors

- ① Future Site Users
- ② Off Site Land Users
- ③ Surface water features
- ④ Secondary A Aquifer

Pathways

- ① Dermal Contact / Ingestion
- ② Migration Through Permeable Strata
- ③ Inhalation of Dust
- ④ Vertical / Lateral migration
- ⑤ Inhalation / Accumulation

Notes:

P1	REVA	16.07.2021	LM	MD
Phase	Issue	Date	Drawn	Checked

Client:

Duchy Homes

Job Title:

North Manchester Golf Club

Job No:

14-807

Drawing No:

010

Date:

16.07.2021

Scale:

NTS

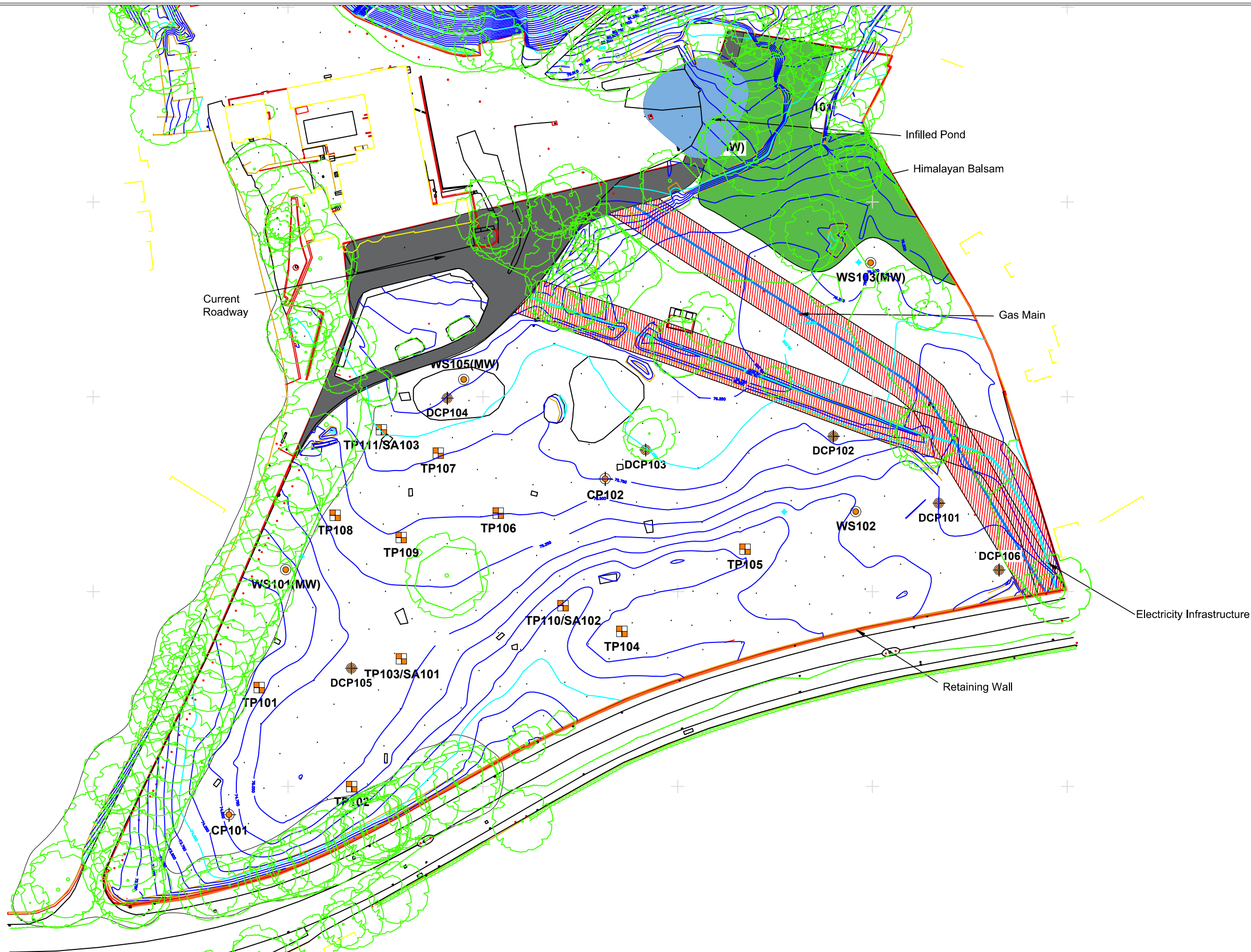
Drawing Title:

Conceptual Site Model

Environmental Engineering Partnership Ltd

Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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- Location Symbols**
- WS101 Approximate Window Sample Probehole Location
 - TP101 Approximate Trial Pit Location
 - HD101 Approximate Hand Dug Pit Location
 - SA101 Approximate Soakaway Test Location
 - CP101 Approximate Cable Percussive Borehole Location
 - CB101 Proposed California Bearing Ratio Test Location
 - DCP101 Approximate Dynamic Cone Penetrometer Test Location

- Development Constraints**
- Electricity Cable
 - Gas Main
 - 5m Gas Main Easement
 - Himalayan Balsam
 - Infilled Pond
 - Current Roadway
 - Retaining Wall

Notes:					
P1	REVB	16.07.2021	LM	BH	
P1	REVA	02.06.2021	EB	BH	
Phase	Issue	Date	Drawn	Checked	

Client:		Duchy Homes	
Job Title:		North Manchester Golf Club	

Job No:	14-807	Date:	16.07.2021
Drawing No:	015	Scale:	NTS @ A3
Drawing Title:		Development Constraints Plan	



Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
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APPENDIX IV PHOTOGRAPHS

PLATE 1 VIEW OF THE NORTH EASTERN SECTOR OF THE SITE



PLATE 2 HIMALAYAN BALSAM (DEAD AT TIME OF WALKOVER)



PLATE 3 CAR PARKING IN NORTH OF SITE



PLATE 4 VIEW OF THE EASTERN SECTOR IN PROXIMITY TO LHP GAS MAIN AND BUND



PLATE 5 OVERGROWN VEGETATION IN EAST OF SITE



PLATE 6 VIEW OF GOLF COURSE



PLATE 7 VIEW OF GOLF COURSE LOOKING WEST



PLATE 8 VIEW OF GOLF COURSE LOOKING NORTH WEST



PLATE 9 VIEW OF GOLF COURSE LOOKING SOUTH TO MANCHESTER OLD ROAD



PLATE 10 VIEW OF CLUB HOUSE AND NORTH OF SITE



PLATE 11 CHAMBER IN SOUTH OF SITE



PLATE 12 SOUTH OF SITE



APPENDIX V

E3P EXPLORATORY HOLE LOGS

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385788.00 - 405422.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

Scale
1:30

Client: Duchy Homes

Depth
2.20

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30			MADE GROUND: Black slightly clayey medium sand (Topsoil) with frequent rootlets.	
							MADE GROUND: Brown slightly clayey medium sand.	
	0.70	B						
	0.95	ES		0.90			MADE GROUND: Blackish brown very clayey medium sand.	1
	1.10	ES		1.00			Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	2
				2.20			End of Pit at 2.20m	3
								4

Trial Pit Photographs



Trial Pit 101



Trial Pit 101 Spoil

Remarks: Complete.

Stability: Stable

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385815.00 - 405405.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

Scale
1:30

Client: Duchy Homes

Depth
2.10

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.25	ES		0.30			MADE GROUND: Black slightly clayey medium sand (Topsoil) with frequent rootlets.	
							MADE GROUND: Brown slightly clayey medium sand.	
	0.89	ES		0.86 1.00			MADE GROUND: Blackish brown very clayey medium sand.	1
							Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	2
				2.10			End of Pit at 2.10m	3
								4

Trial Pit Photographs



Trial Pit 102



Trial Pit 102 Spoil

Remarks: Complete.

Stability: Stable



e3p

Trial Pit Log

TrialPit No
TP103/
SA101
Sheet 1 of 1

Project Name: North Manchester Golf Club

Project No.
14807Co-ords: 385831.00 - 405439.00
Level:Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

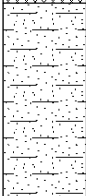
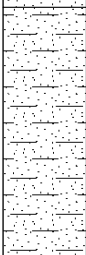
Scale
1:30

Client: Duchy Homes

Depth
2.00

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES		0.21			MADE GROUND: Black slightly clayey medium sand (Topsoil) with frequent rootlets.	
							Brown slightly clayey medium SAND.	
				1.00			Light brown slightly clayey medium SAND.	1
	1.50	ES						
				2.00			End of Pit at 2.00m	2
								3
								4

Remarks: Complete.

Stability: Stable



Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385880.00 - 405439.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

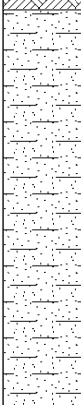
Scale
1:30

Client: Duchy Homes

Depth
1.90

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
	1.80	B		1.90			Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	1
							End of Pit at 1.90m	2
								3
								4

Trial Pit Photographs



Trial Pit 104



Trial Pit 104

Remarks: Complete.

Stability: Stable

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385913.00 - 405464.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

Scale
1:30

Client: Duchy Homes

Depth
1.90

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 0.80	1.00	ES		0.25			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	1
				0.50			Brown slightly clayey medium SAND.	
							Brown slightly clayey very gravelly medium SAND with occasional cobbles and rare boulders. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone. Boulders are sub-angular to sub-rounded of mudstone.	
	2.00	ES		1.90			End of Pit at 1.90m	2
								3
								4

Trial Pit Photographs



Trial Pit 105



Trial Pti 105 Spoil

Remarks: 1. Complete. 2. Water strike encountered at 0.80m bgl. 3. SANDS noted to be saturated from 0.80m bgl.

Stability: Unstable

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385845.00 - 405465.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

Scale
1:30

Client: Duchy Homes

Depth
2.00

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 1.00	0.10	ES					Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
	0.30	ES		0.25			Brown very clayey medium SAND with rare rootlets.	
				0.50			Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	1
				2.00			End of Pit at 2.00m	2
								3
								4

Trial Pit Photographs



Trial Pit 106



Trial Pit 106 Spoil

Remarks: 1. Complete. 2. Water strike encountered at 1.00m bgl. 3. SANDS noted to be saturated from 1.00m bgl.

Stability: Slightly unstable.

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385837.00 - 405485.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

Scale
1:30

Client: Duchy Homes

Depth
1.80

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 1.60	0.15	ES		0.20			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
				0.50			Brown very clayey medium SAND.	
	1.00	ES					Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	1
				1.80			End of Pit at 1.80m	2
								3
								4

Trial Pit Photographs



Trial Pit 107



Trial Pit 107 Spoil

Remarks: 1. Complete. 2. Water strike encountered at 1.60m bgl. 3. SANDS noted to be saturated from 1.60m bgl.

Stability: Stable

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385816.00 - 405483.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

Scale
1:30

Client: Duchy Homes

Depth
1.80

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 1.80	0.20	ES		0.30			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
				0.70			Brown slightly gravelly medium SAND with rootlets. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	
				1.80			Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	1
							End of Pit at 1.80m	2
								3
								4

Trial Pit Photographs



Trial Pit 108



Trial Pit 108 Spoil

Remarks: 1. Complete. 2. Water strike encountered at 1.80m bgl. 3. SANDS noted to be saturated.

Stability: Stable

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385829.00 - 405480.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.30

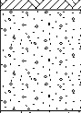
Scale
1:30

Client: Duchy Homes

Depth
1.80

0.50

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 1.60	0.20	ES		0.30			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
	0.60	ES		0.70			Brown slightly gravelly clayey medium SAND with rootlets. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	
	1.00	B					Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	1
				1.80			End of Pit at 1.80m	2
								3
								4

Trial Pit Photographs



Trial Pit 109



Trial Pit 109 Spoil

Remarks: 1. Complete. 2. Water strike encountered at 1.60m bgl.

Stability: Unstable



Trial Pit Log

TrialPit No
TP110/
SA102
Sheet 1 of 1

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385870.00 - 405447.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.20

Scale
1:30

Client: Duchy Homes

Depth
1.80

0.40

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
				1.80			Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	1
							End of Pit at 1.80m	2
								3
								4

Remarks: Complete.

Stability: Stable



Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385826.00 - 405501.00
Level:

Date
15/03/2021

Location: Middleton

Dimensions (m): 2.10

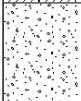
Scale
1:30

Client: Duchy Homes

Depth
1.60

0.40

Logged
J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
				0.70			Brown slightly gravelly clayey medium SAND with rootlets. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	
				1.60			Brown slightly clayey very gravelly medium SAND with occasional cobbles. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. Cobbles are sub-angular to sub-rounded to rounded of mudstone.	1
							End of Pit at 1.60m	2
								3
								4

Trial Pit Photographs



Trial Pit 111/ Soakaway 103



Trial Pit 111/ Soakaway 103 Spoil

Remarks: Complete.

Stability: Stable

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385802E - 405450N

Hole Type
WS

Location: Middleton

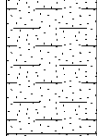
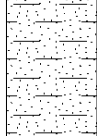
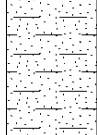
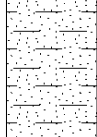
Level:

Scale
1:50

Client: Duchy Homes

Dates: 15/03/2021

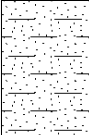
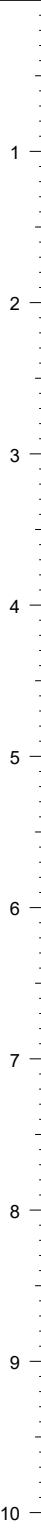
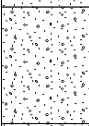
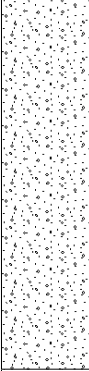
Logged By
J. Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.20			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
		0.50	ES		0.40			Grey slightly clayey very gravelly medium SAND. Gravel is fine to coarse sub-angular to rounded of mudstone, sandstone and limestone.	
		1.20	SPT	N=13 (3,5/4,3,3,3)	1.20			Brown slightly clayey, slightly gravelly medium SAND. Gravel is fine to coarse angular to sub-angular of mudstone and fragments of coal.	1
		2.00	SPT	N=18 (3,2/3,4,5,6)	2.10			Medium dense brown grey slightly clayey very gravelly medium SAND. Gravel is fine to coarse sub-angular to rounded of mudstone, sandstone and limestone.	2
		3.00	SPT	N=6 (1,2/2,1,1,2)				Medium dense brown slightly clayey, slightly gravelly medium SAND. Gravel is fine to coarse angular to sub-angular of mudstone and fragments of coal. (Circa 3.00m bgl becomes loose) (Circa 4.00m bgl becomes medium dense).	3
		4.00	SPT	N=16 (2,3/3,4,4,5)				Medium dense brown slightly clayey, slightly gravelly medium SAND. Gravel is fine to coarse angular to sub-angular of mudstone and fragments of coal. (Circa 3.00m bgl becomes loose) (Circa 4.00m bgl becomes medium dense).	4
		5.00	SPT	N=25 (4,5/6,7,6,6)				Medium dense brown slightly clayey, slightly gravelly medium SAND. Gravel is fine to coarse angular to sub-angular of mudstone and fragments of coal. (Circa 3.00m bgl becomes loose) (Circa 4.00m bgl becomes medium dense).	5
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

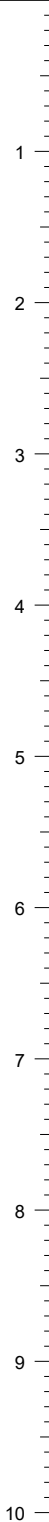
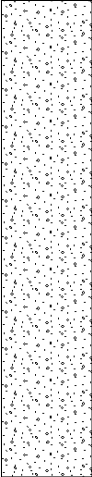
1. Monitoring well installed- response zone 0.50m to 1.50m bgl. 2. Borehole collapsed to 1.50m bgl. 3. Water strike encountered at 1.50m bgl.

				Borehole Log				Borehole No. WS102 Sheet 1 of 1	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385944E - 405468N		Hole Type WS	
Location: Middleton				Level:		Scale 1:50			
Client: Duchy Homes				Dates: 15/03/2021		Logged By J. Craig			

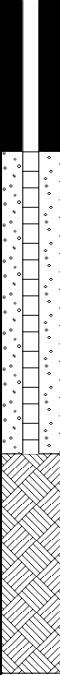
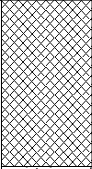
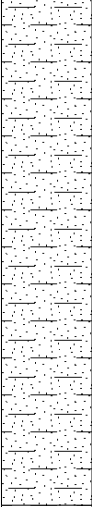
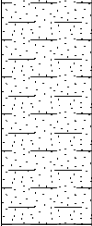
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
	 0.50				0.30		 Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.  Brown slightly clayey medium SAND.		
		1.00	ES						
		1.20	SPT	N=8 (2,3/2,2,2,2)	1.23				
		2.00	SPT	N=0 (1,0/0,0,0,0)	2.00		 Loose grey slightly clayey very gravelly fine to medium SAND. Gravel is fine to coarse sub-angular to rounded of mudstone, sandstone and limestone.		
		3.00	SPT	N=13 (1,2/3,4,3,3)			 Very loose brown slightly clayey very gravelly medium SAND. Gravel is fine to coarse sub-angular to rounded of mudstone, sandstone and limestone. (Circa 3.00m bgl becomes medium dense).		
		4.00	SPT	N=26 (4,5/5,6,8,7)					
					4.45		End of Borehole at 4.45m		

Remarks
 1. Hand dug pit to 1.20m bgl for service clearance 2. Borehole collapsed to 0.50m bgl 3. Water strike encountered at 0.50m bgl



				Borehole Log				Borehole No. WS103 Sheet 1 of 1	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385951E - 405528N		Hole Type WS	
Location: Middleton				Level:		Scale 1:50			
Client: Duchy Homes				Dates: 15/03/2021		Logged By J. Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
		1.00	ES						
		1.20	SPT	N=13 (2,3/3,4,3,3)					
		2.00	SPT	N=8 (1,2/2,2,2,2)					
		3.00	SPT	N=9 (2,2/2,3,2,2)					
					3.45		End of Borehole at 3.45m		
Remarks 1. Hand dug pit to 1.20m bgl for service clearance. 2. Monitoring well installed- response zone 0.50m to 1.00m bgl. 3. Borehole collapsed to 1.00m bgl. 4. Water strike encountered at 1.00m bgl.									

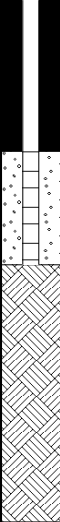
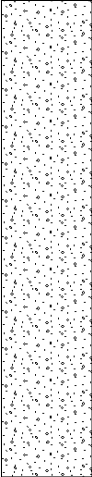
				Borehole Log				Borehole No. WS104 Sheet 1 of 1	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385909E - 405576N		Hole Type WS	
Location: Middleton				Level:				Scale 1:50	
Client: Duchy Homes				Dates: 15/03/2021				Logged By J. Craig	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00	ES	N=8 (1,1/2,2,2,2)	1.10			MADE GROUND: Blackish grey slightly clayey medium sand with occasional brick fragments.	1
		1.20	SPT						
		1.50	ES	N=19 (4,5/6,5,4,4)				Loose brownish grey slightly clayey very silty medium SAND. (Possible pond silt material). (Circa 2.00m bgl becomes medium dense) (Circa 3.00m bgl becomes loose) (Circa 4.00m bgl becomes medium dense).	2
		2.00	SPT						
		3.00	SPT						
	4.00	SPT	N=16 (2,3/3,4,4,5)	4.45			End of Borehole at 4.45m	4	
									5
									6
									7
									8
									9
									10

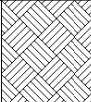
Remarks

1. Hand dug pit to 1.20m bgl for service clearance. 2. Monitoring well installed- response zone 1.00m to 3.00m bgl. 3. Water strike encountered at 1.50m bgl. 4. Borehole terminated at 4.45m bgl due to jamming of barrel with saturated sands. 5. Saturated SANDS encountered.



				Borehole Log				Borehole No. WS105 Sheet 1 of 1	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385850E - 405512N		Hole Type WS	
Location: Middleton				Level:		Scale 1:50			
Client: Duchy Homes				Dates: 15/03/2021		Logged By J. Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
	 1.75	0.20	ES		0.30		 Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	Medium dense brown slightly clayey very gravelly medium SAND. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. (Circa 2.00m bgl becomes loose).	
		0.60	ES						
		1.20	SPT	N=11 (2,2/2,3,4,2)					
		2.00	SPT	N=7 (2,3/3,2,1,1)					
		3.00	SPT	N=8 (1,1/1,2,2,3)	3.45		End of Borehole at 3.45m		
Remarks 1. Hand dug pit to 1.20m bgl for service clearance 2. Monitoring well installed- response zone 1.00m to 1.75m bgl. 3. Borehole collapsed to 1.75m bgl 4. Water strike encountered at 1.75 m bgl									

				Borehole Log				Borehole No. HDP101 Sheet 1 of 1	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385922E - 405605N		Hole Type DP	
Location: Middleton				Level:		Scale 1:50			
Client: Duchy Homes				Dates: 15/03/2021		Logged By J. Newall			

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.70			MADE GROUND: Black slightly clayey medium sand (Topsoil) with frequent rootlets.	
					0.90			MADE GROUND: Orange medium sand.	
					1.10			Brown slightly clayey very gravelly medium SAND. Gravel is rounded to subangular, fine to coarse of sandstone, mudstone and limestone.	1
								End of Borehole at 1.10m	
									2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks
 1. Hand pit terminated at 1.10m bgl



Borehole Log

Borehole No.

CP101

Sheet 1 of 3

Project Name: North Manchester Golf Club

Project No.
14807

Co-ords: 385786E - 405398N

Hole Type
CP

Location: Middleton

Level:

Scale
1:50

Client: Duchy Homes

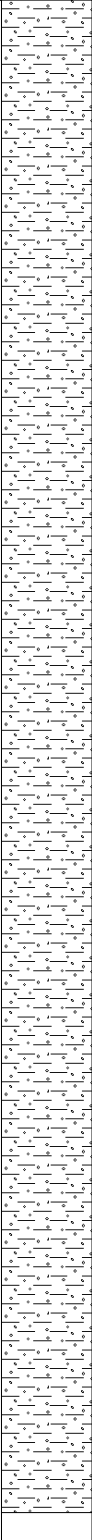
Dates: 15/03/2021

Logged By
J. Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D		0.30			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
		0.40	D					Medium dense brown slightly clayey very gravelly medium SAND. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone.	
		1.20	SPT	N=18 (2,3/4,4,5,5)	3.50				1
		2.00	SPT	N=15 (2,3/3,4,4,4)					2
		3.00	SPT	N=16 (2,3/4,4,4,4)					3
		4.00	SPT	N=9 (1,2/3,2,2,2)	5.60			Loose brown slightly clayey very gravelly medium SAND with soft silty clay bands. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone.	4
		5.00	SPT	N=8 (1,1/2,2,2,2)					5
		5.60	D						
		6.50	SPT	N=20 (2,3/4,4,5,7)				Very stiff high strength brown gravelly sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone.	6
		8.00	SPT	N=25 (2,4/5,5,7,8)					7
		9.50	SPT	N=27 (3,4/5,7,7,8)					8
									9
									10

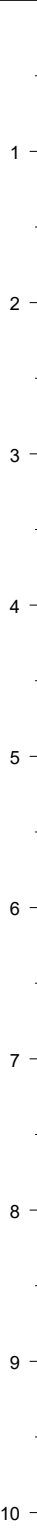
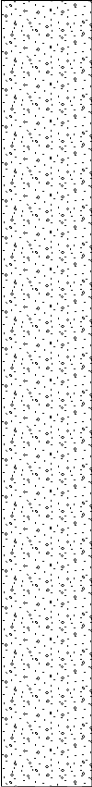
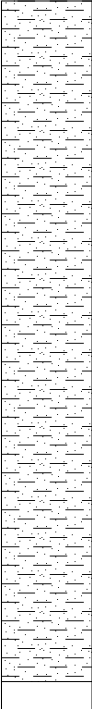
Remarks

1. Borehole terminated upon refusal at 18.50m and 20.45m bgl

				Borehole Log				Borehole No. CP101 Sheet 2 of 3	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385786E - 405398N		Hole Type CP	
Location: Middleton				Level:		Scale 1:50			
Client: Duchy Homes				Dates: 15/03/2021		Logged By J. Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00	SPT	N=29 (3,5/5,6,8,10)				Very stiff high strength brown gravelly sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone.	11
		12.50	SPT	N=29 (3,4/5,6,8,10)					12
		14.00	SPT	N=30 (3,4/5,7,8,10)					13
		15.50	SPT	N=35 (4,5/6,8,10,11)					14
		17.00	SPT	N=40 (4,6/8,9,11,12)					15
		18.50	SPT	50 (5,7/50 for 290mm)					16
		20.00	SPT	50 (6,8/50 for 228mm)					17
Remarks 1. Borehole terminated upon refusal at 18.50m and 20.45m bgl									

				Borehole Log				Borehole No. CP101 Sheet 3 of 3	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385786E - 405398N		Hole Type CP	
Location: Middleton				Level:		Scale 1:50			
Client: Duchy Homes				Dates: 15/03/2021		Logged By J. Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					20.45		 Very stiff high strength brown gravelly sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone.		
							End of Borehole at 20.45m		
									21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Borehole terminated upon refusal at 18.50m and 20.45m bgl									

					Borehole Log			Borehole No. CP102 Sheet 1 of 3		
Project Name: North Manchester Golf Club					Project No. 14807		Co-ords: 385881E - 405481N		Hole Type CP	
Location: Middleton					Level:			Scale 1:50		
Client: Duchy Homes					Dates: 16/03/2021			Logged By J. Craig		

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
	 1.00	0.20	D		0.30			Black slightly clayey medium SAND (TOPSOIL) with frequent rootlets.	
		0.40	D					Medium dense brown slightly clayey very gravelly medium SAND. Gravel is fine to coarse sub-angular to rounded of sandstone, mudstone and limestone. (Circa 2.00m bgl becomes loose).	
		1.20	SPT	N=15 (2,2/3,3,4,5)	5.50				
		2.00	SPT	N=10 (2,3/3,2,3,2)					
		3.00	SPT	N=8 (1,1/2,2,2,2)					
		4.00	SPT	N=9 (1,1/2,2,2,3)					
		5.00	SPT	N=11 (1,2/2,3,3,3)					
		5.50	D						
		6.50	SPT	N=23 (2,3/4,5,7,7)					
		8.00	SPT	N=26 (2,3/5,6,7,8)					
9.50	SPT	N=27 (2,3/4,6,8,9)							
								Very stiff high strength brown gravelly sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone.	

Remarks
 1. Borehole terminated upon refusal at 20.45m bgl. 2. Water strike encountered at 1.00m bgl.



				Borehole Log				Borehole No. CP102 Sheet 2 of 3	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385881E - 405481N		Hole Type CP	
Location: Middleton				Level:		Scale 1:50			
Client: Duchy Homes				Dates: 16/03/2021		Logged By J. Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00	SPT	N=31 (3,5/6,7,8,10)				Very stiff high strength brown gravelly sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone.	11
		12.50	SPT	N=33 (3,5/6,8,9,10)					12
		14.00	SPT	N=34 (3,5/7,8,9,10)					13
		15.50	SPT	N=41 (4,6/8,10,11,12)					14
		17.00	SPT	N=42 (4,5/8,9,12,13)					15
		18.50	SPT	50 (6,7/50 for 232mm)					16
		20.00	SPT	50 (6,9/50 for 228mm)					17
Remarks 1. Borehole terminated upon refusal at 20.45m bgl. 2. Water strike encountered at 1.00m bgl.									

				Borehole Log				Borehole No. CP102 Sheet 3 of 3	
Project Name: North Manchester Golf Club				Project No. 14807		Co-ords: 385881E - 405481N		Hole Type CP	
Location: Middleton				Level:		Scale 1:50			
Client: Duchy Homes				Dates: 16/03/2021		Logged By J. Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					20.45		 Very stiff high strength brown gravelly sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone.		
							End of Borehole at 20.45m		
									21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Borehole terminated upon refusal at 20.45m bgl. 2. Water strike encountered at 1.00m bgl.									

APPENDIX VI

CHEMICAL TESTING

RESULTS



Rebecca Hodnett

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: rhodnett@e3p.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-63072

Project / Site name:	North Manchester Golf Club	Samples received on:	16/03/2021
Your job number:	14-807	Samples instructed on/ Analysis started on:	17/03/2021
Your order number:	14807-JC-E	Analysis completed by:	24/03/2021
Report Issue Number:	1	Report issued on:	24/03/2021
Samples Analysed:	1 leachate sample - 16 soil samples		

Signed: *Karolina Marek*

Karolina Marek
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

Analytical Report Number: 21-63072
 Project / Site name: North Manchester Golf Club
 Your Order No: 14807-JC-E

Lab Sample Number				1805634	1805635	1805636	1805637	1805638
Sample Reference				TP101	TP101	TP102	TP104	WS101
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.90	0.25	0.20	0.50
Date Sampled				15/03/2021	15/03/2021	15/03/2021	15/03/2021	15/03/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	16	14	19	28	10
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.50	0.50	0.90

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	-
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	7.1	6.5	-	7.5
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	340	620	-	140
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-	0.0062	0.016	-	0.0044
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-	12	33	-	8.7
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	6.2	16.4	-	4.4
Sulphide	mg/kg	1	MCERTS	-	< 1.0	1.1	-	< 1.0
Total Sulphur	mg/kg	50	MCERTS	-	97	250	-	< 50
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	0.6	-	-	< 0.1

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	< 1.0	< 1.0	-	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.38	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	0.23	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	1.9	2.6	0.56	0.57	< 0.05
Anthracene	mg/kg	0.05	MCERTS	0.57	0.55	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	3.5	2.5	1.2	1.9	< 0.05
Pyrene	mg/kg	0.05	MCERTS	3.5	2.4	1.3	1.8	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.9	1.1	0.66	0.97	< 0.05
Chrysene	mg/kg	0.05	MCERTS	1.4	1.1	0.58	0.95	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.9	0.92	0.83	1.2	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.80	0.29	0.23	0.51	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.8	0.77	0.62	0.84	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.78	0.31	0.28	0.45	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.94	0.38	0.38	0.57	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	19.1	13.6	6.63	9.75	< 0.80
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Analytical Report Number: 21-63072
 Project / Site name: North Manchester Golf Club
 Your Order No: 14807-JC-E

Lab Sample Number				1805634	1805635	1805636	1805637	1805638
Sample Reference				TP101	TP101	TP102	TP104	WS101
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.90	0.25	0.20	0.50
Date Sampled				15/03/2021	15/03/2021	15/03/2021	15/03/2021	15/03/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	6.1	12	25	17
Barium (aqua regia extractable)	mg/kg	1	MCERTS	54	-	-	80	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.63	-	-	0.71	-
Boron (water soluble)	mg/kg	0.2	MCERTS	< 0.2	-	-	< 0.2	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	9.2	14	-	8.8
Copper (aqua regia extractable)	mg/kg	1	MCERTS	31	20	25	51	32
Lead (aqua regia extractable)	mg/kg	1	MCERTS	40	17	49	140	22
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	8.2	16	17	13
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	22	-	-	36	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	45	34	52	59	120

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	21	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	15	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	39	< 10	< 10	< 10	< 10

Pesticide and Herbicide Screen

GCMS Pesticide Screen		N/A	NONE	-	-	None Detected	None Detected	-
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U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-63072
 Project / Site name: North Manchester Golf Club
 Your Order No: 14807-JC-E

Lab Sample Number				1805639	1805640	1805641	1805642	1805643
Sample Reference				TP106	TP107	TP108	WS102	WS103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10	1.00	0.20	1.00	1.00
Date Sampled				15/03/2021	15/03/2021	15/03/2021	15/03/2021	15/03/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	14	17	19	13
Total mass of sample received	kg	0.001	NONE	0.40	0.50	0.50	0.90	0.50

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	-	-
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	5.6	-	5.6	7.7	7.8
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	860	-	780	96	170
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.019	-	0.021	0.0046	0.0085
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	37	-	43	9.2	17
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	18.5	-	21.4	4.6	8.5
Sulphide	mg/kg	1	MCERTS	1.1	-	< 1.0	< 1.0	< 1.0
Total Sulphur	mg/kg	50	MCERTS	370	-	400	< 50	< 50
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	-	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.46	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.50	< 0.05	0.99	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	0.55	< 0.05	0.97	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.28	< 0.05	0.47	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	0.25	< 0.05	0.48	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.25	< 0.05	0.53	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.18	< 0.05	0.22	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.26	< 0.05	0.40	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.23	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.29	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	2.27	< 0.80	5.04	< 0.80	< 0.80
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Analytical Report Number: 21-63072
 Project / Site name: North Manchester Golf Club
 Your Order No: 14807-JC-E

Lab Sample Number				1805639	1805640	1805641	1805642	1805643
Sample Reference				TP106	TP107	TP108	WS102	WS103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10	1.00	0.20	1.00	1.00
Date Sampled				15/03/2021	15/03/2021	15/03/2021	15/03/2021	15/03/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	16	3.8	22	2.3	4.3
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	14	-	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	0.22	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	< 0.2	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	14	-	15	5.4	8.3
Copper (aqua regia extractable)	mg/kg	1	MCERTS	26	14	36	16	15
Lead (aqua regia extractable)	mg/kg	1	MCERTS	66	4.3	100	4.1	5.8
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	13	6.2	18	6.0	8.4
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	8.0	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	54	21	61	25	29

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10

Pesticide and Herbicide Screen

GCMS Pesticide Screen		N/A	NONE	None Detected	-	-	-	-
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U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-63072

Project / Site name: North Manchester Golf Club

Your Order No: 14807-JC-E

Lab Sample Number				1805644	1805645	1805646	1805647	1807060
Sample Reference				WS104	WS104	WS105	HP101	TP107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.50	0.60	0.80	0.15
Date Sampled				15/03/2021	15/03/2021	15/03/2021	15/03/2021	15/03/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	23	20	19	16	20
Total mass of sample received	kg	0.001	NONE	0.90	0.50	0.50	0.50	0.40

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	-	-	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	6.4	8.1	-	8.4	-
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	610	120	-	230	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.032	0.014	-	0.019	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	63	28	-	37	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	31.5	14.0	-	18.5	-
Sulphide	mg/kg	1	MCERTS	7.4	2.0	-	1.1	-
Total Sulphur	mg/kg	50	MCERTS	460	120	-	130	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.7	-	-	0.9	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.42	< 0.05	< 0.05	< 0.05	0.47
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.89	< 0.05	< 0.05	< 0.05	1.1
Pyrene	mg/kg	0.05	MCERTS	0.93	< 0.05	< 0.05	< 0.05	1.1
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.51	< 0.05	< 0.05	< 0.05	0.57
Chrysene	mg/kg	0.05	MCERTS	0.46	< 0.05	< 0.05	< 0.05	0.57
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.50	< 0.05	< 0.05	< 0.05	0.53
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.28	< 0.05	< 0.05	< 0.05	0.29
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.42	< 0.05	< 0.05	< 0.05	0.53
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.20	< 0.05	< 0.05	< 0.05	0.23
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.24	< 0.05	< 0.05	< 0.05	0.31

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	4.85	< 0.80	< 0.80	< 0.80	5.66
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Analytical Report Number: 21-63072
 Project / Site name: North Manchester Golf Club
 Your Order No: 14807-JC-E

Lab Sample Number				1805644	1805645	1805646	1805647	1807060
Sample Reference				WS104	WS104	WS105	HP101	TP107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.50	0.60	0.80	0.15
Date Sampled				15/03/2021	15/03/2021	15/03/2021	15/03/2021	15/03/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	6.8	2.8	9.4	11	21
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	18	-	80
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	0.24	-	0.76
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	< 0.2	-	0.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	9.1	6.8	-	9.4	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	13	17	16	21	37
Lead (aqua regia extractable)	mg/kg	1	MCERTS	31	5.3	20	14	110
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	9.1	5.0	7.6	8.9	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	8.6	-	28
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	38	26	30	32	54

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10

Pesticide and Herbicide Screen

GCMS Pesticide Screen		N/A	NONE	-	-	-	-	None Detected
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U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-63072

Project / Site name: North Manchester Golf Club

Your Order No: 14807-JC-E

Lab Sample Number				1807061
Sample Reference				HP101
Sample Number				None Supplied
Depth (m)				0.20
Date Sampled				15/03/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	28
Total mass of sample received	kg	0.001	NONE	0.40

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-
Total Cyanide	mg/kg	1	MCERTS	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-
Sulphide	mg/kg	1	MCERTS	-
Total Sulphur	mg/kg	50	MCERTS	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.47
Pyrene	mg/kg	0.05	MCERTS	0.50
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.26
Chrysene	mg/kg	0.05	MCERTS	0.25
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	1.48
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Analytical Report Number: 21-63072

Project / Site name: North Manchester Golf Club

Your Order No: 14807-JC-E

Lab Sample Number				1807061
Sample Reference				HP101
Sample Number				None Supplied
Depth (m)				0.20
Date Sampled				15/03/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	25
Barium (aqua regia extractable)	mg/kg	1	MCERTS	110
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.76
Boron (water soluble)	mg/kg	0.2	MCERTS	0.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	42
Lead (aqua regia extractable)	mg/kg	1	MCERTS	110
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	19
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	28
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	60

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10

Pesticide and Herbicide Screen

GCMS Pesticide Screen		N/A	NONE	-
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U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number: 21-63072

Project / Site name: North Manchester Golf Club

Your Order No: 14807-JC-E

Lab Sample Number				1805648
Sample Reference				WS104
Sample Number				None Supplied
Depth (m)				1.00
Date Sampled				15/03/2021
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	

General Inorganics

pH	pH Units	N/A	ISO 17025	7.2
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	3.5
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	1.4
Copper (dissolved)	µg/l	0.7	ISO 17025	20
Lead (dissolved)	µg/l	1	ISO 17025	2.8
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	3.9
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	15

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	10	NONE	< 10



Analytical Report Number: 21-63072

Project / Site name: North Manchester Golf Club

Your Order No: 14807-JC-E

Lab Sample Number				1805648
Sample Reference				WS104
Sample Number				None Supplied
Depth (m)				1.00
Date Sampled				15/03/2021
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	< 10
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TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 21-63072

Project / Site name: North Manchester Golf Club

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1805634	TP101	None Supplied	0.2	Brown loam and sand with gravel and vegetation.
1805635	TP101	None Supplied	0.9	Brown clay and loam with gravel and vegetation.
1805636	TP102	None Supplied	0.25	Brown loam and clay with gravel and vegetation.
1805637	TP104	None Supplied	0.2	Brown loam and clay with gravel and vegetation.
1805638	WS101	None Supplied	0.5	Brown sand with gravel.
1805639	TP106	None Supplied	0.1	Brown loam and clay with gravel and vegetation.
1805640	TP107	None Supplied	1	Brown sand with gravel.
1805641	TP108	None Supplied	0.2	Brown loam and clay with gravel and vegetation.
1805642	WS102	None Supplied	1	Brown clay and sand with gravel.
1805643	WS103	None Supplied	1	Brown clay and sand with gravel.
1805644	WS104	None Supplied	1	Brown clay and loam with gravel.
1805645	WS104	None Supplied	1.5	Brown clay and sand with gravel.
1805646	WS105	None Supplied	0.6	Brown clay and sand with gravel.
1805647	HP101	None Supplied	0.8	Brown clay and sand with gravel.
1807060	TP107	None Supplied	0.15	Brown loam and clay with vegetation and gravel
1807061	HP101	None Supplied	0.2	Brown clay and loam with gravel and vegetation.

Analytical Report Number : 21-63072

Project / Site name: North Manchester Golf Club

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
BS EN 12457-1 (2:1) Leachate Prep	2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-1.	L043-PL	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in leachate - LOW LEVEL 1 ug/l	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in leachate	Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L102B-PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in leachate	Determination of pH in leachate by electrometric measurement.	In house method.	L005-PL	W	ISO 17025
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS

Analytical Report Number : 21-63072

Project / Site name: North Manchester Golf Club

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
TPH1 (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
GC Pesticide Screen (TIC)	Analysis of unknown pesticides by GCMS	GC Pesticide Screen (TIC)	L064B	D	NONE
Total cyanide in leachate - 1µg/l	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Sample Deviation Report



Analytical Report Number : 21-63072

Project / Site name: North Manchester Golf Club

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS102	None Supplied	S	1805642	b	Monohydric phenols in soil	L080-PL	b
WS102	None Supplied	S	1805642	b	Speciated EPA-16 PAHs in soil	L064-PL	b
WS102	None Supplied	S	1805642	b	TPH in (Soil)	L076-PL	b
WS104	None Supplied	S	1805644	b	Monohydric phenols in soil	L080-PL	b
WS104	None Supplied	S	1805644	b	Speciated EPA-16 PAHs in soil	L064-PL	b
WS104	None Supplied	S	1805644	b	TPH in (Soil)	L076-PL	b



Jamie Craig
e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jcraig@e3p.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS
t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 21-75298

Project / Site name:	NMEC	Samples received on:	17/05/2021
Your job number:	14-807	Samples instructed on/ Analysis started on:	17/05/2021
Your order number:	14-807-JC-L	Analysis completed by:	24/05/2021
Report Issue Number:	1	Report issued on:	24/05/2021
Samples Analysed:	1 water sample		

Signed: *Karolina Marek*

Karolina Marek
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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



Analytical Report Number: 21-75298

Project / Site name: NMEC

Your Order No: 14-807-JC-L

Lab Sample Number				1872846
Sample Reference				WS105
Sample Number				Sample 2
Depth (m)				None Supplied
Date Sampled				17/05/2021
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

General Inorganics

pH	pH Units	N/A	ISO 17025	7.4
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	3.6
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	10.3

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	5.2
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Heavy Metals / Metalloids

Calcium (dissolved)	mg/l	0.012	ISO 17025	50
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0

Arsenic (dissolved)	µg/l	0.15	ISO 17025	10.3
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.06
Chromium (dissolved)	µg/l	0.2	ISO 17025	2.9
Copper (dissolved)	µg/l	0.5	ISO 17025	10
Lead (dissolved)	µg/l	0.2	ISO 17025	0.9
Manganese (dissolved)	µg/l	0.05	ISO 17025	910
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	2.8
Selenium (dissolved)	µg/l	0.6	ISO 17025	71
Zinc (dissolved)	µg/l	0.5	ISO 17025	1.8

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	25
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TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	11
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	13
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	24



Analytical Report Number: 21-75298

Project / Site name: NMEC

Your Order No: 14-807-JC-L

Lab Sample Number				1872846
Sample Reference				WS105
Sample Number				Sample 2
Depth (m)				None Supplied
Date Sampled				17/05/2021
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0
Chloroethane	µg/l	1	ISO 17025	< 1.0
Bromomethane	µg/l	1	ISO 17025	< 1.0
Vinyl Chloride	µg/l	1	NONE	< 1.0
Trichlorofluoromethane	µg/l	1	NONE	< 1.0
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0
Trichloromethane	µg/l	1	ISO 17025	< 1.0
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0
Benzene	µg/l	1	ISO 17025	< 1.0
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0
Trichloroethene	µg/l	1	ISO 17025	< 1.0
Dibromomethane	µg/l	1	ISO 17025	< 1.0
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0
Chlorobenzene	µg/l	1	ISO 17025	< 1.0
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0
p & m-Xylene	µg/l	1	ISO 17025	< 1.0
Styrene	µg/l	1	ISO 17025	< 1.0
Tribromomethane	µg/l	1	ISO 17025	< 1.0
o-Xylene	µg/l	1	ISO 17025	< 1.0
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0
Bromobenzene	µg/l	1	ISO 17025	< 1.0
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0



Analytical Report Number: 21-75298

Project / Site name: NMEC

Your Order No: 14-807-JC-L

Lab Sample Number				1872846
Sample Reference				WS105
Sample Number				Sample 2
Depth (m)				None Supplied
Date Sampled				17/05/2021
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	
Butylbenzene	µg/l	1	ISO 17025	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0

SVOCs

Aniline	µg/l	0.05	NONE	< 0.05
Phenol	µg/l	0.05	NONE	< 0.05
2-Chlorophenol	µg/l	0.05	NONE	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05
Hexachloroethane	µg/l	0.05	NONE	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05
4-Methylphenol	µg/l	0.05	NONE	< 0.05
Isophorone	µg/l	0.05	NONE	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05
Naphthalene	µg/l	0.01	ISO 17025	0.26
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05
Dimethylphthalate	µg/l	0.05	NONE	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05
Dibenzofuran	µg/l	0.05	NONE	< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05
Fluorene	µg/l	0.01	ISO 17025	< 0.01
Azobenzene	µg/l	0.05	NONE	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05
Phenanthrene	µg/l	0.01	ISO 17025	1.3
Anthracene	µg/l	0.01	ISO 17025	0.29
Carbazole	µg/l	0.05	NONE	< 0.05
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05
Fluoranthene	µg/l	0.01	ISO 17025	4.2
Pyrene	µg/l	0.01	ISO 17025	4.0



Analytical Report Number: 21-75298

Project / Site name: NMEC

Your Order No: 14-807-JC-L

Lab Sample Number				1872846
Sample Reference				WS105
Sample Number				Sample 2
Depth (m)				None Supplied
Date Sampled				17/05/2021
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	2.3
Chrysene	µg/l	0.01	ISO 17025	2.1
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	2.4
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	1.1
Benzo(a)pyrene	µg/l	0.01	ISO 17025	1.9
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	0.69
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	0.72
3&4-Methylphenol	µg/l	0.1	NONE	< 0.10

U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number : 21-75298

Project / Site name: NMEC

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	NONE
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

**Becky Hodnett**

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: rhodnett@e3p.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-64381

Project / Site name:	North Manchester Golf Club	Samples received on:	23/03/2021
Your job number:	14 807	Samples instructed on/ Analysis started on:	23/03/2021
Your order number:	14 807 BH F	Analysis completed by:	30/03/2021
Report Issue Number:	1	Report issued on:	30/03/2021
Samples Analysed:	2 water samples		

Signed:

Rachel Bradley
Deputy Quality Manager
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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



Analytical Report Number: 21-64381

Project / Site name: North Manchester Golf Club

Your Order No: 14 807 BH F

Lab Sample Number				1813166	1813167
Sample Reference				WS104	WS105
Sample Number				None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied
Date Sampled				22/03/2021	22/03/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

General Inorganics

pH	pH Units	N/A	ISO 17025	6.9	8.1
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	12.5	359

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	< 1.0
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Heavy Metals / Metalloids

Calcium (dissolved)	mg/l	0.012	ISO 17025	86	120
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	U/S*

Arsenic (dissolved)	µg/l	0.15	ISO 17025	8.15	74.6
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.98
Chromium (dissolved)	µg/l	0.2	ISO 17025	3.9	5.4
Copper (dissolved)	µg/l	0.5	ISO 17025	1.5	210
Lead (dissolved)	µg/l	0.2	ISO 17025	0.3	460
Manganese (dissolved)	µg/l	0.05	ISO 17025	4400	1000
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	2.8	26
Selenium (dissolved)	µg/l	0.6	ISO 17025	6.9	63
Zinc (dissolved)	µg/l	0.5	ISO 17025	3.6	97

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0



Analytical Report Number: 21-64381

Project / Site name: North Manchester Golf Club

Your Order No: 14 807 BH F

Lab Sample Number				1813166	1813167
Sample Reference				WS104	WS105
Sample Number				None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied
Date Sampled				22/03/2021	22/03/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	< 10	< 10
------------------	------	----	------	------	------

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Chloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Bromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Vinyl Chloride	µg/l	1	NONE	< 1.0	< 1.0
Trichlorofluoromethane	µg/l	1	NONE	< 1.0	< 1.0
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0
Trichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0
Trichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0
Dibromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Chlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0



Analytical Report Number: 21-64381

Project / Site name: North Manchester Golf Club

Your Order No: 14 807 BH F

Lab Sample Number				1813166	1813167
Sample Reference				WS104	WS105
Sample Number				None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied
Date Sampled				22/03/2021	22/03/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
p & m-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
Styrene	µg/l	1	ISO 17025	< 1.0	< 1.0
Tribromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0
o-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
Bromobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0	< 1.0
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0

SVOCs

Aniline	µg/l	0.05	NONE	< 0.05	< 0.05
Phenol	µg/l	0.05	NONE	< 0.05	< 0.05
2-Chlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05
Hexachloroethane	µg/l	0.05	NONE	< 0.05	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05	< 0.05
4-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05
Isophorone	µg/l	0.05	NONE	< 0.05	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05	< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05



Analytical Report Number: 21-64381

Project / Site name: North Manchester Golf Club

Your Order No: 14 807 BH F

Lab Sample Number				1813166	1813167
Sample Reference				WS104	WS105
Sample Number				None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied
Date Sampled				22/03/2021	22/03/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		
Dimethylphthalate	µg/l	0.05	NONE	< 0.05	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05
Dibenzofuran	µg/l	0.05	NONE	< 0.05	< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05	< 0.05
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Azobenzene	µg/l	0.05	NONE	< 0.05	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Carbazole	µg/l	0.05	NONE	< 0.05	< 0.05
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05	< 0.05
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
3&4-Methylphenol	µg/l	0.1	NONE	< 0.10	< 0.10

U/S = Unsuitable Sample I/S = Insufficient Sample

*U/S due to highly coloured sample/extract.



Analytical Report Number : 21-64381
Project / Site name: North Manchester Golf Club

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	NONE
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

APPENDIX VII

ORIGIN OF TIER I GENERIC ASSESSMENT CRITERIA

CONSTITUENT	ORIGIN OF RISK ASSESSMENT VALUE
Arsenic	2014 LQM/CIEH S4ULs
Cadmium	2014 LQM/CIEH S4ULs
Chromium	2014 LQM/CIEH S4ULs
Lead	2014 LQM/CIEH S4ULs
Mercury	2014 LQM/CIEH S4ULs – methylmercury
Nickel	2014 LQM/CIEH S4ULs
Selenium	2014 LQM/CIEH S4ULs
Copper	2014 LQM/CIEH S4ULs
Zinc	2014 LQM/CIEH S4ULs
Cyanide – Total	2014 LQM/CIEH S4ULs
Phenols – Total	2014 LQM/CIEH S4ULs
Naphthalene	General assessment criteria (GAC) developed by CIEH/LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM.
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene	
Chrysene	
Benzo(b/k)Fluoranthene ⁽ⁱⁱⁱ⁾	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C ₅ -C ₆ (aliphatic)	
TPH C ₆ -C ₈ (aliphatic)	
TPH C ₈ -C ₁₀ (aliphatic)	
TPH C ₁₀ -C ₁₂ (aliphatic)	
TPH C ₁₂ -C ₁₆ (aromatic)	
TPH C ₁₆ -C ₂₁ (aromatic)	
TPH C ₂₁ -C ₃₅ (aromatic)	



APPENDIX VIII DYNAMIC CONE PENETROMETER TEST CERTIFICATES

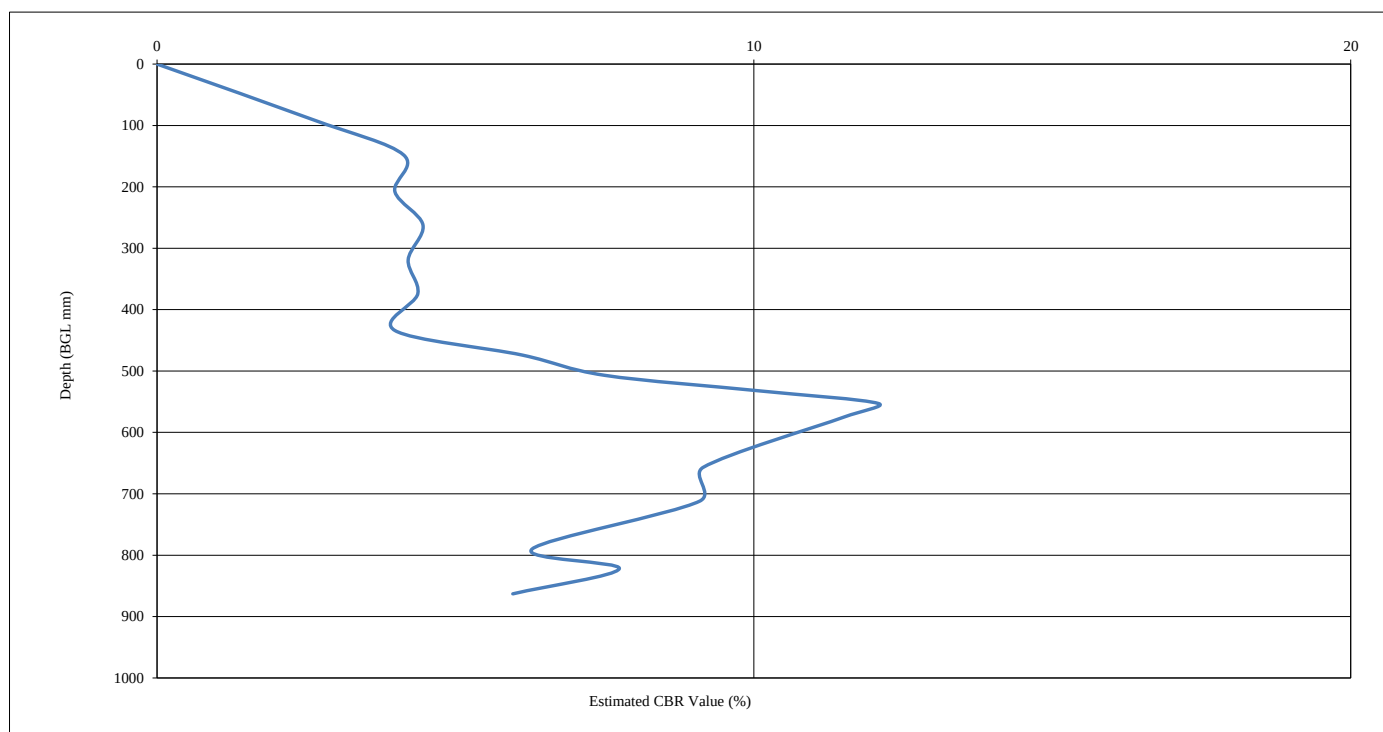


Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	North Manchester Golf Club	Test Date:	05/03/2021
Site Ref	14-807	Test Location:	Manchester Golf Course
Test No.:	DCP101	Easting:	0
Initial Depth (mm BGL):	0	Northing:	0
Final Depth (mm BGL):	863		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	148	2	2	74.00	3.19
148	434	7	5	57.20	4.19
434	863	21	14	30.64	8.11

Comments

Site Engineer:	Checked By:	Date:	Approved By:	Date:
RW	JC	19/05/2021	BH	21/05/2021

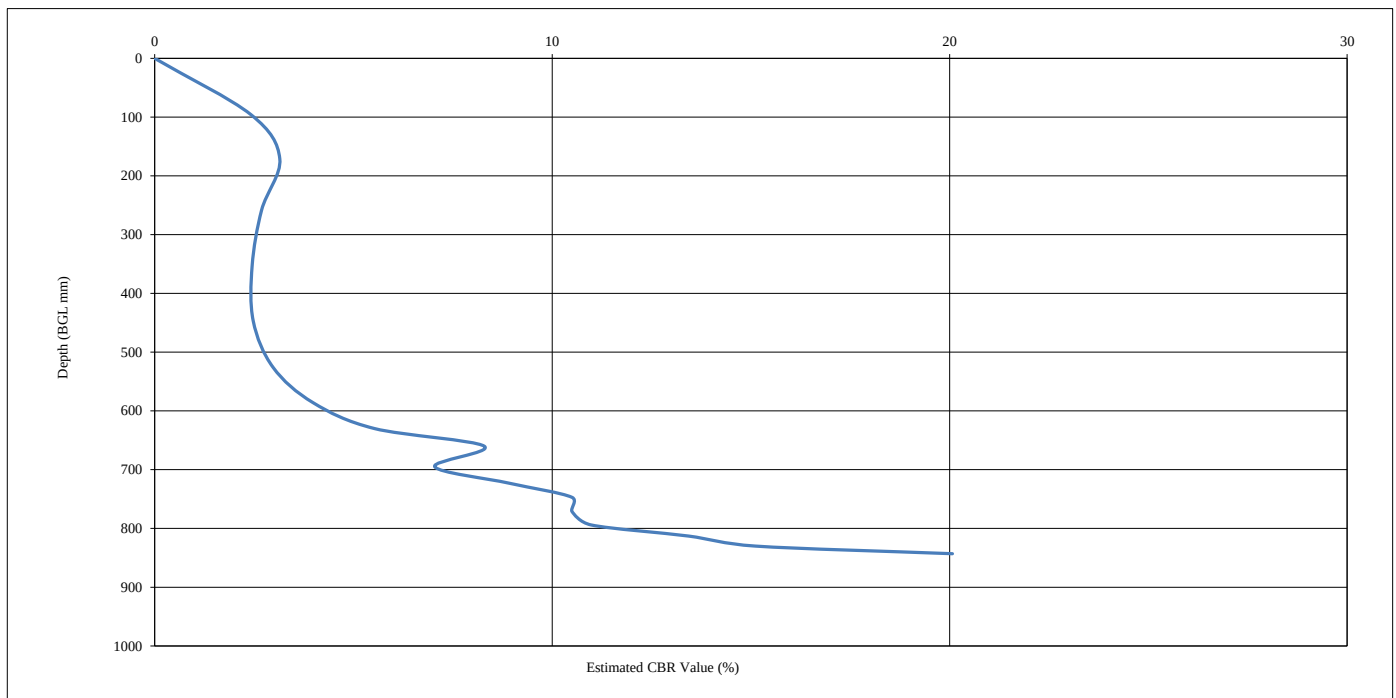


Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	North Manchester Golf Club	Test Date:	14/05/2021
Site Ref	14-807	Test Location:	North Manchester Golf Course
Test No.:	DCP102	Easting:	0
Initial Depth (mm BGL):	0	Northing:	0
Final Depth (mm BGL):	843		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	171	2	2	85.50	2.74
171	660	9	7	69.86	3.39
660	843	17	8	22.88	11.04

Comments

Site Engineer:	Checked By:	Date:	Approved By:	Date:
RW	JC	19/05/2021	BH	21/05/2021

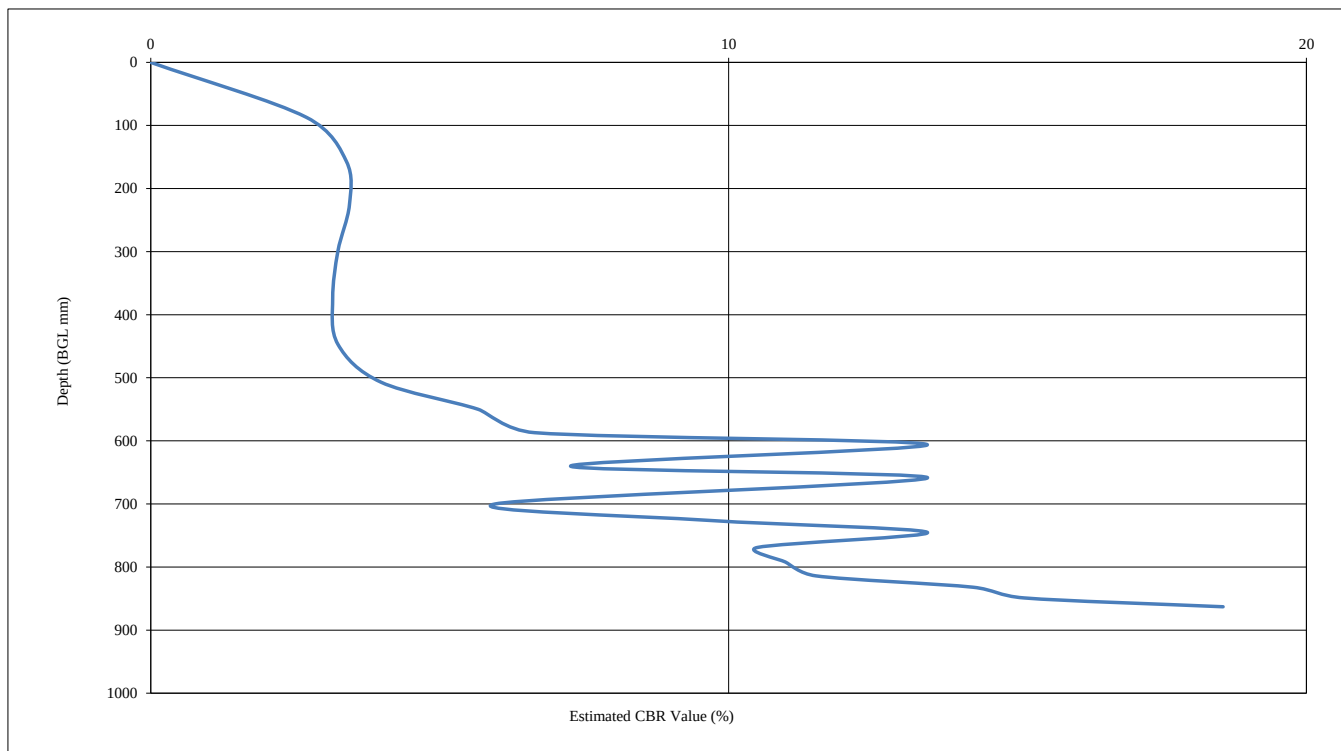


Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	h Manchester Golf Club	Test Date:	14/05/2021
Site Ref	14-807	Test Location:	1 Manchester Golf Course
Test No.:	DCP103	Easting:	0
Initial Depth (mm BGL):	0	Northing:	0
Final Depth (mm BGL):	863		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	157	2	2	78.50	3.00
157	550	8	6	65.50	3.63
550	863	21	13	24.08	10.46

Comments

Site Engineer:	Checked By:	Date:	Approved By:	Date:
RW	JC	19/05/2021	BH	15/07/2021

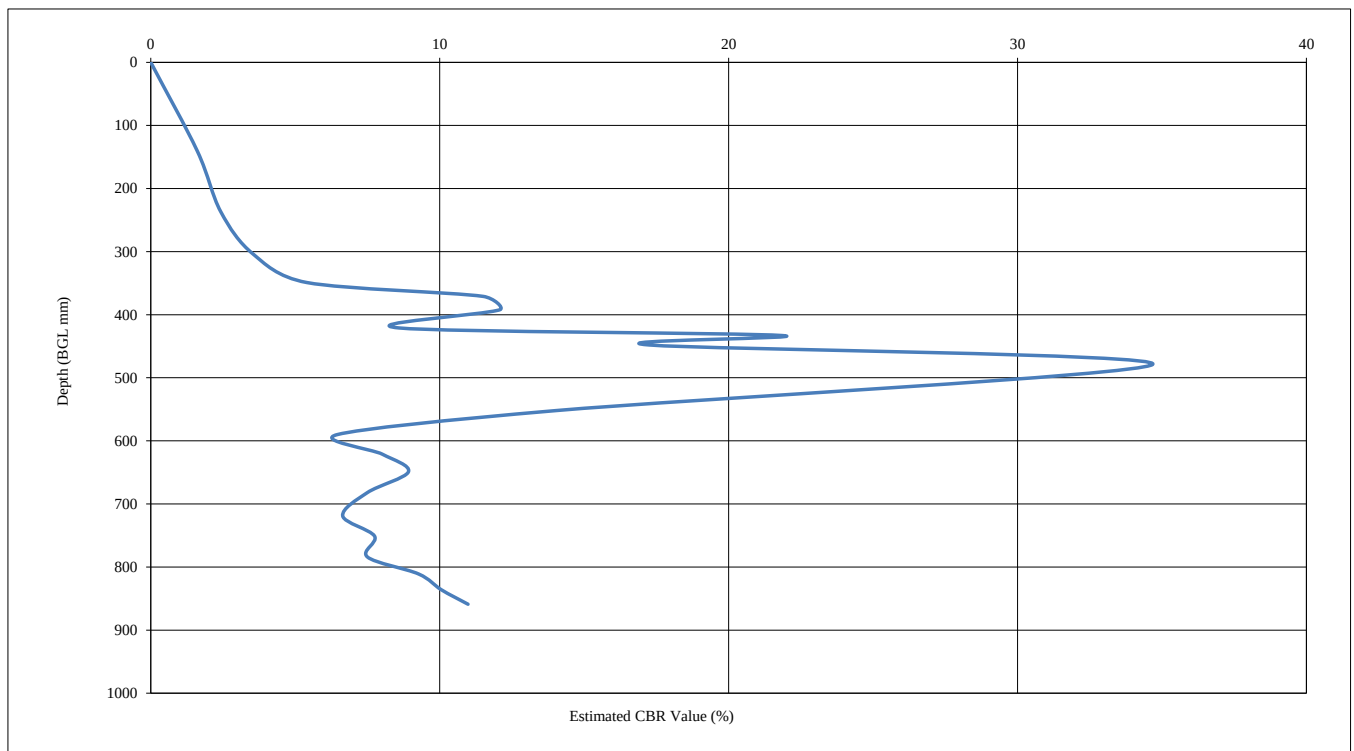


Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	North Manchester Golf Club	Test Date:	14/05/2021
Site Ref	14-807	Test Location:	1 Manchester Golf Course
Test No.:	DCP104	Easting:	0
Initial Depth (mm BGL):	0	Northing:	0
Final Depth (mm BGL):	859		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	349	4	4	87.25	2.68
349	590	18	14	17.21	14.92
590	859	27	9	29.89	8.33

Comments

Site Engineer:	Checked By:	Date:	Approved By:	Date:
RW	JC	19/05/2021	BH	15/07/2021

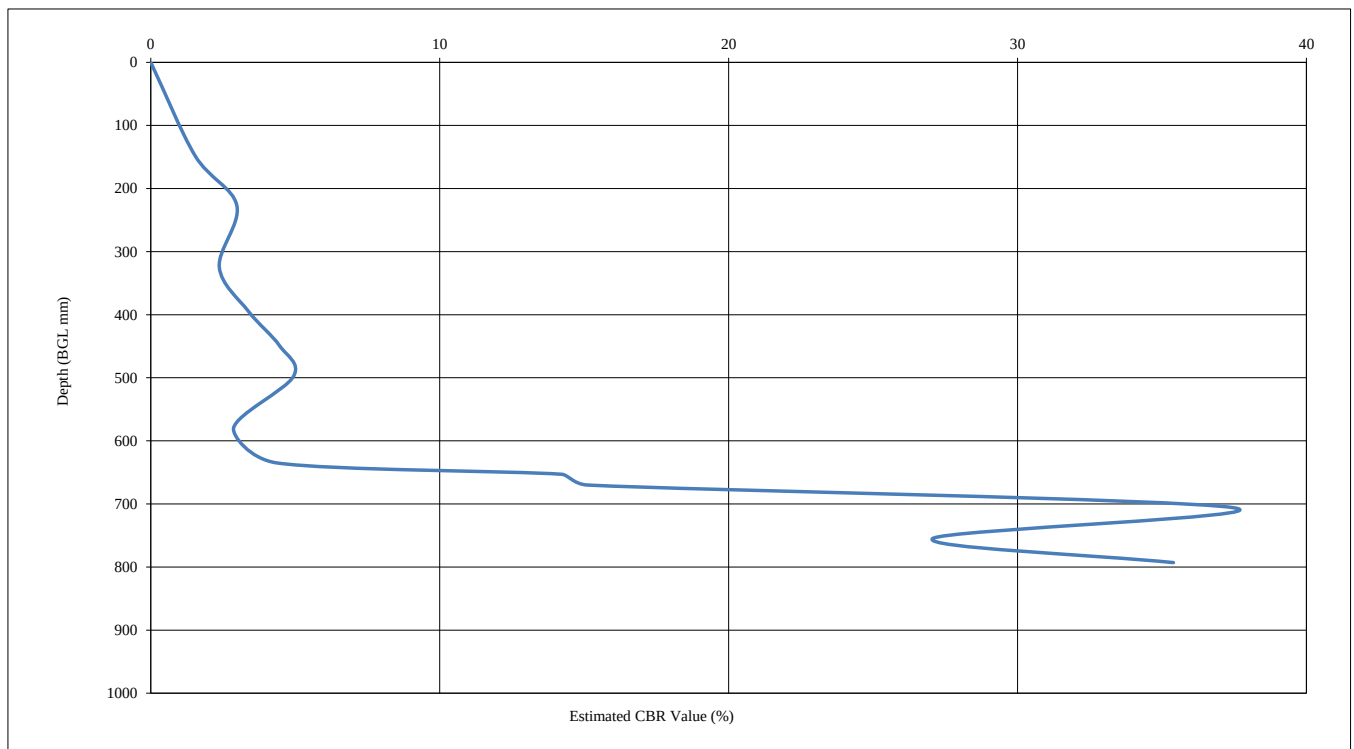


Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	North Manchester Golf Club	Test Date:	14/05/2021
Site Ref	14-807	Test Location:	1 Manchester Golf Course
Test No.:	DCP104	Easting:	0
Initial Depth (mm BGL):	0	Northing:	0
Final Depth (mm BGL):	793		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	227	2	2	113.50	2.03
227	580	7	5	70.60	3.36
580	793	25	18	11.83	22.17

Comments

1. Probe encountered obstruction at 793mm bgl

Site Engineer:	Checked By:	Date:	Approved By:	Date:
RW	JC	19/05/2021	BH	15/07/2021

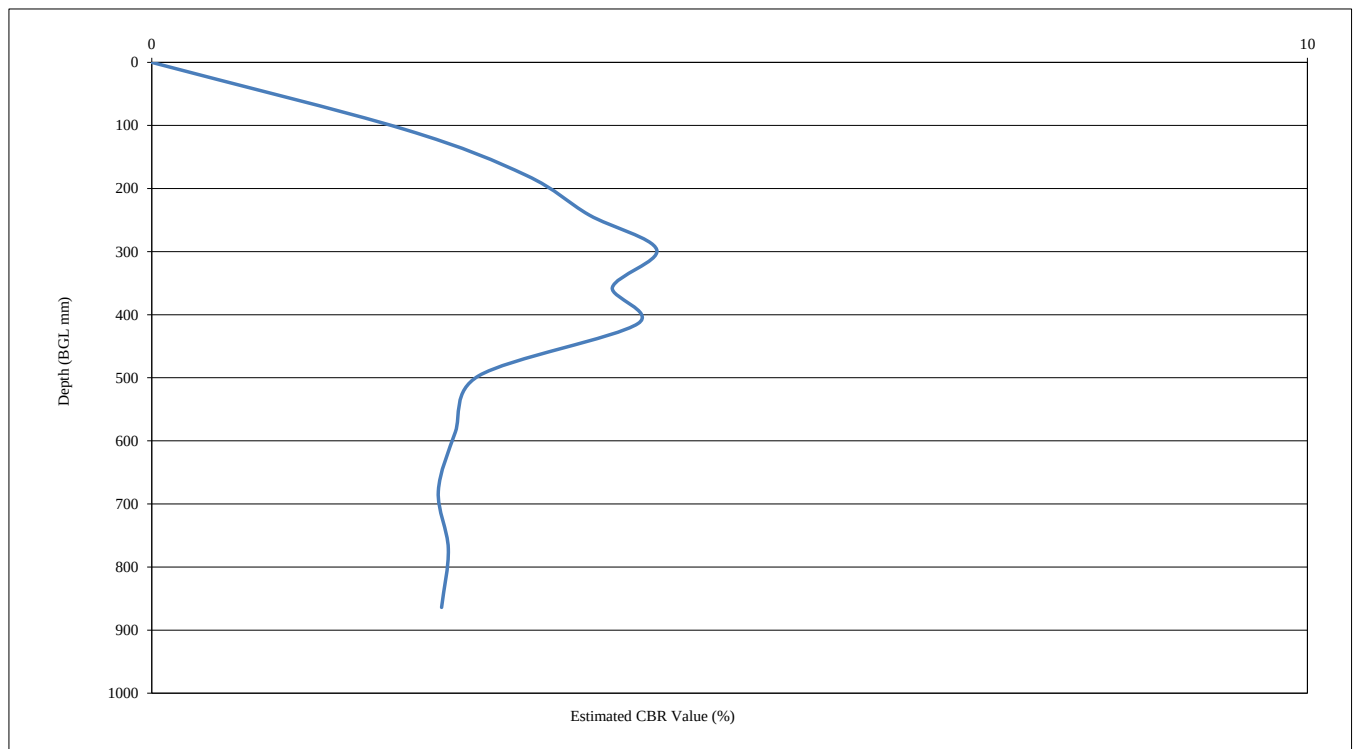


Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	North Manchester Golf Club	Test Date:	14/05/2021
Site Ref	14-807	Test Location:	1 Manchester Golf Course
Test No.:	DCP106	Easting:	0
Initial Depth (mm BGL):	0	Northing:	0
Final Depth (mm BGL):	864		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	242	3	3	80.67	2.91
242	497	7	4	63.75	3.74
497	864	11	4	91.75	2.54

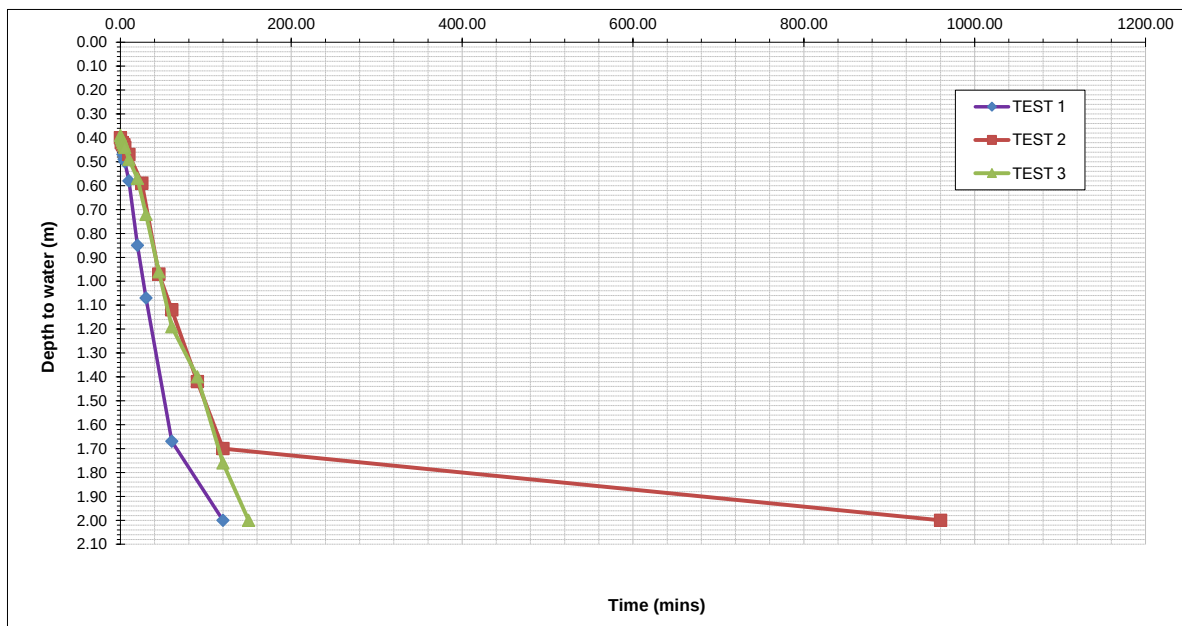
Comments

Site Engineer:	Checked By:	Date:	Approved By:	Date:
RW	JC	19/05/2021	BH	15/07/2021

APPENDIX IX SOAKAWAY PERMEABILITY TEST CERTIFICATES

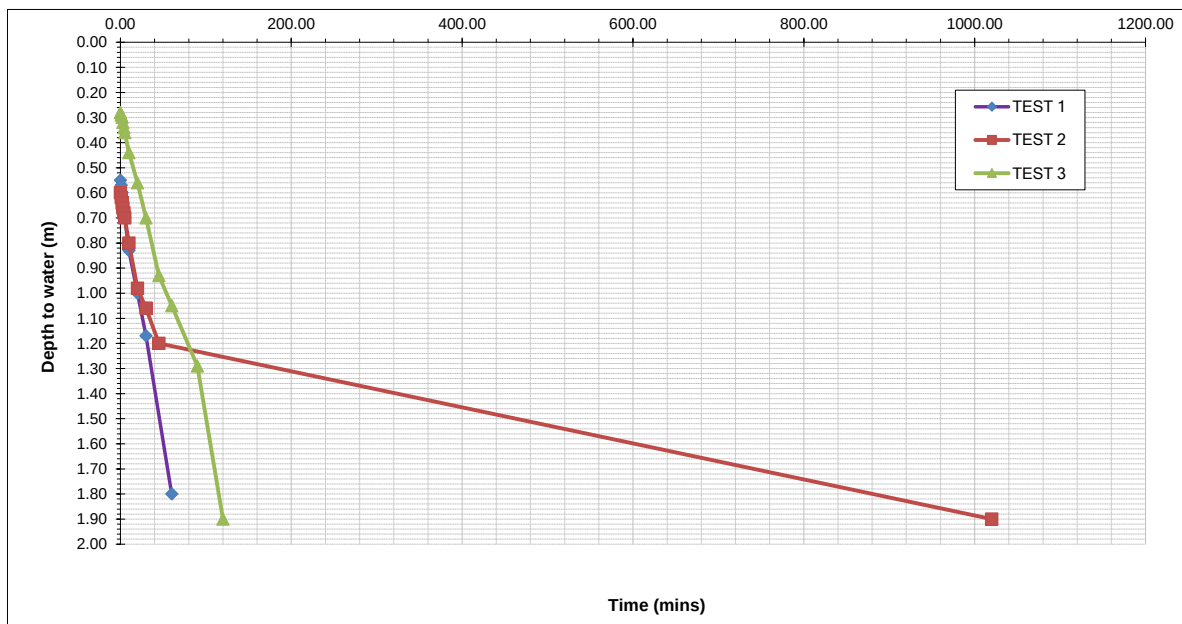
		Site: N.MAN GOLF COURSE Job Number: 14-807 Date of Test: 15/03/2021		Trial Pit Number: SA101 Length: 1.90 m Width: 0.40 m Depth: 2.00 m Groundwater Level: N/A m		
Three tests completed; 25% and 75% effective storage depth reached in all tests.	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0.00	0.41	0.00	0.40	0.00	0.39
	1.00	0.43	1.00	0.42	1.00	0.40
	2.00	0.45	2.00	0.42	2.00	0.41
	3.00	0.47	3.00	0.43	3.00	0.42
	4.00	0.49	4.00	0.43	4.00	0.43
	5.00	0.5	5.00	0.44	5.00	0.44
	10.00	0.58	10.00	0.47	10.00	0.49
	20.00	0.85	25.00	0.59	20.00	0.57
	30.00	1.07	45.00	0.97	30.00	0.72
	60.00	1.67	60.00	1.12	45.00	0.96
	120.00	2	90.00	1.42	60.00	1.19
			120.00	1.7	90.00	1.40
			960.00	2	120.00	1.76
				150.00	2.00	
Effective Storage Depth	m	1.59	1.60	1.71		
75% Effective Storage Depth	m	1.19	1.20	1.28		
(i.e. depth below GL)	m	0.81	0.80	0.82		
25% Effective Storage Depth	m	0.40	0.40	0.43		
(i.e. depth below GL)	m	1.60	1.60	1.67		
Effective Storage Depth 75%-25%	m	0.80	0.80	0.86		
Time to fall to 75% effective depth	mins	18.50	36.50	36.00		
Time to fall to 25% effective depth	mins	56.50	109.50	112.50		
V (75%-25%)	m3	0.60	0.61	0.65		
a (50%)	m2	4.42	4.44	4.69		
t (75%-25%)	mins	38.00	73.00	76.50		
SOIL INFILTRATION RATE	m/s	6.00E-05	3.13E-05	3.02E-05		

DESIGN SOIL INFILTRATION RATE, f	3.02E-05
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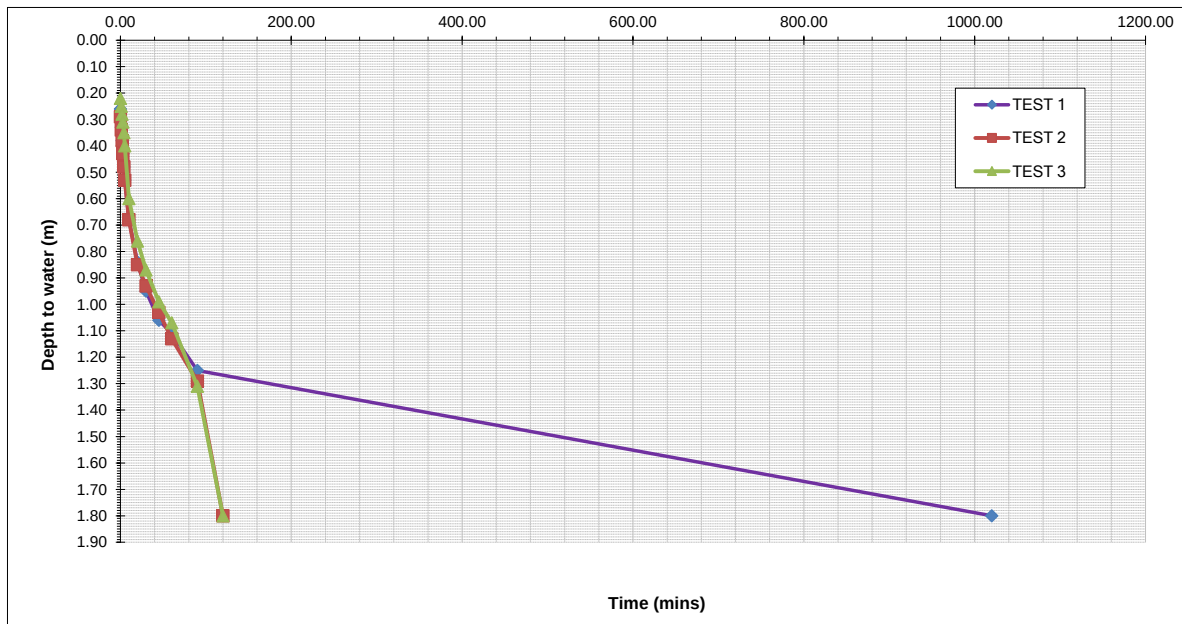
		Site: N.MAN GOLF COURSE Job Number: 14-807 Date of Test: 15/03/2021		Trial Pit Number: SA102 Length: 2.20 m Width: 0.40 m Depth: 1.80 m Groundwater Level: N/A m		
Three tests completed; 25% and 75% effective storage depth reached in all tests.	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0.00	0.55	0.00	0.60	0.00	0.28
	1.00	0.57	1.00	0.62	1.00	0.29
	2.00	0.6	2.00	0.64	2.00	0.30
	3.00	0.64	3.00	0.66	3.00	0.32
	4.00	0.67	4.00	0.68	4.00	0.34
	5.00	0.7	5.00	0.7	5.00	0.36
	10.00	0.83	10.00	0.8	10.00	0.44
	20.00	1	20.00	0.98	20.00	0.56
	30.00	1.17	30.00	1.06	30.00	0.70
	60.00	1.8	45.00	1.2	45.00	0.93
			1020.00	1.9	60.00	1.05
				90.00	1.29	
				120.00	1.90	
Effective Storage Depth	m	1.25	1.20	1.52		
75% Effective Storage Depth	m	0.94	0.90	1.14		
(i.e. depth below GL)	m	0.86	0.90	0.66		
25% Effective Storage Depth	m	0.31	0.30	0.38		
(i.e. depth below GL)	m	1.49	1.50	1.42		
Effective Storage Depth 75%-25%	m	0.63	0.60	0.76		
Time to fall to 75% effective depth	mins	12.00	16.00	27.00		
Time to fall to 25% effective depth	mins	45.50	470.00	96.50		
V (75%-25%)	m3	0.55	0.53	0.67		
a (50%)	m2	4.13	4.00	4.83		
t (75%-25%)	mins	33.50	454.00	69.50		
SOIL INFILTRATION RATE	m/s	6.63E-05	4.85E-06	3.32E-05		

DESIGN SOIL INFILTRATION RATE, f	6.63E-05
----------------------------------	----------



		Site: N.MAN GOLF COURSE Job Number: 14-807 Date of Test: 15/03/2021		Trial Pit Number: SA103 Length: 2.10 m Width: 0.40 m Depth: 1.60 m Groundwater Level: N/A m		
Three tests completed; 25% and 75% effective storage depth reached in all tests	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0.00	0.26	0.00	0.29	0.00	0.22
	1.00	0.33	1.00	0.34	1.00	0.25
	2.00	0.38	2.00	0.38	2.00	0.28
	3.00	0.43	3.00	0.43	3.00	0.31
	4.00	0.48	4.00	0.48	4.00	0.35
	5.00	0.53	5.00	0.53	5.00	0.40
	10.00	0.68	10.00	0.68	10.00	0.60
	20.00	0.84	20.00	0.85	20.00	0.76
	30.00	0.95	30.00	0.93	30.00	0.87
	45.00	1.06	45.00	1.03	45.00	0.99
	60.00	1.11	60.00	1.13	60.00	1.07
	90.00	1.25	90.00	1.29	90.00	1.31
	1020.00	1.8	120.00	1.8	120.00	1.80
Effective Storage Depth		m	1.34	1.31	1.38	
75% Effective Storage Depth		m	1.01	0.98	1.04	
(i.e. depth below GL)		m	0.60	0.62	0.57	
25% Effective Storage Depth		m	0.34	0.33	0.35	
(i.e. depth below GL)		m	1.27	1.27	1.26	
Effective Storage Depth 75%-25%		m	0.67	0.66	0.69	
Time to fall to 75% effective depth		mins	7.00	8.00	9.50	
Time to fall to 25% effective depth		mins	106.00	87.50	84.00	
V (75%-25%)		m3	0.56	0.55	0.58	
a (50%)		m2	4.19	4.12	4.29	
t (75%-25%)		mins	99.00	79.50	74.50	
SOIL INFILTRATION RATE		m/s	2.26E-05	2.80E-05	3.02E-05	

DESIGN SOIL INFILTRATION RATE, f	2.26E-05
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APPENDIX X

COAL AUTHORITY REPORT



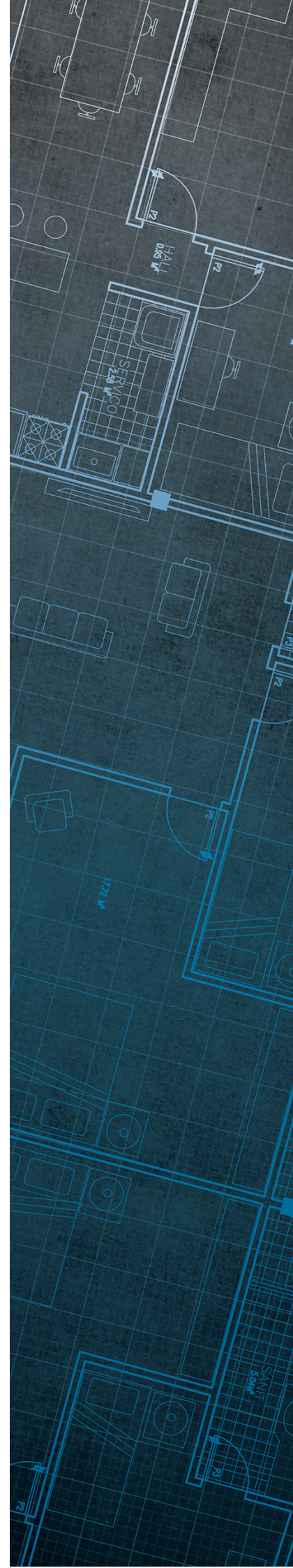
The Coal
Authority

Consultants Coal Mining Report

North Manchester Golf Club
Manchester Old Road
Middleton
Rochdale
M24 4PE

Date of enquiry:	16 April 2021
Date enquiry received:	16 April 2021
Issue date:	16 April 2021

Our reference:	51002462756001
Your reference:	14807/JC/I



Consultants

Coal Mining Report

This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

E3P

Enquiry address

North Manchester Golf Club
Manchester Old Road
Middleton
Rochdale
M24 4PE

How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

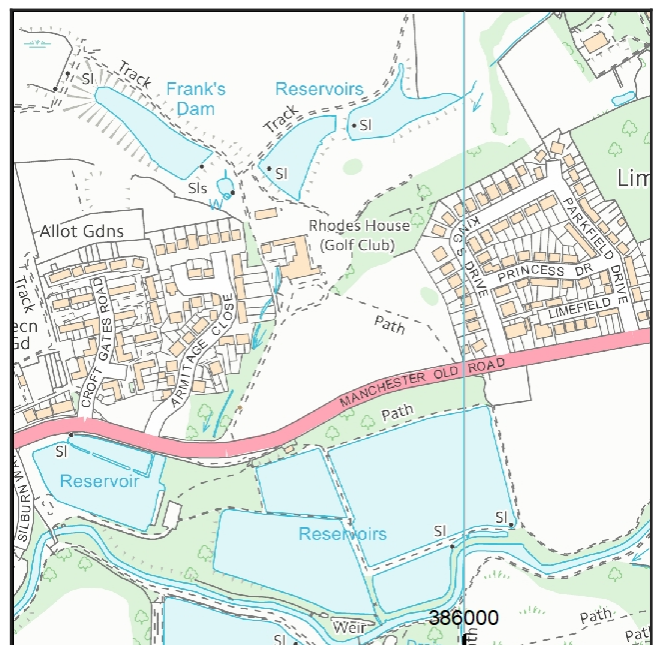
www.groundstability.com

 @coalauthority

 /company/the-coal-authority

 /thecoalauthority

 /thecoalauthority



Approximate position of property



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Section 1 – Mining activity and geology

Past underground mining

No past mining recorded.

Probable unrecorded shallow workings

None.

Spine roadways at shallow depth

No spine roadway recorded at shallow depth.

Mine entries

None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers

The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

16820		
-------	--	--

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops

No outcrops recorded.

Geological faults, fissures and breaklines

Please refer to the 'Summary of findings' map (on separate sheet) for details of any geological faults, fissures or breaklines either within or intersecting the enquiry boundary.

Fault under or close to the property recorded.

Opencast mines

None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations

None recorded within 50 metres of the enquiry boundary.

Remediated sites

None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas

None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes

None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining

None recorded.

Coal mining licensing

None recorded within 200 metres of the enquiry boundary.

Court orders

None recorded.

Section 46 notices

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices

The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Section 4 – Further information

Based on the responses in this report, no further information has been highlighted.

Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk**.

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

Opencast mines

Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips

Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations

Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites

Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence

Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas

Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

Mine water treatment schemes

Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining

Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing

Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders

Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices

Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

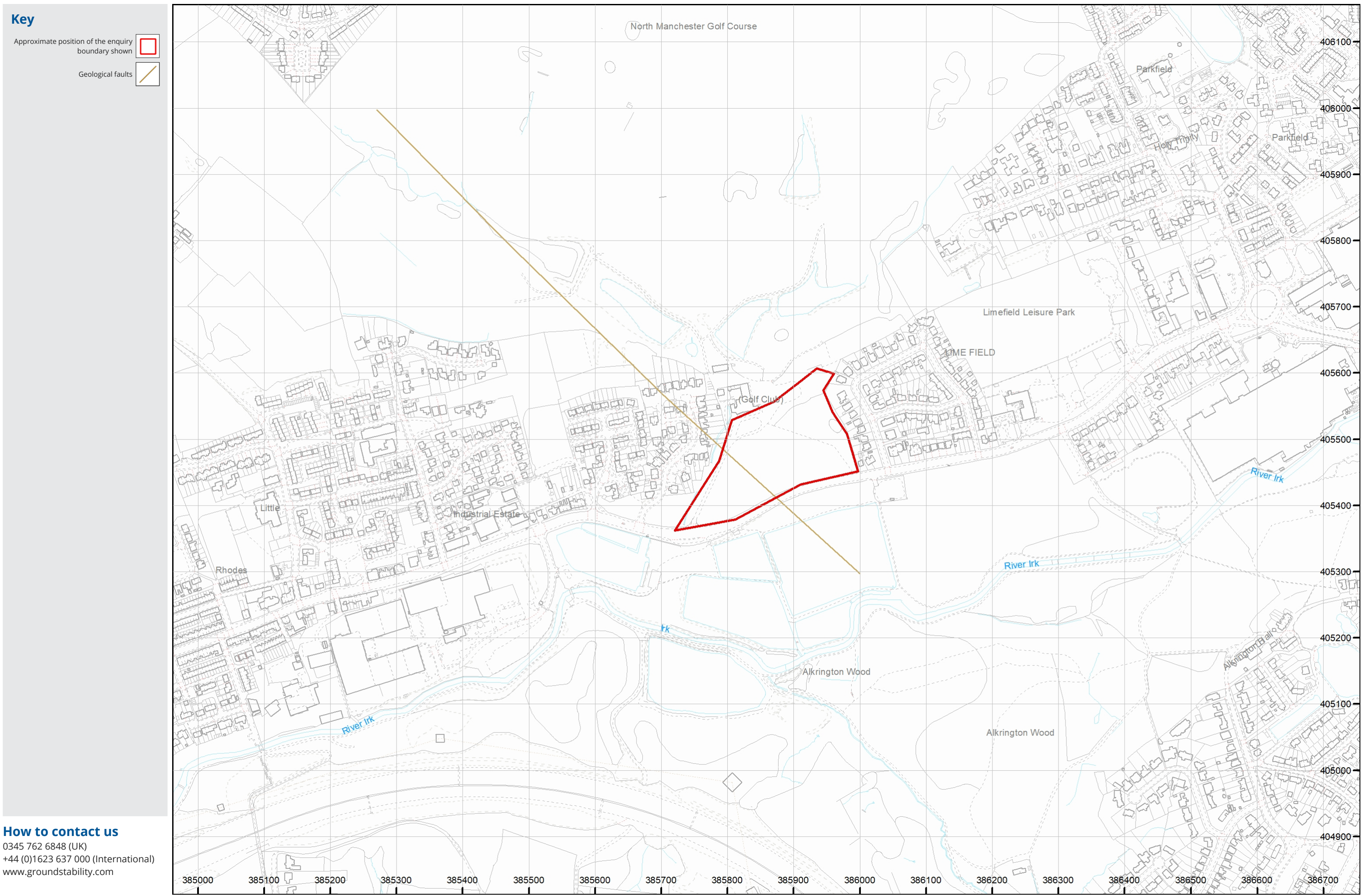
Withdrawal of support notices

Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land

Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

The map highlights any specific surface or subsurface features within or near to the boundary of the site.



APPENDIX XI

GEOTECHNICAL TESTING

RESULTS



LABORATORY REPORT



4043

Contract Number: PSL21/2520

Report Date: 21 April 2021

Client's Reference: 14-807

Client Name: E3P
Taylor Road
Urmston
Manchester
M41 7JQ

For the attention of: Jamie Craig

Contract Title: North Manchester Golf

Date Received: 25/3/2021

Date Commenced: 25/3/2021

Date Completed: 21/4/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Senior Technician)


S Eyre
(Senior Technician)

H Daniels
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

4043

PSL
Professional Soils Laboratory

North Manchester Golf

Contract No:

PSL21/2520

Client Ref:

14-807

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

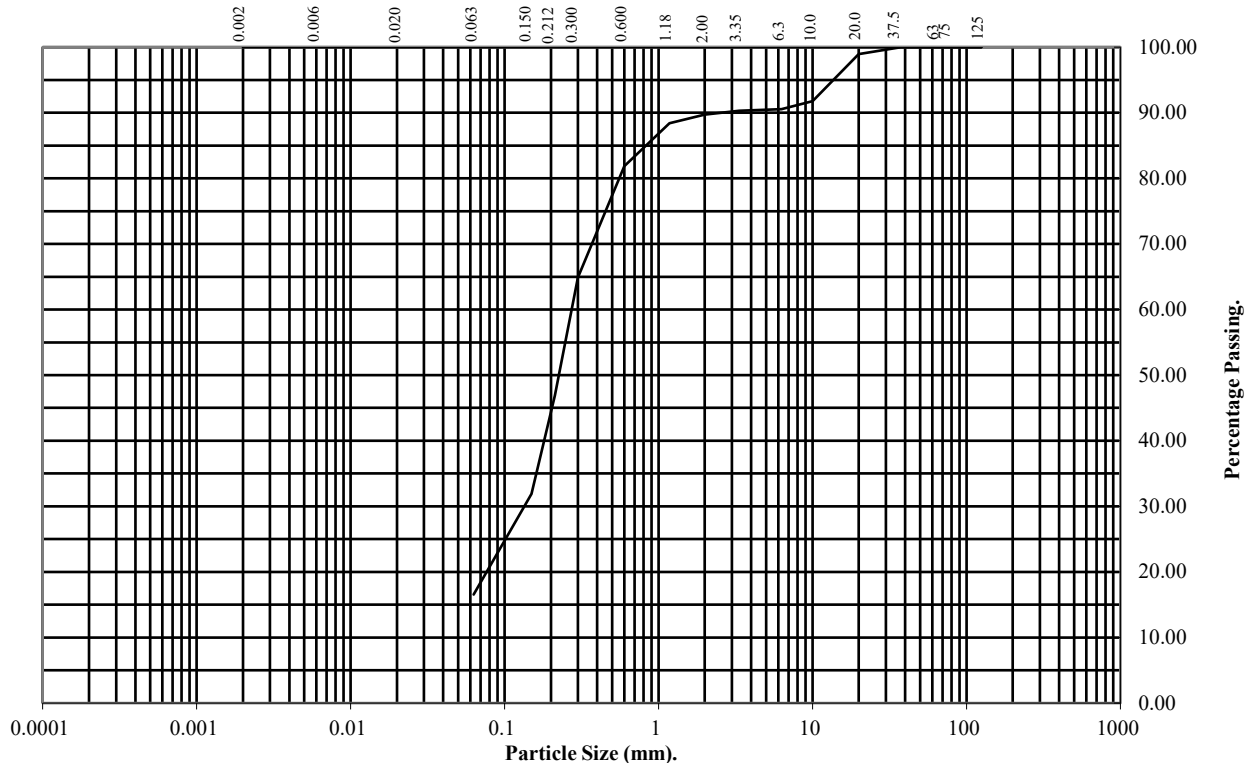
Hole Number: TP101

Top Depth (m): 0.70

Sample Number:

Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	99
10	92
6.3	91
3.35	90
2	90
1.18	88
0.6	82
0.3	65
0.212	47
0.15	32
0.063	17

Soil Fraction	Total Percentage
Cobbles	0
Gravel	10
Sand	73
Silt/Clay	17

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

North Manchester Golf

Contract No:
PSL21/2520
Client Ref:
14-807

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

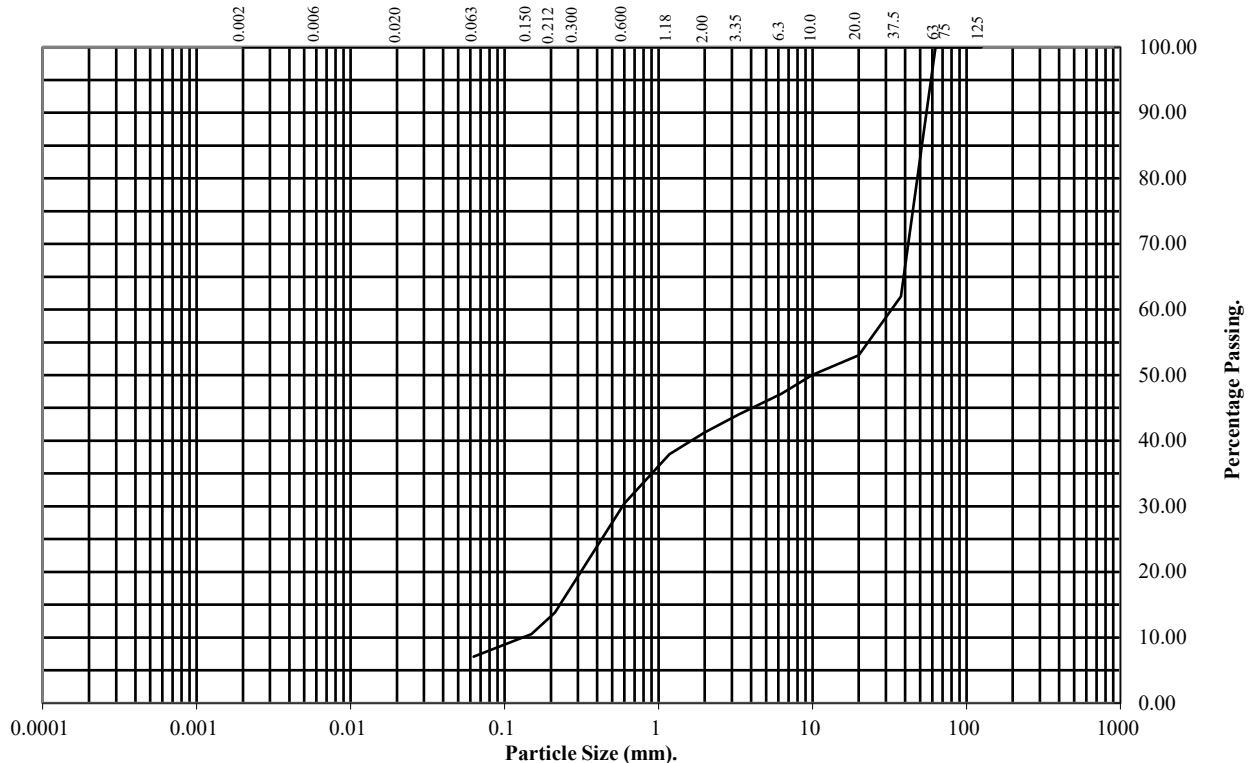
Hole Number: TP104

Top Depth (m): 1.80

Sample Number:

Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	62
20	53
10	50
6.3	47
3.35	44
2	41
1.18	38
0.6	30
0.3	19
0.212	14
0.15	11
0.063	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	59
Sand	34
Silt/Clay	7

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

North Manchester Golf

Contract No:
PSL21/2520
Client Ref:
14-807

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: CP101

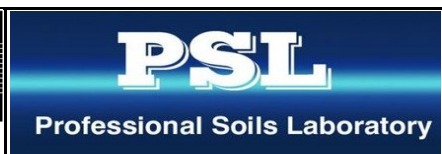
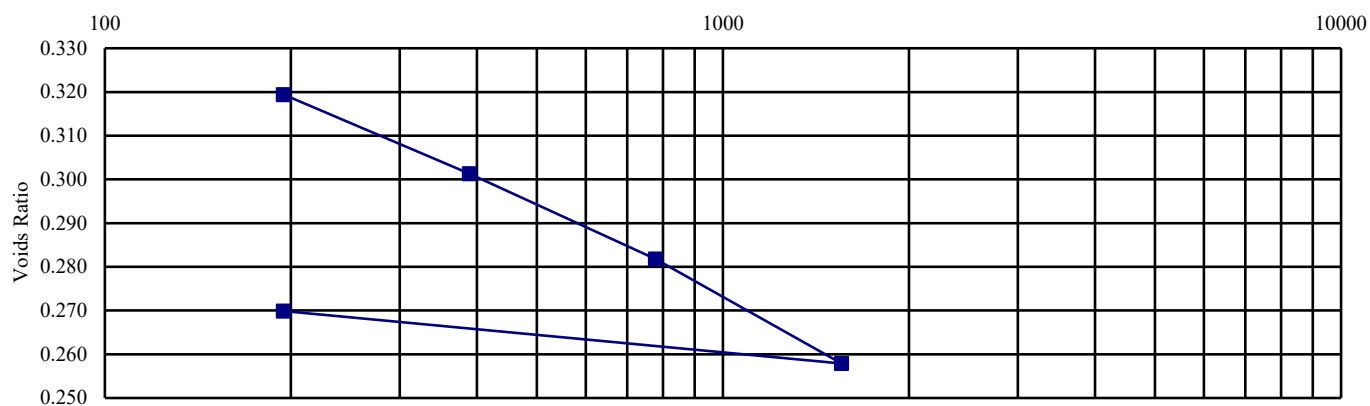
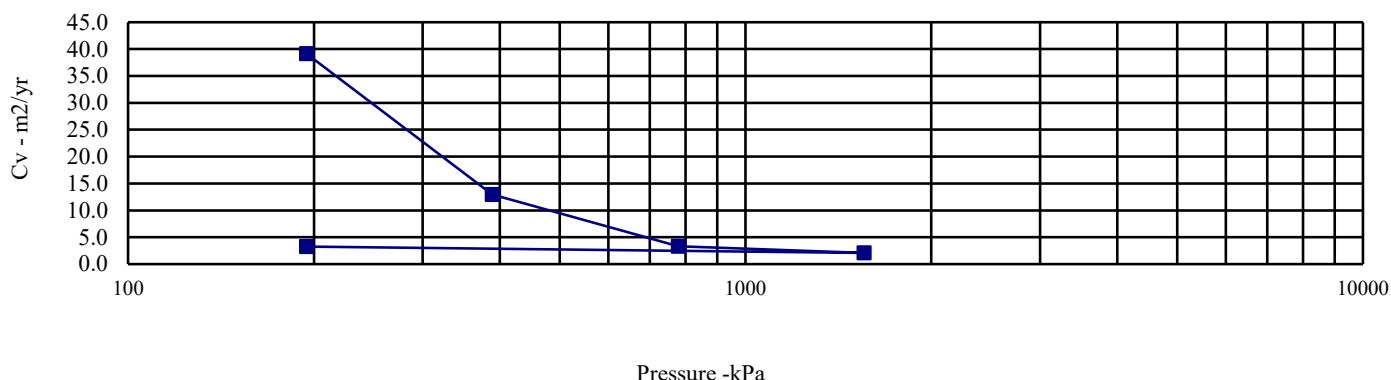
Top Depth (m): 9.50

Sample Number:

Base Depth (m) : 9.95

Sample Type: TUB

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	13	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.18	0	194.5	0.220	39.161	Method used to	
Dry Density (Mg/m3):	1.92	194.5	389	0.071	12.952	determine CV:	T90
Voids Ratio:	0.378	389	778	0.038	3.334	Nominal temperature	
Degree of saturation:	92.2	778	1556	0.024	2.080	during test ' C:	20
Height (mm):	20.094	1556	194.5	0.007	3.280	Remarks:	
Diameter (mm)	75.01					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



North Manchester Golf

Contract No:

PSL21/2520

Client Ref:

14-807

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: CP101

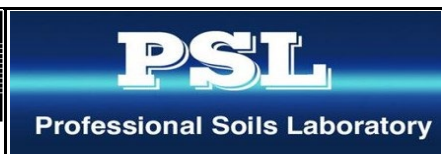
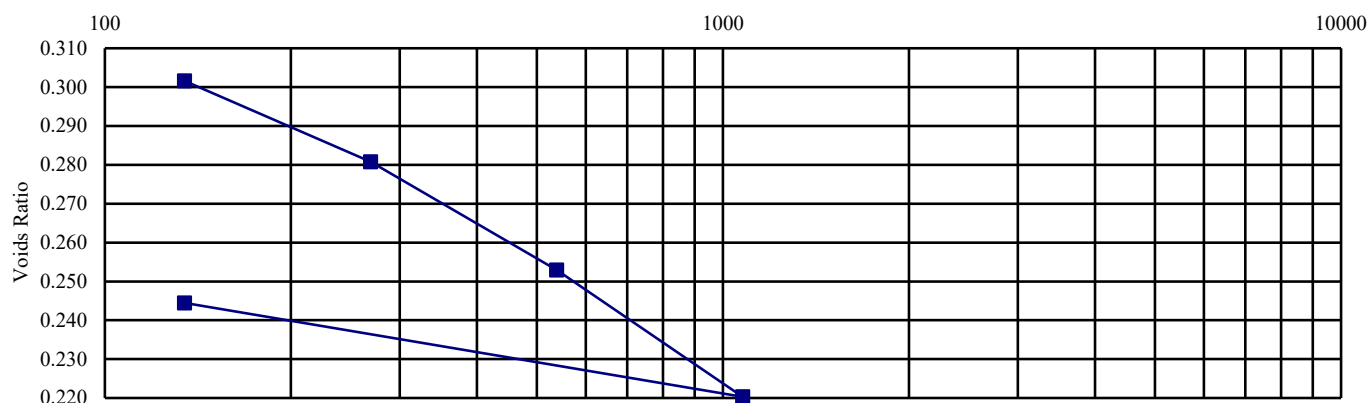
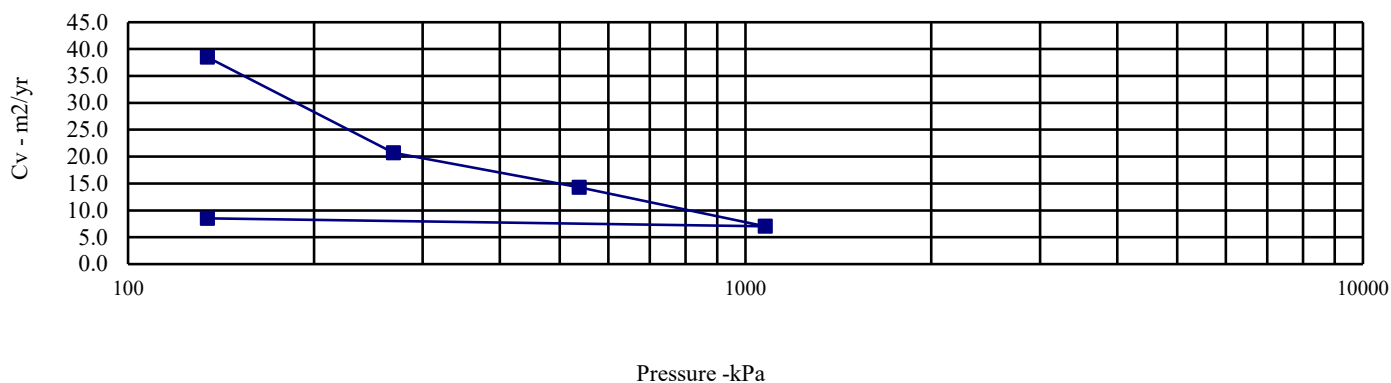
Top Depth (m): 6.50

Sample Number:

Base Depth (m) : 6.95

Sample Type: TUB

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	13	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.19	0	134.5	0.382	38.482	Method used to	
Dry Density (Mg/m3):	1.93	134.5	269	0.119	20.736	determine CV:	T90
Voids Ratio:	0.372	269	538	0.081	14.278	Nominal temperature	
Degree of saturation:	94.4	538	1076	0.048	7.034	during test ' C:	20
Height (mm):	20.016	1076	134.5	0.021	8.499	Remarks:	
Diameter (mm)	75.003					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



North Manchester Golf

Contract No:

PSL21/2520

Client Ref:

14-807

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: CP102

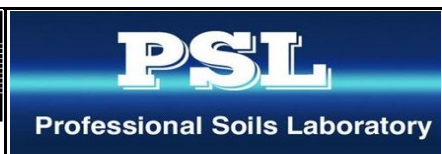
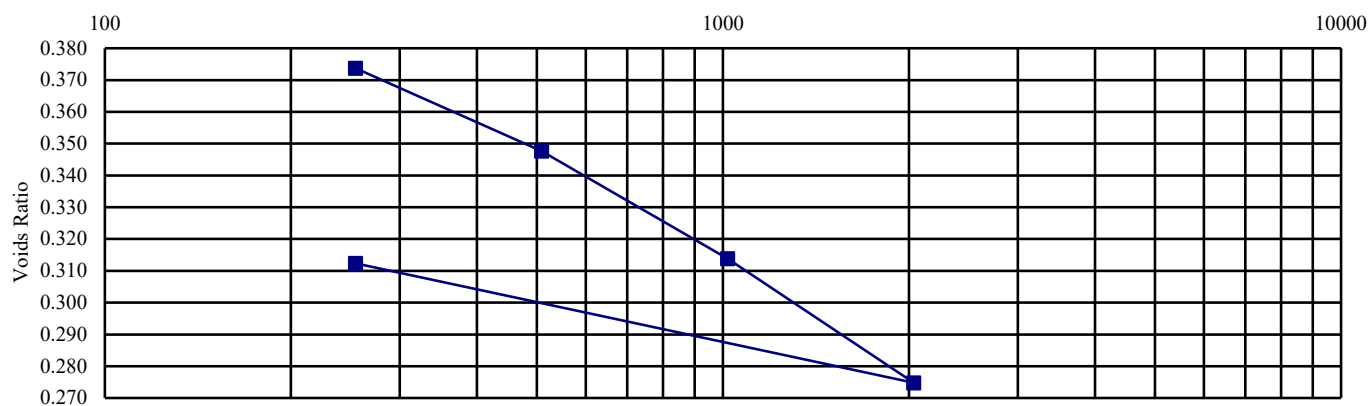
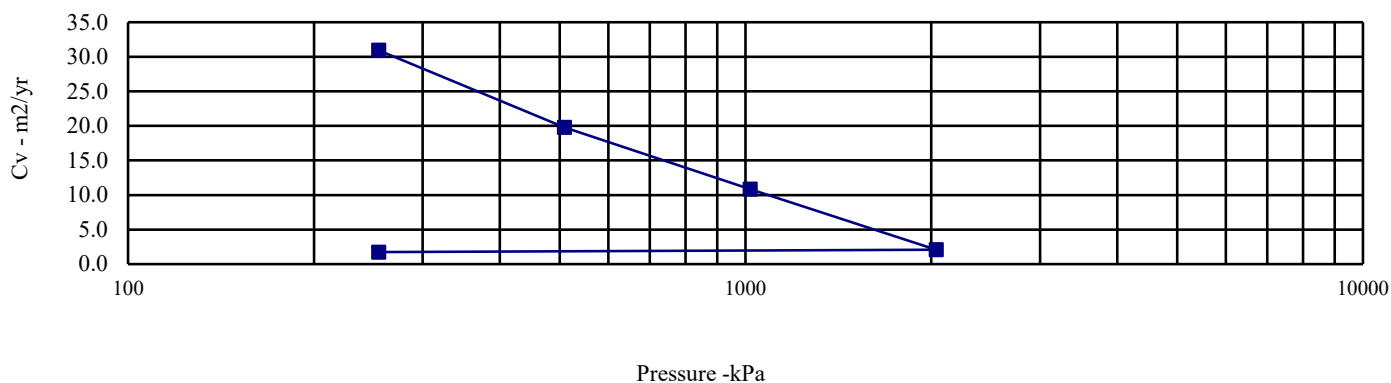
Top Depth (m): 12.50

Sample Number:

Base Depth (m) : 12.95

Sample Type: TUB

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	15	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.15	0	254.5	0.114	30.943	Method used to	
Dry Density (Mg/m3):	1.87	254.5	509	0.075	19.774	determine CV:	T90
Voids Ratio:	0.415	509	1018	0.049	10.837	Nominal temperature	
Degree of saturation:	95.7	1018	2036	0.029	2.079	during test ' C:	20
Height (mm):	20.096	2036	254.5	0.017	1.740	Remarks:	
Diameter (mm)	75.093					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



North Manchester Golf

Contract No:

PSL21/2520

Client Ref:

14-807

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: CP102

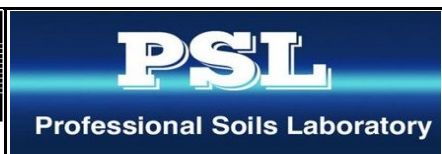
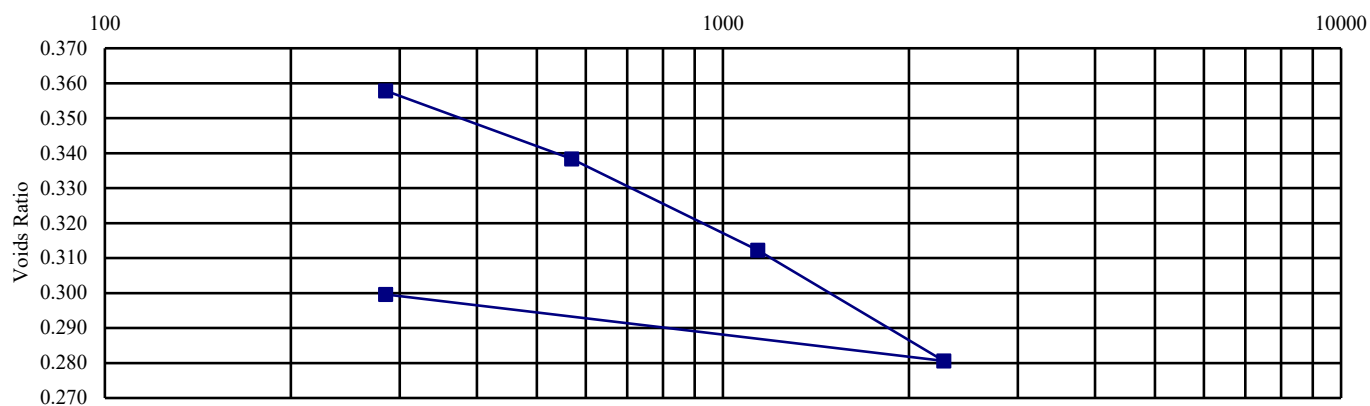
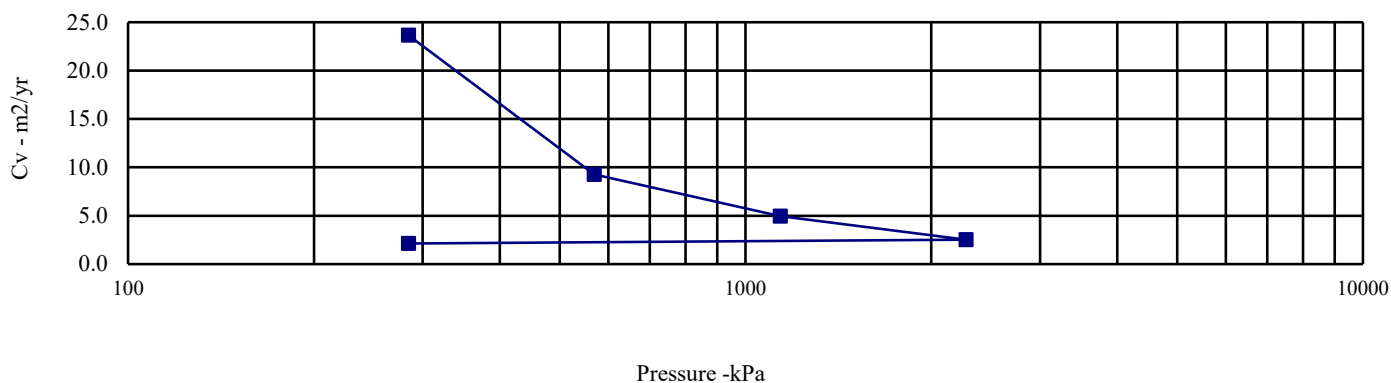
Top Depth (m): 14.00

Sample Number:

Base Depth (m) : 14.45

Sample Type: TUB

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	15	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.18	0	284.5	0.100	23.654	Method used to	
Dry Density (Mg/m3):	1.90	284.5	569	0.050	9.263	determine CV:	T90
Voids Ratio:	0.398	569	1138	0.034	4.957	Nominal temperature	
Degree of saturation:	99.6	1138	2276	0.021	2.518	during test ' C:	20
Height (mm):	19.988	2276	284.5	0.007	2.129	Remarks:	
Diameter (mm)	75.01					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



North Manchester Golf

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ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: CP102

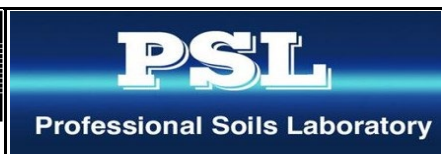
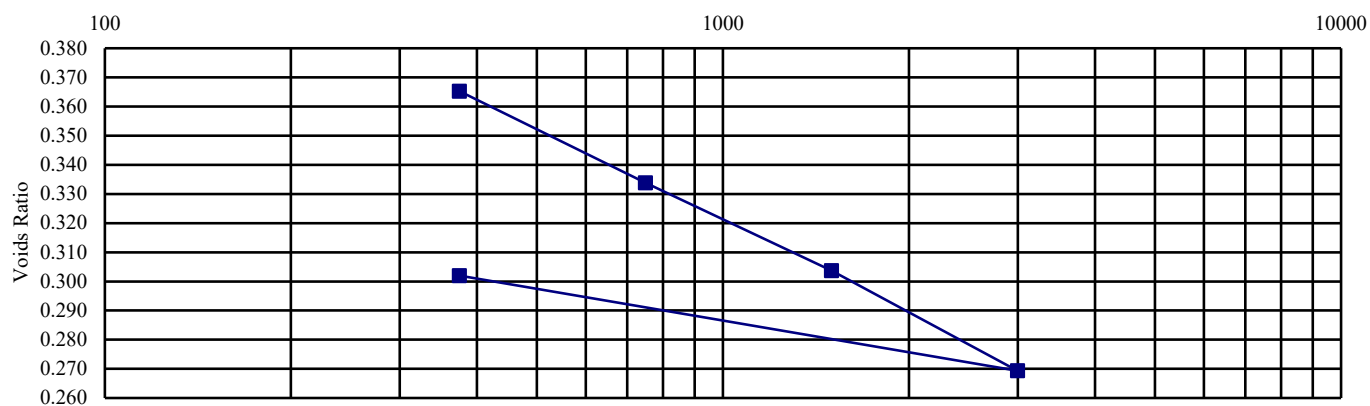
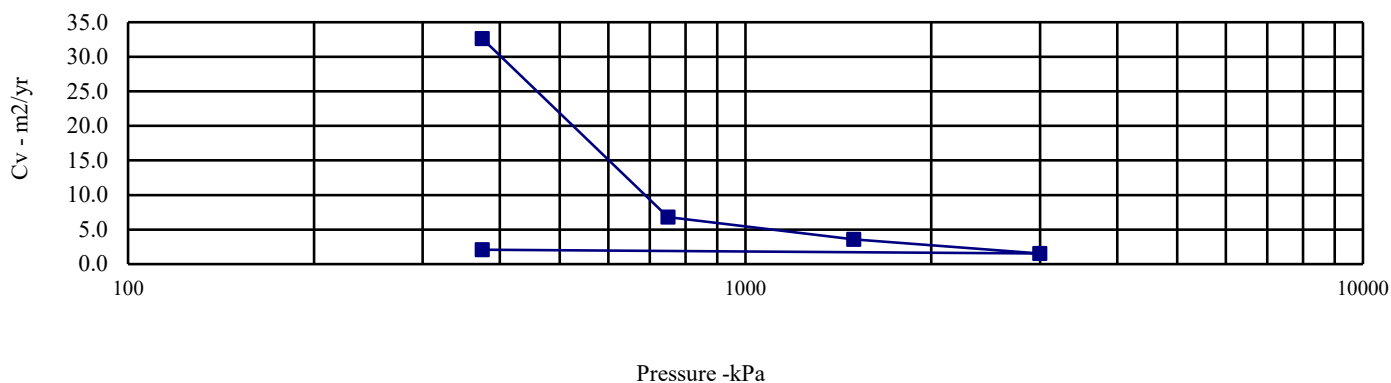
Top Depth (m): 18.50

Sample Number:

Base Depth (m) : 18.95

Sample Type: TUB

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	17	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.14	0	374.5	0.141	32.648	Method used to	
Dry Density (Mg/m3):	1.84	374.5	749	0.062	6.797	determine CV:	T90
Voids Ratio:	0.441	749	1498	0.030	3.562	Nominal temperature	
Degree of saturation:	99.8	1498	2996	0.018	1.539	during test ' C:	20
Height (mm):	20.022	2996	374.5	0.010	2.092	Remarks:	
Diameter (mm)	74.993					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



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