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FLOOD RISK ASSESSMENT

ON

LAND TO OFF DENBY LANE, GRANGE MOOR, HUDDERSFIELD

FOR

ORION HOMES

E24/8223/FR01

OCTOBER 2024

Haigh Huddleston Associates is the trading name of Haigh Huddleston Associates Limited
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1.0 INTRODUCTION

1.1 This report is commissioned to investigate and report on the Flood Risk for this site in accordance Planning Practise Guidance- Flood Risk and Coastal Change Aug 2022 (PPG-FRCC) and the proposals for drainage of this site when redeveloped as residential land. The report is based on information supplied by the client and from relevant authorities in both written and verbal format. Some of this information is in verbal form only. No liability can be accepted for information supplied by third parties which is subsequently found to be inaccurate or incorrect.

2.0 THE SITE

2.1 The site is located to the north of Denby Lane, Grange Moor and is situated around Ordnance Survey grid reference 422351, 416268. A site location plan is included in Appendix A.

2.2 The proposed development site is predominantly grassed field. There is a wooden post barn, storage container and stone building situated to the north of the site. There is access to the field from the southern boundary with Denby Lane, and a second more formal access in the north west corner with an unmade track (Red Deer park Lane) and parking area to the wooden barn. The area of the development is approximately 0.91ha.

2.3 To the east and further north of the site is a wooded area, and to the west are overgrown area of scrub land with numerous trees. A public footpath runs from south to north adjacent the western boundary. To the south of Denby Lane there is a residential area.

2.4 A 300mm diameter culverted watercourse flows from south to north along the eastern boundary. An adopted 225mm diameter combined sewer flows from south to north along the western boundary. The locations of these are shown in the constraints plan to the rear of the report.

2.5 The site falls at an average grade of 1 in 16 from a high point of approximately 215.45m AOD in the south west corner to a low point of 205.65.m adjacent the wood post barn in the north east. The site banks up approximately 0.5-1.0m on the western boundary to the adjacent public footpath.

2.6 Site Investigation works have been undertaken by Groundtech Consulting and are detailed in their report reference GRO-24078-5170 dated May 2024. The site investigation works generally proved up to 1.0m of made ground consisting of gravelly clayey sand with occasional brick and ceramic. Beneath the made ground was a layer of firm becoming stiff occasionally sandy and gravelly silty clay. A bedrock of weak grey brown mudstone was encountered at 1.3-4.5m below existing ground levels, generally deeper towards the south of the site. Groundwater was encountered within three window samples and three trial pits within the shallow clay deposits.

2.7 No infiltration tests were undertaken on site as the presence of the natural cohesive soils on site indicate low soil infiltration rates. Excerpts from the site investigation are included to the rear of this report.

3.0 PROPOSED DEVELOPMENT AND DRAINAGE CONSTRAINTS

3.1 It is understood that the proposed development is for a series of detached, semi-detached, terraced town houses (totalling 20 units) with associated car parking and access roads. An engineering feasibility site layout is attached in the appendices.

3.2 The Phase One Desk Top Study has indicated that the land has had former industrial legacy which has involved quarrying and mining. In addition a Yorkshire Water treatment works was historically situated on the site. The geology of the site consists of Pennine Lower Coal measures consisting of Mudstone, Siltstone and Sandstone, while the south western third is underlain by the Birstall Rock formation consisting of Sandstone. During a site walkover a small grip/overland flow of surface water was noted to run along the lower western boundary of the site. In addition the ground was soft, this has been anecdotally confirmed by local residents who have described the land as boggy in wet weather.

3.3 No infiltration testing has been undertaken to date, however, the site investigation proved the site to be underlain by relatively impermeable silty sandy clays with a mudstone bedrock. The use of soakaways has therefore been discounted.

3.4 There are existing public foul and surface water sewers crossing the development land located along the southern boundary and close to the eastern boundary of the site (see constraints plan). The surface water system which serves the residential properties to the south outfalls into the watercourse along the eastern boundary of the site. Note the watercourse has been previously culverted via ribbed plastic 300mm diameter pipe. A CCTV study of the existing watercourse has proved it is running (although minor pipe deformations were noted) freely for the initial 97m from the last manhole. The plastic pipe had suffered a significant deformation at this point and the survey was unable to progress.

3.5 A second combined sewer is situated to the southern boundary before leaving the site boundary and re-entering and running parallel with the western site boundary. It is evident that the surface water flowing in the small grip also discharges into this system. A copy of the Yorkshire Water records for the site are in the appendices at the rear of the report.

3.6 Yorkshire Water have confirmed that there is no capacity within adjacent adopted combined sewer to service the site. They have recommended that surface water is discharged to the adjacent watercourse on the eastern boundary of the site. This will require a right of discharge in perpetuity to the existing watercourse which will need to be agreed with the current landowner. Due to the site being open field a greenfield discharge will need to be agreed with the LLFA. The development site is just over 1 hectare and therefore the governing criteria for the discharge rate will be the minimum orifice size accepted by Yorkshire Water for adoption. A maximum 3.5l/s surface water discharge rate is therefore proposed for the scheme.

3.7 Due to the slope of the land and the depth of the adjacent watercourse it is likely that a gravity connection for the surface water should be feasible.

4.0 FLOOD RISK

4.1 On reviewing the Environment Agency websites flood risk maps, the site currently falls within flood zone 1: which is designated as low probability of flooding from sea or rivers less than 0.1% (ie 1 in 1000 year) probability of flooding.
The hierarchy of flood zones are described as:

Flood Zone 1: Low Probability. Land assessed as having a less than 1 in 1000 chance of river and sea flooding in any year (<0.1%).

Flood Zone 2: Medium Probability. Land assessed as having between a 1 in 100 and 1 in 1000 chance of river flooding (1% 0.1%) and between a 1 in 200 and 1 in 1000 chance of sea flooding (0.5% 0.1%) in any year.

Flood Zone 3: High Probability. Land assessed as having a 1 in 100 or greater chance of river flooding (>1%) and 1 in 200 or greater chance of sea flooding (>0.5%) in any year.

The site is therefore considered not to be at risk from fluvial flooding from rivers or sea for the 1 in 100 or 1 in 1000 year flood event. The proposed use of the site would be classified as More Vulnerable in Table 2: Flood Risk Vulnerability Classification in the Planning Practise Guidance- Flood Risk and Coastal Change Aug 2022. In accordance with that table the proposed development would be considered to be appropriate for the site.

Fig 1 A copy of the Environment Agency Flood Risk Maps for Planning

4.2 The site does fall partially within an area subject to surface water flooding according to the EA maps see Fig 2 and 3 below.

4.2.1 High risk means that each year this area has a chance of flooding of greater than 3.3%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

4.2.2 Medium risk means that each year this area has a chance of flooding of between 1% and 3.3%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

4.2.3 Low risk means that each year this area has a chance of flooding of between 0.1% and 1%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

4.2.4 Very low risk means that each year this area has a chance of flooding of less than 0.1%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

Fig 2 A copy of the Environment Agency overland Surface Water Plan

4.2 The available EA plans indicate that the site is not affected by overland surface water flood water. The surface water flooding maps indicate a low level risk of surface water ingress on land adjacent to Denby Lane, note this is consistent with the on site topography.

4.3 The site does not appear to fall within an area subject to flooding from reservoirs according to the EA maps. We consider the risk of such a source of flooding would be low. The site does not fall within a flood warning zone.

Fig 3 A copy of the Environment Agency overland Surface Water Plan – Medium Risk Depth

4.4 Due to the size of the development being in below a hectare, it would not always be a requirement to prepare a site specific Flood Risk Assessment for the site. However we understand that this has been requested by KMBC in this instance.

4.5 There are a number of potential flooding mechanisms that the Planning Practise Guidance- Flood Risk and Coastal Change Aug 2022 now requires to be evaluated for each proposed development site. Each method of flooding requires an assessment to be made on its probability relative to the site development. The normal requirement of the document is for no flooding of properties for storms up to a 1% probability or a once in a 100 years storm. The risk assessment also includes for flooding both on site and off site, and the effects of the development on the downstream catchment or the flow regime of the watercourse. NPPG also requires that the effects of severe storms above the normal 1% probability are reviewed together with the effects of climatic change relating to the design life of the development.

4.6 It also requires that the effects of climate change are taken into account together with the impacts of extreme events and flood defence failures. Prior to this the Sequential Test, and where necessary, the Exception test as outlined in Planning Practise Guidance- Flood Risk and Coastal Change Aug 2022, must also be applied to each development site. These aspects are

not covered in this report but the proposed site being in Flood Zone 1, would mean these requirements are already met and do not apply.

4.7 The Planning Practise Guidance- Flood Risk and Coastal Change Aug 2022 requires that each flooding mechanism is addressed and levels of risk evaluated. We consider there are three main risks of flooding to the site. The alternative mechanisms are not applicable to this site.

- Inundation from floodwaters leaving watercourses or rivers entering the site. This can include the effects on culverted watercourses and where the risk of blockage can occur and from breach scenarios.
- Rainwater falling on the site and not being able to leave the site at sufficient rate to prevent flooding on the site.
- Overland flows from adjacent land sites due to surcharging of sewerage systems or other watercourses.
- The impact of the developed site on the existing drainage systems and off-site surface water systems must also be assessed as part of this flood risk assessment.

5.0 DISCUSSION OF FLOOD RISKS

5.1 Flood Risk from Watercourses, River & Tidal

5.1.1 The proposed development area does not fall within the 0.1% or the 1% probability Flood Risk Maps (Zone 2 and 3) as published by the Environment Agency. The site is therefore considered not to be at risk from fluvial flooding for the once in 100 year flood event. We therefore consider the risk of flooding of the site from River and Sea is acceptable for this type of development on this site.

5.2 Risk of Flooding from overland flows from adjacent land.

5.2.1 The site lies on an area of sloping land, with residential development slightly elevated to the southern boundary. A culverted watercourse and an area of woodland occupy the land to the east. The line of the watercourse is at a lower level than the site and therefore should channel any surface water flows away from the site. The open land to the north is at a lower level than the site. The scrubland to the west is at a slightly elevated level than the site the site walkover has confirmed a small grip adjacent to the western boundary conveying a small surface water flow. This will need to be intercepted via a more robust land drainage system and conveyed to the existing watercourse along the eastern boundary. The residential properties to the south of the site are at a slightly higher level, these properties are served by existing public drainage systems and as such the level of risk of flooding from surcharged sewers or drains is considered to be less than 3%. In extreme events or failure of the existing system would generate low level flood waters potentially entering the site along from Denby Lane. However, Denby lane will act as a flood route and should convey any overland flows in an easterly direction away from the proposed site entrance.

5.2.2 We would recommend that an overland flood route is provided through the site to cater for extreme events and in addition to any blockage failure of new drainage systems on site. As is normal under the sewers for adoption criteria and floor levels are to be based a minimum of 300mm above existing ground levels.

5.3 **Risk of Flooding from Rainwater Falling on Site**

5.3.1 The risk of flooding from water falling on site and not being able to leave the site is relatively high. The impermeable area of the site will increase significantly due to the development, and this would increase the run off from the site. This would increase the flood risk to downstream properties unless attenuation measures and restriction of flows took place.

5.3.2 The normal hierarchy for surface water discharge in accordance with current planning and SUDS policies is as follows:

1. The use of infiltration systems such as Soakaways.
2. Discharge to nearby rivers or watercourses with the use of attenuation.
3. Discharge to existing public sewer network with the use of attenuation.

5.3.3 No infiltration testing has been undertaken to date, however, the site investigation proved the site to be underlain by relatively impermeable silty sandy clays with a mudstone bedrock. The use of soakaways has therefore been discounted.

5.3.4 Therefore the development should drain to the identified culverted watercourse located to the eastern boundary of the site. Initial investigation work has identified that the existing culverted watercourse is in a reasonable condition although some areas of deformation have been observed in the CCTV survey. An existing connection from the site is noted this is thought to be a land drainage connection. A new connection from the development is to be constructed to the watercourse, the existing landowner will need to confirm that this is acceptable and provide Yorkshire Water a discharge in perpetuity from the site. Storm water attenuation systems should be utilised to ensure the flows from the site are reduced to agricultural run-off rates or as otherwise agreed with the Kirklees Land Drainage Authority.

5.3.5 There are no significant existing buildings or paved areas on site. In conjunction with infiltration systems not being suitable a greenfield discharge rate of 3.5l/s has been proposed for the development into the existing culverted watercourse. Therefore, this has been considered as the design option for the treatment of the discharge of surface water and storage volumes calculated based upon this discharge rate. Negotiations would be required with the authorities and current landowners to secure permission to discharge in perpetuity

together with easements etc. for the construction of a new sewers and connecting manhole onto the watercourse. Any run off from the site post development would have to be limited to 3.5lit/s.

5.3.6 With attenuation of flows there would have to be a storm-water storage facility. The use of above storage systems such as swales, detention basins or ponds, would provide the most sustainable urban drainage system and possibly the most economic but this would entail significant land up take and potentially large, commuted sums. With the recent implementation of the Codes for Adoption by Yorkshire Water there is greater scope for a regulatory body to adopt and maintain the above ground storage facilities than previously. However there is detailed criteria to be met to able this to take place. For the onsite sewerage system to be adopted there would still be a need for underground tanks to provide sufficient attenuation storage for the site so that pipework does not surcharge for the 1 in 2 year event. Based on this criteria, the estimated volumes of storage required are shown in the attached calculation sheets. For this run off the storage volumes require 81-116 cu.m for the 30 year storm, 116-160cu.m. for the 100 year storm and 186-255 cu.m when 45% extra for climatic change allowance is made.

5.3.7 The use of below ground storage facilities on their own, may not provide a suitable level of treatment of the run off from the site and biological systems, at source, may be needed to ensure contaminants are dealt with prior to discharge of site. The use of open swales and ponds would allow the use of reed beds and other organic systems to be employed so should still be considered in the final designs. Primary treatment for the roads would be the use of trapped gullies for all hard standings. The use of filter drains adjacent to private drives or permeable paving on private drives would also provide a first stage treatment of run off from drives and allow a discharge into the top soils on site. Rainwater butts may also be provided to enable some recycling of run off from the roofs and paved areas. The use of green roofs is not considered appropriate in this development. We understand that open space to the north of the site has been designated as a possible area to locate surface water attenuation. Due to the above requirements an off line basin is proposed which is unlikely to provide the same water quality benefits as an on line system. Please note Yorkshire Water will require an easement and access for future maintenance.

5.3.8 The size of the storm water storage facilities would need to be determined accurately in the final detailed designs. These should be all in accordance with the current PPG. The volumes of storage can include flooding to roads and designated areas such as carpark areas or public open space for the 100 year storm with 45% allowance for climate change, but must ensure that no buildings are flooded.

5.3.9 The position and levels of the attenuation has been considered to ensure that any failure or blockage of the outfall will result in above ground flooding to the open section of watercourse to the eastern boundary of the site and not affect any of the new or existing properties.

5.3.10 The proposed discharge point and discharge rates from the site needs to be formally agreed with Yorkshire Water, the Environment Agency and the Local Land Drainage Authority prior to detailed design being undertaken.

5.4 **Impact on existing drainage systems.**

5.4.1 If the site is developed with attenuation systems and an agreed discharge rate of 3.5l/s reduced to agricultural rates of discharge, there should be no increase in the flood risk to properties off site or in the drainage networks downstream of the site. In real terms there would be slight reduction in flood risk to adjacent land due to the attenuation provided on site for the 1 in 100 year storms with the discharge rate cut to below the current estimated 1 in 1 year storm agricultural discharge rate.

5.4.2 In addition to the above, the existing surface and combined Yorkshire Water sewers are to be diverted from the proposed back gardens of the development. The existing surface water will re- connected into the watercourse to avoid the proposed residential properties. The combined sewer will be diverted beneath the proposed highway to provide future access for maintenance.

5.4.3 The future maintenance of the onsite proposed drainage and attenuation would be carried out by Yorkshire Water as part of the Section 104 Agreement and they would adopt the underground oversized pipework and manholes.

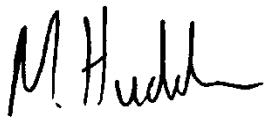
5.4.4 The developer will be responsible to maintain the drainage systems on site until final adoption by Yorkshire Water ensuring that they are working effectively in the intervening period between construction and adoption.

6.0 CONCLUSIONS

6.1 The area of the site to be developed currently falls within Flood Zone 1 as defined by the EA Flood maps. The area of the site to be developed is not at risk of flooding from river or tidal water up to a 1% return period. The flood risk is considered to be acceptable for residential development.

6.2 The use of infiltration techniques for the development is not currently considered suitable. A surface water attenuation system should be designed to reduce the run-off from the site to an agricultural discharge rate of 3.5l/s, to ensure there is no increase in flood risk to the downstream catchment. The use of underground storage for surface water attenuation is proposed. The location of the final outfall to the watercourse will require further investigation on site.

6.3 The risk of overland flows entering the site is considered to be low due to the topography of the area around the site and the drainage systems to the previously developed areas to the south. The risk can be further minimised by providing a flood water route through the site to ensure flood water flows are directed away from the existing and proposed housing. We would recommend that the floor levels of the proposed houses should be a minimum of 300mm above the existing ground/road levels.



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APPENDIX A

LOCATION PLAN

SITE LOCATION PLAN

LAND NORTH OF DENBY LANE, GRANGE MOOR

APPENDIX B

ENGINEERING FEASIBILITY PLAN

PHASE: 0

MH No.	MANHOLE DIAMETER (mm)	MANHOLE TYPE	COVER LEVEL (m)	INVERT LEVEL (m)	DEPTH TO SOFFIT (m)	EASTING (m)	NORTHING (m)
PS1	900	Type E	214.800	213.700	0.950	422400.228	416184.428
PS2	900	Type E	212.300	210.900	1.250	422385.076	416225.034
PS3	900	Type E	210.750	208.900	1.700	422360.334	416270.546
PS4	900	Type E	210.300	207.850	2.300	422342.116	416297.025
PS5	900	Type E	210.450	208.300	2.000	422350.831	416278.554
PS6	900	Type E	210.450	208.700	1.600	422379.186	416270.113
PS7	900	Type E	214.500	213.200	1.150	422407.426	416197.302
S1	1350	Type C	214.280	212.900	1.230	422403.754	416196.599
S2	1350	Type C	212.317	210.900	1.267	422399.763	416218.201
S3	1350	Type C	211.950	210.500	1.300	422396.636	416224.208
S4	1200	Type C	211.754	210.225	1.304	422389.188	416230.463
S5	1200	Type C	211.640	209.925	1.490	422378.408	416238.445
S6	1200	Type C	211.420	209.725	1.470	422372.603	416247.561
S7	1200	Type C	211.103	209.600	1.278	422370.695	416255.678
S8	1200	Type C	209.732	208.300	1.282	422379.186	416275.016
S9	1200	Type B	210.294	208.200	1.794	422370.508	416275.241
S10	1200	Type B	210.689	208.000	2.389	422351.581	416275.390
S11	1200	Type B	210.557	207.900	2.357	422347.316	416279.243
S12	1200	Type B	210.000	207.000	2.700	422347.646	416302.521
S13	TANK INSPECTION CHAMBER		209.800	205.650	2.650	422352.023	416302.486
S14	TANK INSPECTION CHAMBER		209.300	205.600	3.475	422378.529	416302.486
S15	FLOW CONTROL MANHOLE		209.300	205.500	3.650	422383.593	416302.371
S16	HEADWALL		208.333	205.450	2.733	422388.173	416302.322
PF1	900	Type E	212.300	211.100	1.050	422377.840	416230.514
PF2	900	Type E	210.750	209.900	0.700	422346.237	416269.244
PF3	900	Type E	210.300	209.350	0.800	422342.377	416291.712
PF4	900	Type E	210.450	209.250	1.050	422350.482	416289.204
PF5	900	Type E	210.300	209.400	0.750	422373.824	416268.135

NOTES

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KEY

- EXISTING COMBINED SEWER
- EXISTING SURFACE WATER SEWER
- DIVERTED COMBINED SEWER
- PROP S104 SURFACE WATER SEWER
- SEWER TO BE ABANDONED
- SITE BOUNDARY
- SEWER EASEMENT

REV		BY	DATE
G	DRAINAGE UPDATED	MJM	22.07.24
F	LAYOUT UPDATED	MJM	12.07.24
E	LEVELS UPDATED	MJM	03.07.24
D	DRAINAGE DIVERSIONS UPDATED	MJM	28.05.24
C	DRAINAGE & LAYOUT UPDATED	MJM	20.05.24
B	FOUL SEWER DIVERSION UPDATED	MJM	15.05.24
A	INITIAL ISSUE	MJM	20.03.24

FOR COMMENT

STATUS		CHK'D
PRELIMINARY		MJM
FOR COMMENT	✓	MJM
FOR APPROVAL		
FOR CONSTRUCTION		
AS BUILT		

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CLIENT
ORION HOMES LTD

CONTRACT
DENBY LANE
GRANGE MOOR

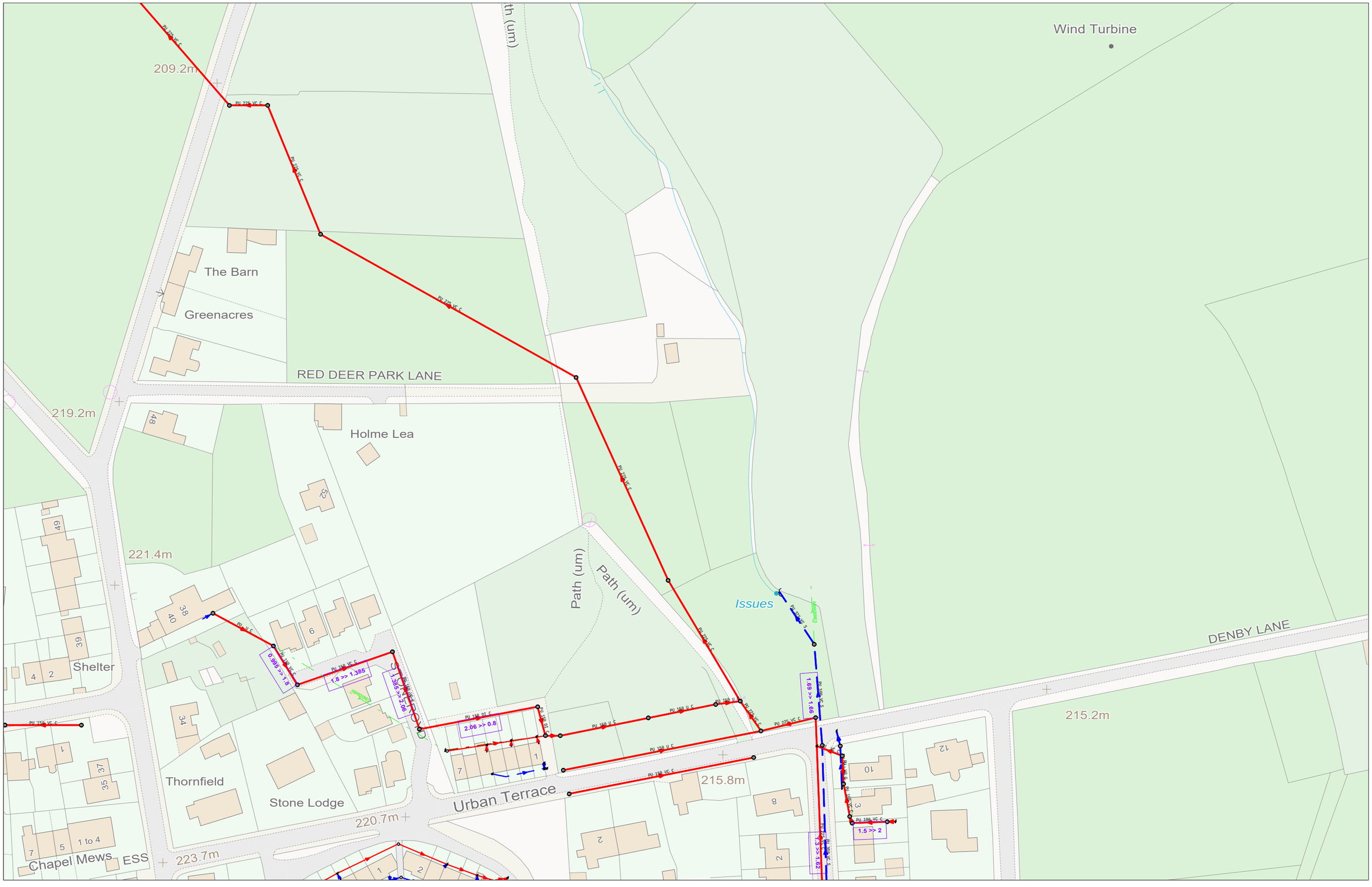
TITLE
S104 DRAINAGE LAYOUT

DRAWN	MJM	CHK'D	MJM
SCALE	1:250 @ A1	DATE	20.03.24

JOB No	DRG No	REV
24017	101	G

APPENDIX C

YORKSHIRE WATER RECORDS



Date Requested : 22/12/2020, 13:27:09

Date Generated : 22/12/2020, 13:27:10

Scale : 1:1250

The position and depth of any YW apparatus shown on this map are approximate only.

UPN: Undefined

Originator: S P Midgley, Waste Water Technical, 75 4486

Grange Moor

Pond
Shaft (disused)
Def
Falhouse Beck
Ward Bdy
Fixby
206.6m
Hilltop
Valley View
Track
BRIESTFIELD ROAD
191.2m
Cherry Tree Farm
Hill Farm
Goat Hill Farm
Pond
Pond
167.9m
Woodend Cottage
SOWOOD LANE
184.6m
Issues
0.91m RH
Track
BS
FW
FW
FW
Path (um)
Hoyles House
Meadowcroft
Meadowcroft Cottage
FIXBY LANE
Rose Cottage Farm
CS
209.2m
212.7m
Wind Turbine
Def
Ward Bdy
Hunt Royd
202.1m
The Barn
Greenacres
RED DEER PARK LANE
0.91m RH
FW
0.91m RH
FW
BS
219.2m
Holme Lea
Und
BS
FW
Issues
Und
Path (um)
Path (um) FW
BACK LANE
Track
Allotment Gardens
Shelter
WELLFIELD AVENUE
HOLME CLOSE
BELLFIELD CLOSE
STONEHOUSE
Def
DENBY LANE
211.9m
215.2m
221.4m
Thornfield
Stone Lodge
220.7m
Urban Terrace
215.8m
Chapel Mews
ESS
223.7m
Orchard House
Denby Lane Crescent
Windwhistle
WHITLEY WAY
DENBY PARK DRIVE
BEN BOOTH LANE
Clough Gate Farm
Pond
LB
CLOUGH GATE DRIVE
BACK LANE
BEDFORD AVENUE
Leys Quarry (disused)
221.7m
Workings (dis)
B 6118
B 6118
LILEY LANE
212.0m
B 6118
BACK LANE
Path
School House
Upper Row
225.6m
Dumb Steeple
Path (um)
Ben Booth Cottage
CLOUGH GATE
STEEPLE AVENUE
Grange Moor Primary School
Garage
215.9m
GREENFIELD CRESCENT
MOORFIELDS
SHUTE LEE WAY
B 6118
SOUTH VIEW TERRACE
220.5m
Path
BRIESTFIELD ROAD
Bowling Green
Path
Church
Play Area
Sunday School
Chapel Row
New Inn (PH)
TCB
Recreation Ground
Play Area
Brown Hill
Wind Turbine
223.2m
LILEY LANE
Unit 8
Unit 7
Unit 2
Warehouse
Pond
Tank
Track
The Kaye Arms (PH)
Path (um)
Pond
El Sub Sta
JUBILEE WAY
224.1m
El Sub Sta
Path
A 642
A 642

Date Requested : 05/05/2021, 15:31:01
Date Generated : 05/05/2021, 15:31:31

Scale : 1:1250

The position and depth of any 'PW' apparatus shown on this map are approximate only.

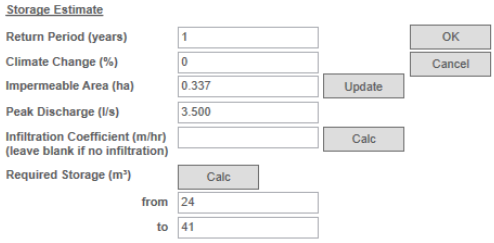
UPN: Undefined

Originator: C ROBERTS, YorMap, 87 2582

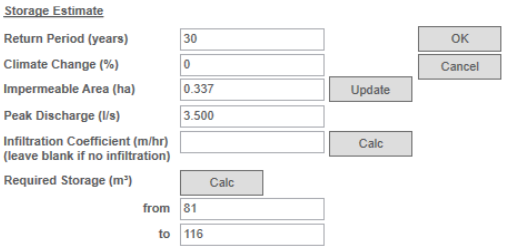
APPENDIX D

PRELIMINARY DRAINAGE CALCULATIONS

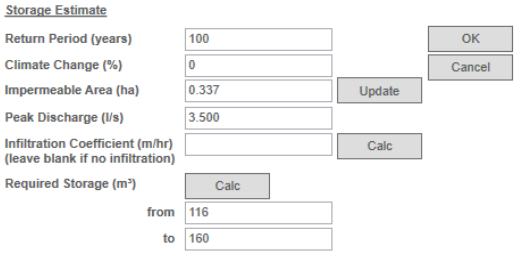
1 IN 1 YEAR STORAGE ESTIMATE



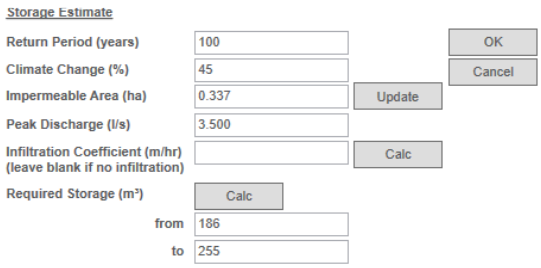
1 IN 30 YEAR STORAGE ESTIMATE



1 IN 100 YEAR STORAGE ESTIMATE



1 IN 100 YEAR + 45% CLIMATE CHANGE STORAGE ESTIMATE



Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	5.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	1.000
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Adoptable Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	749	1500
499	1350	900	1800

>900 Link+900 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	1050	99.999	1200

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100	150

Tank 1500 Link Type

Shape	Closed Rectangular	Auto Increment (mm)	500
Barrels	1	Follow Ground	x
Height (mm)	1500		

Available Diameters (mm)

500

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.061	5.00	214.280	1350	422403.754	416196.599	1.380
S2	0.006	5.00	212.317	1350	422399.763	416218.201	1.417
S3	0.018	5.00	211.950	1350	422396.636	416224.208	1.450
S4	0.024	5.00	211.754	1200	422389.188	416230.463	1.529
S5	0.020	5.00	211.640	1200	422378.408	416238.445	1.715
S6	0.017	5.00	211.420	1200	422372.603	416247.561	1.695
S7	0.041	5.00	211.103	1200	422370.695	416255.678	1.503
S8	0.048	5.00	209.732	1200	422379.186	416275.016	1.432
S9	0.024	5.00	210.294	1200	422370.508	416275.241	2.094
S10	0.007	5.00	210.689	1200	422351.581	416275.390	2.689
S11	0.054	5.00	210.557	1200	422347.316	416279.243	2.657
S12	0.017	5.00	210.000	1200	422347.646	416302.521	3.000
S13			209.800	1350	422352.023	416302.486	4.150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S14			209.300	1350	422378.529	416302.486	3.700
S15			209.300	2100	422383.593	416302.371	3.800
S16			208.333	1200	422388.173	416302.322	2.883

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S1	S2	21.967	0.600	212.900	210.900	2.000	11.0	150	5.00	50.0
1.001	S2	S3	6.773	0.600	210.900	210.500	0.400	16.9	150	5.00	50.0
1.002	S3	S4	9.725	0.600	210.500	210.300	0.200	48.6	150	5.00	50.0
1.003	S4	S5	13.414	0.600	210.225	209.925	0.300	44.7	225	5.00	50.0
1.004	S5	S6	10.807	0.600	209.925	209.725	0.200	54.0	225	5.00	50.0
1.005	S6	S7	8.338	0.600	209.725	209.600	0.125	66.7	225	5.00	50.0
1.006	S7	S9	19.564	0.600	209.600	208.200	1.400	14.0	225	5.00	50.0
2.000	S8	S9	8.681	0.600	208.300	208.200	0.100	86.8	150	5.00	50.0
1.007	S9	S10	18.928	0.600	208.200	208.000	0.200	94.6	300	5.00	50.0
1.008	S10	S11	5.747	0.600	208.000	207.900	0.100	57.5	300	5.00	50.0
1.009	S11	S12	23.280	0.600	207.900	207.000	0.900	25.9	300	5.00	50.0
1.010	S12	S13	4.376	0.600	207.000	206.850	0.150	29.2	300	5.00	50.0
1.011	S13	S14	27.000	0.600	205.650	205.600	0.050	540.0	3500	5.00	50.0
1.012	S14	S15	5.065	0.600	205.600	205.500	0.100	50.7	225	5.00	50.0
1.013	S15	S16	4.581	0.600	205.500	205.450	0.050	91.6	150	5.00	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	3.057	54.0	8.3	1.230	1.267	0.061	0.0	40	2.220
1.001	2.460	43.5	9.1	1.267	1.300	0.067	0.0	47	1.954
1.002	1.446	25.6	11.5	1.300	1.304	0.085	0.0	71	1.409
1.003	1.961	78.0	14.8	1.304	1.490	0.109	0.0	66	1.520
1.004	1.783	70.9	17.5	1.490	1.470	0.129	0.0	76	1.484
1.005	1.603	63.7	19.8	1.470	1.278	0.146	0.0	86	1.417
1.006	3.518	139.9	25.3	1.278	1.869	0.187	0.0	65	2.689
2.000	1.079	19.1	6.5	1.282	1.944	0.048	0.0	60	0.976
1.007	1.616	114.2	35.1	1.794	2.389	0.259	0.0	114	1.428
1.008	2.078	146.9	36.0	2.389	2.357	0.266	0.0	101	1.730
1.009	3.103	219.4	43.4	2.357	2.700	0.320	0.0	90	2.433
1.010	2.921	206.5	45.7	2.700	2.650	0.337	0.0	95	2.360
1.011	2.258	11856.1	45.7	2.650	2.200	0.337	0.0	33	0.389
1.012	1.842	73.2	45.7	3.475	3.575	0.337	0.0	129	1.939
1.013	1.050	18.6	45.7	3.650	2.733	0.337	0.0	150	1.070

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	21.967	11.0	150	Circular	214.280	212.900	1.230	212.317	210.900	1.267
1.001	6.773	16.9	150	Circular	212.317	210.900	1.267	211.950	210.500	1.300
1.002	9.725	48.6	150	Circular	211.950	210.500	1.300	211.754	210.300	1.304
1.003	13.414	44.7	225	Circular	211.754	210.225	1.304	211.640	209.925	1.490
1.004	10.807	54.0	225	Circular	211.640	209.925	1.490	211.420	209.725	1.470
1.005	8.338	66.7	225	Circular	211.420	209.725	1.470	211.103	209.600	1.278
1.006	19.564	14.0	225	Circular	211.103	209.600	1.278	210.294	208.200	1.869
2.000	8.681	86.8	150	Circular	209.732	208.300	1.282	210.294	208.200	1.944
1.007	18.928	94.6	300	Circular	210.294	208.200	1.794	210.689	208.000	2.389
1.008	5.747	57.5	300	Circular	210.689	208.000	2.389	210.557	207.900	2.357
1.009	23.280	25.9	300	Circular	210.557	207.900	2.357	210.000	207.000	2.700
1.010	4.376	29.2	300	Circular	210.000	207.000	2.700	209.800	206.850	2.650
1.011	27.000	540.0	3500	Tank 1500	209.800	205.650	2.650	209.300	205.600	2.200
1.012	5.065	50.7	225	Circular	209.300	205.600	3.475	209.300	205.500	3.575
1.013	4.581	91.6	150	Circular	209.300	205.500	3.650	208.333	205.450	2.733

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S1	1350	Manhole	Adoptable	S2	1350	Manhole	Adoptable
1.001	S2	1350	Manhole	Adoptable	S3	1350	Manhole	Adoptable
1.002	S3	1350	Manhole	Adoptable	S4	1200	Manhole	Adoptable
1.003	S4	1200	Manhole	Adoptable	S5	1200	Manhole	Adoptable
1.004	S5	1200	Manhole	Adoptable	S6	1200	Manhole	Adoptable
1.005	S6	1200	Manhole	Adoptable	S7	1200	Manhole	Adoptable
1.006	S7	1200	Manhole	Adoptable	S9	1200	Manhole	Adoptable
2.000	S8	1200	Manhole	Adoptable	S9	1200	Manhole	Adoptable
1.007	S9	1200	Manhole	Adoptable	S10	1200	Manhole	Adoptable
1.008	S10	1200	Manhole	Adoptable	S11	1200	Manhole	Adoptable
1.009	S11	1200	Manhole	Adoptable	S12	1200	Manhole	Adoptable
1.010	S12	1200	Manhole	Adoptable	S13	1350	Manhole	Adoptable
1.011	S13	1350	Manhole	Adoptable	S14	1350	Manhole	Adoptable
1.012	S14	1350	Manhole	Adoptable	S15	2100	Manhole	Adoptable
1.013	S15	2100	Manhole	Adoptable	S16	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	422403.754	416196.599	214.280	1.380	1350				
						0	1.000	212.900	150
S2	422399.763	416218.201	212.317	1.417	1350		1	1.000	210.900	150
							0	1.001	210.900	150
S3	422396.636	416224.208	211.950	1.450	1350		1	1.001	210.500	150
							0	1.002	210.500	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S4	422389.188	416230.463	211.754	1.529	1200	1	1.002	210.300	150
						0	1.003	210.225	225
S5	422378.408	416238.445	211.640	1.715	1200	1	1.003	209.925	225
						0	1.004	209.925	225
S6	422372.603	416247.561	211.420	1.695	1200	1	1.004	209.725	225
						0	1.005	209.725	225
S7	422370.695	416255.678	211.103	1.503	1200	1	1.005	209.600	225
						0	1.006	209.600	225
S8	422379.186	416275.016	209.732	1.432	1200				
						0	2.000	208.300	150
S9	422370.508	416275.241	210.294	2.094	1200	1	2.000	208.200	150
						2	1.006	208.200	225
						0	1.007	208.200	300
S10	422351.581	416275.390	210.689	2.689	1200	1	1.007	208.000	300
						0	1.008	208.000	300
S11	422347.316	416279.243	210.557	2.657	1200	1	1.008	207.900	300
						0	1.009	207.900	300
S12	422347.646	416302.521	210.000	3.000	1200	1	1.009	207.000	300
						0	1.010	207.000	300
S13	422352.023	416302.486	209.800	4.150	1350	1	1.010	206.850	300
						0	1.011	205.650	3500
S14	422378.529	416302.486	209.300	3.700	1350	1	1.011	205.600	3500
						0	1.012	205.600	225
S15	422383.593	416302.371	209.300	3.800	2100	1	1.012	205.500	225
						0	1.013	205.500	150
S16	422388.173	416302.322	208.333	2.883	1200	1	1.013	205.450	150

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	1440
Ratio-R	0.400	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Node S15 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	205.500	Product Number	CTL-SHE-0080-5000-3500-5000
Design Depth (m)	3.500	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	1 year 960 minute summer	6.768	1.782
1 year 15 minute winter	76.857	30.991	1 year 960 minute winter	4.483	1.782
1 year 30 minute summer	71.439	20.215	1 year 1440 minute summer	4.949	1.326
1 year 30 minute winter	50.133	20.215	1 year 1440 minute winter	3.326	1.326
1 year 60 minute summer	48.435	12.800	30 year 15 minute summer	268.706	76.035
1 year 60 minute winter	32.179	12.800	30 year 15 minute winter	188.566	76.035
1 year 120 minute summer	30.053	7.942	30 year 30 minute summer	174.929	49.499
1 year 120 minute winter	19.966	7.942	30 year 30 minute winter	122.757	49.499
1 year 180 minute summer	23.233	5.979	30 year 60 minute summer	116.589	30.811
1 year 180 minute winter	15.102	5.979	30 year 60 minute winter	77.459	30.811
1 year 240 minute summer	18.475	4.882	30 year 120 minute summer	70.438	18.615
1 year 240 minute winter	12.274	4.882	30 year 120 minute winter	46.797	18.615
1 year 360 minute summer	14.169	3.646	30 year 180 minute summer	53.298	13.715
1 year 360 minute winter	9.210	3.646	30 year 180 minute winter	34.645	13.715
1 year 480 minute summer	11.185	2.956	30 year 240 minute summer	41.604	10.995
1 year 480 minute winter	7.431	2.956	30 year 240 minute winter	27.641	10.995
1 year 600 minute summer	9.182	2.511	30 year 360 minute summer	31.221	8.034
1 year 600 minute winter	6.274	2.511	30 year 360 minute winter	20.295	8.034
1 year 720 minute summer	8.203	2.199	30 year 480 minute summer	24.324	6.428
1 year 720 minute winter	5.513	2.199	30 year 480 minute winter	16.160	6.428

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 600 minute summer	19.756	5.404
30 year 600 minute winter	13.498	5.404
30 year 720 minute summer	17.490	4.687
30 year 720 minute winter	11.754	4.687
30 year 960 minute summer	14.215	3.743
30 year 960 minute winter	9.416	3.743
30 year 1440 minute summer	10.161	2.723
30 year 1440 minute winter	6.829	2.723
100 year 15 minute summer	348.738	98.681
100 year 15 minute winter	244.728	98.681
100 year 30 minute summer	228.965	64.789
100 year 30 minute winter	160.677	64.789
100 year 60 minute summer	153.288	40.510
100 year 60 minute winter	101.841	40.510
100 year 120 minute summer	92.562	24.461
100 year 120 minute winter	61.496	24.461
100 year 180 minute summer	69.806	17.964
100 year 180 minute winter	45.376	17.964
100 year 240 minute summer	54.269	14.342
100 year 240 minute winter	36.055	14.342
100 year 360 minute summer	40.484	10.418
100 year 360 minute winter	26.315	10.418
100 year 480 minute summer	31.414	8.302
100 year 480 minute winter	20.871	8.302
100 year 600 minute summer	25.431	6.956
100 year 600 minute winter	17.376	6.956
100 year 720 minute summer	22.452	6.017
100 year 720 minute winter	15.089	6.017
100 year 960 minute summer	18.166	4.784
100 year 960 minute winter	12.033	4.784
100 year 1440 minute summer	12.896	3.456
100 year 1440 minute winter	8.667	3.456
100 year +40% CC 15 minute summer	488.233	138.153
100 year +40% CC 15 minute winter	342.620	138.153
100 year +40% CC 30 minute summer	320.551	90.705
100 year +40% CC 30 minute winter	224.948	90.705
100 year +40% CC 60 minute summer	214.603	56.713
100 year +40% CC 60 minute winter	142.577	56.713
100 year +40% CC 120 minute summer	129.587	34.246
100 year +40% CC 120 minute winter	86.094	34.246
100 year +40% CC 180 minute summer	97.729	25.149
100 year +40% CC 180 minute winter	63.526	25.149
100 year +40% CC 240 minute summer	75.977	20.078
100 year +40% CC 240 minute winter	50.477	20.078
100 year +40% CC 360 minute summer	56.677	14.585
100 year +40% CC 360 minute winter	36.841	14.585
100 year +40% CC 480 minute summer	43.979	11.622
100 year +40% CC 480 minute winter	29.219	11.622
100 year +40% CC 600 minute summer	35.604	9.738
100 year +40% CC 600 minute winter	24.327	9.738
100 year +40% CC 720 minute summer	31.433	8.424
100 year +40% CC 720 minute winter	21.125	8.424
100 year +40% CC 960 minute summer	25.432	6.697
100 year +40% CC 960 minute winter	16.847	6.697
100 year +40% CC 1440 minute summer	18.055	4.839
100 year +40% CC 1440 minute winter	12.134	4.839

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	212.940	0.040	8.6	0.0578	0.0000	OK
15 minute winter	S2	10	210.947	0.047	9.3	0.0674	0.0000	OK
15 minute winter	S3	10	210.577	0.077	11.8	0.1098	0.0000	OK
15 minute winter	S4	10	210.294	0.068	15.0	0.0774	0.0000	OK
15 minute winter	S5	10	210.006	0.081	17.7	0.0913	0.0000	OK
15 minute winter	S6	11	209.822	0.097	20.0	0.1094	0.0000	OK
15 minute winter	S7	11	209.665	0.065	25.6	0.0734	0.0000	OK
15 minute winter	S8	10	208.362	0.061	6.8	0.0695	0.0000	OK
15 minute winter	S9	11	208.322	0.122	35.5	0.1375	0.0000	OK
15 minute winter	S10	11	208.118	0.118	36.4	0.1339	0.0000	OK
15 minute winter	S11	11	207.990	0.090	43.8	0.1021	0.0000	OK
15 minute winter	S12	11	207.119	0.118	46.2	0.1340	0.0000	OK
120 minute winter	S13	102	205.896	0.246	15.5	0.3523	0.0000	OK
120 minute winter	S14	102	205.896	0.296	10.6	0.4240	0.0000	SURCHARGED
120 minute winter	S15	102	205.896	0.396	13.9	1.3717	0.0000	SURCHARGED
15 minute summer	S16	1	205.450	0.000	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	8.5	2.002	0.158	0.0938	
15 minute winter	S2	1.001	S3	9.3	1.352	0.213	0.0467	
15 minute winter	S3	1.002	S4	11.6	1.350	0.455	0.0839	
15 minute winter	S4	1.003	S5	14.9	1.301	0.191	0.1542	
15 minute winter	S5	1.004	S6	17.7	1.218	0.249	0.1571	
15 minute winter	S6	1.005	S7	20.1	1.569	0.315	0.1074	
15 minute winter	S7	1.006	S9	25.6	1.647	0.183	0.3066	
15 minute winter	S8	2.000	S9	6.7	0.600	0.354	0.0957	
15 minute winter	S9	1.007	S10	35.5	1.351	0.311	0.4977	
15 minute winter	S10	1.008	S11	36.6	1.681	0.249	0.1254	
15 minute winter	S11	1.009	S12	43.9	2.015	0.200	0.5084	
15 minute winter	S12	1.010	S13	46.3	2.052	0.224	0.0989	
120 minute winter	S13	1.011	S14	10.6	0.122	0.001	25.6318	
120 minute winter	S14	1.012	S15	13.9	0.619	0.190	0.2014	
120 minute winter	S15	Hydro-Brake®	S16	3.0				44.8

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	212.965	0.065	21.1	0.0930	0.0000	OK
15 minute winter	S2	11	210.992	0.092	23.1	0.1320	0.0000	OK
15 minute winter	S3	11	210.761	0.261	28.5	0.3731	0.0000	SURCHARGED
15 minute winter	S4	11	210.340	0.115	36.0	0.1300	0.0000	OK
15 minute winter	S5	11	210.069	0.144	42.6	0.1631	0.0000	OK
15 minute winter	S6	11	209.893	0.168	48.2	0.1897	0.0000	OK
15 minute winter	S7	11	209.704	0.104	61.6	0.1177	0.0000	OK
15 minute winter	S8	10	208.513	0.213	16.6	0.2408	0.0000	SURCHARGED
15 minute winter	S9	11	208.416	0.216	85.4	0.2447	0.0000	OK
15 minute winter	S10	11	208.205	0.205	88.1	0.2318	0.0000	OK
15 minute winter	S11	11	208.050	0.150	105.9	0.1695	0.0000	OK
15 minute winter	S12	11	207.212	0.212	111.6	0.2400	0.0000	OK
180 minute winter	S13	180	206.500	0.850	27.0	1.2158	0.0000	OK
180 minute winter	S14	180	206.500	0.900	15.4	1.2874	0.0000	SURCHARGED
180 minute winter	S15	180	206.499	0.999	11.4	3.4617	0.0000	SURCHARGED
15 minute summer	S16	1	205.450	0.000	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	21.0	2.444	0.389	0.2022	
15 minute winter	S2	1.001	S3	22.3	1.515	0.514	0.0981	
15 minute winter	S3	1.002	S4	28.2	1.602	1.104	0.1695	
15 minute winter	S4	1.003	S5	36.1	1.524	0.462	0.3169	
15 minute winter	S5	1.004	S6	42.7	1.453	0.602	0.3168	
15 minute winter	S6	1.005	S7	48.2	1.925	0.757	0.2071	
15 minute winter	S7	1.006	S9	61.7	2.041	0.441	0.5593	
15 minute winter	S8	2.000	S9	16.2	0.919	0.849	0.1528	
15 minute winter	S9	1.007	S10	85.8	1.622	0.751	1.0003	
15 minute winter	S10	1.008	S11	88.3	2.036	0.601	0.2485	
15 minute winter	S11	1.009	S12	106.1	2.388	0.484	1.0297	
15 minute winter	S12	1.010	S13	111.8	2.470	0.542	0.1974	
180 minute winter	S13	1.011	S14	15.4	0.096	0.001	82.6525	
180 minute winter	S14	1.012	S15	11.4	0.666	0.156	0.2014	
180 minute winter	S15	Hydro-Brake®	S16	3.0				116.1

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	212.976	0.075	27.4	0.1080	0.0000	OK
15 minute winter	S2	11	211.158	0.258	30.0	0.3686	0.0000	SURCHARGED
15 minute winter	S3	11	210.921	0.421	35.1	0.6026	0.0000	SURCHARGED
15 minute winter	S4	11	210.359	0.134	44.6	0.1513	0.0000	OK
15 minute winter	S5	11	210.101	0.176	53.1	0.1989	0.0000	OK
15 minute winter	S6	11	209.928	0.203	60.3	0.2293	0.0000	OK
15 minute winter	S7	11	209.719	0.119	77.6	0.1346	0.0000	OK
15 minute winter	S8	11	208.637	0.337	21.6	0.3808	0.0000	SURCHARGED
15 minute winter	S9	11	208.475	0.275	108.7	0.3114	0.0000	OK
15 minute winter	S10	11	208.245	0.245	112.0	0.2770	0.0000	OK
15 minute winter	S11	11	208.077	0.177	134.9	0.1999	0.0000	OK
15 minute winter	S12	11	207.258	0.258	142.4	0.2921	0.0000	OK
240 minute winter	S13	236	206.843	1.193	28.1	1.7072	0.0000	OK
240 minute winter	S14	236	206.843	1.243	15.7	1.7788	0.0000	SURCHARGED
240 minute winter	S15	236	206.843	1.343	9.8	4.6510	0.0000	SURCHARGED
15 minute summer	S16	1	205.450	0.000	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	27.3	2.482	0.505	0.2909	
15 minute winter	S2	1.001	S3	27.5	1.561	0.632	0.1192	
15 minute winter	S3	1.002	S4	34.5	1.962	1.352	0.1695	
15 minute winter	S4	1.003	S5	44.6	1.561	0.572	0.3883	
15 minute winter	S5	1.004	S6	53.1	1.494	0.749	0.3837	
15 minute winter	S6	1.005	S7	60.3	1.996	0.946	0.2460	
15 minute winter	S7	1.006	S9	77.7	2.240	0.555	0.5975	
15 minute winter	S8	2.000	S9	20.7	1.176	1.086	0.1528	
15 minute winter	S9	1.007	S10	109.0	1.680	0.954	1.2236	
15 minute winter	S10	1.008	S11	112.1	2.123	0.764	0.3010	
15 minute winter	S11	1.009	S12	135.2	2.471	0.616	1.2535	
15 minute winter	S12	1.010	S13	142.6	2.579	0.691	0.2386	
240 minute winter	S13	1.011	S14	15.7	0.103	0.001	115.1068	
240 minute winter	S14	1.012	S15	9.8	0.647	0.134	0.2014	
240 minute winter	S15	Hydro-Brake®	S16	3.2				162.6

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	11	213.000	0.099	38.3	0.1423	0.0000	OK
15 minute winter	S2	12	211.752	0.852	41.5	1.2189	0.0000	SURCHARGED
15 minute winter	S3	12	211.368	0.868	45.8	1.2418	0.0000	SURCHARGED
15 minute winter	S4	11	210.553	0.328	57.1	0.3712	0.0000	SURCHARGED
15 minute winter	S5	11	210.337	0.412	67.9	0.4664	0.0000	SURCHARGED
15 minute winter	S6	11	210.074	0.349	77.3	0.3946	0.0000	SURCHARGED
15 minute winter	S7	11	209.766	0.166	101.2	0.1881	0.0000	OK
240 minute winter	S8	232	209.205	0.905	5.7	1.0233	0.0000	SURCHARGED
240 minute winter	S9	232	209.205	1.005	30.5	1.1362	0.0000	SURCHARGED
240 minute winter	S10	232	209.204	1.204	31.2	1.3620	0.0000	SURCHARGED
240 minute winter	S11	232	209.204	1.304	37.6	1.4749	0.0000	SURCHARGED
240 minute winter	S12	232	209.204	2.203	39.6	2.4921	0.0000	SURCHARGED
240 minute winter	S13	232	209.203	3.553	39.6	5.0847	0.0000	SURCHARGED
240 minute winter	S14	232	209.203	3.603	21.9	5.1562	0.0000	FLOOD RISK
240 minute winter	S15	232	209.202	3.702	12.0	12.8245	0.0000	FLOOD RISK
15 minute summer	S16	1	205.450	0.000	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	37.7	2.494	0.698	0.3295	
15 minute winter	S2	1.001	S3	35.1	1.997	0.809	0.1192	
15 minute winter	S3	1.002	S4	44.4	2.522	1.737	0.1712	
15 minute winter	S4	1.003	S5	57.0	1.582	0.731	0.5335	
15 minute winter	S5	1.004	S6	67.6	1.699	0.953	0.4298	
15 minute winter	S6	1.005	S7	76.9	2.035	1.207	0.2970	
15 minute winter	S7	1.006	S9	100.9	2.638	0.722	0.6969	
240 minute winter	S8	2.000	S9	5.7	0.563	0.299	0.1528	
240 minute winter	S9	1.007	S10	30.4	1.304	0.266	1.3329	
240 minute winter	S10	1.008	S11	31.2	1.614	0.213	0.4047	
240 minute winter	S11	1.009	S12	37.6	1.969	0.172	1.6394	
240 minute winter	S12	1.010	S13	39.6	1.982	0.192	0.3082	
240 minute winter	S13	1.011	S14	21.9	0.104	0.002	141.8154	
240 minute winter	S14	1.012	S15	12.0	0.679	0.164	0.2014	
240 minute winter	S15	Hydro-Brake®	S16	5.1				227.5

APPENDIX E

SITE INVESTIGATION EXTRACTS

GROUNDTECH CONSULTING	CLIENT: ORION HOMES	DATE: MARCH 2024
	PROJECT TITLE: DENBY LANE, GRANGE MOOR	SCALE: NTS
	PLAN TITLE: EXPLORATORY HOLE LOCATION PLAN - EXISTING	PLAN NUMBER: GRO-24078-P02A

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

- Groundtech Consulting Rotary Borehole (March 2024)
- Groundtech Consulting Trial Pit (March 2024)
- Groundtech Consulting Windowless Sample Borehole (March 2024)
- Lithos Consulting Rotary Probehole (October 2022)
- Groundtech Consulting Trial Pit (October 2022)

GROUNDTECH CONSULTING

Borehole Log

Borehole No. **WS01**

Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422381.60 - 416251.82	Hole Type WS
Location: GRANGE MOOR		Level: 210.84	Scale 1:25
Client: ORION HOMES		Dates: 26/03/2024 -	Logged By JR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.30	210.54		MADE GROUND: Dark brown sandy clayey topsoil. Sand is fine to coarse. Frequent rootlets present.
		0.50	ES					MADE GROUND: Soft dark brown gravelly sandy clay. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse.
		1.00	D		0.90	209.94		Firm light brown mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone.
		1.00	ES					
		1.20		N=19 (3,3/4,5,5,5)				
		2.00	D		1.70	209.14		Extremely weak grey brown MUDSTONE residually weathered recovered as stiff gravelly sandy clay. Gravel is angular to subrounded fine to medium of mudstone. Sand is fine to medium.
		2.00		N=22 (3,4/5,5,6,6)				
	▼	3.00	D					*Becoming very gravelly and dark grey from 3.00m bgl.*
		3.00		N=41 (5,6/9,10,10,12)				
								Gravel of coal encountered from 3.60m bgl.
		4.00	D		4.00	206.84		End of borehole at 4.00 m
		4.00		N=50 (12,13/50 for 20mm)				

1 2 3 4 5

Remarks

1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Hand dug inspection pit to 1.20m bgl. 3. Groundwater encountered at 3.00m bgl. 4. Borehole terminated at 4.00m bgl due to SPT refusal. 5. Monitoring standpipe installed to 4.00m bgl (1.00m plain, 3.00m slotted).

GROUNDTECH CONSULTING

Borehole Log

Borehole No. **WS02**

Sheet 1 of 1

Project Name:	DENBY LANE	Project No. GRO-24078	Co-ords:	422382.71 - 416283.53	Hole Type WS
Location:	GRANGE MOOR		Level:	209.10	Scale 1:25
Client:	ORION HOMES		Dates:	26/03/2024 -	Logged By JR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.50	ES					MADE GROUND: Dark brown gravelly clayey fine to coarse sand. Gravel is angular to subangular fine to medium of brick. Occasional rootlets present.
		1.00	D		1.00	208.10		
		1.00	ES					Firm light brown mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone.
		1.20		N=5 (1,1/1,1,1,2)				
		2.00	D					
		2.00		N=26 (2,3/3,5,8,10)				
					2.25	206.85		Extremely weak black bituminous COAL residually weathered recovered as clayey angular to subangular fine to medium gravel.
	▼	2.50	D					
					2.70	206.40		Extremely weak grey brown MUDSTONE residually weathered recovered as stiff gravelly sandy clay. Gravel is angular to subrounded fine to medium of mudstone. Sand is fine to medium.
		3.00	D		3.00	206.10		End of borehole at 3.00 m
		3.00		N=50 (11,14/50 for 10mm)				

Remarks

1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Hand dug inspection pit to 1.20m bgl. 3. Groundwater encountered at 2.50m bgl. 4. Borehole terminated at 3.00m bgl due to SPT refusal. 5. Monitoring standpipe installed to 3.00m bgl (1.00m plain, 2.00m slotted).

GROUNDTECH CONSULTING

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422342.94 - 416295.45	Hole Type WS
Location: GRANGE MOOR		Level: 209.70	Scale 1:25
Client: ORION HOMES		Dates: 26/03/2024 -	Logged By JR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES					MADE GROUND: Dark brown gravelly sandy clayey topsoil. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
		0.60	ES		0.50	209.20		Firm light brown mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone.
		1.00	D					
		1.20		N=11 (3,3/3,3,2,3)				
		2.00	D		1.60	208.10		Extremely weak grey brown MUDSTONE residually weathered recovered as stiff gravelly sandy clay. Gravel is angular to subrounded fine to medium of mudstone. Sand is fine to medium.
		2.00		N=12 (2,2/3,3,3,3)				
					2.80	206.90		Extremely weak black bituminous COAL residually weathered recovered as clayey angular to subangular fine to medium gravel.
		3.00	D		3.00	206.70		End of borehole at 3.00 m
		3.00		N=50 (7,7/50 for 40mm)				

Remarks

1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Hand dug inspection pit to 1.20m bgl. 3. Groundwater encountered at 3.00m bgl. 4. Borehole terminated at 3.00m bgl due to SPT refusal. 5. Monitoring standpipe installed to 3.00m bgl (1.00m plain, 2.00m slotted).

GROUNDTECH CONSULTING

Borehole Log

Borehole No. **WS04**

Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422349.59 - 416242.71	Hole Type WS
Location: GRANGE MOOR		Level: 212.36	Scale 1:25
Client: ORION HOMES		Dates: 26/03/2024 -	Logged By JR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES					MADE GROUND: Dark brown gravelly sandy clayey topsoil. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
		0.50	D		0.50	211.86		
		0.60	ES					Firm light brown mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone.
					1.00	211.36		Extremely weak grey brown MUDSTONE residually weathered recovered as stiff gravelly sandy clay. Gravel is angular to subrounded fine to medium of mudstone. Sand is fine to medium.
		1.20		N=16 (4,3/4,4,4,4)				
		1.50	D					
		2.00		N=50 (7,8/50 for 10mm)	2.00	210.36		End of borehole at 2.00 m

1
2
3
4
5

Remarks

1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Hand dug inspection pit to 1.20m bgl. 3. No groundwater encountered. 4. Borehole terminated at 2.00m bgl due to SPT refusal. 5. Monitoring standpipe installed to 2.00m bgl (1.00m plain, 1.00m slotted).

Borehole Log

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422362.31 - 416225.90	Hole Type WS
Location: GRANGE MOOR		Level: 212.70	Scale 1:25
Client: ORION HOMES		Dates: 26/03/2024 -	Logged By JR

Borehole No. **WS05** Sheet 1 of 1

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES		0.60	212.10		MADE GROUND: Dark brown gravelly sandy clayey topsoil with a low cobble content of brick. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
		0.80	ES					Firm light brown mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone.
		1.00	D					
		1.20		N=16 (2,2/3,4,4,5)				
		1.50	D					
		2.00	D		2.00	210.70		Extremely weak grey brown MUDSTONE residually weathered recovered as stiff gravelly sandy friable clay. Gravel is angular to subrounded fine to medium of mudstone. Sand is fine to medium.
		2.00		N=42 (7,9/9,10,11,12)				
		3.00	D		3.00	209.70		*Becoming very gravelly from 2.90m bgl.*
		3.00		N=50 (10,12/50 for 10mm)				End of borehole at 3.00 m

Remarks

1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Hand dug inspection pit to 1.20m bgl. 3. No groundwater encountered. 4. Borehole terminated at 3.00m bgl due to SPT refusal. 5. Monitoring standpipe installed to 3.00m bgl (1.00m plain, 2.00m slotted).

GROUNDTECH CONSULTING

Borehole Log

Borehole No. **WS06**

Sheet 1 of 1

Project Name:	DENBY LANE	Project No. GRO-24078	Co-ords: 422382.59 - 416202.18	Hole Type WS
Location:	GRANGE MOOR		Level: 213.20	Scale 1:25
Client:	ORION HOMES		Dates: 26/03/2024 -	Logged By JR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES		0.55	212.65		MADE GROUND: Dark brown gravelly sandy clayey topsoil. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
	▼	0.60	ES					Firm light brown mottled grey very sandy gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone. Sand is fine to coarse.
		0.70	D					
		1.20		N=18 (1,2/3,4,5,6)				
		1.50	D					*Becoming grey from 1.50m bgl.*
		2.00		N=20 (4,4/4,4,6,6)				*Poor recovery from 2.00m to 3.00m bgl.*
		3.00		N=50 (3,8/50 for 30mm)	3.00	210.20		End of borehole at 3.00 m

1 2 3 4 5

Remarks

1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Hand dug inspection pit to 1.20m bgl. 3. Groundwater encountered at 0.70m bgl. 4. Borehole terminated at 3.00m bgl due to SPT refusal. 5. Borehole collapsed to 2.00m bgl. 6. Monitoring standpipe installed to 2.00m bgl (1.00m plain, 1.00m slotted).

GROUNDTECH CONSULTING

Trial Pit Log

Trialpit No **TP01**

Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422362.77 - 416295.47 Level: 209.17	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.00	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.50	D	HVP=55	0.30	208.87		MADE GROUND: Dark brown clayey sandy topsoil. Sand is fine to coarse. Frequent rootlets present.
							Firm medium strength light brown mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone.
	1.50	D					
▼				2.20	206.97		Extremely weak black bituminous COAL residually weathered recovered as clayey angular to subangular fine to medium gravel.
	2.50	D		2.60	206.57		Extremely weak light brown MUDSTONE residually weathered recovered as firm gravelly sandy friable clay. Gravel is angular to subangular fine to medium of mudstone and coal. Sand is fine to coarse.
	3.00	D		3.00	206.17		End of pit at 3.00 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Groundwater seepage encountered at 2.20m bgl. 3. Trial pit terminated at 3.00m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

Trial Pit Log

GROUNDTECH CONSULTING

Trialpit No **TP02** Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422331.63 - 416277.28 Level: 211.08	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.20	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	ES					MADE GROUND: Dark brown clayey sandy topsoil. Sand is fine to coarse. Frequent rootlets present.
	0.50	D		0.40	210.68		Firm high strength light brown mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone.
			HVP=95				
	1.50	D		1.60	209.48		Extremely weak grey brown MUDSTONE residually weathered recovered as stiff gravelly sandy clay. Gravel is angular to subrounded fine to medium of coal and mudstone. Sand is fine to medium.
	2.00	D		1.90	209.18		Extremely weak black bituminous COAL residually weathered recovered as clayey angular to subangular fine to medium gravel.
				2.10	208.98		Extremely weak grey brown MUDSTONE residually weathered recovered as slightly clayey very sandy angular to subrounded fine to coarse gravel of coal and mudstone. Sand is fine to coarse.
	2.50	D					
	3.00	D					
				3.20	207.88		End of pit at 3.20 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit terminated at 3.20m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

Trial Pit Log

GROUNDTECH CONSULTING

Trialpit No **TP03** Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422367.79 - 416263.17 Level: 210.51	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.30	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.25	210.26		MADE GROUND: Dark brown clayey sandy topsoil. Sand is fine to coarse. Frequent rootlets present.
	0.50	D					Firm medium strength light brown orange mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone.
	1.50	D	HVP=69				
				1.80	208.71		Extremely weak grey brown MUDSTONE residually weathered recovered as stiff medium strength gravelly sandy clay. Gravel is angular to subrounded fine to coarse of coal and mudstone. Sand is fine to coarse.
	2.00	D	HVP=65				
				2.30	208.21		Extremely weak black bituminous COAL residually weathered recovered as clayey angular to subangular fine to medium gravel.
	2.50 2.50	B D					
				2.70	207.81		Extremely weak grey brown MUDSTONE residually weathered recovered as slightly clayey very sandy angular to subrounded fine to coarse gravel of coal and mudstone. Sand is fine to coarse.
	3.00	D					
				3.30	207.21		End of pit at 3.30 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit terminated at 3.30m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

GROUNDTECH CONSULTING

Trial Pit Log

Trialpit No
TP04
Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422334.55 - 416250.81 Level: 212.66	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.10	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.20	212.46		MADE GROUND: Dark brown clayey sandy gravelly topsoil. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
	0.40	ES		0.50	212.16		MADE GROUND: Dark grey black gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of brick, sandstone, and plastic.
	1.00	D					Light brown orange clayey sandy angular to subangular fine to coarse GRAVEL of mudstone and sandstone with a high cobble content of sandstone. Sand is fine to coarse.
▼				1.70	210.96		Extremely weak grey brown MUDSTONE residually weathered recovered as stiff gravelly sandy friable clay. Gravel is angular to subrounded fine to coarse of mudstone and rare coal. Sand is fine to coarse.
	2.00	D					
	3.00	D		3.10	209.56		End of pit at 3.10 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Groundwater seepage encountered at 1.70m bgl. 3. Trial pit terminated at 3.10m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

GROUNDTECH CONSULTING

Trial Pit Log

Trialpit No **TP05**

Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422362.72 - 416221.57 Level: 212.76	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.20	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.50	212.26		MADE GROUND: Dark brown clayey sandy topsoil. Sand is fine to coarse. Frequent rootlets present.
	1.00	D	HVP=79				Firm high strength light brown orange mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone and sandstone.
	1.50	D					
				1.80	210.96		Extremely weak brown mottled light grey MUDSTONE residually weathered recovered as stiff gravelly sandy friable clay. Gravel is angular to subrounded fine to coarse of mudstone and rare coal. Sand is fine to coarse.
	2.00	D					
	3.00	D					
				3.20	209.56		End of pit at 3.20 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit terminated at 3.20m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

Trial Pit Log

GROUNDTECH CONSULTING

Trialpit No **TP06** Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422372.74 - 416245.91 Level: 211.35	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.20	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
▼	0.10	ES		0.20	211.15		MADE GROUND: Dark brown clayey sandy gravelly topsoil. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
	0.50	ES					MADE GROUND: Dark grey gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of brick, plastic, ceramics and sandstone.
	1.00	D	HVP=45	0.75	210.60		Firm medium strength light brown orange mottled grey gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone and sandstone.
	2.00	D	HVP=74	1.90	209.45		Extremely weak brown mottled light grey MUDSTONE residually weathered recovered as stiff high strength gravelly sandy clay. Gravel is angular to subrounded fine to coarse of mudstone and rare coal. Sand is fine to coarse.
				2.20	209.15		Extremely weak grey brown MUDSTONE residually weathered recovered as slightly clayey very sandy angular to subrounded fine to coarse gravel of coal and mudstone. Sand is fine to coarse.
	3.00	D		3.20	208.15		End of pit at 3.20 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Perched water seepage encountered at 0.30m bgl. 3. Trial pit terminated at 3.20m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

Trial Pit Log

GROUNDTECH CONSULTING

Trialpit No **TP07** Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422379.30 - 416242.46 Level: 211.32	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.30	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.35	210.97		MADE GROUND: Dark brown clayey sandy gravelly topsoil. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
▼	0.50	ES					MADE GROUND: Light brown gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of brick, plastic, sandstone, ceramics and wood. *Becoming dark brown at 0.60m bgl.*
	1.50	D	HVP=64	1.00	210.32		Firm medium strength light brown orange mottled light grey gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone and sandstone.
	2.00	D	HVP=61	1.90	209.42		Extremely weak brown mottled light grey MUDSTONE residually weathered recovered as stiff medium strength gravelly sandy clay. Gravel is angular to subrounded fine to coarse of mudstone and rare coal. Sand is fine to coarse.
	3.00	D		3.30	208.02		End of pit at 3.30 m

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Perched water seepage encountered at 0.60m bgl. 3. Trial pit terminated at 3.30m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

Trial Pit Log

GROUNDTECH CONSULTING

Trialpit No **TP08** Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422382.60 - 416247.04 Level: 211.04	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.30	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.25	210.79		MADE GROUND: Dark brown clayey sandy gravelly topsoil. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
	0.50	ES					MADE GROUND: Dark brown gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of brick, plastic, ceramics and wood.
				1.00	210.04		Firm medium light brown orange mottled light grey gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone and sandstone.
	1.50	D	HVP=45				
				1.70	209.34		Extremely weak brown mottled light grey MUDSTONE residually weathered recovered as stiff high strength gravelly sandy clay. Gravel is angular to subrounded fine to coarse of mudstone and rare coal. Sand is fine to coarse.
	2.00	D	HVP=77				
	3.00	D					
				3.30	207.74		End of pit at 3.30 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit terminated at 3.30m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

Trial Pit Log

GROUNDTECH CONSULTING

Trialpit No **TP09** Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422362.33 - 416221.45 Level: 212.93	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.20	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.30	212.63		MADE GROUND: Dark brown clayey sandy gravelly topsoil. Gravel is angular to subangular fine to medium of brick. Sand is fine to coarse. Frequent rootlets present.
	0.70	ES					MADE GROUND: Dark brown gravelly fine to coarse sand with a moderate cobble content of brick. Gravel is angular to subangular fine to coarse of brick and sandstone.
▼	1.20	D	HVP=56	1.10 1.30	211.83 211.63		Firm medium strength light brown orange mottled light grey gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone and sandstone.
	2.00	D					Extremely weak brown mottled light grey MUDSTONE residually weathered recovered as stiff gravelly sandy friable clay. Gravel is angular to subrounded fine to coarse of mudstone and rare coal. Sand is fine to coarse.
	3.00	D		3.20	209.73		End of pit at 3.20 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Perched water seepage encountered at 1.00m bgl. 3. Trial pit terminated at 3.20m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

GROUNDTECH CONSULTING

Trial Pit Log

Trialpit No **TP10**

Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422372.38 - 416210.40 Level: 213.08	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.20	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.50	212.58		MADE GROUND: Dark brown clayey sandy gravelly topsoil. Gravel is angular to subangular fine to medium of brick and ceramics. Sand is fine to coarse. Frequent rootlets present.
	1.00	D	HVP=46				Firm medium strength light brown orange mottled light grey gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone and sandstone.
				1.55	211.53		Extremely weak brown mottled light grey MUDSTONE residually weathered recovered as stiff gravelly sandy friable clay. Gravel is angular to subrounded fine to coarse of mudstone and rare coal. Sand is fine to coarse.
	2.00	D					
	3.00	D					
				3.20	209.88		End of pit at 3.20 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit terminated at 3.20m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable

Trial Pit Log

GROUNDTECH CONSULTING

Trialpit No **TP11** Sheet 1 of 1

Project Name: DENBY LANE	Project No. GRO-24078	Co-ords: 422400.21 - 416215.35 Level: 212.16	Date 27/03/2024
Location: GRANGE MOOR		Dimensions (m): Depth 3.10	Scale 1:25
Client: ORION HOMES			Logged JR

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES					MADE GROUND: Dark brown clayey sandy topsoil. Sand is fine to coarse. Frequent rootlets present.
				0.50	211.66		
	1.00	D	HVP=100				Firm high strength light brown orange mottled light grey gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone and sandstone.
	1.40	D	HVP=93	1.40	210.76		
	1.50	B		1.45	210.71		Extremely weak brown mottled light grey MUDSTONE residually weathered recovered as stiff high strength gravelly sandy clay. Gravel is angular to subrounded fine to coarse of mudstone and rare coal. Sand is fine to coarse.
▼	1.50	D		1.60	210.56		Extremely weak black bituminous COAL residually weathered recovered as clayey angular to subangular fine to medium gravel.
	2.00	D					Extremely weak grey brown MUDSTONE residually weathered recovered as slightly clayey very sandy angular to subrounded fine to coarse gravel of coal and mudstone. Sand is fine to coarse.
	3.00	D					
				3.10	209.06		End of pit at 3.10 m

1 2 3 4 5

Remarks: 1. Location cleared of services using handheld Cable Avoidance Tool (CAT). 2. Groundwater seepage encountered at 1.70m bgl. 3. Trial pit terminated at 3.10m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable