NPPF: Flood Risk Assessment

Garstang Road, Broughton

Hollins Strategic Land

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Garstang Road, Broughton

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Executive Summary

This report presents an FRA in accordance with the NPPF and NPPG ID: 7 guidance, for a proposed residential development located on land west of Garstang Road, Broughton, Preston.

The report includes an assessment of the surface water drainage requirements of the Site and details the flood risk and how this could be managed and mitigated to allow the Site to be developed in support of the outline planning application.

The FRA has demonstrated the following:

- The 2.60-hectare (ha) Site is comprised of vacant grassed land.
- The Site slopes in a northerly/westerly direction and is underlain by clayey soils and superficial deposits with low infiltration potential.
- A land drain is orientated north to south along the western boundary; however, mapping does not show onward connectivity to a wider watercourse network.
- The risk of flooding is assessed as follows:
    - The risk of fluvial flooding is assessed as negligible. There is however a residual risk of flooding from the bounding land drain.
    - The risk of surface water flooding is assessed as negligible for most of the Site, with areas of low to medium risk associated with surface water flow ponding.
    - The risk of flooding from all other sources is assessed as negligible.
- Flood risk from identified sources can be mitigated to a negligible or low and acceptable level through the following approach:
    - Provide an easement free from development along the reach of the bounding land drain. This easement would provide access for inspection and maintenance purposes, including vehicle access.
    - Undertake maintenance activities to keep the land drain clear from debris and overgrown vegetation to maintain the conveyance of the channels.
    - Set finished floor levels above external levels.
    - Adoption of a surface water management strategy.
- The proposed residential use is classified as more vulnerable. More vulnerable uses are considered acceptable in terms of flood risk in Flood Zone 1 (low risk). Subject to the implementation of the above mitigation measures, the Sequential Test would be passed, and the Exception Test would not be required.

The FRA has considered the potential impact of the development on surface water runoff rates, given the increase in impermeable areas post-development. These rates have been calculated, and it has been demonstrated that surface water can be managed, such that flood risk to and from the Site following development will not increase. This will be achieved through appropriately sized attenuation (detention basin) with a restricted discharge rate to either the drainage network serving the adjacent/western development (a right of road/service connection has been maintained for the proposed development), or a connection to the culverted watercourse beneath Garstang Road serving the adjacent/eastern development.

The FRA demonstrates that the proposed development would be operated with minimal risk from flooding and would not increase flood risk elsewhere. The development should therefore not be precluded on the grounds of flood risk, as well as surface water and foul drainage.

1.0 Introduction

1.1 Background

1.1.1 Enzygo Ltd was commissioned by Hollins Strategic Land to carry out a site-specific flood risk assessment (FRA), including a surface water drainage strategy, in support of an outline planning application for a proposed residential development. The Site is located on land west of Garstang Road, Broughton, Preston (the 'Site').

1.1.2 The proposal is for 51 residential dwellings, public open space, landscaping, sustainable drainage system (SuDS) within the 2.60ha Site, with vehicular access point from Garstang Road. All matters reserved except for means of access. A copy of the proposed layout is included in Appendix 1.

1.1.3 A site-specific FRA assesses the current and future flood risk to and from a development site. It demonstrates how flood risk will be managed now and over the development's lifetime, taking climate change, drainage, and the vulnerability of its intended users into account.

1.1.4 The objectives of a site-specific FRA are to:

- Assess whether a proposed development is likely to be affected by current or future flooding from a range of sources.
- Assess whether the development will increase flood risk elsewhere.
- Decide on measures to deal with these effects and risks and assess their appropriateness.
- Provide enough evidence for the local planning authority to apply (if necessary) the Sequential Test.
- Decide whether the development will be safe and will pass the Exception Test if applicable.

1.1.5 In England, planning applications for development need an FRA[1] for most developments including:

- In Flood Zones 2 and 3 including minor development and change of use.
- Sites of 1ha or larger in Flood Zone 1.
- Sites of less than 1ha in Flood Zone 1, including change of use to a more vulnerable class (for example from commercial to residential), and where they could be affected by sources of flooding other than rivers and the sea.
- Land in Flood Zone 1 in a Critical Drainage Area (CDA) as notified by the Environment Agency.
- Land in Flood Zone 1 identified in a strategic flood risk assessment as being at increased flood risk in future.

1.1.6 An FRA is required for this development, as initial screening using Environment Agency online indicative flood mapping shows that the Site is in Flood Zone 1 but is more than 1ha and is at risk of surface water flooding.

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[1] Department for Communities and Local Government (2017). Flood Risk Assessments if You're Applying for Planning Permission [https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications].

1.1.7 The purpose of this FRA is to assess the risk of flooding to the proposed development and where possible provide sufficient mitigation to demonstrate that future users of the development would remain safe throughout its lifetime, that the development would not increase flood risk on Site and elsewhere and, where practicable, would reduce flood risk overall.

1.2 Scope

1.2.1 Government policy on development and flood risk is set out in the National Planning Policy Framework (NPPF)[2] and is supported by National Planning Practice Guidance: Flood Risk and Coastal Change [NPPG ID7][3].

1.2.2 NPPF paragraphs 148-169 set out the need for an appropriate assessment of flood risk at all levels of the planning process and require the application of a sequential risk-based approach to assess the suitability of land for development in flood risk areas.

1.2.3 The FRA should also make allowances for climate change[4] to minimise vulnerability and provide resilience to flooding and coastal change in the future. The allowances are predictions of anticipated change in:

- Peak river flow by river basin district.
- Peak rainfall intensity.
- Sea level rise.
- Offshore wind speed and extreme wave height.

1.2.4 The allowances are based on climate change projections and different scenarios of carbon dioxide emissions to the atmosphere. There are different allowances for different periods of time over the next century.

1.2.5 Site-specific FRAs are categorised according to level. Simple Level 1 Screening studies give a general indication of the potential flood risk to a site and identify whether more detailed Level 2 assessment is required or not. A Level 2 assessment is a qualitative appraisal to develop understanding of flood risk to a site and the effects of the site on flooding elsewhere including recommended mitigation measures. Level 3 assessments are more detailed quantitative studies, for example modelling to establish flood levels at a site in the absence of Environment Agency or other data or providing detailed outline drainage designs.

1.2.6 This report is a Level 2 qualitative FRA but includes a Level 3 assessment of the surface water drainage requirements for the proposed development.

1.3 Aims

1.3.1 This FRA aims to provide enough flood risk information to satisfy the requirements of the NPPF, PPG ID7 and regional/local government plans and policies. It describes the potential for the Site to be impacted by flooding, the impacts of the proposed development on flooding

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[2] Department for Communities and Local Government (2018). Revised National Planning Policy Framework (published July 2018 and updated February 2019) [https://www.gov.uk/government/collections/revised-national-planning-policy-framework].

[3] Department for Communities and Local Government (published March 2014). Planning Practice Guidance ID7-030-20140306; Flood Risk & Coastal Change [https://www.gov.uk/guidance/flood-risk-and-coastal-change].

[4] Department for Communities and Local Government (published February 2016 and updated February 2019). Flood Risk Assessments: Climate Change Allowances [https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances].

elsewhere near the Site, and the proposed measures that could be incorporated into the development to mitigate the identified risks.

1.4 Planning Context

National Policy

1.4.1 The FRA was prepared in accordance with the NPPF and NPPG ID7.

Regional/Local Policy

The FRA considers the following:

- Preston City Council (2015) Preston Local Plan (2012-2026)[5]:
  - CS 29: Water Management
- Central Lancashire Adopted Core Strategy (July 2012)6
  - SO23: To manage flood risk and the impacts of flooding.

1.5 Report Structure

1.5.1 This report is structured as follows:

- Section 2 identifies the sources of information that were consulted.
- Section 3 describes the existing Site.
- Section 4 outlines the flood risk to the existing site and proposed development.
- Section 5 details the proposed mitigation measures against identified flooding sources.
- Section 6 assesses the potential impacts of the proposed development on surface water drainage and proposes mitigation for those effects.
- Section 7 presents a summary and conclusions.

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[5] https://www.preston.gov.uk/media/1952/Preston-s-Local-Plan/pdf/Preston-Local-Plan-2012-2026-_8.pdf?m=637056240884300000

[6] https://www.preston.gov.uk/media/974/Adopted-Core-Strategy-Part-1/pdf/Adopted-Core-Strategy-July-2012-Part-1_1.pdf?m=636941232688970000

2.0 Sources of Information

2.1 Sources of Information

2.1.1 The following information was consulted:

- Ordnance Survey 1:25,000 mapping.
- Detailed topographic survey (Appendix 2).
- Environment Agency online mapping (Flood Map for Planning[7], Long Term Flood Risk Assessment for Locations in England[8], Catchment Data Explorer[9] and Main River Map[10]).
- River Basin District (RBD) Maps[11] (North West RBD) together with guidance on climate change allowances[12].
- National River Flow Archive[13].
- Central Lancashire Level 1 Strategic Flood Risk Assessment (SFRA).
- British Hydrological Society Chronology of British Hydrological Events[14].
- National Soils Resources Institute (NSRI): Soilscapes online mapping[15].
- British Geological Survey [BGS] online mapping: Geology of Britain Viewer[16].
- Landmark's Promap: Flood Data package: Additional flood mapping.
- Geosmart 1 in 100-year groundwater flood risk map.
- United Utilities sewer asset plans (Appendix 3).
- DEFRA's Magic Map for identifying Designated Sites[17].
- River Levels UK for identifying Flood Alert and Flood Warning areas[18].

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[7] https://flood-map-for-planning.service.gov.uk/
[8] https://flood-warning-information.service.gov.uk/long-term-flood-risk/
[9] http://environment.data.gov.uk/catchment-planning/
[10] https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386
[11] https://www.gov.uk/government/publications/flood-risk-assessments-river-basin-district-maps
[12] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
[13] http://nrfa.ceh.ac.uk
[14] http://www.cbhe.hydrology.org.uk/search.php
[15] http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html
[16] http://mapapps.bgs.ac.uk/geologyofbritain/home.html
[17] http://www.natureonthemap.naturalengland.org.uk/
[18] https://riverlevels.uk/flood-map#.XclKwPn7RPZ

2.2 Consultation and Discussion with Regulators

2.2.1 Consultation and discussions were undertaken with the Environment Agency, the Local Planning Authority (LPA)/Lead Local Flood Authority (LLFA), and Water Utility.

Environment Agency

2.2.2 The Environment Agency is a statutory consultee on flood risk and planning and is directly responsible for the prevention, mitigation, and remediation of flood damage for main rivers and coastal areas; and it has a strategic overview for all forms of flooding.

2.2.3 Environment Agency Standing Advice[19] and the NPPF/PPG ID: 7 was consulted and reviewed.

2.2.4 Correspondence with the Environment Agency is included in Appendix 4.

Lead Local Food Authority (LLFA)

2.2.5 Lancashire County Council as the Lead Local Flood Authority (LLFA) is responsible for local flood risk management in their areas and for maintaining a register of flood risk assets. They also have lead responsibility for managing the risk of flooding from surface water, groundwater, and ordinary watercourses.

2.2.6 Lancashire County Council as the LLFA was consulted on flood risk issues. A response from the LLFA had not been received at the time this report was prepared.

Water Utility

2.2.7 Drainage and sewerage services in the UK are provided by a number of water and sewerage companies. United Utilities is responsible for sewerage within the area of the Site.

2.2.8 All sewerage undertakers maintain the 'DG5 register' of properties and external areas (such as gardens, highways, open spaces) which have suffered flooding from public foul/combined sewers. It does not include flooding caused by blockages.

2.3 Site Walkover

2.3.1 A walkover was not instructed as part of the FRA works. Site observations are based on a desktop study of online mapping and other publicly available information.

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[19] Department for Communities and Local Government (published April 2012 and updated March 2019). Preparing a Flood Risk Assessment: Standing Advice [https://www.gov.uk/guidance/flood-risk-assessment-standing-advice].

3.0 Site Location and Description

3.1 Location

3.1.1 The Site is located on land west of Garstang Road, Broughton, Preston, PR3 5JA. The Site is centred on National Grid Reference (NGR) 352483, 434681. The Site location is shown in Drawing 001 and in more detail in Drawing 002, which shows the red line boundary enclosing an area of 2.60ha.

3.2 Land Use

3.2.1 The land use is comprised of vacant grassed land (Figures 3.1 and 3.2). The Site is bounded by Garstang Road with Keyfold Farm beyond to the east (which has reserved matters approval for 129 dwellings [06/2019/0040]); Garstang Road with Bank Hall Farm beyond to the south; Bank Hall Farm to the south-west; a new residential development to the north-west (under construction in accordance with RM approval [06/2019/0974] for 97 dwellings); an access track with sports fields associated with Broughton Business and Enterprise College to the north.

3.2.2 The Site is currently accessed along the south-west boundary via an access track along the southern boundary.

Figure 3.1: Google Street View

View south-west across the Site from Garstang Road (along the eastern boundary).

View west across the southern extent of the Suite from Garstang Road (along the eastern boundary).

View north across the Site from Garstang Road (along the southern boundary).

Image © 2021 Digital Globe.

Figure 3.2: Aerial Photograph of the Site

Image © 2021 Digital Globe.

3.3 Topographic Information

3.3.1 A detailed topographic survey was carried out during December 2015 and updated in April 2021 to take account of road works on Garstang Road. A copy is included as (Appendix 2).

3.3.2 Flow pathway analysis was undertaken using the topographic survey in KeyTERRA-FIRMA (KTF Software (Drawing 010), which shows the Site is divided into two watershed catchments: Northern (Area A - 0.87ha) and Southern (Area B - 1.76ha).

i. Northern Watershed (Area A)

3.3.3 The Northern Watershed falls in a northerly direction from 42.57 metres Above Ordnance Datum (m AOD) in the south-east corner of the catchment boundary, to 41.01m AOD along the northern catchment boundary. The fall of 14.89m over 106m gives an average gradient of 1:68.

ii. Southern Watershed (Area B)

3.3.4 The Southern Watershed falls mostly in an eastern direction from 42.57m AOD in the north-east corner of the catchment boundary, to 40.65m AOD along the western boundary. The fall of 1.92m over 131m gives an average gradient of 1:68.

3.3.5 An area in the southern extent falls in a northerly direction, from 42.90m AOD along the southern catchment boundary to 41.25 at the toe of the slope in the southern extent of the catchment. The fall of 2.25m over 34m gives a gradient of 1:20.

3.4 Soils and Geology

Soils Mapping

3.4.1 The Soilscapes online soils map viewer (Figure 3.3) shows the Site is underlain by slowly permeable, seasonally wet, loamy, and clayey soils.

Figure 3.3: Soils Mapping

Soils Data © Cranfield University (NSRI) and for the Controller of HMSO [2021].

Geology Mapping

3.4.2 The Geology of Britain online map viewer (Figure 3.4) shows the superficial deposits recorded beneath the Site is Till, Devensian - Diamicton. The bedrock beneath the Site is Sherwood Sandstone Group - Sandstone.

Figure 3.4: Geology Mapping

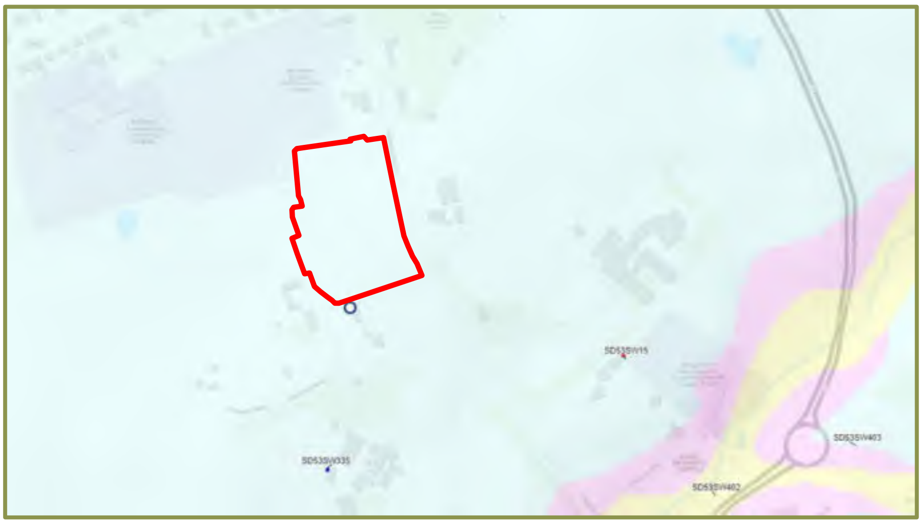
Top: Bedrock Geology Bottom: Superficial Deposits. Contains British Geological Survey materials © NERC [2021].

BGS Historical Borehole Records

3.4.3 The Geology of Britain online map viewer (Figure 3.5) shows there are no historical boreholes located in the Site boundary. There are however two nearby borehole locations (SP46NW41 to SP46NW8) within the Penarth Group to the south-west of the Site. There is also a single borehole (SP46NW1) located within the same mapped geology.

3.4.4 The borehole records (Appendix 5) confirm the geology as depicted by the Geology of Britain mapping (Table 3.1).

Figure 3.5: Borehole Mapping



Contains British Geological Survey materials © NERC [2021].

Table 3.1: BGS Borehole Data

Reference	Summary of Strata	Depth (m bgl)	Groundwater Depth (m bgl)
SD53SW335	0.00 - 0.30m = Made Ground 0.30 – 1.00m = Clay	1.00	Not encountered
SD53SW15	0.00 - 0.30m = topsoil 0.30 - 2.30m = sandy clay 2.30 - 6.00 = silty clay 6.00 - 15.00 = silty sand 15.00 - 25.00 = silty clay 25.00 - 28.00 = sand and gravel 28.00 - 30.00 = silty sand 30.00 - 31.40 = silty clay 31.40 - 56.4 = sandstone	56.40	Not recorded

Contains British Geological Survey materials © NERC [2021].

3.5 Hydrogeology

Infiltration potential

3.5.1 Soils mapping indicates that the loamy and clayey soils are likely to represent a low infiltration potential.

3.5.2 The infiltration potential of the superficial deposits is likely to be low based on the clayey nature of the glacial deposits.

3.5.3 Infiltration potential of the bedrock is likely to be moderate to good subject to the depth of the weathered layer. Borehole records recorded sandstone +30m bgl.

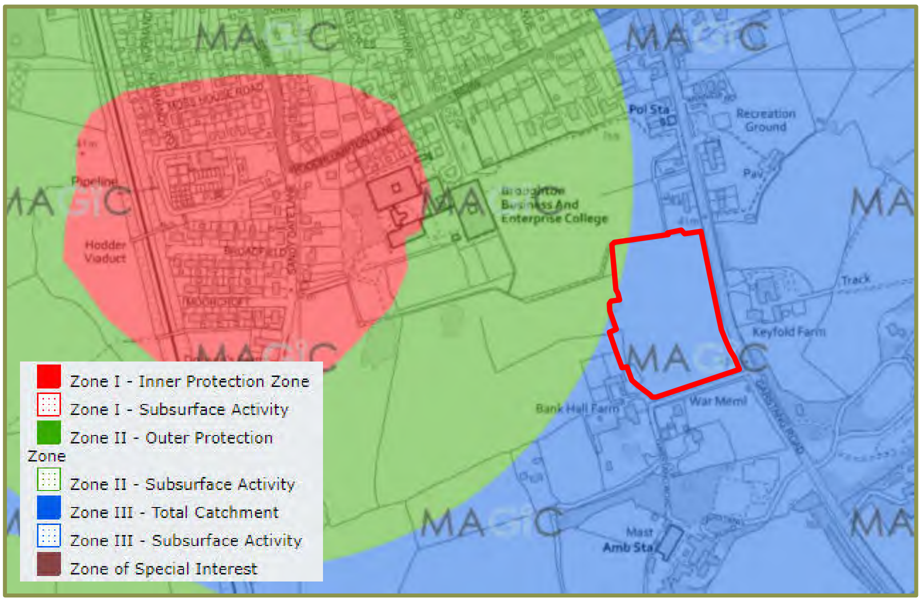
3.5.4 BGS online borehole records shows groundwater ingress was not encountered in any of the borehole records.

Defra Magic Map

3.5.5 Defra Magic Map online mapping (Figure 3.7) shows the Site is in a groundwater Source Protection Zone (SPZ). The Site is located mostly in the ‘Total Catchment’ (Zone 3), with the north-west extent located in the 400-day travel time of the ‘Outer Zone’ (Zone 2), and close to the 50-day travel time ‘Inner Zone’ (Zone 1) of a groundwater abstraction.

3.5.6 These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. Where infiltration-based SuDS are proposed to manage surface water from a development, then direct discharge into groundwater would not be permissible. Therefore, the elevation of the groundwater table with respect to the base of the soakaway is critical, and there must be an unsaturated zone in the aquifer unit.

Figure 3.7: Source Protection Zone Map

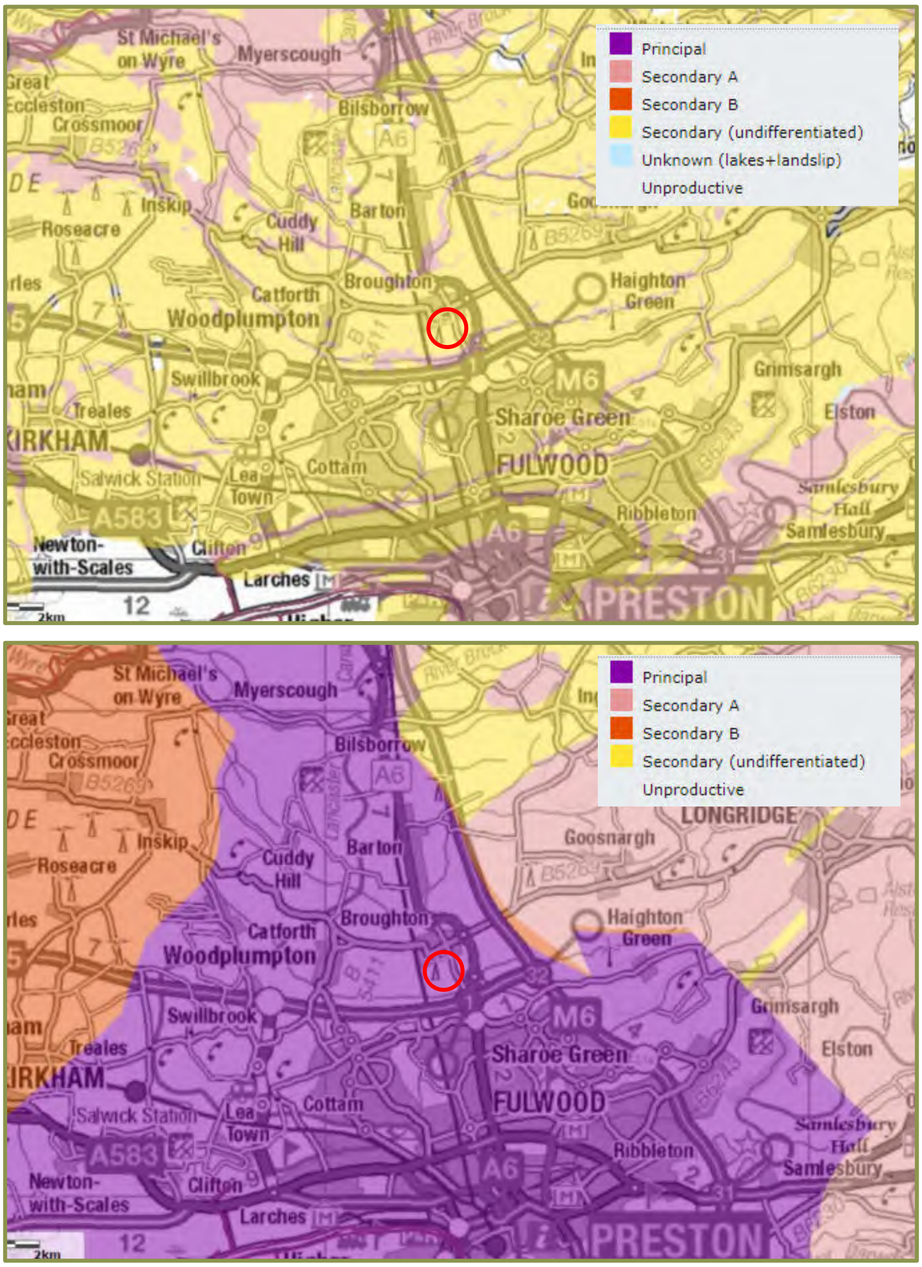


From Magic Map. Contains Environment Agency information © Environment Agency and database right [2021].

3.5.7 The Site is located above a Principal Aquifer (bedrock designation). The Site is also located above a Secondary Undifferentiated Aquifer (superficial deposits) (Figure 3.8).

3.5.8 Indirect inputs of clean surface water to groundwater are permissible, for example where the base of the soakaway is above the water table and there is an unsaturated zone in the aquifer unit.

Figure 3.8: Aquifer Designation Map



Top: Aquifer Designation (superficial deposits). Bottom: Aquifer Designation (bedrock). From Magic Map. Contains Environment Agency information © Environment Agency and database right [2021].

3.6 Catchment Hydrology

OS Mapping and Main River Map

OS mapping (Figure 3.10) and the Environment Agency Main River Map (Figure 3.10) shows Blundel Brook conveys flows west, through land approximately 400m to the south of the Site. Barton Brook conveys flows west, through land approximately 1.2km to the north-west of the Site. Both watercourses are classified as 'main rivers', which is a watercourse where flood risk work is carried out by the Environment Agency.

3.6.1 A land drain ('Drain 1') is orientated north to south along the western boundary; however, mapping does not show onward connectivity to a wider watercourse network. Drain 1 originates from a pond ('Pond 1') in the western boundary.

3.6.2 There is a land drain ('Drain 2') orientated east to west, then north through land approximately 150m to the north of the Site, and a land drain ('Drain 3') orientated north to south through land approximately 230m to the south-east. Mapping does not show onward connectivity to a wider watercourse network.

3.6.3 Drains 1 to 3 are classified as 'ordinary watercourses', which is a watercourse where flood risk work is carried out by the local drainage authority/riparian landowners.

Figure 3.9: Map of Watercourses

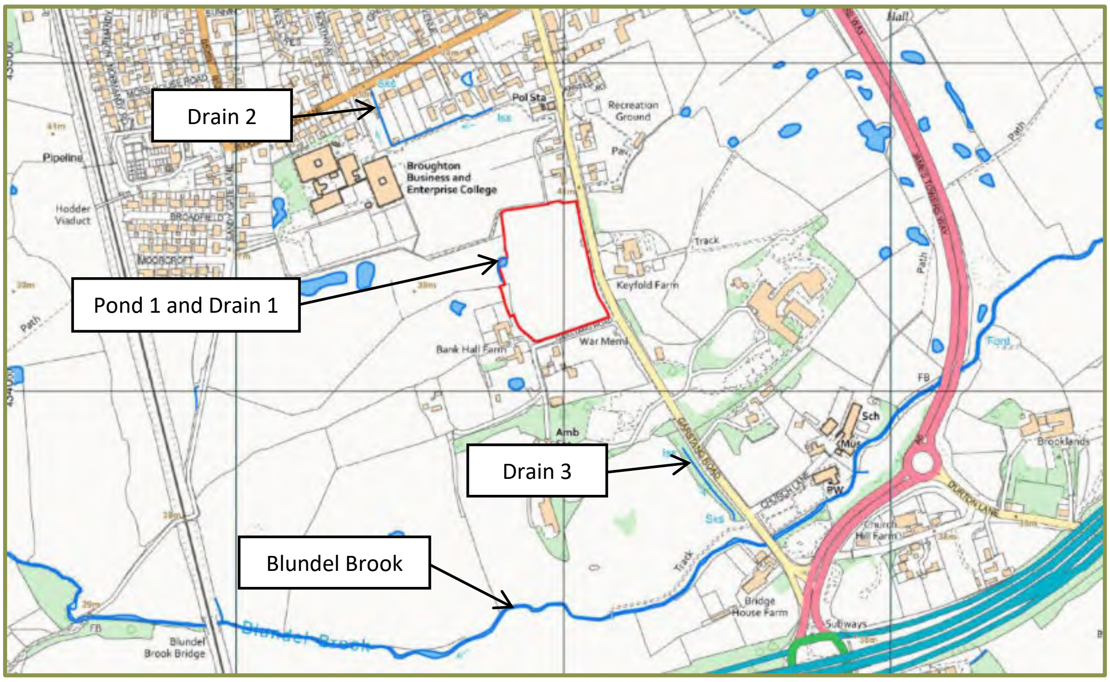
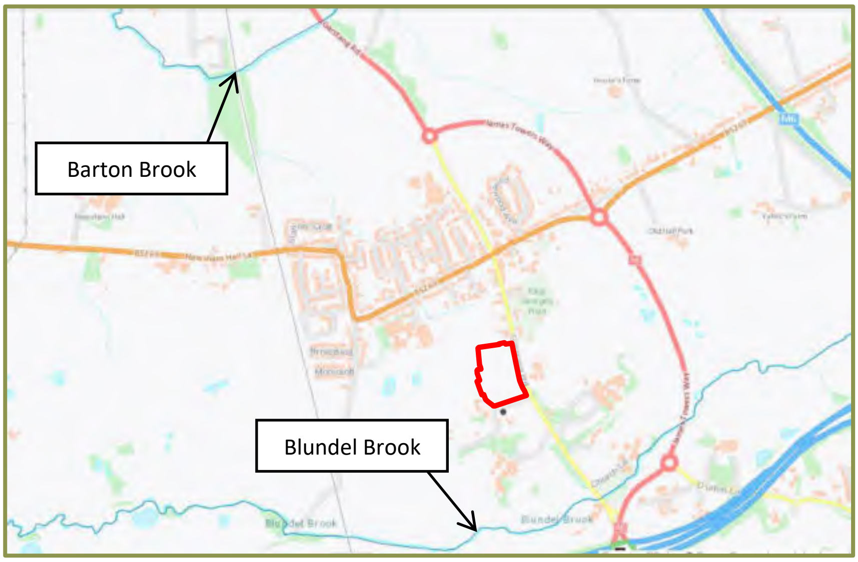


Figure 3.10: Main River Map



Environment Agency Catchment Data Explorer Mapping

3.6.4 The northern extent of the Site resides in the Barton (Westfield) Brook Catchment, whereas the southern extent resides in the Woodplumpton Brook Catchment (Figure 3.10). The catchment split is similar to the flow pathway analysis (Drawing 010). Both catchments reside in the Brock and Trib Operational Catchments, Wyre Management Catchment and North West River Basin District.

Figure 3.10: Catchment Data Explorer (continues over page)

Top Left Barton (Westfield) Brook and Woodplumpton Brook Catchments. Top Right: Brock and Trib Operational Catchments. Bottom Left: Wyre Management Catchment. Bottom Right: North West River Basin District. Contains Environment Agency information © Environment Agency and database right [2021].

FEH Webservice

The Site

3.6.5 The FEH Webservice shows the Site is entirely in the 1.13km^2 tributary catchment of Barton Brook at NGR. 351500, 435650 (Figure 3.11 - red boundary).

Western Development

6.1.1 The proposed drainage strategy serving the adjacent/western development (Figure 3.11 – blue boundary) shows an outfall to a culverted watercourse along the western boundary (Appendix 6).

6.1.2 The FEH Webservice shows most of the western development falls into the same Barton Brook catchment, however the western/south-west extent falls in the 13.25km^2 Blundel Brook catchment at NGR. 351700,434250.

6.1.3 The planning application documents for the western development (Application number: 06/2021/0102 – CCE [July 2019] Drainage Strategy Assessment and Drainage Maintenance & Management Plan, Doc Ref: S7604-SDA-MMP-01) reports the culvert watercourse ultimately outfalls to Blundel Brook to the south of the Site. The western development therefore potentially introduces flows from one catchment (Barton Brook) into a different catchment (Blundel Brook) for part (central and eastern extent) of the site.

Eastern Development

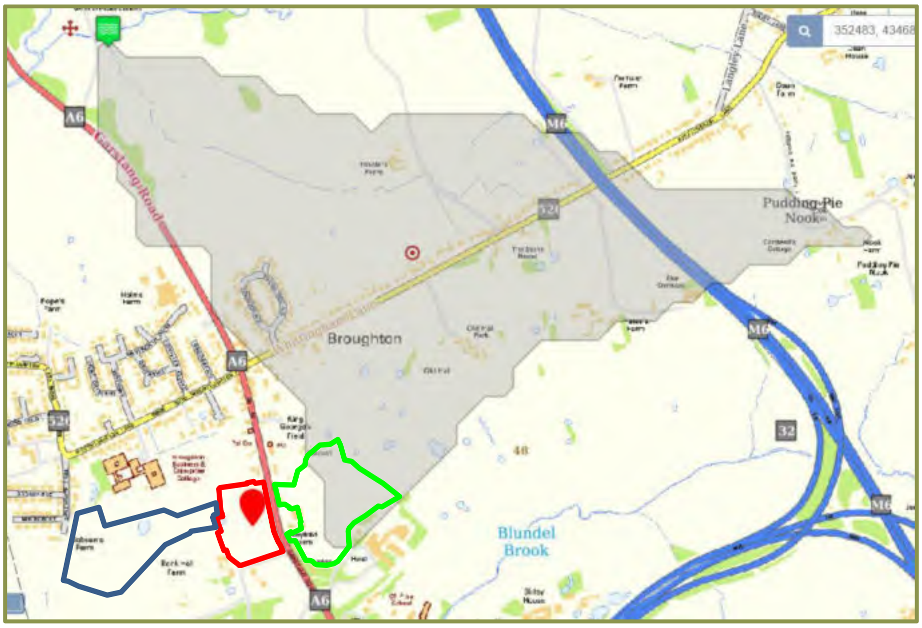
6.1.4 The proposed drainage strategy which will serve for the adjacent/eastern development (Figure 3.11 - green boundary and Appendix 6) shows an outfall to a culverted watercourse beneath Garstang Road, which discharges to Drain 2 to the north-west.

6.1.5 The FEH Webservice shows the western extent of the eastern development falls into the same Barton Brook catchment. The eastern extent falls in the 1.14km^2 Dean Brook catchment at NGR. 352100,435950. The eastern development therefore potentially introduces flows from one catchment (Dean Brook) into a different catchment (Barrton Brook) for part (eastern extent) of the site.

Figure 3.11: FEH Webservice Catchment

Barton Brook Catchment.

Blundel Brook Catchment.



Dean Brook Catchment.

3.7 Sewerage Assets

Public Sewers

3.7.1 United Utilities asset plans show there are no onsite assets. The nearest public sewer asset is a Ø225mm foul sewer orientated south to north beneath land to the east of the Site/Garstang Road.

3.7.2 There is a separate surface water and foul sewer network serving the developed area of Broughton to the north of the Site.

Western Development

3.7.3 A consented residential development (currently under construction) is located on land to the west of the Site (Application number: 06/2021/0102 - Bank Hall Farm, Sandy Gate Lane).

3.7.4 The new development is served by a separate surface water/foul sewer network, utilising pond attenuation with an outfall to a culverted watercourse and a pumped foul connection to the public foul network to the north. A copy of the drainage plan is included in Appendix 6.

3.7.5 It is assumed the drainage network will be adopted by United Utilities.

3.7.6 Land to the south of the new development is under the same land ownership and a right of road/service connection has been maintained for the proposed development.

Eastern Development

3.7.7 A consented residential development is located on land to the east of the Site (Application number: 06/2021/0102 - Key Fold Farm, Garstang Road).

3.7.8 The new development will be served by a separate surface water/foul sewer network, utilising oversized pipes with an outfall to a culverted watercourse beneath Garstang Road (assumed outfall to Drain 2), and a pumped foul connection to an onsite public foul rising main. A copy of the drainage plan is included in Appendix 6.

3.7.9 It is assumed the drainage network will be adopted by United Utilities.

3.8 Designated Sites

3.8.1 The DEFRA Magic Map (England and Wales) (Figure 3.12) shows there are no designated sites in or close to the Site including downstream (from a flood risk and drainage perspective).

Figure 3.12: Designated Sites

From Magic Map. Contains Environment Agency information © Environment Agency and database right [2021].

4.0 Flood Risk Assessment

4.1 Potential Sources of Flooding

4.1.1 A summary of the potential sources of flooding and the potential risk posed by each source at the Site is presented in Table 4.1. Each source of flooding and level of risk is then assessed in further detail.

Table 4.1: Potential Risk Posed by Flooding Sources

Flooding Source	Potential Flood Risk at Application Site (Yes/No)	Potential Source	Data Sources
Fluvial	Yes	Drain 1	Environment consultation response Agency (Appendix 4), JBA Flooding from Rivers (Drawing 004.2) and Environment Agency flood mapping (Drawing 005).
Tidal	No	None identified	OS mapping (Drawings 001 and 002) and Environment Agency flood mapping (Drawing 005).
Groundwater	No	Principal Aquifer (bedrock)	BGS mapping (Drawing 003) and Geosmart Groundwater (Drawing 006).
Surface Water	Yes	Poor permeability and Site topography	JBA Surface Water Flooding (Drawing 004.1) and Environment Agency Complex mapping (Drawings 009.1 to 009.2).
Sewer	No	Public/private sewers	United Utilities asset plans (Appendix 3) and western/eastern development drainage strategies (Appendix 6).
Infrastructure Failure	Yes	Reservoir and pond failure	Environment Agency online flood mapping and OS Mapping.

4.2 Fluvial Flooding

Environment Agency Flood Zone Mapping

4.2.1 The Environment Agency Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, since these can be breached, overtopped and may not be in existence for the lifetime of a development.

4.2.2 The Environment Agency flood map (Drawing 006) shows the Site is located in Flood Zone 1; outside the 1 in 1000-year probability of fluvial (river) flooding (0.1% Annual Exceedance Probability [AEP]), at ‘low’ risk.

JBA Flooding from Rivers

4.2.3 The JBA mapping (Drawing 004.2) shows the Site is outside the mapped extent of fluvial flooding.

Flood History

4.2.4 Correspondence with the Environment Agency and LLFA confirmed they hold no records of historical flooding in the immediate vicinity of the Site.

Flood Defences

4.2.5 Environment Agency online flood mapping and SFRA mapping show that the Site does not benefit from flood defences.

Flood Warning Service

4.2.6 The River Levels UK website shows the Site is not located in a flood warning area.

Summary Flood Risk

4.2.7 The risk of fluvial flooding is assessed as negligible.

Residual Risk

4.2.8 Residual flood risk mitigation from the bounding Drain 1 is described in Section 5.

4.3 Tidal Flooding

4.3.1 The Site is not located close to tidally affected flooding sources and so the flood risk from this source is assessed as negligible.

4.4 Groundwater Flooding

Introduction

4.4.1 Groundwater flooding occurs when subsurface water emerges either at surface or in made ground or in subsurface structures such as basements and services ducts. It occurs as diffuse seepage, emergence from new point source springs or an increase in flow from existing springs. It results from aquifer recharge from infiltrating rainfall, from sinking streams entering aquifers from adjacent non-aquifers, or from high river levels or tides driving water through near surface deposits. It tends to occur with a delay following rainfall and can last for several weeks or months. Groundwater flooding or shallow water tables also prevent or reduce infiltration and so can worsen surface water flooding.

Flood History

4.4.2 Consultation with the LLFA reported no historical groundwater flooding incidents within the Site boundary.

BGS Groundwater Flooding Susceptibility Map

4.4.1 The BGS Groundwater Flooding Susceptibility Map (Drawing 006) shows the Site is in area where there is limited potential for groundwater flooding.

4.4.2 The risk of groundwater flooding is likely to be associated with the underlying Sandstone (Principal Aquifer). However, the Site is underlain by clayey soils and superficial deposits with low infiltration potential, therefore it is unlikely that groundwater would rise to the surface.

4.4.3 The BGS mapping is coarse and should be superseded by the Geosmart groundwater flood risk map.

Geosmart Groundwater Flood Risk Map

4.4.4 The Geosmart 1 in 100-year groundwater flood risk map (Drawing 006) shows that the Site is at negligible risk of groundwater flooding and falls within Risk Class 4 (Table 4.2).

4.4.5 Mapped classes combine understanding of likelihood, model and data uncertainty, and possible severity. Likelihood is ranked according to whether we expect groundwater flooding at a site due to extreme elevated groundwater levels with an annual probability of occurrence greater than 1%, considering model and data uncertainty. Severity relates to expectations of the amount of property damage or other harm that groundwater flooding at that location might cause (Table 4.2).

Table 4.2: Groundwater Flood Risk Classification

Risk Class	Probability of Groundwater Flooding	Effect
4: Negligible	Annual probability less than 1%.	Negligible unless unusually sensitive use.
3: Low	Annual probability greater than 1%.	Remote possibility of damage to property or harm to sensitive receptors Flooding likely to be limited to seepages and waterlogged ground, damage to basements and subsurface infrastructure, and should pose no significant risk to life. Surface water flooding may be worsened.
2: Moderate	Annual probability greater than 1%.	Significant possibility of damage to property or harm to other sensitive receptors at or near this location. flooding is likely to be in the form of shallow pools or streams. Surface water flooding and failure of drainage systems may be worsened when groundwater levels are high.
1: High	Annual probability greater than 1%.	Groundwater flooding will occur which could lead to damage to property or harm to other sensitive receptors at or near this location. Flooding may result in damage to property, road, or rail closures and, in exceptional cases, may pose a risk to life. Surface water flooding and failure of drainage systems may be worsened when groundwater levels are high.

Borehole Records

4.4.6 BGS online borehole records did not report the presence of groundwater ingress up to 56.40m bgl.

Flood Risk

4.4.7 The risk of groundwater flooding is assessed as negligible.

4.5 Surface Water Flooding

Introduction

4.5.1 Surface water flooding occurs following rainfall on ground where infiltration rates are less than the rainfall precipitation rate. This can occur when either:

- Soils or ground materials are naturally of low permeability or have been compacted (infiltration excess runoff).
- Soils or ground materials are saturated from previous rainfall either directly or from upslope (saturation excess runoff and return flow) or from high groundwater levels.

Flood History

4.5.2 Consultation with the LLFA reported no historical surface water flooding incidents within the Site boundary.

JBA Surface Water Flood Map

4.5.3 The JBA Surface Water Flood Map (Drawing 004.1) shows most of the Site is located outside the mapped extent of surface water flooding. There are however areas of surface water ponding in the western and southern extent of the Site. The surface water flooding is associated with the 1 in 75-year, 200-year and 1000-year events.

4.5.4 The surface water flow ponding is likely to be generated by the Site topography when the underlying soils become saturated.

4.5.5 The JBA Surface Water Flood mapping is superseded by the more detailed Environment Agency Complex Surface Water Flood mapping.

Environment Agency Complex Surface Water Flood Mapping

4.5.6 The Environment Agency Complex Surface Water Flood Mapping (Drawings 009.1 to 009.4) shows most of the Site is located outside the mapped extent of surface water flooding. There are however areas of surface water ponding in the western and southern extent of the Site.

4.5.7 The flood outline is associated with the 1 in 30-year, 100-year and 1000-year events. Flood depths are up to 0.60m during the extreme 1 in 1000-year event. The flood velocity is mostly up to 0.25m/s and the flood hazard is 'low' (0.50-0.75) to 'moderate' (0.75-1.25).

Flood Risk

4.5.8 The risk of surface water flooding is assessed as negligible for most of the Site, with areas of low to medium risk associated with surface water flow ponding.

4.5.9 Mitigation measures against surface water flooding are discussed in Section 5.

4.6 Sewer Flooding

Introduction

4.6.1 Sewer flooding occurs when urban drainage networks become overwhelmed after heavy or prolonged rainfall due to restrictions or blockage in the sewer network or if the volume of water draining into the system exceeds the sewer design capacity.

4.6.2 New sewers are built to the guidelines within Sewers for Adoption[20] and have a design standard to the 1 in 30-year flood event. Older sewers were not designed to any standard. Modern sewer systems will only surcharge during rainstorm events with a return period greater than 1 in 30-years (e.g. 1 in 100-years).

COMMERCIALDW Drainage and Water Enquiry

4.6.3 There are no public sewers located in the Site boundary.

Flood Risk

4.6.4 The risk of flooding from sewers is assessed as negligible.

4.7 Flooding from Infrastructure Failure

Reservoir

4.7.1 The Environment Agency online flood mapping shows the Site is located outside the extent of flooding sourced from reservoirs. The risk of flooding from reservoirs is assessed as negligible.

Pond

4.7.2 Pond 1 is in the western boundary. The pond is small and not impounded. Furthermore, the pond drains via Drain 1. The risk of flooding from pond failure is assessed as negligible.

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[20] WRC (2012) Sewers for Adoption 7th Edition.

5.0 Flood Risk Mitigation Measures

5.1 Introduction

5.1.1 The following sources of flooding were identified:

- Residual flooding from the bounding land drain (Drain 1).
- Surface water flooding (ponding).

5.2 Mitigation Measures

Residual Flooding from the Bounding Land Drain

- Provide a 4m easement free from development along the reach of the bounding land drain. This easement would provide access for inspection and maintenance purposes, including vehicle access.
- Undertake maintenance activities to keep the land drain clear from debris and overgrown vegetation to maintain the conveyance of the channels.
- Set finished floor levels a minimum of +150mm above external levels.

Surface Water Flooding

- Adoption of a surface water management strategy.
- Set finished floor levels as per above.

5.3 Summary of Flood Risk

5.3.1 Table 5.1 summarises the probability and level of risk, both with and without mitigation measures.

Table 5.1: Probability and Consequences of All Sources of Flooding

Flooding Source	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact with Mitigation
Fluvial	Drain 1	Negligible with a residual risk from the bounding land drain	Negligible with a residual risk from the bounding land drain	Negligible
Tidal	None identified	Negligible	Negligible	Negligible
Groundwater	Principal Aquifer (bedrock)	Negligible	Negligible	Negligible
Surface Water	Poor permeability and Site topography	Negligible for most of the Site but low to medium where there is surface water ponding	Negligible for most of the Site but low to medium where there is surface water ponding	Negligible
Sewer	Public/private sewers	Negligible	Negligible	Negligible

Flooding Source	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact with Mitigation
Infrastructure Failure	Reservoir and pond failure	Negligible	Negligible	Negligible

Key: Green - Negligible, Yellow - Low, Orange - Medium and Red - High; based on consequence and impact with mitigation from each flooding source.

5.4 Flood Guidance and Sequential Test

5.4.1 The proposal is for a residential development. Table 2 of PPG ID: 7 (not included in this report) classifies the proposed use as 'more vulnerable'.

5.4.2 The Environment Agency Flood Zones and acceptable development types are listed in Table 5.2. All development types (including more vulnerable uses) are acceptable in Flood Zone 1 (low risk). Subject to the above mitigation measures, the Sequential Test would be passed, and the Exception Test would not be required as indicated in Table 5.3.

Table 5.2: Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	All development types generally acceptable.
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year.	Most development type are generally acceptable.
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	Some development types not acceptable.
Zone 3b	'Functional Floodplain'	Land where water must flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).	Some development types not acceptable.

***Note:** The Flood Zones are the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The identified risk of fluvial flooding is highlighted green.*

Table 5.3: Vulnerability and Flood Zone 'Compatibility' as Identified in Table 3 of PPG ID: 7

Flood Risk Vulnerability classification (see Table 1 of PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Key: *Yes: Development is appropriate. No: Development should not be permitted.*
The identified risk of fluvial flooding is highlighted green.

6.0 Site Drainage

6.2 Surface Water Drainage

6.2.1 Consideration of flood issues is not confined to the floodplain. This is recognised in the NPPF and associated guidance where all proposed development of 1ha or more in flood zone 1 and so outside the floodplain nevertheless requires an FRA. The alteration of natural surface water flow patterns through development can lead to problems elsewhere in a catchment, particularly flooding downstream; and the replacement of permeable vegetated areas by low-permeability roofs, roads and other paved surfaces will increase the speed, volume, and peak flow of surface water runoff. So, the NPPF and associated guidance require an FRA for all proposed development of 1ha or more outside the floodplain in flood zone 1.

6.2.2 A surface water management strategy for the development is proposed to manage and reduce the flood risk posed by surface water runoff from the Site. The developer will be required to ensure that any scheme for surface water management should build in enough capacity for the entire Site.

6.2.3 The surface water drainage arrangements for any development Site should be such that the volume and peak flow rates of surface water leaving a developed Site are no greater than the rates prior to the proposed development unless specific off-Site arrangements are made and result in the same net effect.

6.2.4 An assessment of the surface water runoff rates was undertaken to determine the surface water options and attenuation requirements for the Site.

6.3 Existing Drainage System

6.3.1 The 2.65-hectare (ha) Site is comprised of vacant grassed land.

6.3.2 The Site slopes in a northerly and westerly direction and is underlain by clayey soils and superficial deposits with low infiltration potential.

6.3.3 A land drain is orientated north to south along the western boundary; however, mapping does not show onward connectivity to a wider watercourse network.

6.3.4 It is likely that drainage is predominantly via overland flow, following the topography of the Site to the topographic low points, with a small amount of infiltration to bedrock, and throughflow to watercourse.

6.4 Developable and Impermeable Areas

6.4.1 The proposal is for 51 residential dwellings, public open space, landscaping, sustainable drainage system (SuDS), with vehicular access point from Garstang Road.

6.4.2 The proposed impermeable area has been measured from the proposed layout (Appendix 1), inclusive of an additional 10% for urban creep (Drawing 101).

6.4.3 The proposed development will increase the impermeable surfaces and so increase the amount of runoff.

Table 6.1: Impermeable Area

Area	Existing Buildings and Hardstanding	Proposed Buildings and Hardstanding	Difference
Area (ha)	0	1.02	+1.02
Percentage of Total Site Area (%)	0	38	+38

6.5 Greenfield Runoff Rates

6.5.1 An assessment of greenfield runoff rates was undertaken to determine the attenuation requirements for the proposed development.

6.5.2 The runoff rates were calculated using Causeway Flow software, with FEH method inputs (descriptors obtained from the FEH webservice[21]). This is a recommended methodology for Sites up to 50ha in area and the approach is in line with the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS[22], and Environment Agency Report SC030219 – Rainfall runoff management for developments.

6.5.3 The following parameters were used in the runoff calculations:

- Developable Area: 1.85ha
- Average Annual Rainfall (SAAR): 1,015mm/year
- Region No.: 10
- BFIHOST19: 0.361

6.5.4 BFIHOST was updated to BFIHOST19 (November 2019) since a number of issues were identified with BFIHOST, which including a tendency to underestimate BFI in clay-dominated catchments.

6.5.5 BFIHOST19 is the baseflow index developed using the Hydrology of Soil Types (HOST) classification and is the baseflow proportion of the flow on average. It is estimated based on the daily mean flow data. Baseflow comprises water entering the watercourse through shallow subsurface flow and groundwater flow (mechanisms other than direct surface runoff); hence permeable soils and geology tend to yield a higher baseflow.

6.5.6 BFIHOST19 value assigned by the FEH webservice is considered to replicate onsite conditions of clayey soils and superficial deposits, which is supported by nearby borehole records.

6.5.7 Table 6.2 shows the calculated greenfield runoff rates. Runoff calculations are included in Appendix 7.

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[21] Centre for Ecology and Hydrology, Flood Estimation Handbook Web Service [https://fehweb.ceh.ac.uk/].

[22] Office of the Deputy Prime Minister, National SuDS Working Group (July 2004) Interim Code of Practice for Sustainable Drainage Systems [https://www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf].

Table 6.2: Greenfield Runoff Rates

Annual Probability (Return Period, years)	Greenfield Runoff (l/s)
QBAR	19.4
50% (2)	18.0
3.33% (30)	32.9
1% (100)	40.3

***Note:** 40% added to the data to account for long-term climate change as stated in 'Flood Risk Assessment: Climate Change Allowance'. The 1 in 2-year, 30-year and 100-year annual probability events are of importance to the Water Companies and the Environment Agency when looking at sewage discharge and flood risk.*

6.6 Sustainable Drainage Options (SuDS)

Feasibility of SuDS

6.6.1 The SuDS Infiltration Potential Map (Drawing 007) shows the Site is in an area where there is moderate potential.

6.6.2 Soils and geology mapping shows the Site is underlain by low permeable (clayey) soils and superficial deposits. This is supported by nearby borehole records.

Choice of SuDS Options

6.6.3 Sustainable water management measures should be used to control the surface water runoff from the proposed development Site, thereby managing the flood risk to the Site and surrounding areas from surface water runoff. These measures will also improve the quality of water discharged from the Site.

6.6.4 Current guidance promotes sustainable water management using SuDS. Options applicable to this Site are identified in Table 6.3.

Table 6.3: SuDS Options

Green roofs	Infiltration basins
Water butts	Detention basins
Permeable paving	Oversized pipes
Rainwater harvesting	Brown roofs
Filter strips	Swales
Wetland Areas	Cellular Storage

***Note:** SuDS appropriate to the development are highlighted green.*

6.6.5 A hierarchy of SuDS techniques is identified[23]:

1. **Prevention** – the use of good Site design and housekeeping measures on individual Sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).
3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole Site).
4. **Regional Control** – management of runoff from several Sites, typically in a detention pond or wetland.

6.6.6 Using SuDS as opposed to conventional drainage systems provides several benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream.
- Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed Sites.
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources.
- Reducing potable water demand through rainwater harvesting.
- Improving amenity through the provision of public open spaces and wildlife habitat.
- Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

SuDS Maintenance

6.6.7 A detention basin will form the main attenuation feature within the development Site.

6.6.8 Maintenance of the SuDS features would be in line with the SuDS Manual (CIRIA C753, 2015), as detailed in Figure 6.1. The maintenance would be undertaken by a private maintenance company.

6.6.9 It is standard for SuDS features within a new development to be maintained by a private maintenance company unless the council adopt it. If the maintenance company goes into administration, the Site will be contracted to a new maintenance company. Residents will pay a surcharge to the maintenance company and a number of them would be appointed to its board. This will ensure maintenance throughout the lifetime of the development.

6.6.10 Details of other SuDS features, and maintenance would be considered further at detailed design, when a detailed layout has been produced. The level of detailed provided within this FRA should be sufficient at outline stage to demonstrate that SuDS would be deliverable.

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[23] CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

Figure 6.1: Detention Basin Operation and Maintenance Requirements (Table 22.1 of the SuDS Manual)

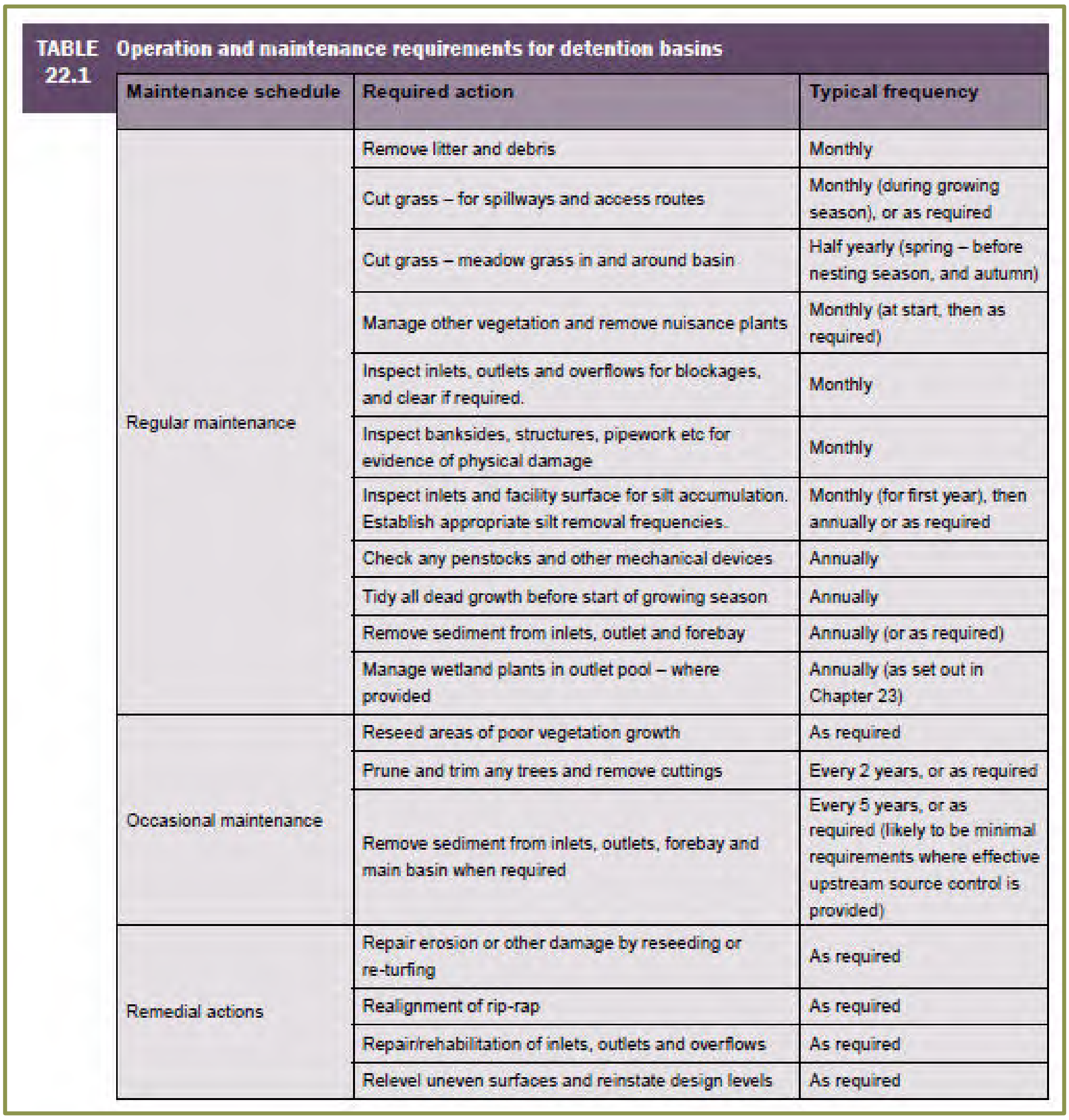

TABLE 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

6.7 Surface Water Management Strategy

Hierarchy of Discharge

6.7.1 In accordance with requirement H3 of the Building Regulations 2000[24] rainwater runoff must discharge to one of the following, listed in order of priority:

1. **An adequate soakaway or some other adequate infiltration system:** The use of infiltration-based SuDS is not considered feasible due to low infiltration potential.
2. **A watercourse:** A land drain is orientated north to south along the western boundary; however, OS mapping does not show onward connectivity to a wider watercourse network.
3. **A sewer:** A consented residential development (currently under construction) is located on land to the west of the Site. The new development is served by a separate surface

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[24] Office of the Deputy Prime Minister, The Building Regulations 2000.

water/foul sewer network, utilising pond attenuation with an outfall to a culverted watercourse and a pumped foul connection to the public foul network to the north. A copy of the drainage plan is included in Appendix 6. It is assumed the drainage network will be adopted by United Utilities. Land to the south of the consented development is under the same land ownership and a right of road/service connection to the consented scheme has been maintained for the proposed development.

A consented residential development is located on land to the east of the Site. The new development will be served by a separate surface water/foul sewer network, utilising oversized pipes with an outfall to a culverted watercourse beneath Garstang Road (assumed outfall to Drain 2), and a pumped foul connection to an onsite public foul rising main. A copy of the drainage plan is included in Appendix 6.

6.7.2 The potential route to discharge surface water from the proposed development will be by connection to the existing drainage system in the adjacent/western development (under a right of road/service connection), or connection to the culverted watercourse beneath Garstang Road.

Drainage Design

6.7.3 Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

6.7.4 Landscaped areas should be incorporated into the layout where possible, and the associated gardens of each unit will allow a proportion of the rainfall to infiltrate into the soil substrate.

6.7.5 Surface water will be directed to an onsite detention basin, positioned to achieve a gravity fed connection to either the sewer network serving the western development, or the culverted watercourse beneath Garstang Road serving the eastern development.

6.7.6 An indicative drainage layout is in Drawing 101.

Attenuation Requirements

6.7.7 Attenuation storage is required to reduce the post-application surface water runoff from the Site to calculated greenfield runoff rates, up to and including the 1 in 100-year (+40%CC) rainfall event, assuming no infiltration losses.

6.7.8 The following input parameters were assumed in the calculations:

- Impermeable Area: 1.02ha (38%)
- Cv (proportion of rainfall forming surface water runoff): 75% summer, 84% winter
- Infiltration losses: 0.00m/hour
- With outfall: restricted to QBar (Table 6.2)

6.7.9 The attenuation volume for the 1 in 100-year event (plus climate change) is 626m^3.

6.7.10 Attenuation calculations are included in Appendix 7. The calculated runoff rates and attenuation volumes will be reviewed at detailed design stage.

6.8 Exceedance Routes

6.8.1 The detention basin will be designed with a capacity up to a 1 in 100-year (plus 40% climate change) event, with a +150mm freeboard allowance, based on the QBar restricted discharge rate. This provides a betterment (reduction) in runoff when compared to existing undeveloped conditions, where runoff is uncontrolled across all return periods.

6.8.2 A storm event in excess of this design standard would be extreme and would cause the detention basin to overtop (with no sudden deluge) and would then shed overland following the topography (north/west), as per existing conditions (Drawing 010).

6.8.3 Finished floor levels of new dwellings will be set above external levels, which will mitigate the residual risk of overtopping.

6.9 Foul Drainage

6.9.1 The potential route to discharge foul flows from the proposed development will be by connection to the existing drainage system in the adjacent/western development.

6.9.2 The topography of the site would allow for a gravity fed connection. An indicative drainage layout has been included in Drawing 101.

6.9.3 In accordance with Sewers for Adoption (7th Edition), peak foul water discharge from a residential development is 4,000 litres per property per day. Using this method, peak foul flows are estimated to be 2.55l/s from the 51-unit residential development (number of dwellings to be confirmed). The calculated foul flow rate will be reviewed at detailed design stage.

6.9.4 All foul sewerage should be designed in accordance with Building Regulations Part H. In areas where sewers are to be adopted by United Utilities, sewerage should be designed in accordance with Sewers for Adoption (7th Edition) and supplemented with additional standards provided by United Utilities. An application to enter into a Section 104 agreement for sewer adoption must be made in writing to United Utilities prior to any works commencing on Site. A connection point should be agreed with United Utilities.

7.0 Summary and Conclusions

7.1 Introduction

7.1.1 A site-specific Flood Risk Assessment (FRA) has been undertaken for a proposed residential development, located on a 2.60ha Site on land west of Garstang Road, Broughton, Preston.

7.2 Flood Risk

7.2.1 The risk of fluvial flooding is assessed as negligible. There is however a residual risk of flooding from the bounding land drain.

7.2.2 The risk of surface water flooding is assessed as negligible for most of the Site, with areas of low to medium risk associated with surface water flow ponding,

7.2.3 The risk of flooding from all other sources is assessed as negligible.

7.3 Mitigation Measures

7.3.1 Flood risk can be mitigated to a negligible or low and acceptable level through the following approach:

- Provide an easement free from development along the reach of the bounding land drain. This easement would provide access for inspection and maintenance purposes, including vehicle access.
- Undertake maintenance activities to keep the land drain clear from debris and overgrown vegetation to maintain the conveyance of the channels.
- Set finished floor levels above external levels.
- Adoption of a surface water management strategy.

7.4 Flood Guidance

7.4.1 The proposed residential use is classified as more vulnerable. More vulnerable uses are considered acceptable in terms of flood risk in Flood Zone 1 (low risk). Subject to the implementation of the above mitigation measures, the Sequential Test would be passed, and the Exception Test would not be required.

7.5 Site Drainage

Surface Water

7.5.1 The proposed development will increase the area of impermeable surfaces and therefore increase the amount of runoff without mitigation.

7.5.2 Surface water runoff from the Site will be restricted to greenfield rate (Qbar), which offers a betterment to existing conditions with uncontrolled runoff across all return periods.

7.5.3 Surface water runoff from the proposed development would be attenuated on-site up to and including the 1 in 100-year event, plus 40% climate change.

7.5.4 A SuDS drainage scheme is proposed to manage excess runoff from the development, comprising a detention basin designed to maintain runoff at pre-development rates, with a gravity outfall to the existing drainage system in the adjacent/western development, or the culverted watercourse beneath Garstang Road serving the adjacent/eastern development.

Foul Water

7.5.5 It is proposed that foul flows will discharge to the existing drainage system via a gravity connection in the adjacent/western development. Foul flows have been calculated at 2.55l/s (number of dwellings to be confirmed.

7.6 Conclusion

7.6.1 This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of national policy and guidance.

7.6.2 The development should therefore not be precluded on the grounds of flood risk, as well as surface water and foul drainage.

DRAWINGS

Flow Control
Hydro-brake
Design Depth: 1.50m
Allowable Discharge (Qbar): 19.4l/s
Downstream hydrobrake to be adjusted.

Surface Water Attenuation Basin
Designed for 1 in 100yr+40%CC
Attenuation Volume: 626m³
Top of Bank: 40.800
Max Water Level: 40.500
Bed Level: 39.000
Freeboard:0.300m
Basin Banks: 1:4

NOTES

1. Do not scale from this drawing
2. All dimensions are in meters unless stated otherwise
3. This drawing is to be read in conjunction with all relevant drawings and documents associated with this project.
4. All surveyed information including levels and layout is provided by others
5. All existing and proposed dimensions, levels and locations to be checked and verified by the main contractor on site prior to the commencement of the works and any anomalies reported to the engineer.
6. All works, workmanship and materials on private drainage to be in accordance with the civil engineering specification for water industry 7th edition published by the water research council.

Key

- Site Boundary
- Foul Water Sewer
- Surface Water Sewer
- Foul Water Manhole
- Surface Water Manhole
- Existing Foul Water Sewer
- Existing Surface Water Sewer

REV:	DATE:	DETAIL:	DES:	CHK:	APP:
P02	06/07/21	Final site layout added & drainage moved	EA	DA	DA
P01	14/05/21	First Issue	CH	WW	EA

enzygo
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Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT:
Hollins Strategic Land

PROJECT:
Garstang Road, Broughton

DRAWING TITLE:
Outline Surface and Foul Water Drainage Strategy

DRAWN:	DESIGNED:	CHECKED:	APPROVED:
CH	CH	WW	EA

DATE:
14/05/2021

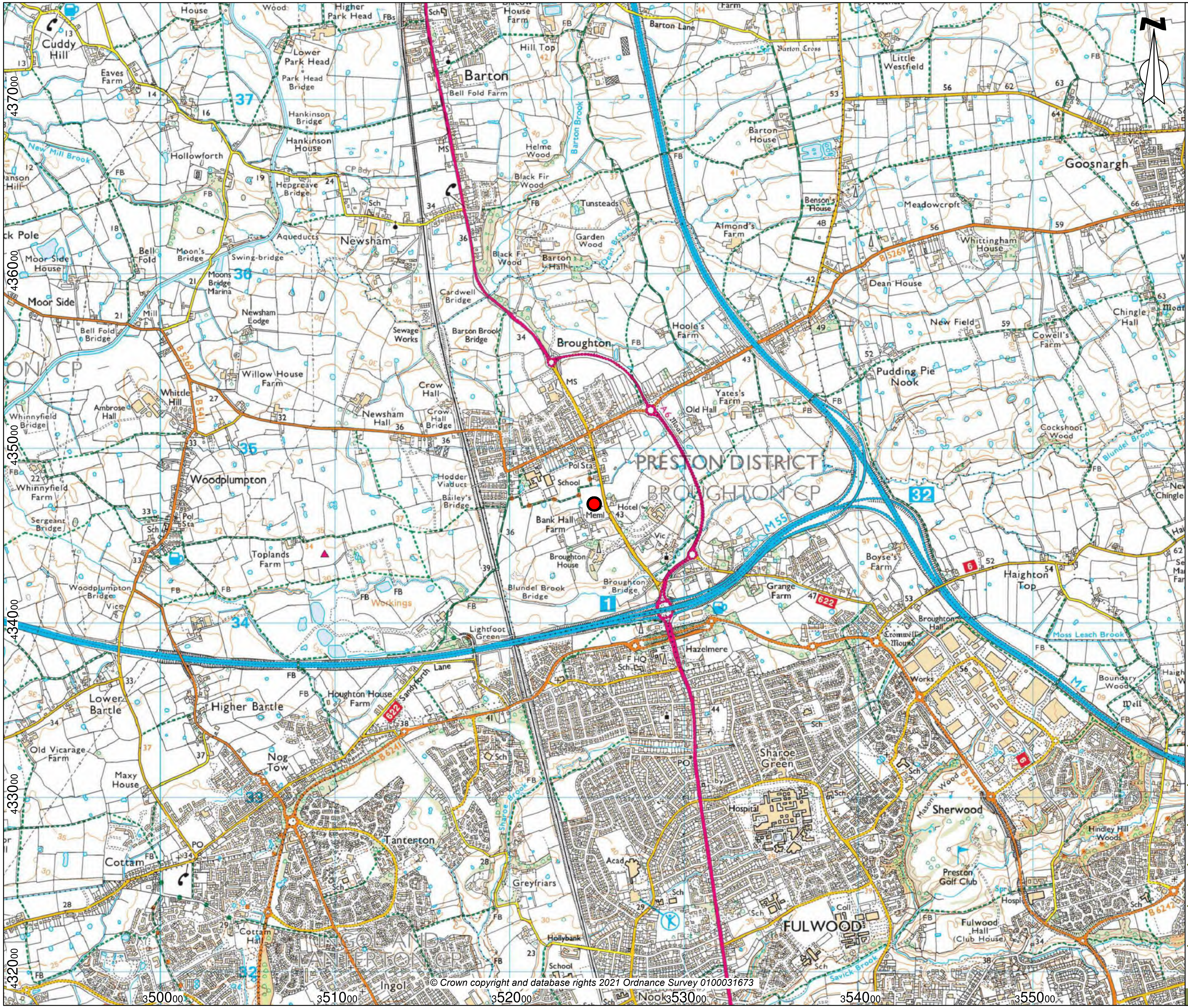
SCALE @ A3:
NTS

PROJECT NO.:
SHF.1671.006

DRAWING NO.:
101

DRAWING STATUS:
Preliminary

ISSUE:
P02



© Crown copyright and database rights 2021 Ordnance Survey 0100031673

Key

● Site Location
(SD 52483 34681)

enzygo
environmental consultants

Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT:
Hollins Strategic Land

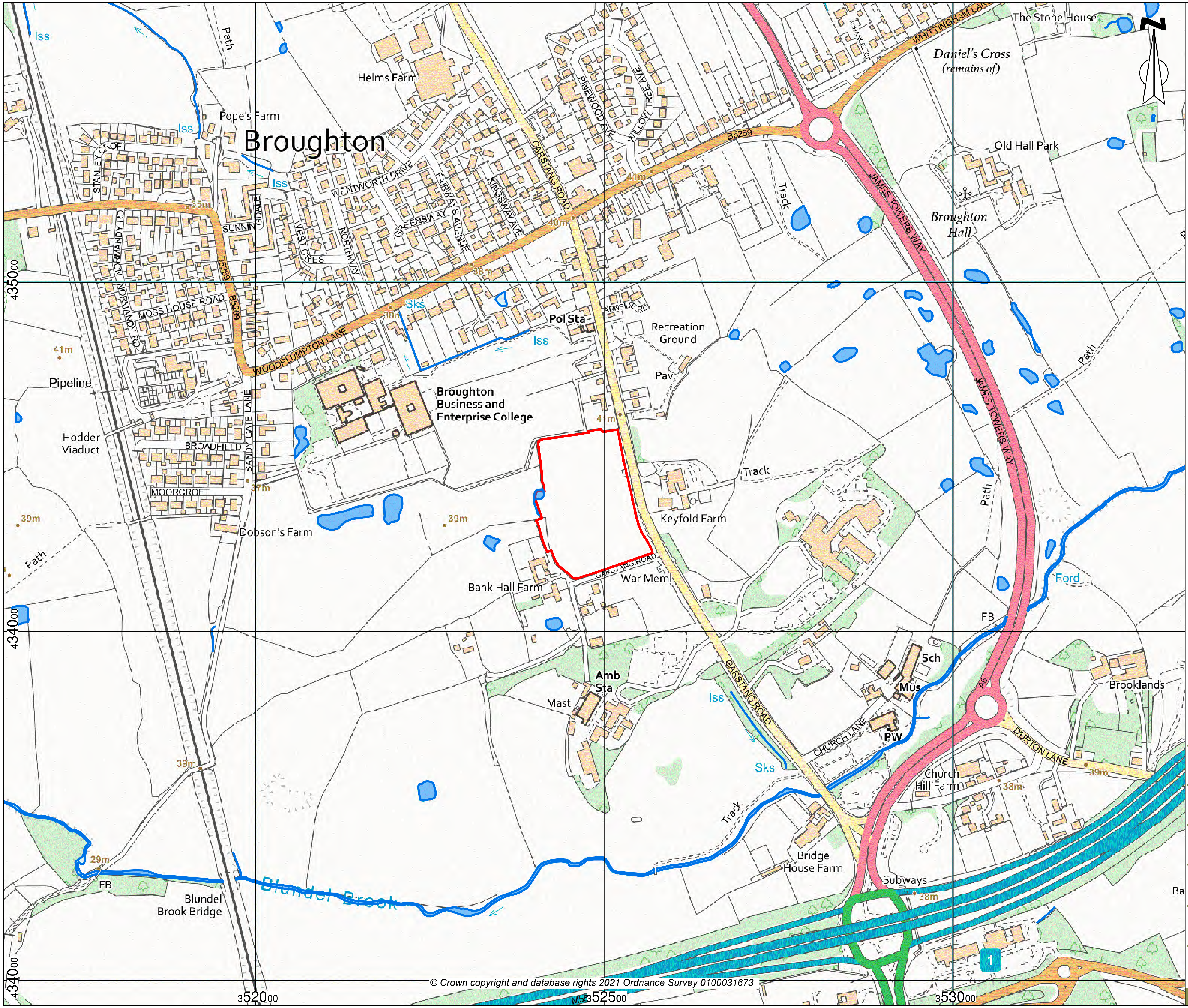
SCALE:	PROJECT REF:
1:20,000@A3	SHF.1671.006

DRAWN:	CHECKED:	DATE:
MG	DA	May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Site Location Plan

DRAWING NO:
SHF.1671.006.HY.D.001



Key

🟥	Site Boundary
🟦	Surface Water Features

Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT:
Hollins Strategic Land

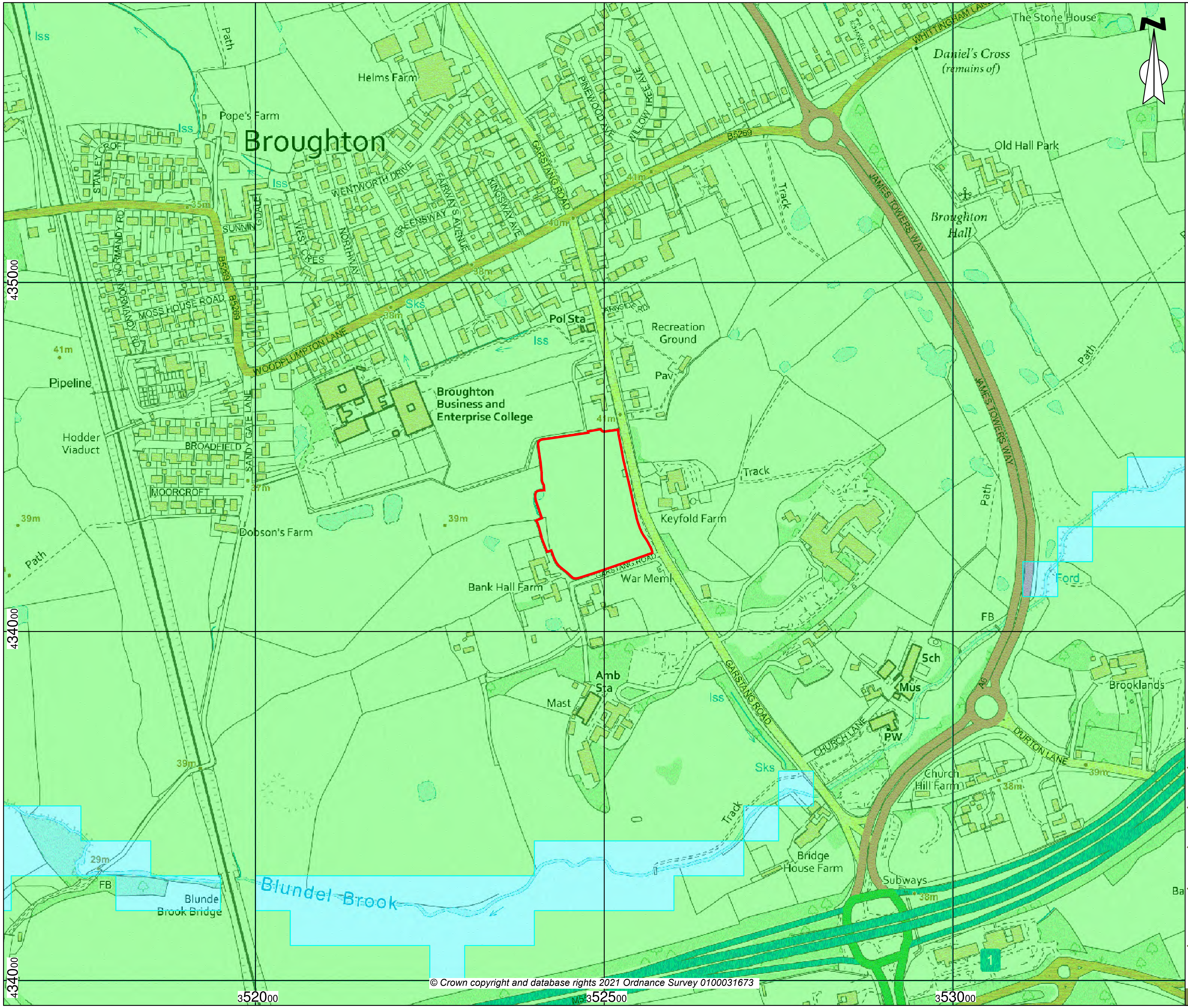
SCALE: 1:5,000@A3
PROJECT REF: SHF.1671.006

DRAWN: MG
CHECKED: DA
DATE: May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Surface Water Features

DRAWING NO:
SHF.1671.006.HY.D.002



Key

▭ Site Boundary

🟪 Potential for Groundwater Flooding to Occur at Surface

🟦 Potential for Groundwater Flooding of Property Situated Below Ground Level

🟩 Limited Potential for Groundwater Flooding to Occur

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environmental consultants

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CLIENT:
Hollins Strategic Land

SCALE:
1:5,000@A3

PROJECT REF:
SHF.1671.006

DRAWN:
MG

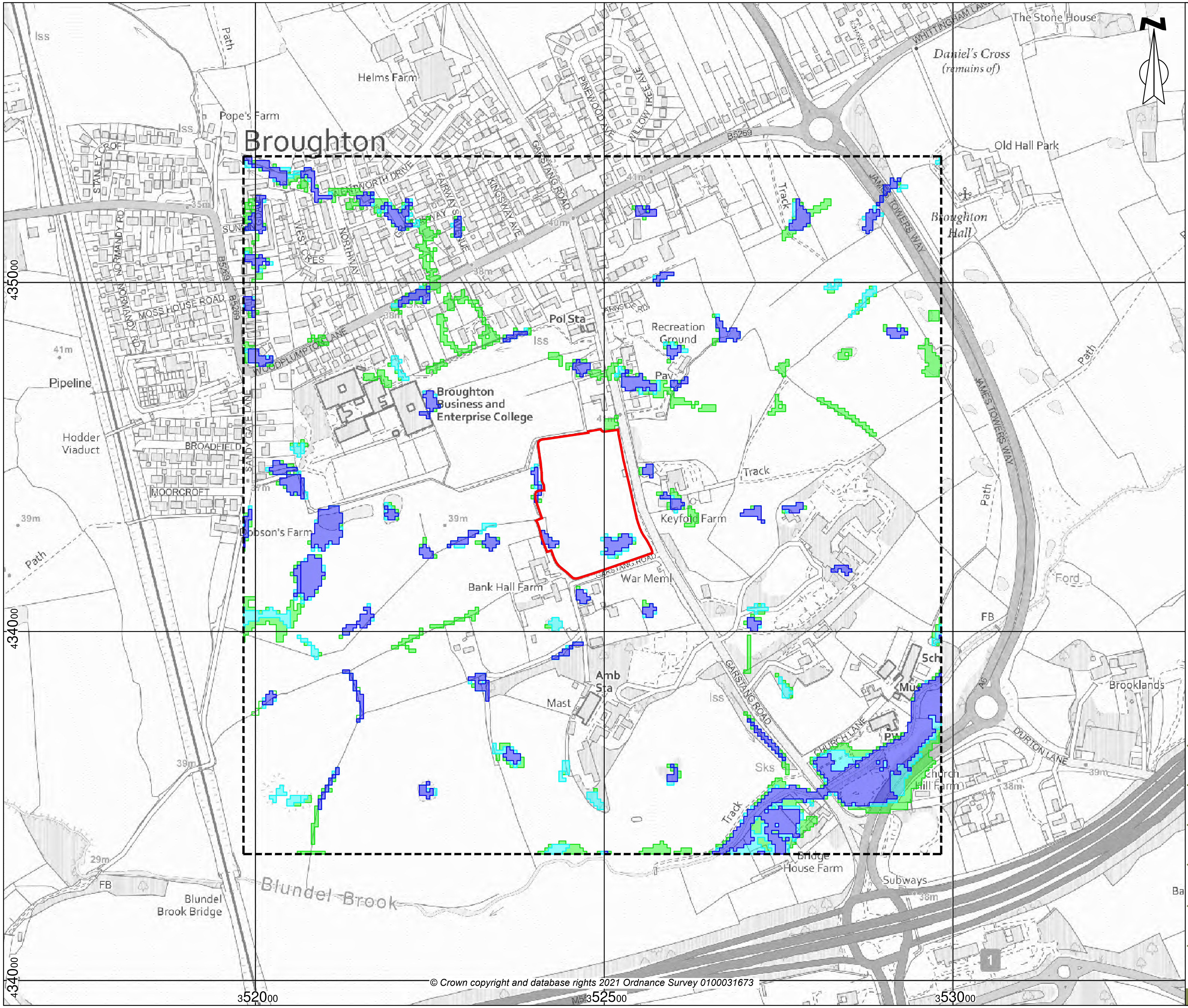
CHECKED:
DA

DATE:
May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
BGS Groundwater
Flooding Susceptibility

DRAWING NO:
SHF.1671.006.HY.D.003



Key

- 🟥 Site Boundary
- ▭ Search Extent
- 🟦 1 in 75 Year Surface Water Flooding
- 🟦 1 in 200 Year Surface Water Flooding
- 🟩 1 in 1000 Year Surface Water Flooding

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CLIENT:
Hollins Strategic Land

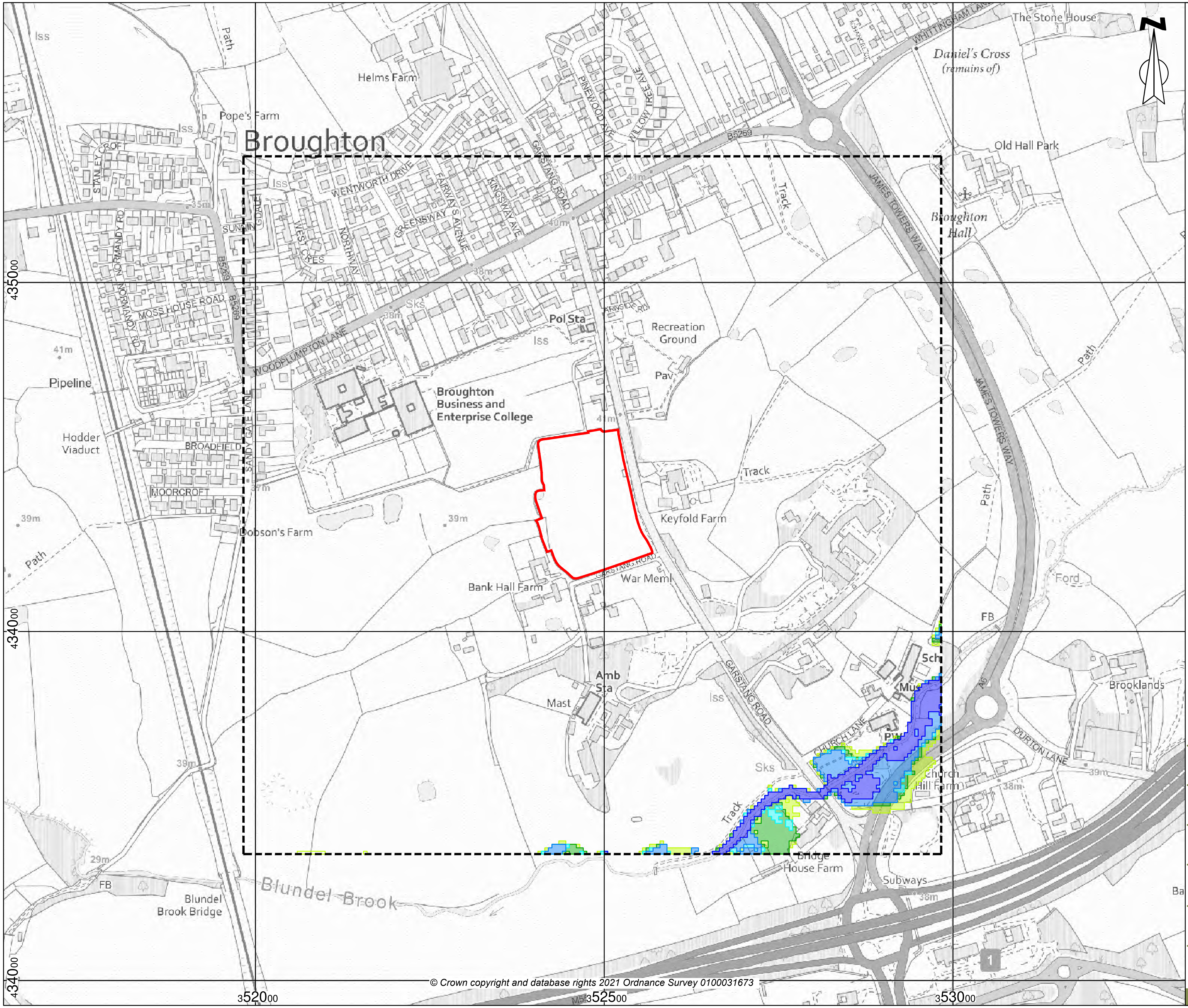
SCALE:	PROJECT REF:
1:5,000@A3	SHF.1671.006

DRAWN:	CHECKED:	DATE:
MG	DA	May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
JBA Surface Water Flooding

DRAWING NO:
SHF.1671.006.HY.D.004.1



Key

━	Site Boundary
╍	Search Extent
🟦	1 in 20 Year Flooding from Rivers
🟦	1 in 75 Year Flooding from Rivers
🟦	1 in 100 Year Flooding from Rivers
🟩	1 in 200 Year Flooding from Rivers
🟨	1 in 1000 Year Flooding from Rivers

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CLIENT:
Hollins Strategic Land

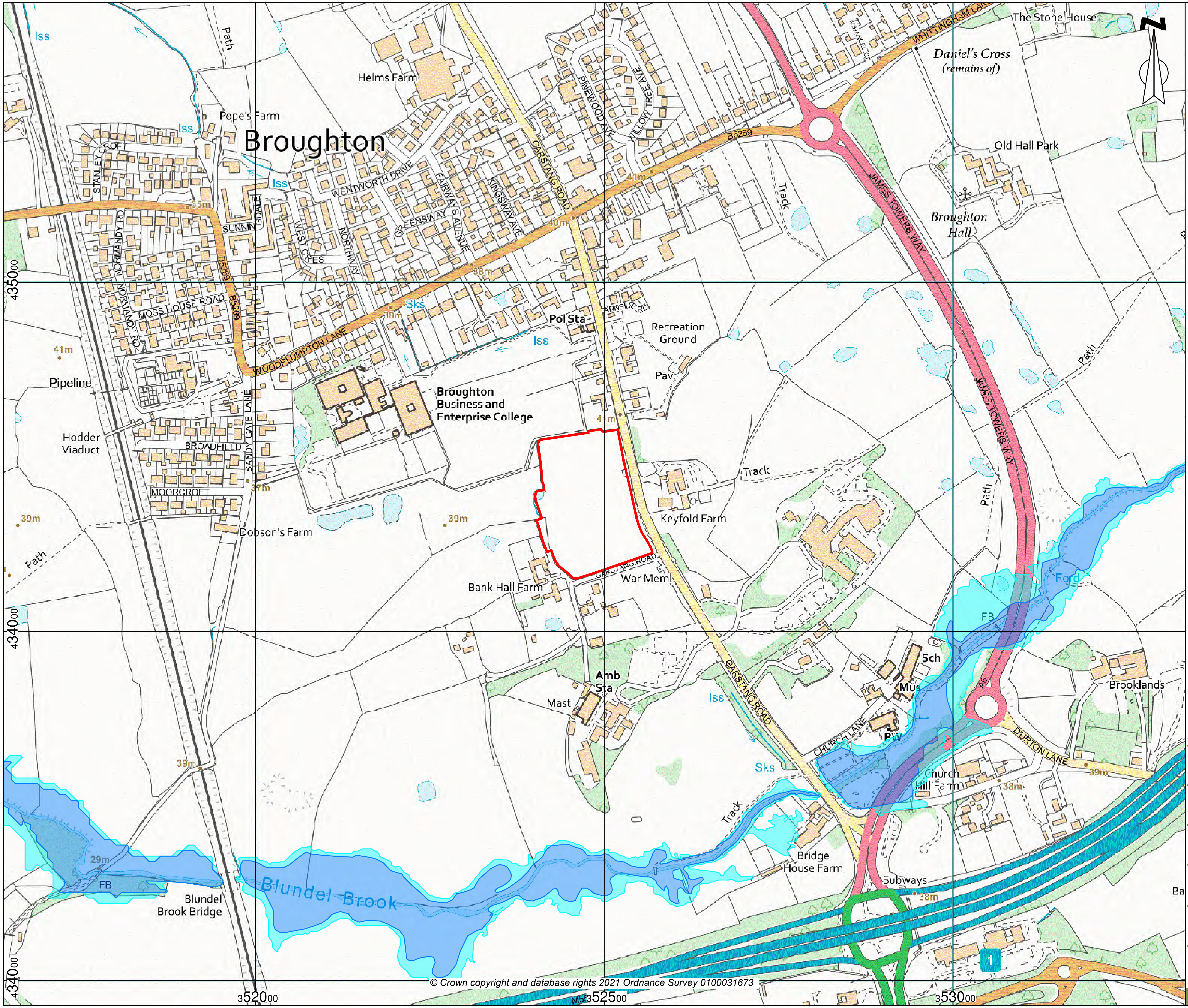
SCALE: 1:5,000@A3
PROJECT REF: SHF.1671.006

DRAWN: MG
CHECKED: DA
DATE: May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
JBA Flooding from Rivers

DRAWING NO:
SHF.1671.006.HY.D.004.2



Key

🟥	Site Boundary
🟦	Flood Zone 3
▨	Flood Zone 2
☐	Flood Zone 1

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Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT:
Hollins Strategic Land

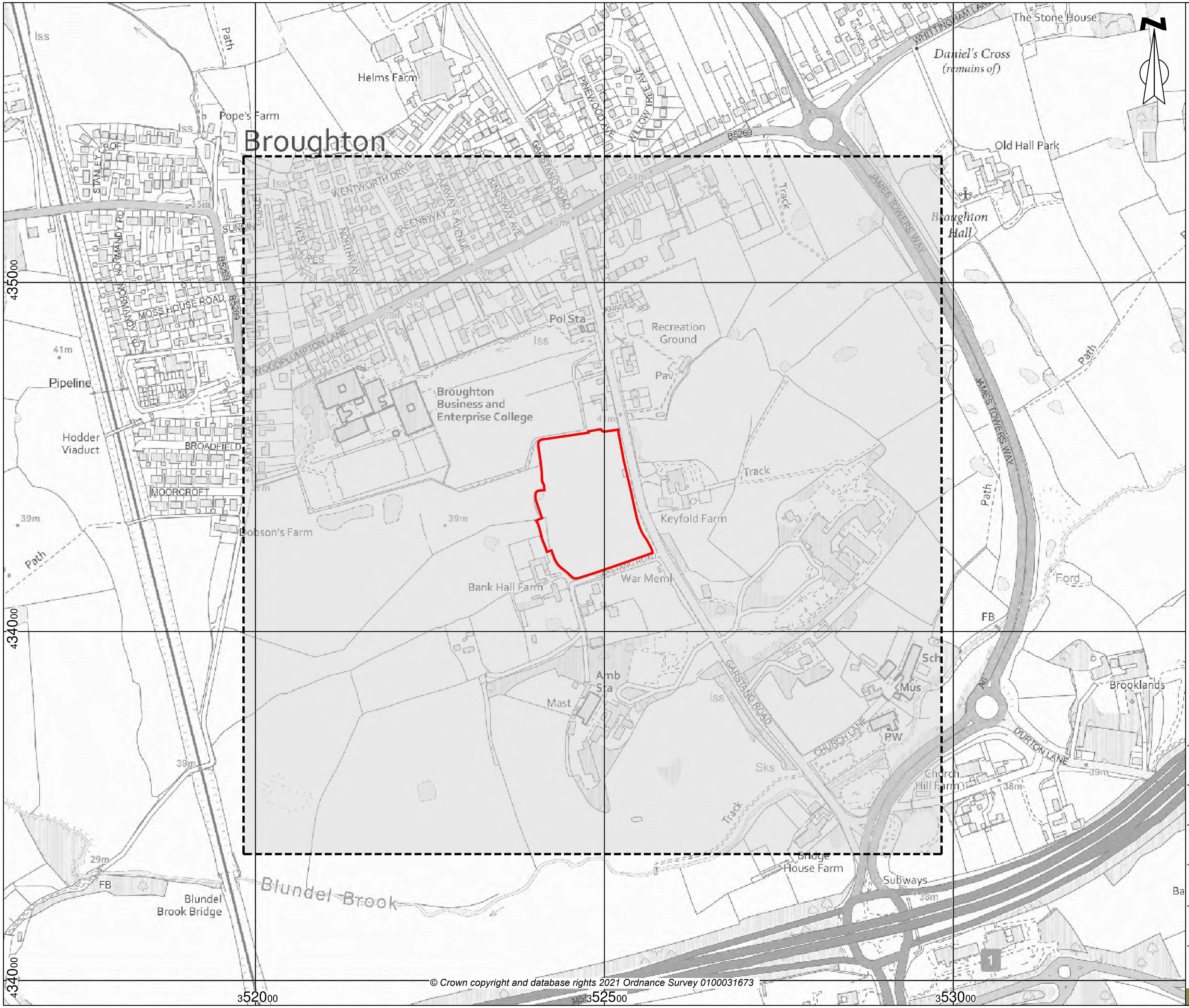
SCALE:	PROJECT REF:
1:5,000@A3	SHF.1671.006

DRAWN:	CHECKED:	DATE:
MG	DA	May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Environment Agency Flood Zones

DRAWING NO:
SHF.1671.006.HY.D.005



Key

🟥	Site Boundary
▭	Search Extent
🟥	Class 1 - High Risk
🟧	Class 2 - Moderate Risk
🟨	Class 3 - Low Risk
⬜	Class 4 - Negligible Risk

Notes:

GEOSMART GROUNDWATER FLOOD RISK MAP GW5
Version 2.3© - www.geosmartinfo.co.uk

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CLIENT:
Hollins Strategic Land

SCALE:
1:5,000@A3

PROJECT REF:
SHF.1671.006

DRAWN:
MG

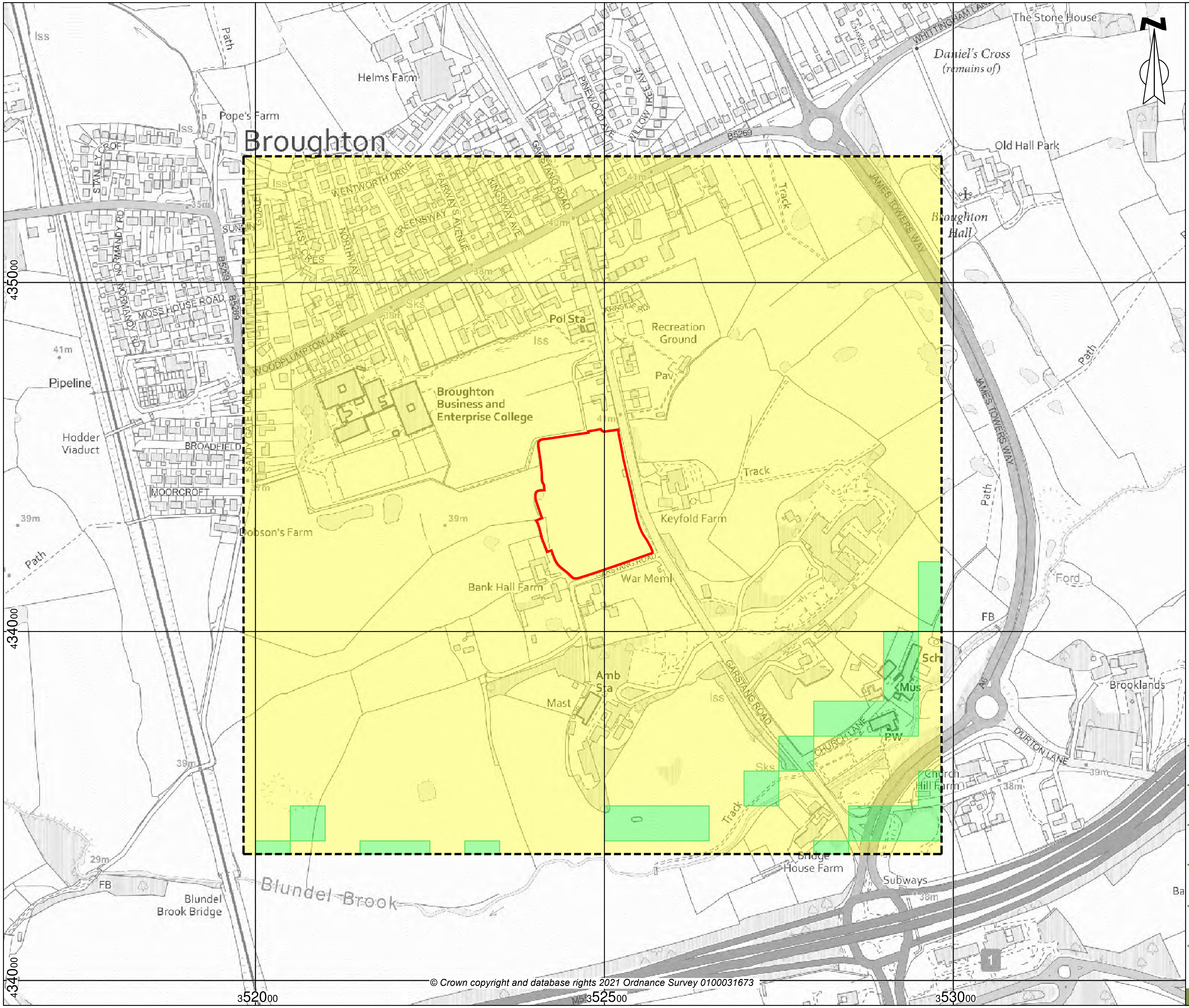
CHECKED:
DA

DATE:
May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Groundwater Flood Risk Map

DRAWING NO:
SHF.1671.006.HY.D.006



Key

- ━ Site Boundary
- ┅ Search Extent
- 🟩 High Potential
- 🟨 Moderate Potential
- 🟧 Low Potential

Notes:

GEOSMART SUDS INFILTRATION POTENTIAL MAP SD50
Version 1.0© - www.geosmartinfo.co.uk

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CLIENT:
Hollins Strategic Land

SCALE:
1:5,000@A3

PROJECT REF:
SHF.1671.006

DRAWN:
MG

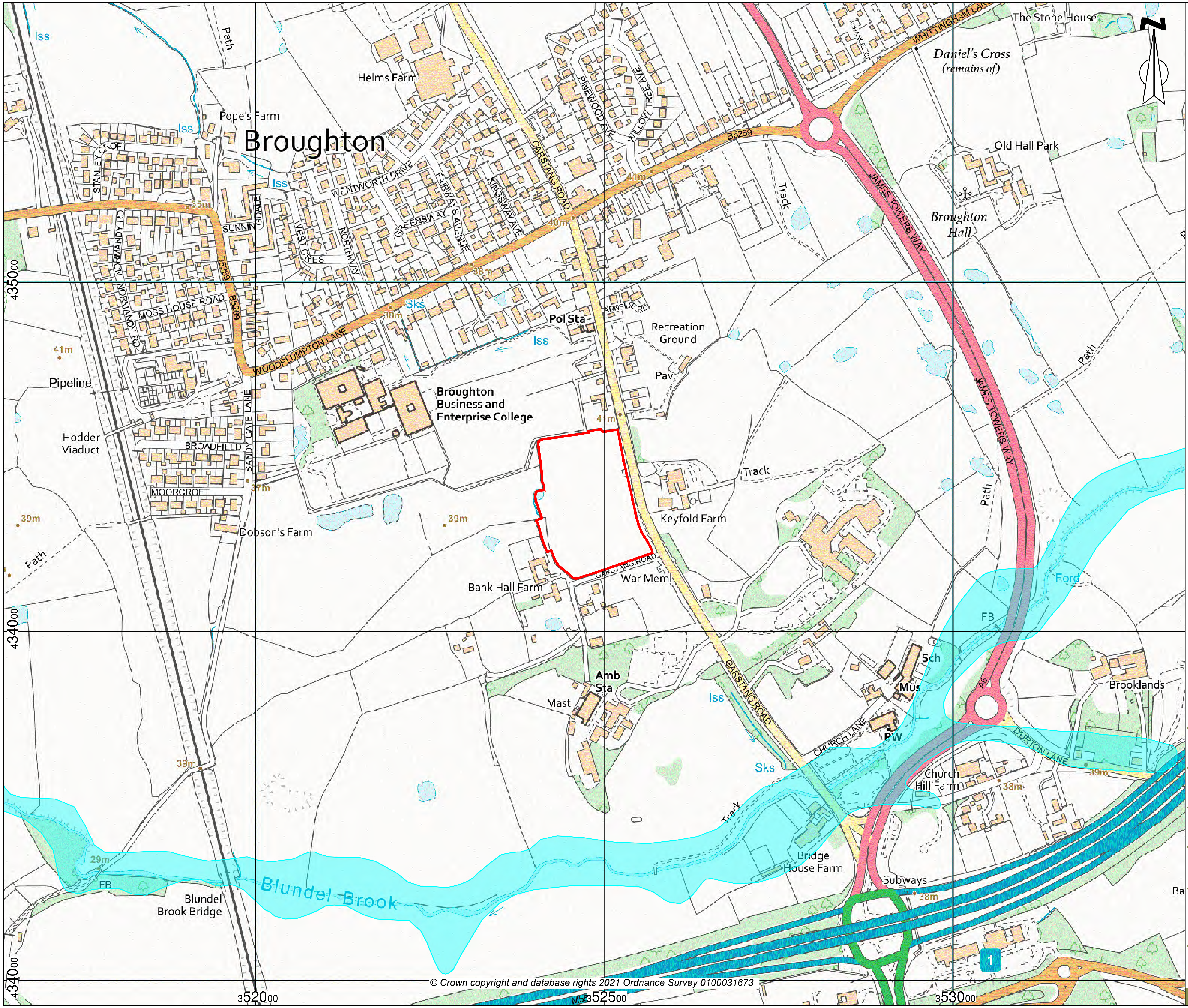
CHECKED:
DA

DATE:
May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
SuDS Infiltration Potential Map

DRAWING NO:
SHF.1671.006.HY.D.007



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Key

━ Site Boundary

🟦 Geological Indicators of Flooding
from Inland Flooding

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environmental consultants

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CLIENT:
Hollins Strategic Land

SCALE:
1:5,000@A3

PROJECT REF:
SHF.1671.006

DRAWN:
MG

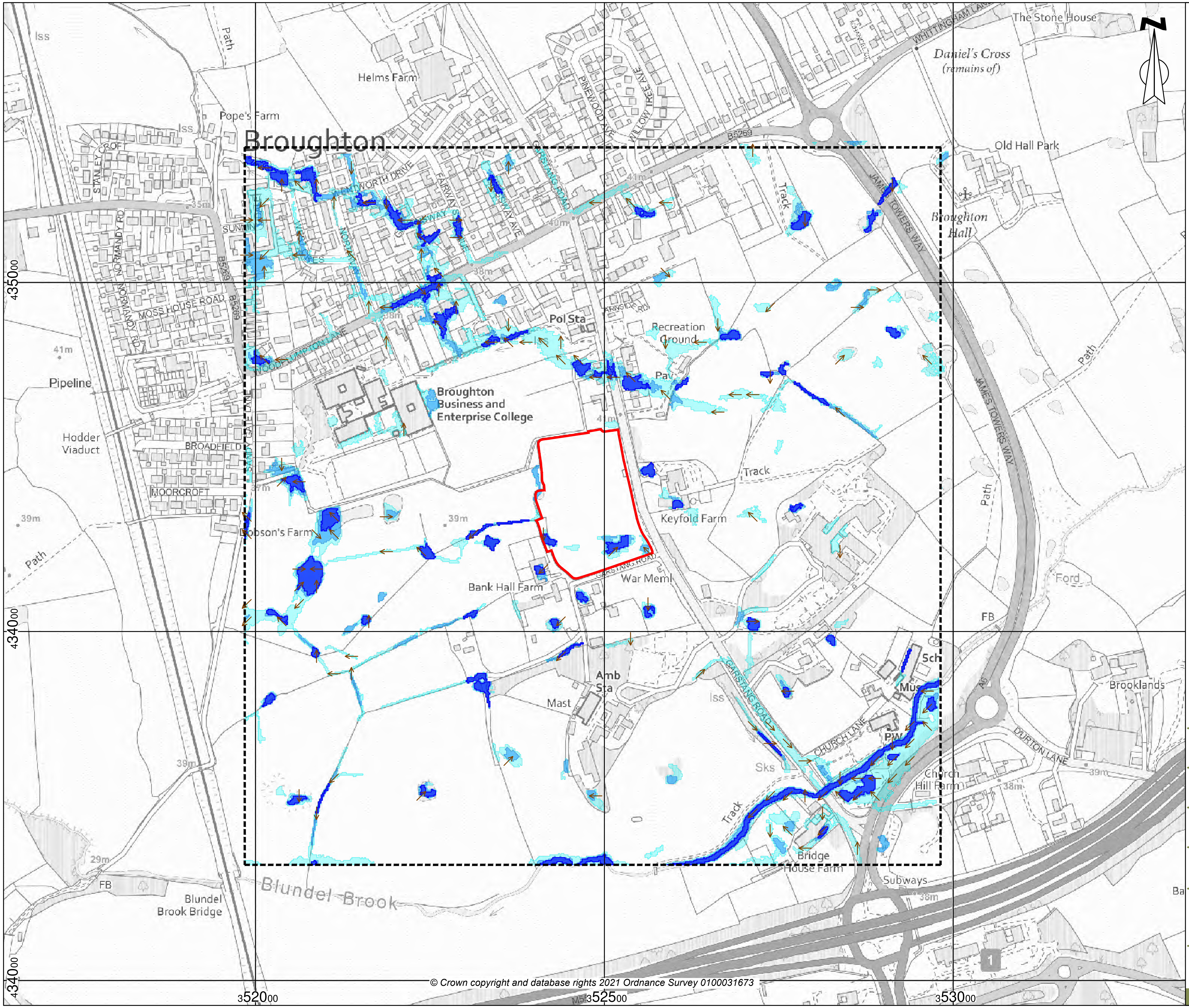
CHECKED:
DA

DATE:
May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Geological Indicators of Flooding
(based on geological deposits)

DRAWING NO:
SHF.1671.006.HY.D.008



Key

▭	Site Boundary
┅	Search Extent
🟦	30 Year Extent
🟦	100 Year Extent
🟦	1000 Year Extent
→	Flow Direction

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Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT:
Hollins Strategic Land

SCALE:
1:5,000@A3

PROJECT REF:
SHF.1671.006

DRAWN:
MG

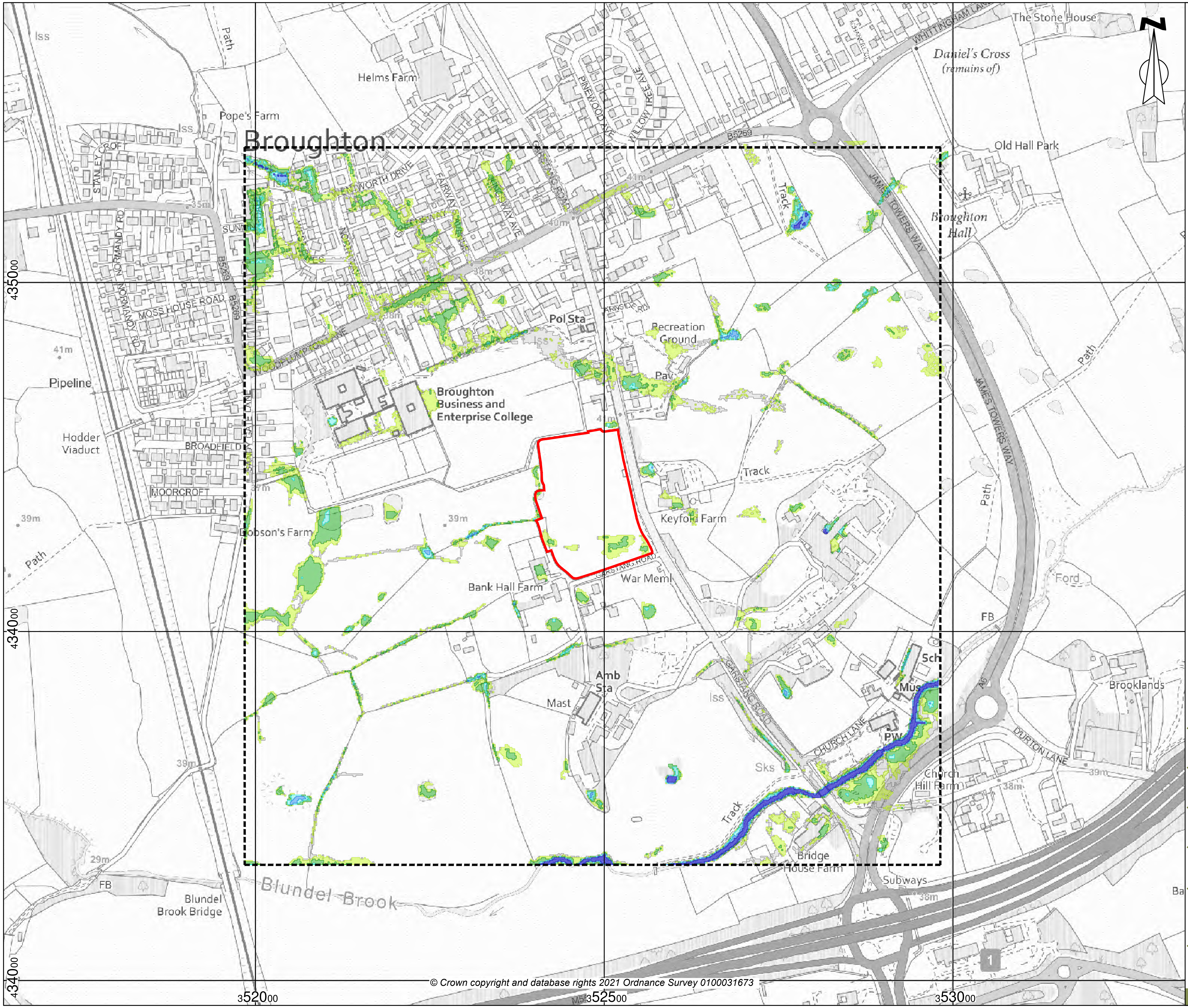
CHECKED:
DA

DATE:
May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Environment Agency Surface Water Flow Paths

DRAWING NO:
SHF.1671.006.HY.D.009.1



Key

- 🟥 Site Boundary
- ▭ Search Extent
- 🟦 Depth greater than 1.20 (m)
- 🟦 Depth 0.90 - 1.20 (m)
- 🟦 Depth 0.60 - 0.90 (m)
- 🟩 Depth 0.30 - 0.60 (m)
- 🟨 Depth 0.15 - 0.30 (m)
- ⬜ Depth 0.0 - 0.15 (m)

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CLIENT:
Hollins Strategic Land

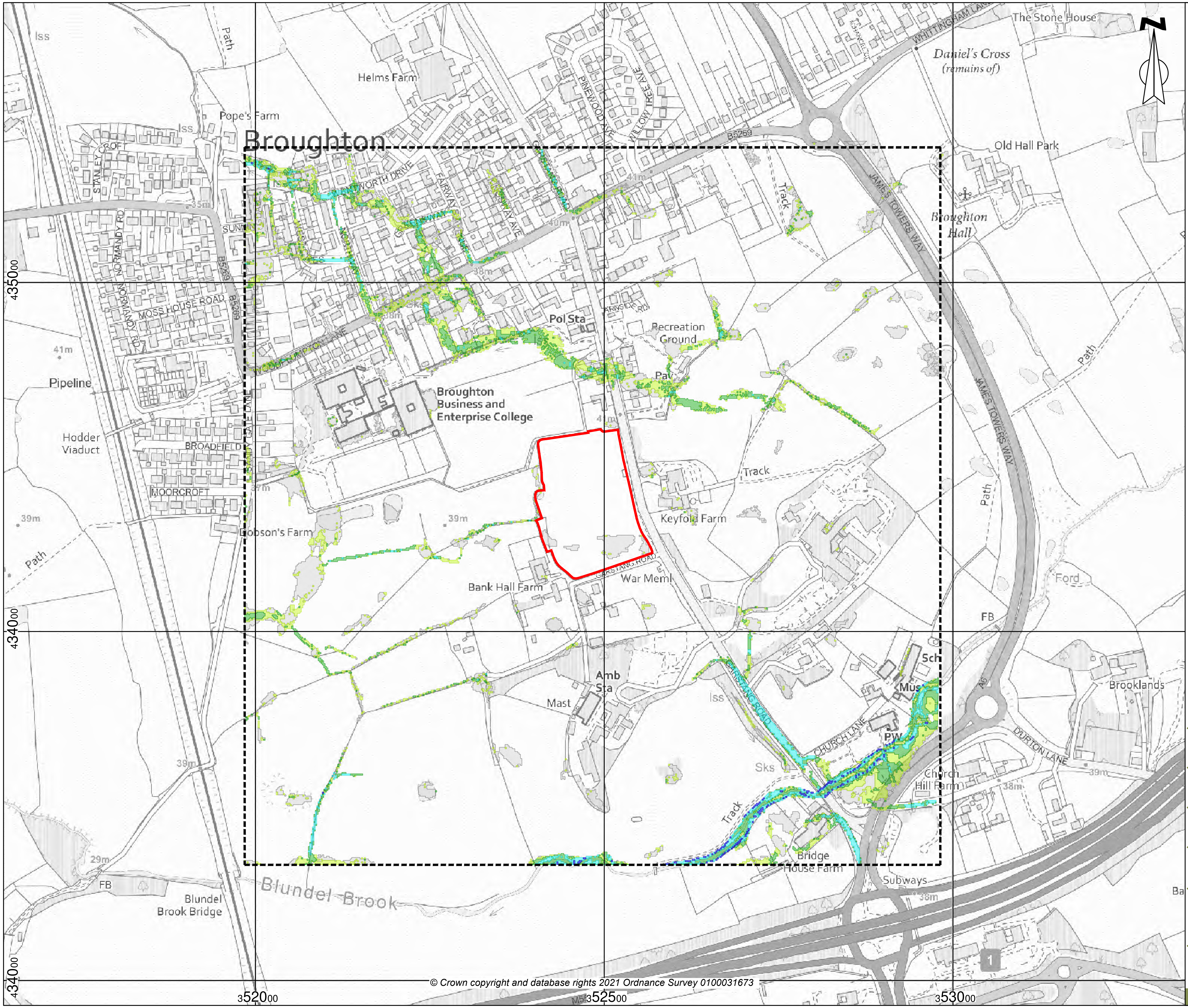
SCALE:	PROJECT REF:
1:5,000@A3	SHF.1671.006

DRAWN:	CHECKED:	DATE:
MG	DA	May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Environment Agency 1 in 1000 Year Surface Water Depth

DRAWING NO:
SHF.1671.006.HY.D.009.2



Key

🟥	Site Boundary
┅	Search Extent
🟦	Velocity 2.00 or greater (m/s)
🟦	Velocity 1.00 - 2.00 (m/s)
🟩	Velocity 0.50 - 1.00 (m/s)
🟨	Velocity 0.25 - 0.50 (m/s)
⬜	Velocity 0.00 - 0.25 (m/s)

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CLIENT:
Hollins Strategic Land

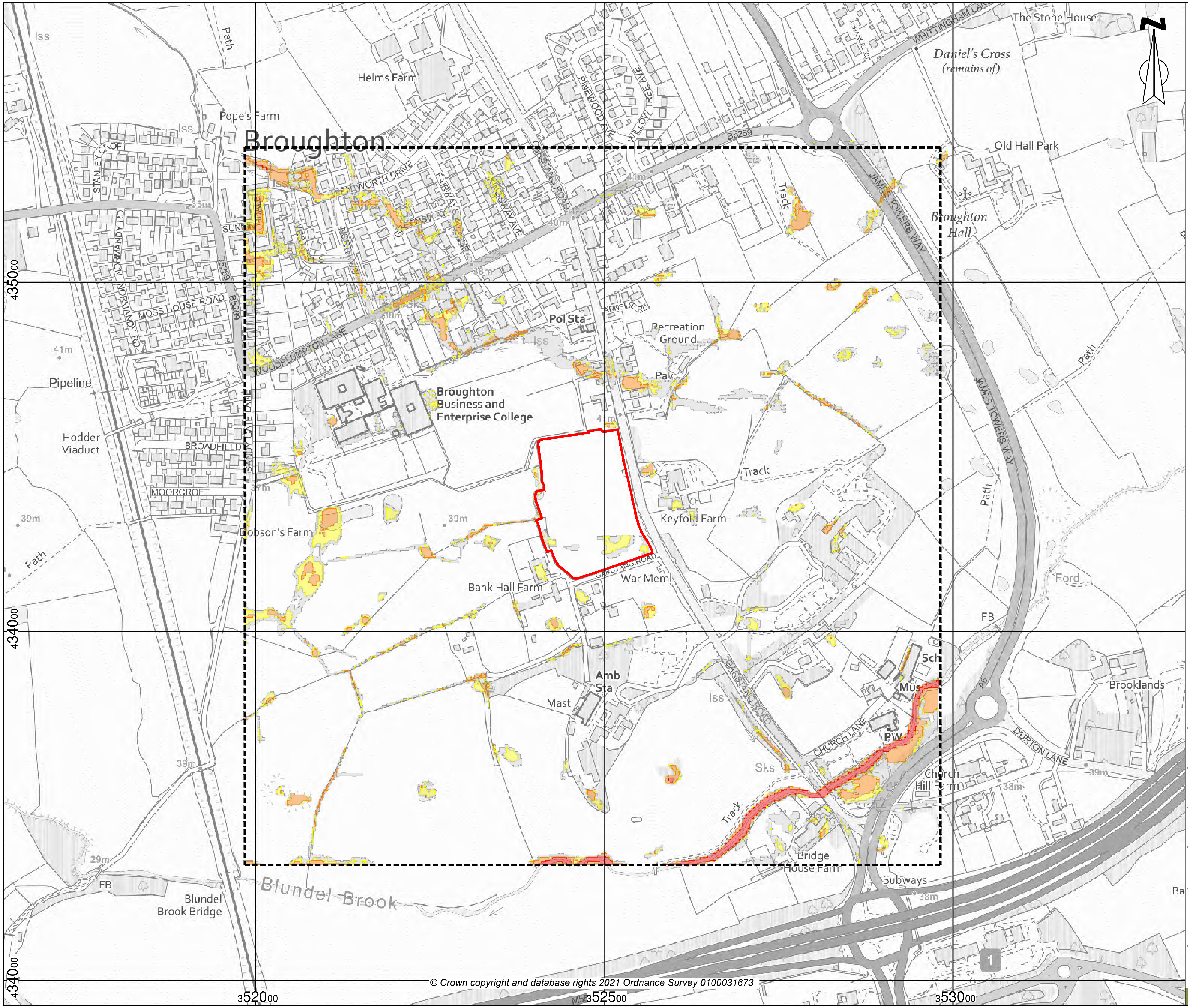
SCALE:	PROJECT REF:
1:5,000@A3	SHF.1671.006

DRAWN:	CHECKED:	DATE:
MG	DA	May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Environment Agency 1 in 1000 Year Surface Water Velocity

DRAWING NO:
SHF.1671.006.HY.D.009.3



Key
- ▭ Site Boundary
- ▭ Search Extent
- 🟥 Extreme Hazard (> 2.0)
- 🟧 Significant Hazard (1.25 - 2.00)
- 🟨 Moderate Hazard (0.75 - 1.25)
- ☐ Low Hazard (0.50 - 0.75)

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CLIENT:
Hollins Strategic Land

SCALE:	PROJECT REF:
1:5,000@A3	SHF.1671.006

DRAWN:	CHECKED:	DATE:
MG	DA	May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Environment Agency Surface Water 1000 Year Hazard Rating

DRAWING NO:
SHF.1671.006.HY.D.009.4

Key

- 🟥 Site Boundary
- Contours 0.25m Intervals (mAOD)
- Surface Water Flow Path

Notes:

Ground Model Specification: Topographical Survey

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CLIENT:
Hollins Strategic Land

SCALE:
1:1,000@A3

PROJECT REF:
SHF.1671.006

DRAWN:
MG

CHECKED:
DA

DATE:
May 2021

PROJECT:
Garstang Road, Broughton

TITLE:
Flow Pathway Analysis

DRAWING NO:
SHF.1671.006.HY.D.010

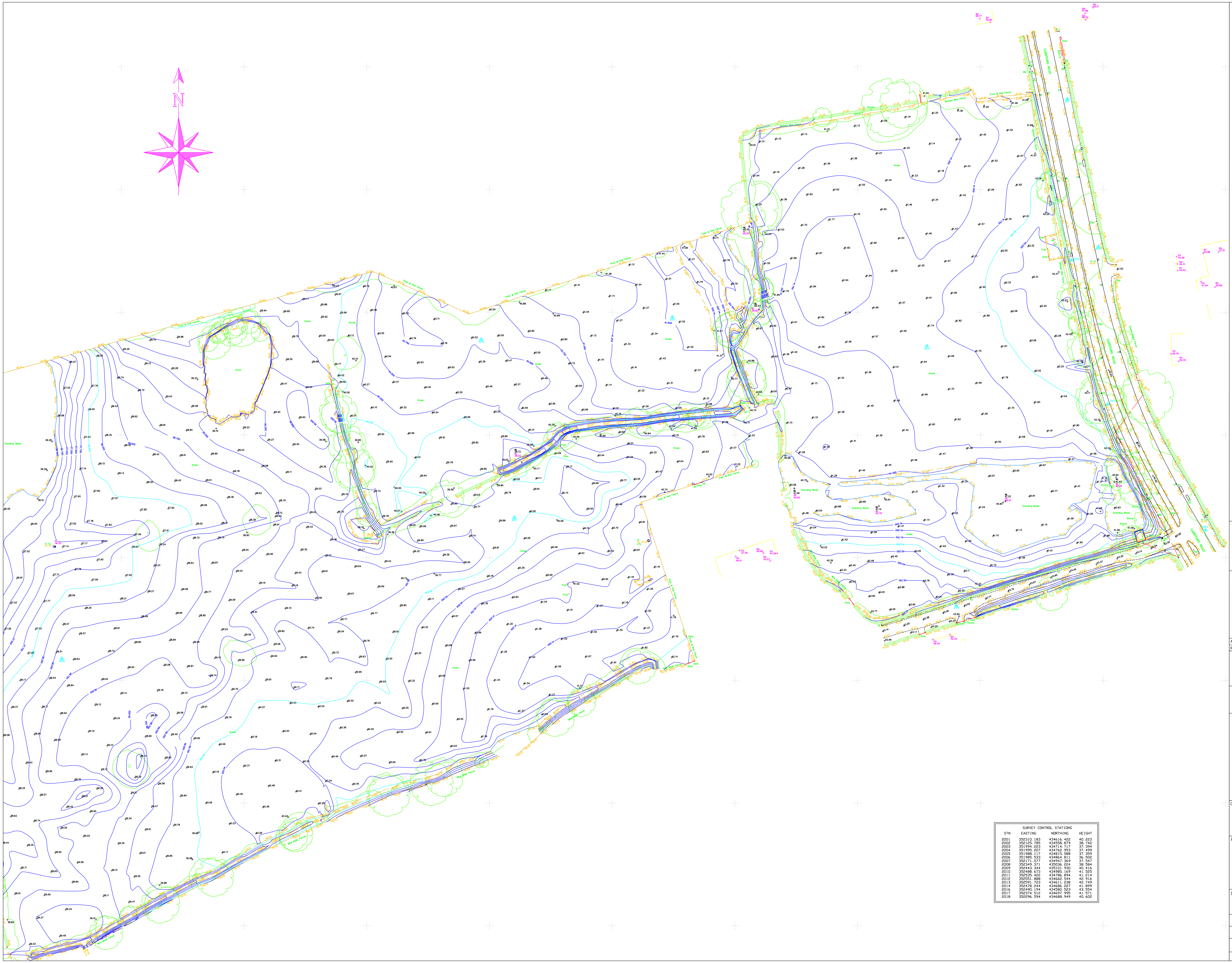
APPENDICES

Appendix 1 – Indicative Layout

Drawing Title: Garstang Road Sketch Layout
Drawing Number: UG1951 - URB - UD - XX - XX - SK - (90) - 002
Project: Garstang Road, Broughton

Revision: B
Scale: 1:500 @ A2
Date: 21.06.21

Appendix 2 – Topographic Survey



SURVEY CONTROL STATIONS

STN	EASTING	NORTHING	HEIGHT
2001	352310.183	434616.422	40.223
2002	352125.785	434558.879	38.742
2003	351994.223	434714.717	37.394
2004	351995.207	434762.953	37.499
2005	351988.117	434815.588	37.359
2006	351985.533	434864.811	36.502
2007	352171.077	434947.369	37.547
2008	352349.371	435036.224	38.584
2009	352443.344	435101.930	40.416
2010	352488.673	434985.169	41.525
2011	352535.422	434786.894	41.214
2012	352551.888	434662.544	42.916
2013	352591.723	434611.238	42.749
2014	352478.244	434686.227	41.899
2016	352490.194	434580.523	43.554
2017	352374.512	434697.995	41.571
2018	352296.594	434688.949	40.602

LEGEND

CONTROL STATIONS	△
MANHOLE	MH CL 31.20
BUSH	
TREE	
DROP KERB	— — — — —
EMBANKMENT	TOP BANK BOTTOM BANK
OVERHEAD ELECTRICITY LINE	
OVERHEAD TELEPHONE LINE	
FOOTPATH	— — — — —
FENCE	
HEDGE	
FOLIAGE	
DITCH	
VERGE	— — — — —
EXISTING BUILDING	☐
MAIN CONTOUR	50.00
CONTOUR	49.50
SW SEWER	
FW SEWER	

AV	Air Valve
BH	Borehole
BD	Bollard
BM	Bench Mark
BS	Bus Stop
BT	BT Inspection Chamber
BL	Bed Level
CATV	Cable TV Cover
CL	Cover Level
C/L	Chain Link Fence
CP	Catch Pit
CPS	Concrete Paving Slab
ECB	Electricity Control Box
EH	Building Eaves Level
ER	Earthing Rod
FB	Flower Bed
FH	Fire Hydrant
FL	Floor Level
GH	Greenhouse
GP	Gate Post
GR	Grate
GV	Gas Valve
G	Gully
IC	Inspection Chamber
IL	Invert Level
KO	Kerb Outlet
JB	Junction Box
LP	Lamp Post
MH	Man Hole
MK	Marker Post
MS	Mile Stone Marker
NP	Street Name Plate
O/H	Overhead
P	Post
PB	Post Box
PI	Pipe
PM	Parking Meter
P/R	Post & Rail Fence
P/W	Post & Wire Fence
PYL	Electricity Pylon
RE	Rodding Eye
RH	Building Ridge Level
RSJ	Reinforced Steel Joist
R/W	Retaining Wall
RWP	Rainwater Pipe
SC	Stop Cock
SL	Soffit Level
SP	Sign Post
ST	Stop Tap
SV	Stop Valve
SY	Stay Wire
TC	Tactile Crossing
TOW	Top Of Wall Level
TH	Trial Hole
TL	Traffic Light
TP	Telegraph Pole
UTL	Unable To Lift
WM	Water Meter
WL	Water Level
VH	Building Valley Level

Disclaimer

Man Entry to sewers has not been undertaken. Depths, Pipesizes etc are measured from the ground. All sewers and inverts to be checked prior to any works commencing on site. Geomatic Surveys Limited are not resposible for manholes, services, information not surveyed which may have an impact on site development.

Boundaries shown are physical and may not represent legally conveyed ownership

Tree species have only been identified using basic identification techniques. For precise tree species identification, it is recommended that a qualified aboroculturist is used prior to tree removal.

REV	DATE	DESCRIPTION	BY	APP.
A	12.04.21	Survey updated and verfified	DB	

Sheet Layout

Sheet 2
Sheet 1

Survey Information

The Survey is related to Ordnance Survey National Grid and Datum, using GPS. A central location for OSNG Grid is Survey Station '2002'. The Scale Factor is 1.0000000.

Geomatic Surveys Ltd
LAND SURVEYORS AND CONSULTING ENGINEERS
Bank House, The Paddock
Wilmslow Road
Handforth
Cheshire
SK9 3HQ
Tel/Fax:– 01625 521405
Email: info@geomaticsurveys.co.uk
Web: www.geomaticsurveys.co.uk

Client

HOLLINS STRATEGIC
LAND LLP

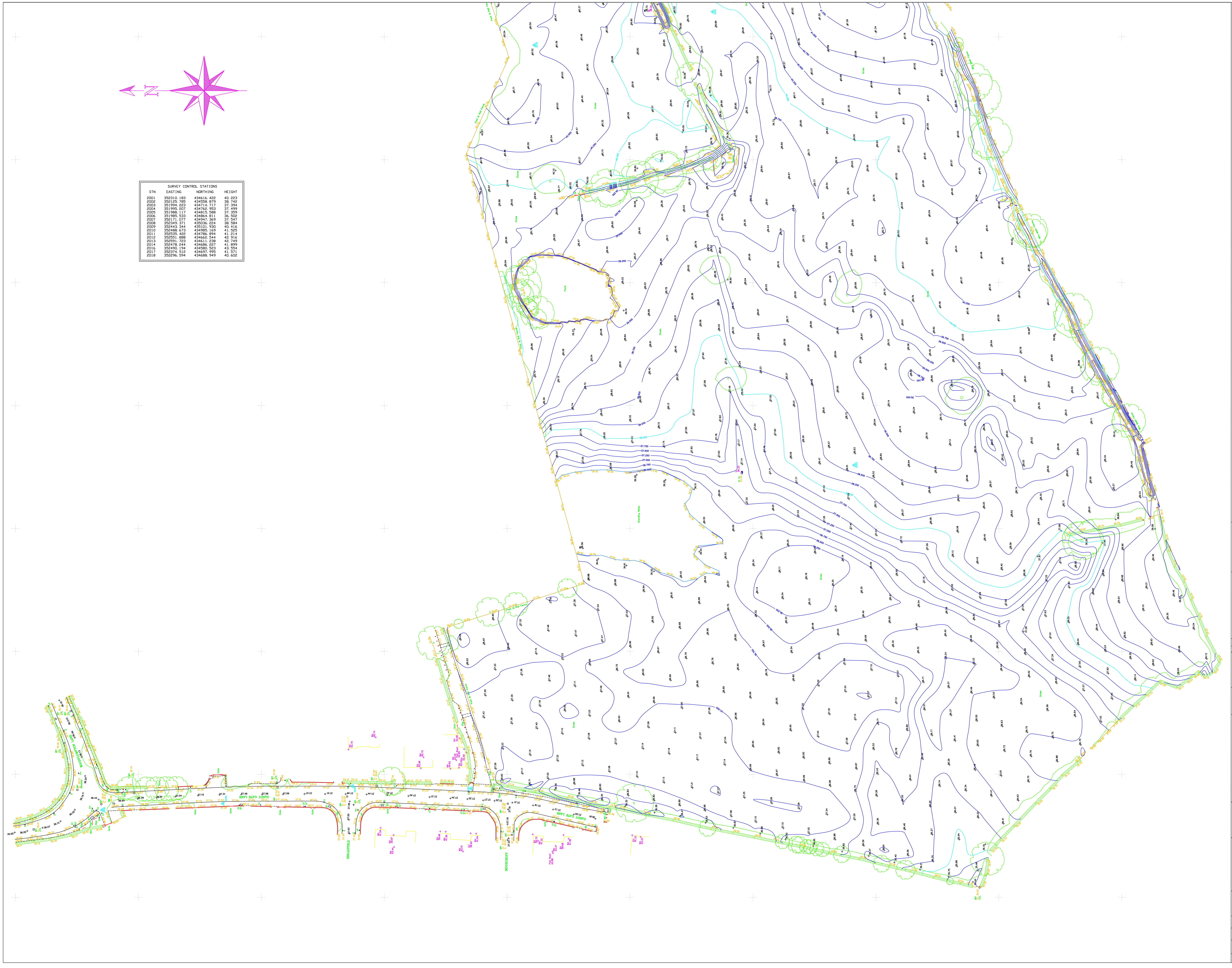
Project Title

LAND AT
'BANK HALL FARM'
BROUGHTON

Drawing Title

TOPOGRAPHICAL SURVEY

Drawn	Checked	Surveyed Date
MRW	IRH	23/12/2015
Date	**Scale**	**Sheet No.**
30/12/2015	1:500 @ A0	SHEET 1 OF 2
Drg. No.		**Rev**
01601/Topo		A



SURVEY CONTROL STATIONS

STN	EASTING	NORTHING	HEIGHT
2001	352310. 183	434616. 422	40. 223
2002	352125. 785	434558. 879	38. 742
2003	351994. 223	434714. 717	37. 394
2004	351995. 207	434762. 953	37. 499
2005	351988. 117	434815. 588	37. 359
2006	351985. 533	434864. 811	36. 502
2007	352171. 077	434947. 369	37. 547
2008	352349. 371	435036. 224	38. 584
2009	352443. 344	435101. 930	40. 416
2010	352488. 673	434985. 169	41. 525
2011	352535. 422	434786. 894	41. 214
2012	352551. 888	434662. 544	42. 916
2013	352591. 723	434611. 238	42. 749
2014	352478. 244	434686. 227	41. 899
2016	352490. 194	434580. 523	43. 554
2017	352374. 512	434697. 995	41. 571
2018	352296. 594	434688. 949	40. 602

LEGEND

CONTROL STATIONS	△
MANHOLE	▭ MH CL 31.20
BUSH	
TREE	
DROP KERB	— — — — —
EMBANKMENT	TOP BANK BOTTOM BANK
OVERHEAD ELECTRICITY LINE	— - — - —
OVERHEAD TELEPHONE LINE	— - — - —
FOOTPATH	— — — — —
FENCE	|——|——
HEDGE	
FOLIAGE	
DITCH	═ ═ ═
VERGE	— — — — —
EXISTING BUILDING	▭
MAIN CONTOUR	50.00
CONTOUR	49.50
SW SEWER	— - — - —
FW SEWER	— — — — —

AV	Air Valve
BH	Borehole
BD	Bollard
BM	Bench Mark
BS	Bus Stop
BT	BT Inspection Chamber
BL	Bed Level
CATV	Cable TV Cover
CL	Cover Level
C/L	Chain Link Fence
CP	Catch Pit
CPS	Concrete Paving Slab
ECB	Electricity Control Box
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ER	Earthing Rod
FB	Flower Bed
FH	Fire Hydrant
FL	Floor Level
GH	Greenhouse
GP	Gate Post
GR	Grate
GV	Gas Valve
G	Gully
IC	Inspection Chamber
IL	Invert Level
KO	Kerb Outlet
JB	Junction Box
LP	Lamp Post
MH	Man Hole
MK	Marker Post
MS	Mile Stone Marker
NP	Street Name Plate
O/H	Overhead
P	Post
PB	Post Box
PI	Pipe
PM	Parking Meter
P/R	Post & Rail Fence
P/W	Post & Wire Fence
PYL	Electricity Pylon
RE	Rodding Eye
RH	Building Ridge Level
RSJ	Reinforced Steel Joist
R/W	Retaining Wall
RWP	Rainwater Pipe
SC	Stop Cock
SL	Soffit Level
SP	Sign Post
ST	Stop Tap
SV	Stop Valve
SY	Stay Wire
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WL	Water Level
VH	Building Valley Level

Disclaimer

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REV	DATE	DESCRIPTION	BY	APP.
A	12.04.21	Survey updated and verified	BY	

Sheet Layout

Sheet 2
Sheet 1

Survey Information

The Survey is related to Ordnance Survey National Grid and Datum, using GPS. A central location for OSNG Grid is Survey Station '2002'. The Scale Factor is 1.0000000.

Geomatic Surveys Ltd
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Email: info@geomaticsurveys.co.uk
Web: www.geomaticsurveys.co.uk

Client

HOLLINS STRATEGIC
LAND LLP

Project Title

LAND AT
'BANK HALL FARM'
BROUGHTON

Drawing Title

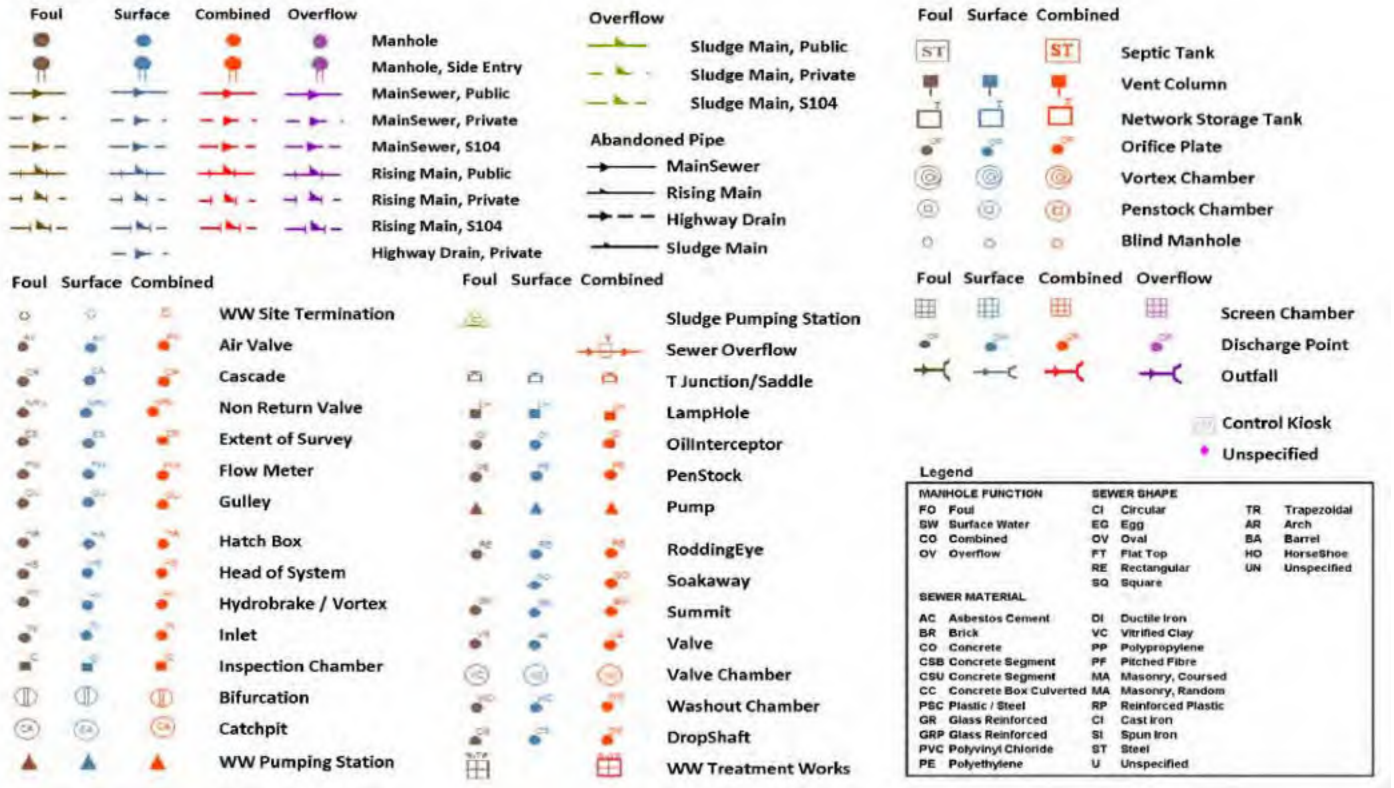
TOPOGRAPHICAL SURVEY

Drawn MRW	Checked IRH	Surveyed Date 23/12/2015
Date 30/12/2015	Scale 1:500 @ A0	Sheet No. SHEET 2 OF 2
Drg. No. 01601/Topo		Rev A

Appendix 3 – United Utilities Asset Plans

United Utilities

WASTE WATER SYMBOLOGY

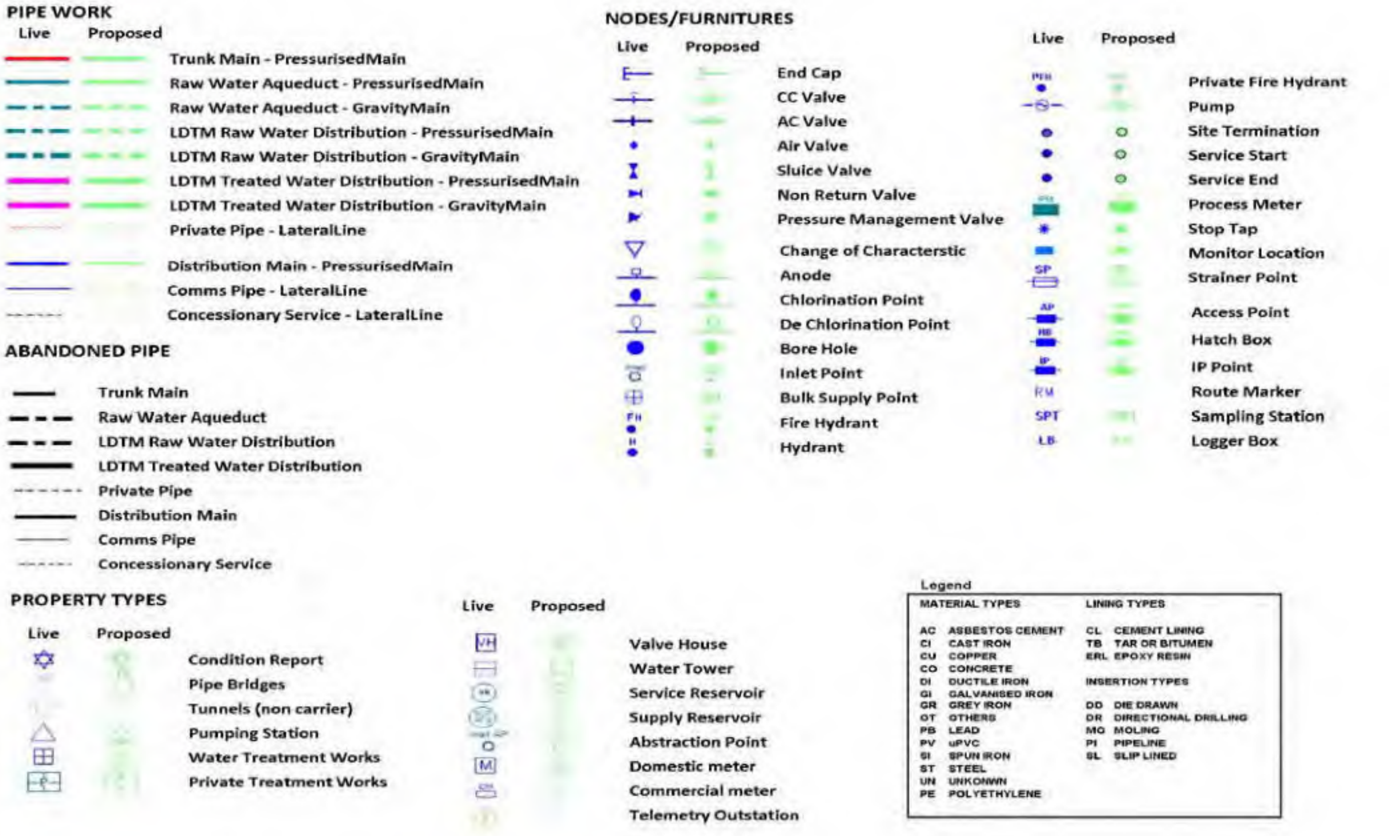


Legend

MANHOLE FUNCTION		SEWER SHAPE			
FO	Foul	CI	Circular	TR	Trapezoidal
SW	Surface Water	EG	Egg	AR	Arch
CO	Combined	OV	Oval	BA	Barrel
OV	Overflow	FT	Flat Top	HO	HorseShoe
		RE	Rectangular	UN	Unspecified
		SQ	Square		

SEWER MATERIAL			
AC	Asbestos Cement	DI	Ductile Iron
BR	Brick	VC	Vitrified Clay
CO	Concrete	PP	Polypropylene
CSB	Concrete Segment	PF	Pitched Fibre
CSU	Concrete Segment	MA	Masonry, Coursed
CC	Concrete Box Culverted	MA	Masonry, Random
PSC	Plastic / Steel	RP	Reinforced Plastic
GR	Glass Reinforced	CI	Cast Iron
GRP	Glass Reinforced	SI	Spun Iron
PVC	Polyvinyl Chloride	ST	Steel
PE	Polyethylene	U	Unspecified

CLEAN WATER SYMBOLOGY



Legend

MATERIAL TYPES		LINING TYPES	
AC	ASBESTOS CEMENT	CL	CEMENT LINING
CI	CAST IRON	TB	TAR OR BITUMEN
CU	COPPER	ERL	EPOXY RESIN
CO	CONCRETE		
DI	DUCTILE IRON	**INSERTION TYPES**	
GI	GALVANISED IRON		
GR	GREY IRON	DD	DIE DRAWN
OT	OTHERS	DR	DIRECTIONAL DRILLING
PB	LEAD	MO	MOLING
PV	uPVC	PI	PIPELINE
SI	SPUN IRON	SL	SLIP LINED
ST	STEEL		
UN	UNKONWN		
PE	POLYETHYLENE		

OS Sheet No: SD5134NE

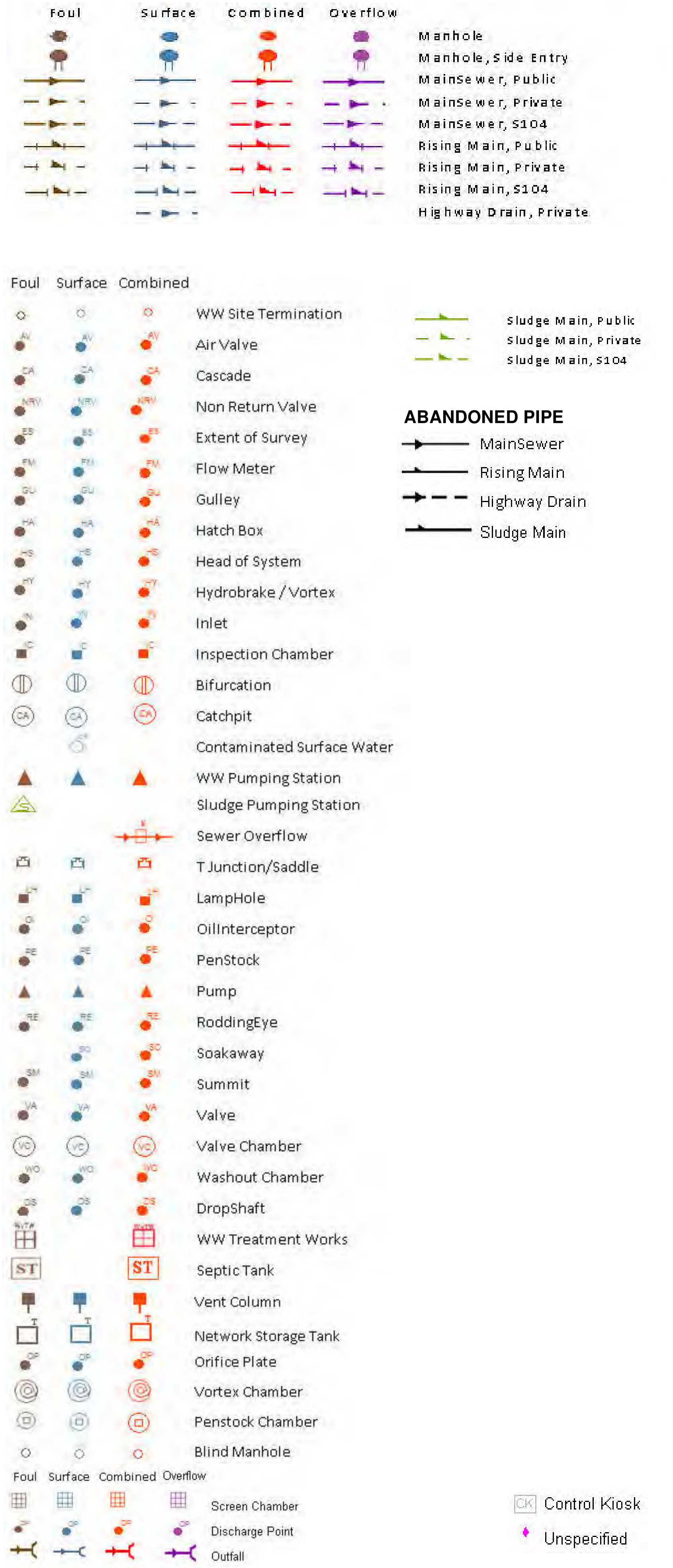
Scale: 1: 1250 Date: 17/12/2015

Printed By: Property Searches

Refno	Cover	Func	Invert	Size.x	Size.y	Shape	Matl	Length	Grad
8601		FO	0	150		CI	VC	51.77	
8701		SW	0	150		CI	VC	67.67	
8702		FO	0	150		CI	VC	31.92	
8703		FO							
8704		SW	0	150		CI	VC	49.19	
8705		FO							
8706		FO							
8901	38.39	FO							
8902	37.49	SW							
8903		FO							
8904	38.18	SW	36.22	150		CI	VC	21.83	75
8905	38.22	FO	36.43	225		CI	VC	45.18	
8906		SW							
8907	39	FO	37.21	225		CI	VC	58.53	143
8908		SW	0	150		CI	VC	43.02	
9601		SW							
9602		SW							
9603	37.33	SW							
9604	37.33	SW							
9605		FO							
9606	37.57	FO							
9607	37.26	FO							
9701	37.63	FO							
9702	37.34	FO							
9703		SW							
9704		FO							
9705	37.54	FO							
9706	37.59	SW							
9801	35.99	FO	33.38	225		CI	VC	82.83	136
9802	36.68	FO							
9803	36.07	SW							
9807		FO	34.71	225		CI	VC	32.99	25
9901	35.9	FO							
9902	35.84	FO							
9903	36.2	SW							
9904	36.48	FO							
9905		SW		600		CI	CO	125.83	
7701		FO				CI	PVC	401.57	
8909		SW	35.93	225		CI	VC	21.39	74
8911		SW							
9608		FO	36.02	225		CI	VC	15.96	123
9609		SW	35.7	225		CI	VC	6.43	129
9707		FO	0	225		CI	VC	29.06	
9708		FO	0	225		CI	VC	24.38	
9709		SW							
9804		SW	0	225		CI	VC	4.93	
8707		FO							
8912		SW							
9805		SW							
9806		SW							

Refno	Cover	Func	Invert	Size.x	Size.y	Shape	Matl	Length	Grad

WASTE WATER SYMBOLOGY



LEGEND

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement	DI	Ductile Iron
BR	Brick	PVC	Polyvinyl Chloride
PE	Polyethylene	CI	Cast Iron
RP	Reinforced Plastic Matrix	SI	Spun Iron
CO	Concrete	ST	Steel
CSB	Concrete Segment Bolted	VC	Vitrified Clay
CSU	Concrete Segment Unbolted	PP	Polypropylene
CC	Concrete Box Culverted	PF	Pitch Fibre
PSC	Plastic/Steel Composite	MAC	Masonry, Coursed
GRC	Glass Reinforced Concrete	MAR	Masonry, Random
GRP	Glass Reinforced Plastic	U	Unspecified

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OS Sheet No: SD5134NE
Scale: 1: 1250 Date: 17/12/2015
50 Nodes
Sheet 1 of 1

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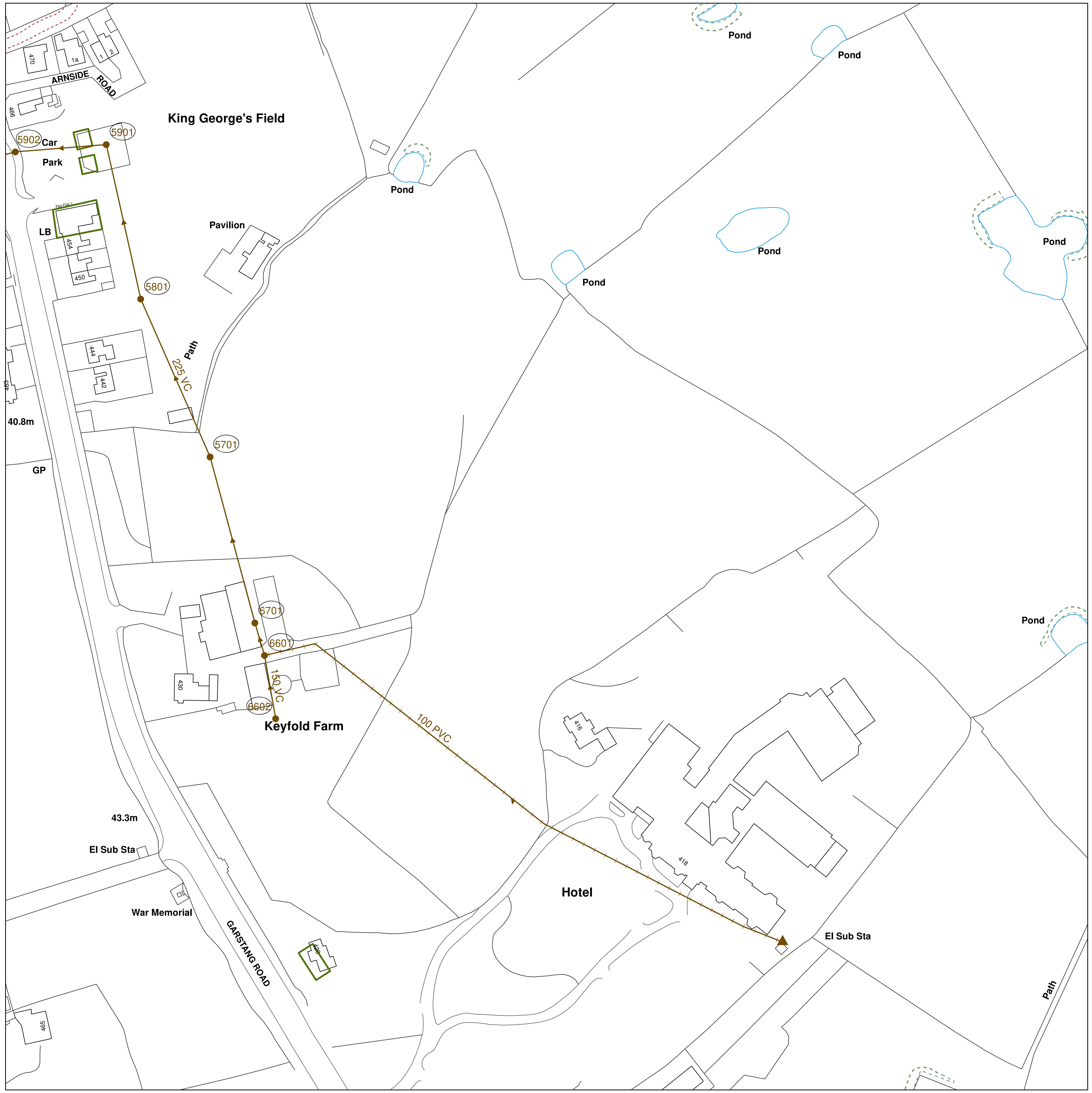
SEWER RECORDS



Refno	Cover	Func	Invert	Size.x	Size.y	Shape	Matl	Length	Grad	Refno	Cover	Func	Invert	Size.x	Size.y	Shape	Matl	Length	Grad
5701		FO																	
5801	40.3	FO																	
5901	41.39	FO																	
5902		FO																	
6601		FO																	
6602		FO	0	150		CI	VC	29.67											
6701		FO																	
8501		FO	0			CI	PVC	281.54											

OS Sheet No: SD5234NE

Scale: 1: 1250 Date: 17/12/2015

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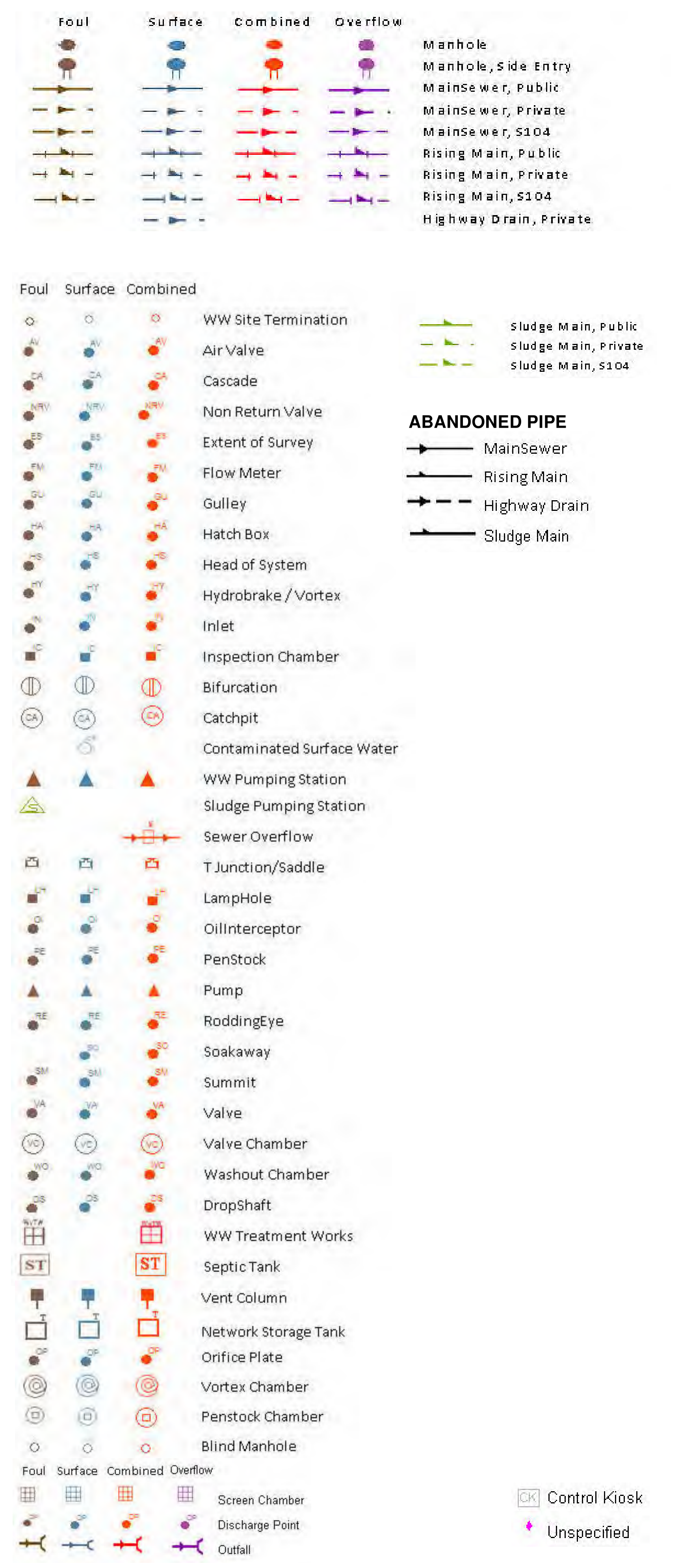
WASTE WATER SYMBOLOGY



LEGEND

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

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BR	Brick	PVC	Polyvinyl Chloride
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OS Sheet No: SD5234NE
Scale: 1: 1250 Date: 17/12/2015
8 Nodes
Sheet 1 of 1

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SEWER RECORDS

Refno	Cover	Func	Invert	Size.x	Size.y	Shape	Matl	Length	Grad
0701		FO							
0702		FO							
0801	36.1	SW							
0802		FO	0	150		CI	VC	151.8	
1901		FO	0	150		CI	VC	56.59	
1905	37.55	FO							
1906	37.59	SW							
1907	37.73	FO							
2801		FO							
2901	37.39	FO							
2904	37.39	FO	36.29	225		CI	VC	59.4	106
2905	37.45	FO							
3901		SW							
3902		SW							
4801		FO	0	300		CI	VC	141.28	
4901		FO	0	225		CI	VC	89.74	
0901		SW	0	100		CI	VC	58.1	
1902		FO	0	300		CI	VC	28.41	
1903		FO	0	225		CI	VC	22.23	
1908		CO							
1909		CO							
1913		FO							
1914		FO							
4902		FO	0	225		CI	VC	68.73	
1904		FO							
1910		FO							
1915		FO							
2902		FO							
2903		SW	36.33	450		CI	VC	13.46	96

Refno	Cover	Func	Invert	Size.x	Size.y	Shape	Matl	Length	Grad

LEGEND

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement	DI	Ductile Iron
BR	Brick	PVC	Polyvinyl Chloride
PE	Polyethylene	CI	Cast Iron
RP	Reinforced Plastic Matrix	SI	Spun Iron
CO	Concrete	ST	Steel
CSB	Concrete Segment Bolted	VC	Vitrified Clay
CSU	Concrete Segment Unbolted	PP	Polypropylene
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PSC	Plastic/Steel Composite	MAC	Masonry, Coursed
GRC	Glass Reinforced Concrete	MAR	Masonry, Random
GRP	Glass Reinforced Plastic	U	Unspecified

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OS Sheet No: SD5234NW
Scale: 1: 1250 Date: 17/12/2015
29 Nodes
Sheet 1 of 1

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SEWER RECORDS

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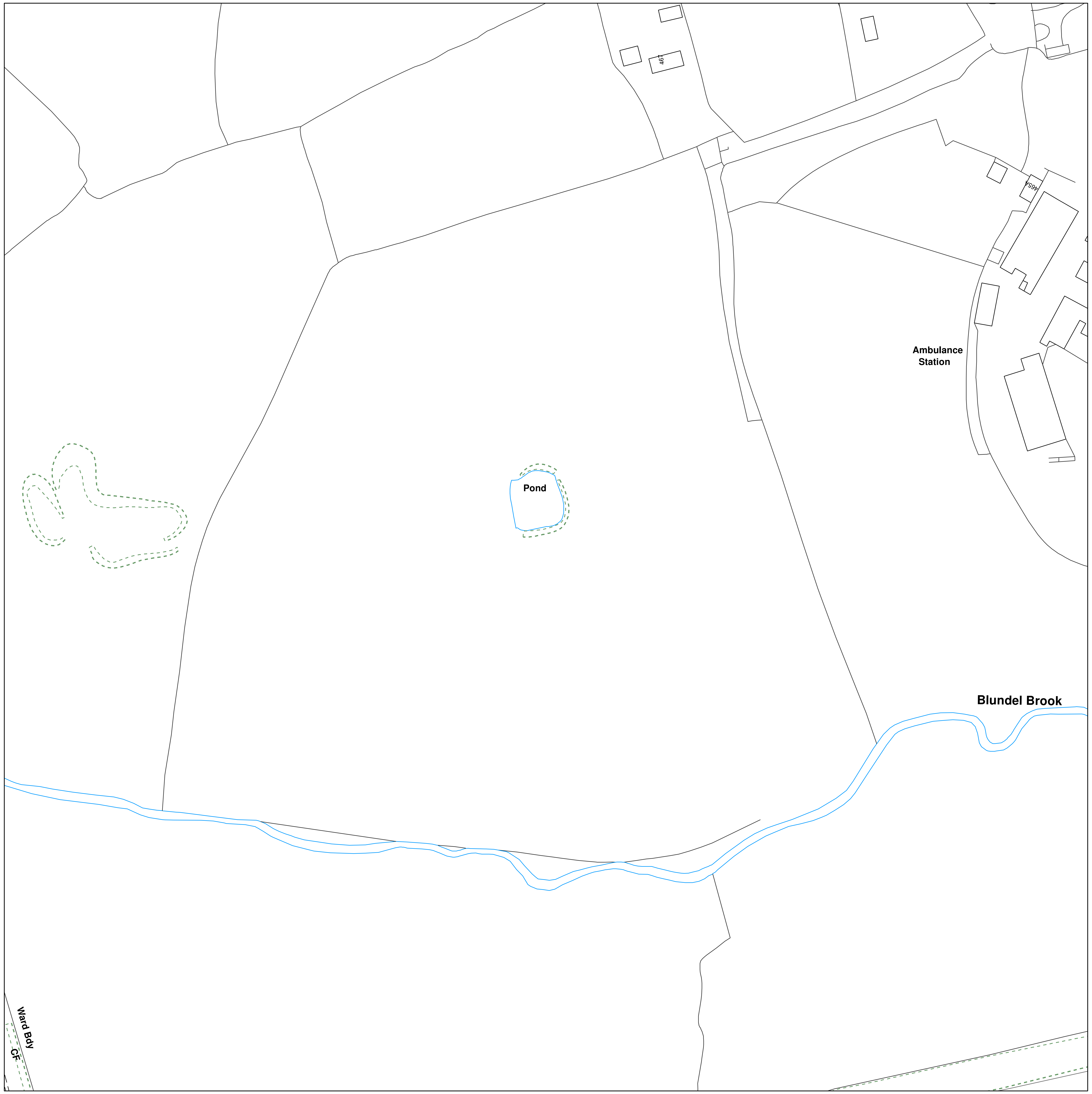
OS Sheet No: SD5234NW

Scale: 1: 1250 Date: 17/12/2015



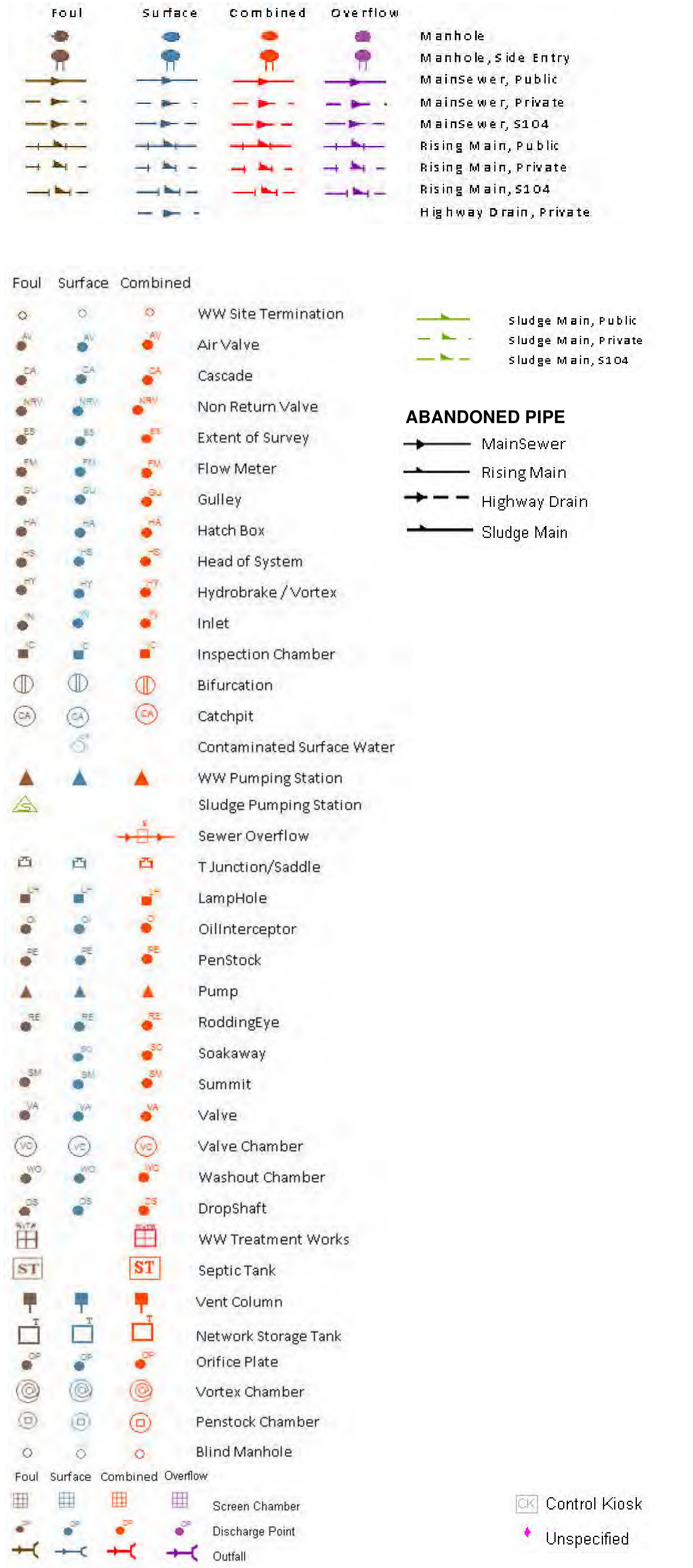
Refno Cover Func Invert Size.x Size.y Shape Matl Length Grad Refno Cover Func Invert Size.x Size.y Shape Matl Length Grad

OS Sheet No: SD5234SW

Scale: 1: 1250 Date: 17/12/2015

Printed By: Property Searches

WASTE WATER SYMBOLOGY



LEGEND

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement	DI	Ductile Iron
BR	Brick	PVC	Polyvinyl Chloride
PE	Polyethylene	CI	Cast Iron
RP	Reinforced Plastic Matrix	SI	Spun Iron
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CSB	Concrete Segment Bolted	VC	Vitrified Clay
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GRP	Glass Reinforced Plastic	U	Unspecified

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OS Sheet No: SD5234SW
Scale: 1: 1250 Date: 17/12/2015
0 Nodes
Sheet 1 of 1

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SEWER RECORDS

Appendix 4 – Environment Agency Correspondence

Daniel Alstead

From: CMBLNC Info Requests <Inforequests.cmblnc@environment-agency.gov.uk>
Sent: 26 April 2021 09:36
To: Daniel Alstead
Cc: CMBLNC Info Requests
Subject: CL213441MG Response - Flood Risk and Drainage Enquiry - Garstang Road, Broughton

Good Morning Daniel

Thank you for contacting the Environment Agency regarding Flood Risk and Drainage Enquiry - Garstang Road, Broughton.

We respond under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. Please refer to the Open Government Licence which explains the permitted use of this information.

As this site is located in Flood Zone 1, and is not covered by local detailed hydraulic modelling for main rivers or the sea, we are unable to provide Product 4 data in this instance.

Flood Risk

- Can you confirm the Flood Zone within the Site boundary as described above?

As identified, the site is located in Flood Zone 1, defined by the Environment Agency's Flood Map for Planning as being at 'very low' risk of flooding from main rivers and the sea. This means that each year this location has less than a 0.1% (1 in 1000) chance of flooding from main rivers and the sea.

- Do you agree with our above interpretation of surface water flooding?

Agreed. However for further information on flooding from surface water, groundwater or ordinary watercourses, please contact the Lead Local Flood Authority for this area, Lancashire County Council. Surface water flood risk maps can be viewed online at: https://flood-warning-information.service.gov.uk/long-term-flood-risk

- Do you have any records of historic flooding events on this Site, either from fluvial, surface water, groundwater, sewers or infrastructure failure sources? If you are aware of historical flooding at the Site, can you please provide us with details of these historical flood events where it is available, including flood levels, estimated return periods, photographs, and other such data as may be relevant to our study?

The Environment Agency does not hold any record of historic flooding in this location.

Drainage

- Do you have any information on drainage within the Site and in the local area, including any known drainage problems?

As above, for further information on drainage, or for flooding from surface water, groundwater or ordinary watercourses, please contact the Lead Local Flood Authority for this area, Lancashire County Council. We are not currently aware of any drainage issues relating to main rivers that may affect this site.

- The proposal is for a development of a greenfield Site. Please could you indicate the maximum allowable discharge rate? Note, we will be undertaking a review of the capacity of the proposed receiving network [i.e. drainage network serving the development on land to the west].

Peak runoff rate from the development must not exceed the existing greenfield runoff rate for the site in both 1 in 1 year and 1 in 100 year design event, accounting for the effects of climate change. Please see the non-statutory technical standards for sustainable drainage design at the following website: https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards. It is your responsibility to calculate both existing and proposed greenfield runoff rates, and to ensure no net impact. Please be aware that for detailed advice and guidance on sustainable drainage design, you should talk to the Lead Local Flood Authority, Lancashire County Council. They will be responsible for reviewing the surface water drainage/attenuation aspects of this proposal.

- What level of allowance for climate change would be required when considering surface water attenuation?

You must consider the ‘Upper End’ 40% peak rainfall intensity allowance, as specified in Table 2 of current government guidance on climate change allowances, available at the following website:
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

- There are no flood defences at this location.

- We hold records for Blundell Brook for eels and its part of eel migratory route.

You are welcome to get in touch if you have any further queries or you can contact us within 2 months if you would like us to review the information we have sent to you.

Kind regards,

Mark

Mark Goucher | Customers and Engagement Officer
Customers and Engagement Team | Cumbria and Lancashire
External: 020 302 50821

Appendix 5 – BGS Historical Borehole Records

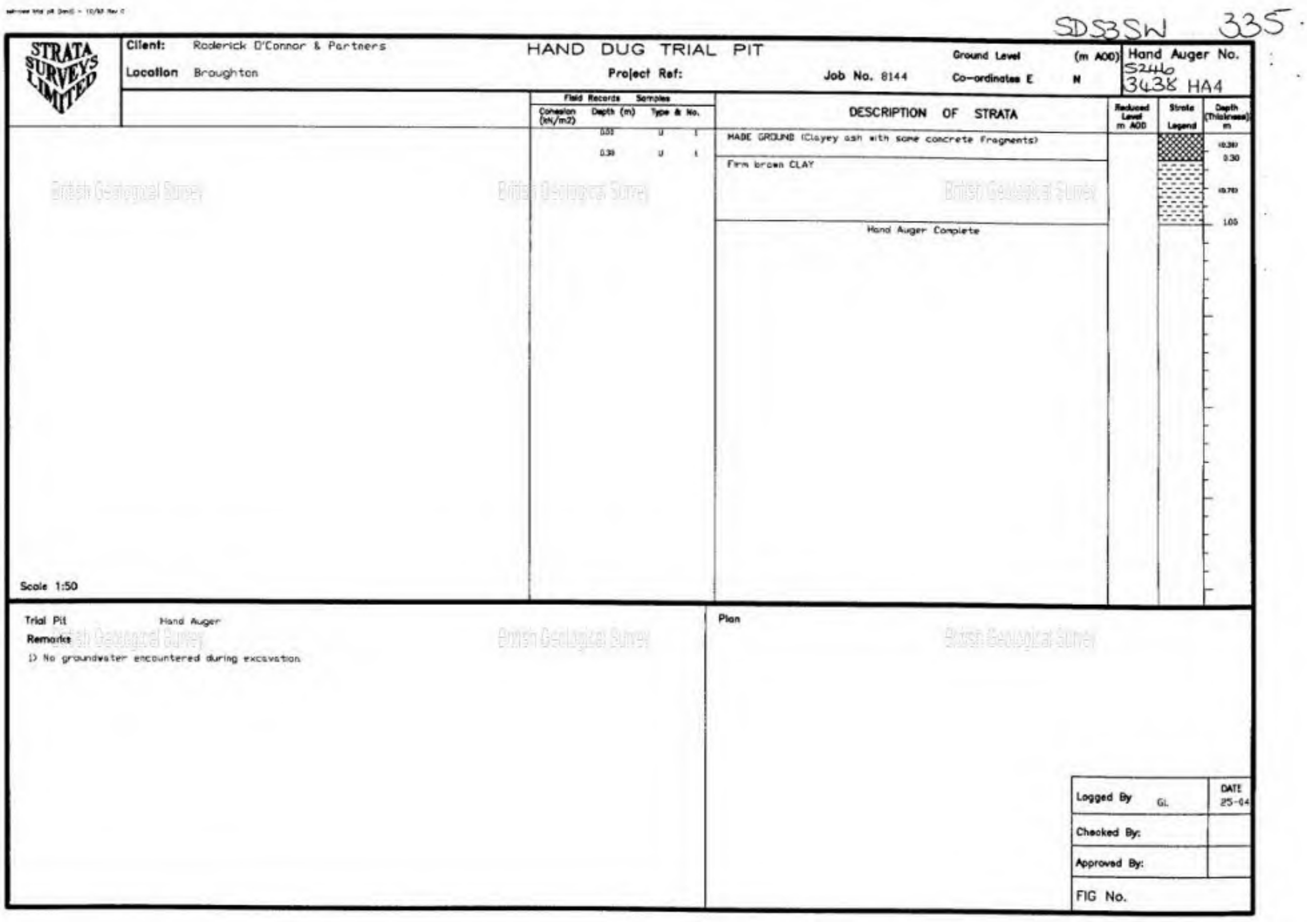
Appendix 6 – Western/Eastern Development Drainage Strategies

Version 2.0.6.3

BGS ID: 12471 : BGS Reference: SD53SW335
British National Grid (27700) : 352460,434380

Report an issue with this borehole

<< < Prev Page 1 of 3 Next > >>



SD53SW 335.

Client: Roderick O'Connor & Partners

Location Broughton

HAND DUG TRIAL PIT

Project Ref:

Job No. 8144

Ground Level (m AOD)

Co-ordinates E **N**

Hand Auger No.
S246
3438 HA4

Field Records Cohesion (kN/m2)	Samples Depth (m)	Samples Type & No.	DESCRIPTION OF STRATA	Reduced Level m AOD	Strata Legend	Depth (Thickness) m
	0.05	U 1	MADE GROUND (Clayey ash with some concrete fragments)		▩	(0.30) 0.30
	0.30	U 1	Firm brown CLAY		┅	(0.70) 1.00
			Hand Auger Complete			

Scale 1:50

Trial Pit Hand Auger

Remarks

1) No groundwater encountered during excavation

Plan

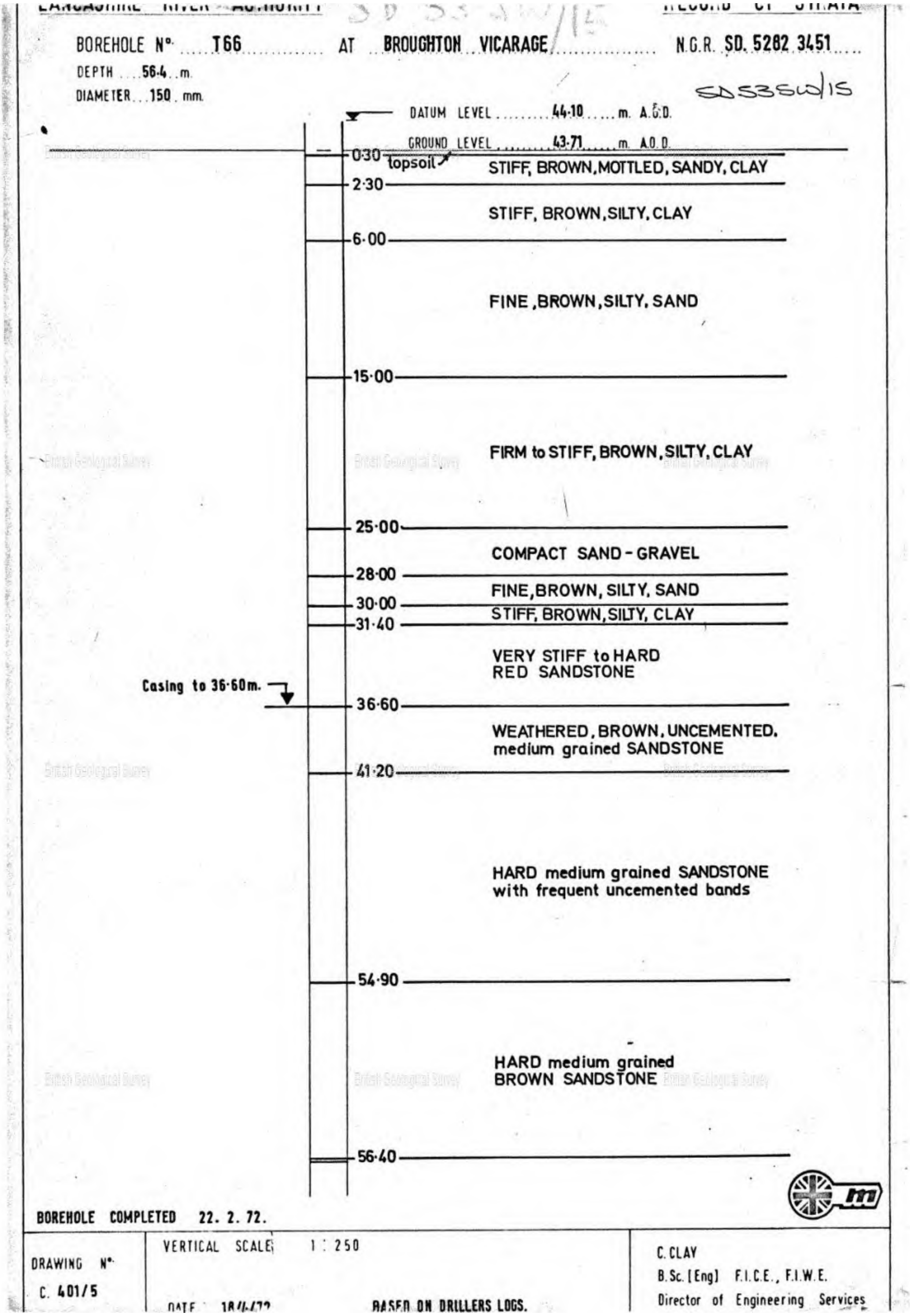
Logged By	GL	DATE 25-04
Checked By:		
Approved By:		
FIG No.		

Version 2.0.6.3

BGS ID: 12151 : BGS Reference: SD53SW15
British National Grid (27700) : 352820,434510

Report an issue with this borehole

<< < Prev Page 1 of 6 Next > >>



LANCASHIRE RIVER AUTHORITY SD 53 SW/15 RECORD OF STRATA

BOREHOLE Nº. T66 AT BROUGHTON VICARAGE N.G.R. SD. 5282 3451

DEPTH 56·4 m.

DIAMETER 150 mm.

SD53SW/15

DATUM LEVEL 44·10 m. A.O.D.

GROUND LEVEL 43·71 m. A.O.D.

Depth (m)	
0·30	topsoil
2·30	STIFF, BROWN, MOTTLED, SANDY, CLAY
6·00	STIFF, BROWN, SILTY, CLAY
15·00	FINE, BROWN, SILTY, SAND
25·00	FIRM to STIFF, BROWN, SILTY, CLAY
28·00	COMPACT SAND - GRAVEL
30·00	FINE, BROWN, SILTY, SAND
31·40	STIFF, BROWN, SILTY, CLAY
36·60	VERY STIFF to HARD RED SANDSTONE
41·20	WEATHERED, BROWN, UNCEMENTED, medium grained SANDSTONE
54·90	HARD medium grained SANDSTONE with frequent uncemented bands
56·40	HARD medium grained BROWN SANDSTONE

Casing to 36·60m.

BOREHOLE COMPLETED 22. 2. 72.

DRAWING Nº. C. 401/5

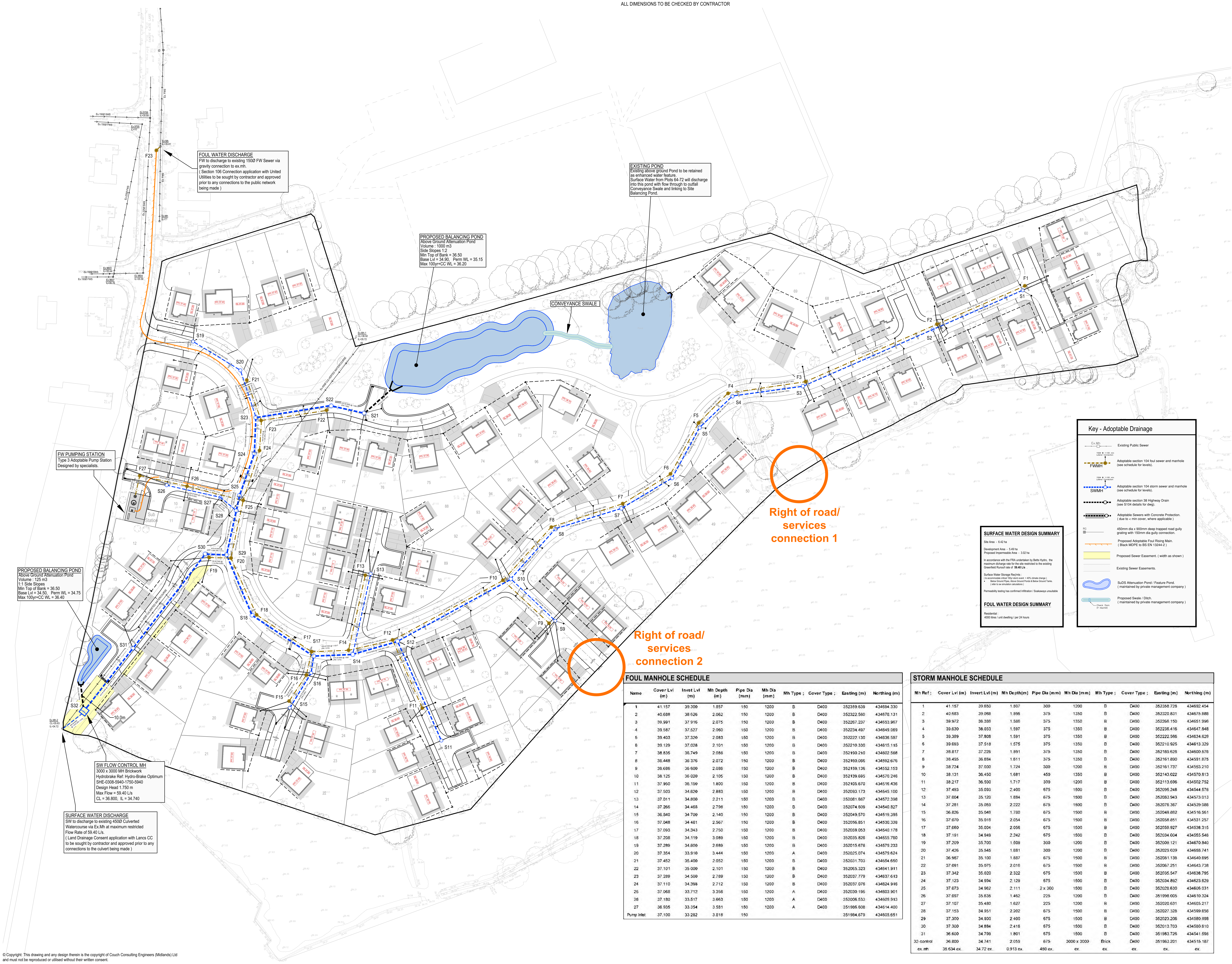
VERTICAL SCALE 1 : 250

DATE 18/4/72

BASED ON DRILLERS LOGS.

C. CLAY
B.Sc. [Eng] F.I.C.E., F.I.W.E.
Director of Engineering Services

ALL DIMENSIONS TO BE CHECKED BY CONTRACTOR



FOUL WATER DISCHARGE
FW to discharge to existing 150Ø FW Sewer via gravity connection to ex.mh.
(Section 106 Connection application with United Utilities to be sought by contractor and approved prior to any connections to the public network being made)

EXISTING POND
Existing above ground Pond to be retained as enhanced water feature.
Surface Water from Plots 64-72 will discharge into this pond with flow through to outfall Conveyance Swale and linking to Site Balancing Pond.

PROPOSED BALANCING POND
Above Ground Attenuation Pond
Volume : 1000 m3
Side Slopes 1:2
Min Top of Bank = 36.50
Base Lvl = 34.90, Perm WL = 35.15
Max 100yr+CC WL = 36.20

FW PUMPING STATION
Type 3 Adoptable Pump Station
Designed by specialists.

PROPOSED BALANCING POND
Above Ground Attenuation Pond
Volume : 125 m3
1:1 Side Slopes
Min Top of Bank = 36.50
Base Lvl = 34.50, Perm WL = 34.75
Max 100yr+CC WL = 36.40

SW FLOW CONTROL MH
3000 x 3000 MH Brickwork
Hydrobrake Ref: Hydro-Brake Optimum
SHE-0308-5940-1750-5940
Design Head 1.750 m
Max Flow = 59.40 L/s
CL = 36.800, IL = 34.740

SURFACE WATER DISCHARGE
SW to discharge to existing 450Ø Culverted Watercourse via Ex.Mh at maximum restricted Flow Rate of 59.40 L/s.
(Land Drainage Consent application with Lancs CC to be sought by contractor and approved prior to any connections to the culvert being made)

SURFACE WATER DESIGN SUMMARY

Site Area - 6.42 ha

Development Area - 5.49 ha
Proposed Impermeable Area - 3.02 ha

In accordance with the FRA undertaken by Betts Hydro, the maximum dicharge rate for the site restricted to the existing Greenfield Runoof rate of **59.40 L/s** .

Surface Water Storage Req'mts :
(to accommodate critical 100yr storm event + 40% climate change)
- Below Ground Pipes, Above Ground Ponds & Below Ground Tanks. (refer to sw simulation calculations)

Permeability testing has confirmed Infiltration / Soakaways unsuitable

FOUL WATER DESIGN SUMMARY

Residential :
4000 litres / unit dwelling / per 24 hours

Key - Adoptable Drainage

Ex.Mh	Existing Public Sewer
150ø @ 1:100 min Lateral Connection FWMH	Adoptable section 104 foul sewer and manhole (see schedule for levels).
150ø @ 1:100 min Lateral Connection SWMH	Adoptable section 104 storm sewer and manhole (see schedule for levels).
	Adoptable section 38 Highway Drain (see S104 details for dwg).
	Adoptable Sewers with Concrete Protection. (due to < min cover, where applicable)
RG	450mm dia x 900mm deep trapped road gully grating with 150mm dia gully connection.
	Proposed Adoptable Foul Rising Main. (Black MDPE to BS EN 13244-2)
🟨	Proposed Sewer Easement. (width as shown)
▨	Existing Sewer Easements.
	SuDS Attenuation Pond / Feature Pond. (maintained by private management company)
Check Dam (if required)	Proposed Swale / Ditch. (maintained by private management company)

FOUL MANHOLE SCHEDULE

Name	Cover Lvl (m)	Invet Lvl (m)	Mh Depth (m)	Pipe Dia (mm)	Mh Dia (mm)	Mh Type ;	Cover Type ;	Easting (m)	Northing (m)
1	41.157	39.300	1.857	150	1200	B	D400	352359.639	434694.330
2	40.688	38.626	2.062	150	1200	B	D400	352322.560	434678.131
3	39.991	37.916	2.075	150	1200	B	D400	352267.237	434653.967
4	39.587	37.527	2.060	150	1200	B	D400	352234.497	434649.069
5	39.403	37.320	2.083	150	1200	B	D400	352222.130	434636.597
6	39.129	37.028	2.101	150	1200	B	D400	352210.330	434615.115
7	38.835	36.749	2.086	150	1200	B	D400	352190.210	434602.568
8	38.448	36.376	2.072	150	1200	B	D400	352160.066	434592.676
9	38.686	36.600	2.086	150	1200	B	D400	352159.136	434552.153
10	38.125	36.020	2.105	150	1200	B	D400	352139.695	434570.246
11	37.950	36.150	1.800	150	1200	B	D400	352105.670	434516.436
12	37.503	34.620	2.883	150	1200	B	D400	352093.173	434545.100
13	37.011	34.800	2.211	150	1200	B	D400	352081.667	434572.398
14	37.266	34.468	2.798	150	1200	B	D400	352074.609	434540.827
15	36.840	34.700	2.140	150	1200	B	D400	352049.570	434519.395
16	37.048	34.481	2.567	150	1200	B	D400	352056.851	434530.338
17	37.093	34.343	2.750	150	1200	B	D400	352059.053	434540.178
18	37.208	34.119	3.089	150	1200	B	D400	352035.826	434555.760
19	37.289	34.600	2.689	150	1200	B	D400	352015.676	434579.233
20	37.354	33.910	3.444	150	1200	A	D400	352025.074	434579.624
21	37.452	35.400	2.052	150	1200	B	D400	352031.703	434654.650
22	37.101	35.000	2.101	150	1200	B	D400	352065.323	434641.911
23	37.289	34.500	2.789	150	1200	B	D400	352037.779	434637.613
24	37.110	34.398	2.712	150	1200	B	D400	352037.076	434624.916
25	37.068	33.712	3.356	150	1200	A	D400	352030.195	434603.901
26	37.180	33.517	3.663	150	1200	A	D400	352006.533	434609.913
27	36.935	33.354	3.581	150	1200	A	D400	351986.608	434614.400
Pump Inlet	37.100	33.282	3.818	150				351984.679	434605.651

STORM MANHOLE SCHEDULE

Mh Ref ;	Cover Lvl (m)	Invert Lvl (m)	Mh Depth(m)	Pipe Dia (mm)	Mh Dia (mm)	Mh Type ;	Cover Type ;	Easting (m)	Northing (m)
1	41.157	39.650	1.507	300	1200	B	D400	352358.728	434692.454
2	40.683	39.088	1.595	375	1350	B	D400	352320.831	434675.888
3	39.972	38.386	1.586	375	1350	B	D400	352266.150	434651.996
4	39.630	38.033	1.597	375	1350	B	D400	352236.416	434647.848
5	39.399	37.808	1.591	375	1350	B	D400	352222.566	434634.629
6	39.093	37.518	1.575	375	1350	B	D400	352210.925	434613.329
7	38.817	37.226	1.591	375	1350	B	D400	352189.628	434600.576
8	38.495	36.884	1.611	375	1350	B	D400	352161.890	434591.875
9	38.724	37.000	1.724	300	1200	B	D400	352161.737	434553.210
10	38.131	36.450	1.681	450	1350	B	D400	352143.022	434570.813
11	38.217	36.500	1.717	300	1200	B	D400	352113.696	434502.752
12	37.493	35.093	2.400	675	1500	B	D400	352095.248	434544.576
13	37.004	35.120	1.884	675	1500	B	D400	352083.943	434573.013
14	37.281	35.059	2.222	675	1500	B	D400	352076.367	434539.086
15	36.826	35.046	1.780	675	1500	B	D400	352049.862	434516.561
16	37.070	35.016	2.054	675	1500	B	D400	352058.851	434531.257
17	37.060	35.004	2.056	675	1500	B	D400	352059.927	434538.315
18	37.191	34.949	2.242	675	1500	B	D400	352034.004	434555.546
19	37.209	35.700	1.509	300	1200	B	D400	352009.121	434670.840
20	37.426	35.545	1.881	300	1200	B	D400	352029.039	434658.741
21	36.987	35.100	1.887	675	1500	B	D400	352081.138	434640.695
22	37.091	35.075	2.016	675	1500	B	D400	352067.251	434643.738
23	37.342	35.020	2.322	675	1500	B	D400	352035.547	434638.795
24	37.123	34.994	2.129	675	1500	B	D400	352034.892	434623.629
25	37.073	34.962	2.111	2 x 300	1500	B	D400	352028.630	434606.031
26	37.097	35.635	1.462	225	1200	B	D400	351998.005	434610.324
27	37.107	35.480	1.627	225	1200	B	D400	352020.631	434605.217
28	37.153	34.951	2.202	675	1500	B	D400	352027.328	434599.656
29	37.300	34.900	2.400	675	1500	B	D400	352023.206	434580.998
30	37.300	34.884	2.416	675	1500	B	D400	352013.703	434580.610
31	36.600	34.799	1.801	675	1500	B	D400	351983.726	434541.598
32-control	36.800	34.741	2.059	675	3000 x 3000	Brick	D400	351963.201	434515.187
ex.mh	35.634 ex.	34.72 ex.	0.913 ex.	450 ex.	ex.	ex.	ex.	ex.	ex.

General Notes - Adoption Works

1. Do not scale this drawing. If in doubt, ask.

2. This drawing is to be read in conjunction with all other relevant Engineers, Architects and specialist design drawings and details.

3. All dimensions are in metres unless noted otherwise. All levels are in metres unless noted otherwise.

4. Any discrepancies noted on site are to be reported to the Engineer immediately.

5. It is the responsibility of the Contractor to locate any service apparatus in the vicinity of the works. The client will accept no claims whatsoever in respect of any losses or damage caused in respect of such apparatus, however caused.

6. It is the responsibility of the Contractor to execute the works at all times in strict accordance with the requirements of the Health And Safety At Work Act 1974, and the C.D.M. Regulations 2015. The Contractor will be deemed to have allowed for full compliance, including full liaison with the Planning Supervisor, within his rates.

7. The Contractor is responsible for ensuring that all works are to the satisfaction of the Engineer, and shall be deemed to have included within his rates for any necessary testing.

8. The Contractor will be responsible for providing all necessary de-watering and trench support to execute the works in a satisfactory manner, and shall be deemed to have allowed for the same within his rates.

9. All new sewers to be adopted under "Section 104" of the Water Industry Act shall be constructed to satisfaction of the Local Water Authority . All construction methods, workmanship and testing to comply with Council Standard Specification and W.A.A. Sewers for Adoption 6th edition.

Location and level of all existing drainage to be verified by contractor on-site prior to laying of any proposed pipework.

All adoptable pipework to be ;-
Clay Class 120 or 28KN/m crushing strength to BS.EN 295-1 (150Ø),
Clay Class 160 or 36KN/m crushing strength to BS.EN 295-1 (225Ø),
Clay Class 160 or 48KN/m crushing strength to BS.EN 295-1 (300Ø),
Class 120 (H) concrete to BS EN 1916 / BS 5911 (375Ø >)

Alternatively PVCu to BS EN 1401-1 may be used ;-
Polypipe 'Polysewer' or similar pipes may be used up to 300mm dia, Polypipe 'Ridgisewer' or similar pipes 450mm dia - 900mm dia, subject to approval by the engineer / adopting authority .
The materials to be used shall be suitable for the ground conditions.

All laid on Class 'S' bedding unless otherwise stated.

All pipes / pipes of different sizes shall be laid with soffits level unless stated otherwise.
Where pipes crossing, plastic membrane to be used for protection to eliminate possible cross contamination.
No backdrop's to be used, steeper gradients are preferred.

No deep rooted trees or shrubs to be planted within 5m of a public or prospective public sewer.

Foul lateral connections to be 150mmØ laid at 1/100.
Storm lateral connections shall be 150mmØ laid at 1/100
(to be taken beyond adoptable highway unless otherwise shown)

At least one week prior to commencement of the drainage works, the contractor shall check the invert level of the existing sewers. if there are any discrepancies with the invert levels shown the engineer shall be contacted immediately.

Redundant sewers to be dug out or grouted and manholes broken down and the void filled with Conc Class ST3.

Protective Concrete cover slabs are to be used on pipes where cover is ;-
< 1200mm under the carriageway or vehicular access area.
< 900mm under non-traffic area's.

Manhole covers and frames to be double triangular, Class D400 cast iron, 150mm deep, having a 675mm x 675mm clear opening to comply with STW Ltd current Health & Safety standards.
All kitemarked to HA104/09 plus BS EN124 (BS 497)
The use of 'infill covers and frames' in block paved areas are NOT to be used.
Precast Concrete manhole rings will not be cut under any circumstances. Other options are preferred, mh built up with concrete or brickwork to top of pipe.
Type 'E' manhole the opening cover/frame should be located centrally over the pipe.
In situations where traffic loading is anticipated to be heavier than would occur on a typical residential estate distributor road (i.e. braking/turning near a junction) a higher spec cover 'E600' should be used.

All new gullies to be heavy duty polypropylene/concrete 900mmx450mm, with 150mm dia trapped outlets surrounded with minimum 150mm thick ST1 concrete surround.

Private drainage connections to public sewers shall be minimum 150mm dia beneath adoptable highway.

When in a highway the ouside of a sewer shall be at least 1.0m from the kerb line and the outside of manholes shall be at least 0.5m from the kerb line.
Easements at any change in width shall be ;- 2.5m to each side of centreline of pipe size up to 300Ø and 5m each side of the centreline of the pipe size greater than 300Ø.

Private inspection chambers shall not be situated in adoptable areas.

Where a private sewer serving more than '3' properties connects to a public sewer the junction shall be via a manhole.

All existing sewers to be abandoned shall be either grouted up or grubbed up.

All proposed adoptable drainage shall be subject to formal approval by respective water authority. Costs of all inspections for approval with water authority to be by contractor.

The first manhole upstream from the connection to the public sewer should, when constructed, be fitted with a screen in order to prevent debris entering the public sewer. the screen should not be removed until immediately prior to the occupation of the premises to be served sewer.

Trees on the dwg are existing or proposed and adhere to B.2.3 of SFA6. The trees specified will be as per SFA and positioned. Where clearances with vegetation is not achievable. root protection will be provided.

10. All new Roads and Footways to be adopted under "Section 38/278" of the Highways Act 1980 and shall be in accordance with the Local Highway Authority's Design Guide and Specifications and the details shown on highway construction details drwg.

All levels/extg levels to be checked against site datum & bench mark, prior to works commencing.

Boundary walls will not be adopted.

Hand laying of bituminous materials is not permitted on adoptable carriageways.

All substrata structures and unconsolidated material, within the construction width of the highway are to be removed.

A minimum distance of 1000mm shall be maintained between any kerb line and any new or existing public sewer, where the pipe does not cross beneath the kerb.

Private drainage is to be provided for hardened areas falling towards the highway to prevent such runoff on the highway.

The provision of a CCTV survey of any highway drainage, at the developers expense, is required prior to laying the wearing course.

(Layout and Specifications shall be in accordance with Respective Local Highway Authority's Guidelines)

11. The Contractor shall check all tie-ins for line and level with existing before commencing any works. The Engineer shall be notified immediately in writing, should any errors be found.

12. Tactile paving shall be provided where indicated at pedestrian and footway/cycleway crossing points in accordance with the details shown on highway construction details drwg. Also in line with 'DETR Environment Transport regions - Guidance on the use of tactile Paving Surfaces'.

13. All buried concrete products and mortar shall be made using sulphate resisting cement.

14. Topographical Survey all to ordnance datum.

REV	AMENDMENT	BY	DATE
P2	Site Plan updated, Drainage Design amended.	MS	04.09.19
P1	Mh Schedules added, MH S24 / pipe run 1.014 omitted.	MS	02.08.19

CE
PROJECT EXECUTION CLASS: N/A
All materials supplied in relations to those specified on this drawing are to be CE marked in accordance with the European Union Declaration of conformity

PURPOSE OF ISSUE
PRELIMINARY

COUCH
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CLIENT
WATKIN JONES GROUP

PROJECT
RESIDENTIAL DEVELOPMENT
BANK HALL FARM, BROUGHTON

DRAWING TITLE
ADOPTABLE DRAINAGE LAYOUT
SECTION 104 WORKS

SHEET SIZE	SCALE	DATE	DRAWN	CHECKED	STATUS
A0	1:500	JUL 2019	MS	CCE	-

CCE PROJECT No.	DRAWING No.	REV
S7604	501	P2

SECTION 104 & 38 NOTES

1. All adoptable drainage works have been designed and are to be constructed in accordance with "Sewers for Adoption, 6th Edition"
2. All clay pipe work shall be Extra Strength Clayware to B.S. EN 295:1991 Part 1
3. All precast concrete pipework shall be to the class stated on the drawings in accordance with BE EN 1916:2002.
   All manholes and chambers shall be to BS EN 1917:2002
4. All plastic pipes being offered for adoption under S104 must be structural wall and must comply with BS EN 13476-1 and WIS 4-35-01
   MAX. PIPE LENGTH TO BE 3.0m
5. All levels relate to an Ordnance Datum.
6. This drawing is to be read in conjunction with all other relevant drawings.
7. House drainage connections to sewers must be 150mm ø and unless otherwise stated laid to the dragout invert level shown.
8. Levels given on drag out chambers are incoming pipe levels.
9. House drainage runs to be kept within the curtilage of the plot they serve wherever possible.
10. The Contractor shall be responsible for ensuring that any existing invert levels indicated on drawings are correct before work commences.
11. The Contractor should satisfy himself as to the position and depth of any existing Statutory Undertakers plant which could effect the works before the works are commenced.
12. Road gully connections are to be 150mm ø connecting either directly to manholes shown, or to sewer runs using pre-formed junctions.
13. All connections to adoptable sewers shall be by manufactured junction pipes. Saddle connections will not be permitted.
14. All sewers for adoption with greater than 1.20 metres cover in roads or 0.9m metres cover in fields shall have Class S granular bed and surround.
15. Any sewer for adoption with less than 1.2 metres cover in roads or 0.9 metres cover in fields shall have a minimum of 150mm ST4 concrete surround. Flexibility shall be maintained by the provision of Flexcell or similar approved joint filler breaks in the concrete surround at each pipe joints
16. Pumping Station to be designed and constructed in accordance with Sewers for Adoption 7th Edition with United Utilities Pumping Station Addendum

All pipes to have class "S" bed
and surround unless shown otherwise
All concrete pipes to be class 120
All clay pipes to be extra strength vitrified clay
All upvc pipes to comply with BS 4660:2000 &
BS EN 1401-1
structured wall upvc pipes to comply with
WIS 4-35-01
Max. pipe length to be 3.0m

Foundations to be designed / constructed to take into account the proximity and depth of adjacent sewers and drains in accordance with SFA 7th edition part b

Contractor to be aware of and take appropriate action to ensure de-stabilization of any existing structures, trees, embankments or other features does not occur as a result of any excavation works undertaken in accordance with the designs shown on this drawing
If contractor is unsure about any aspect of the above he should seek advice before commencing excavation work.

Contractor/client should note the existence of existing buried plant and or overhead power cable(s)
Before work commences contractor must undertake risk assessment and provide method statement for working in this area in accordance with HSE and power suppliers guidelines to satisfaction of the principle designer

To cater for any deviations in the as constructed road / footpath levels in relation to the design levels, the proposed floor levels shown must be checked on site by the site agent or engineer in relation to as built road levels to ensure compliance with part M of the Building Regulations

All existing services to be located at commencement in accordance with undertakers requirements and protected accordingly during the works

All existing manhole invert levels are to located and surveyed prior to start on site to ensure that they are correct and also to ensure that level clashes are avoided and that interpolated invert levels are correct.
Any discrepancy to be reported to REFA prior to start to enable any changes to be made to design that prove necessary

SCALE IN METRES
0 5 10 20 50

CIVILS DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:-

1 EXISTING SERVICES

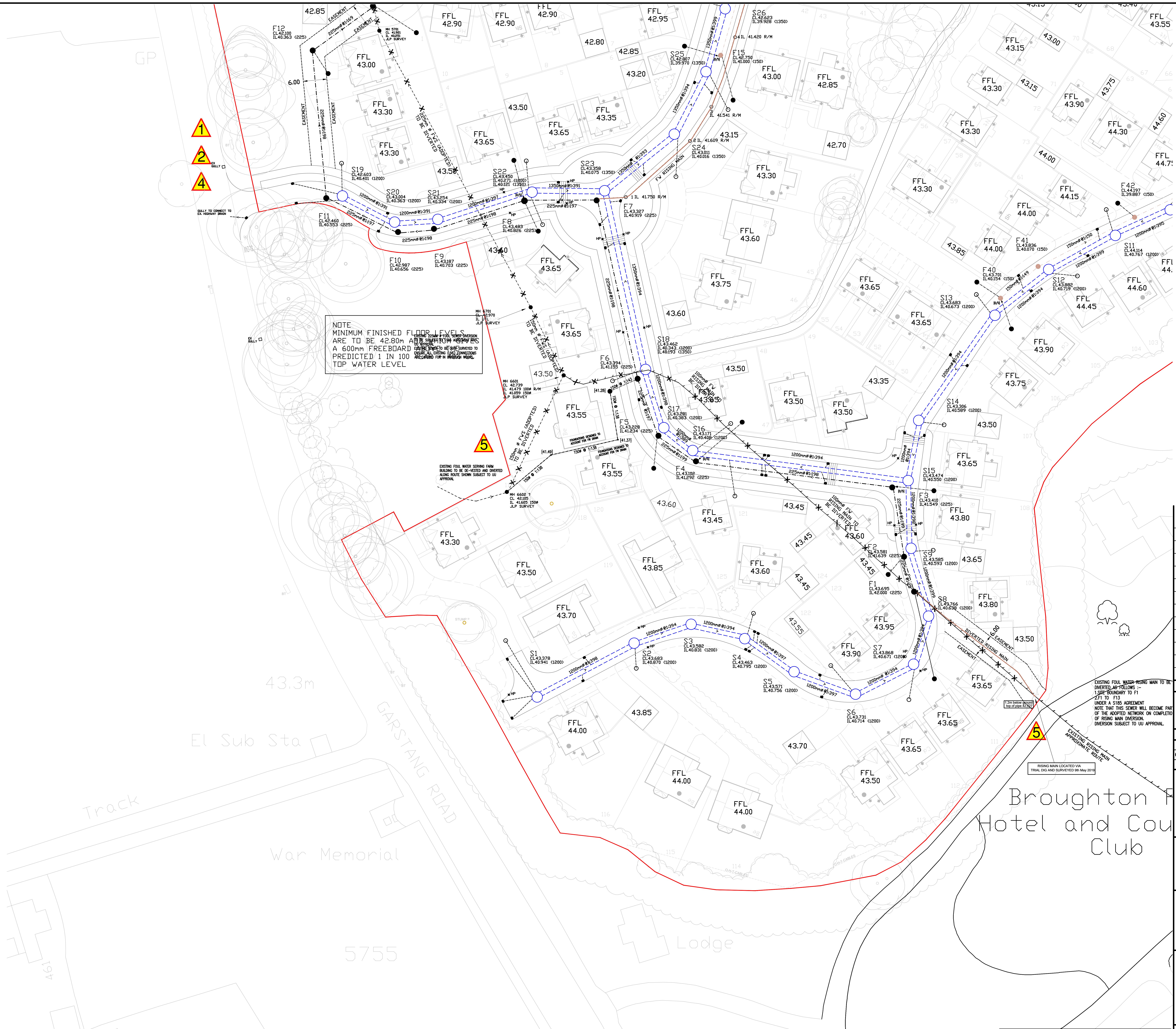
2 WORKING ON EXISTING ROAD

3 DANGER OF COLLAPSE TO ALL EXCAVATIONS - RISK TO BE ASSSESED AND MANAGED BY CONTRACTOR IN ACCORDANCE WITH HSE GUIDANCE

4 WORKING IN AREAS WHERE MEMBERS OF THE PUBLIC HAVE ACCESS E.G. MAIN ROAD

5 WORKING ON LIVE FOUL / COMBINED SEWERS AND RISING MAIN

REFA Ltd has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing.
Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type



NOTE
MINIMUM FINISHED FLOOR LEVELS
ARE TO BE 42.80m AOD WHICH GIVES
A 600mm FREEBOARD ABOVE THE
PREDICTED 1 IN 100 YEAR + 40% CC
TOP WATER LEVEL

EXISTING 225MM ø FOUL SEWER DIVERSION TO BE SUBJECT TO S185 AGREEMENT AND UU APPROVAL
EXISTING SEWER TO BE CCTV SURVEYED TO ENSURE ALL EXISTING (LIVE) CONNECTIONS ARE CATERED FOR IN DIVERSION WORKS.

PLEASE NOTE THAT THIS DRAWING IS ISSUED FOR INFORMATION/TENDER PURPOSES ONLY UNTIL TECHNICAL APPROVAL HAS BEEN GRANTED.
ANY WORK UNDERTAKEN PRIOR TO TECHNICAL APPROVAL BEING GRANTED IS AT THE CLIENTS RISK.

THIS DRAWING IS BASED ON PLANNING
LAYOUT PROVIDED BY CLIENT
DRAWING NUMBER:- 16-151-001
REVISION:- J
CLIENT TO ENSURE THE ABOVE LAYOUT IS CURRENT BEFORE USING THIS DRAWING FOR CONSTRUCTION PURPOSES

GENERAL

1. All adoptable sewers and associated works are to comply fully with "Sewers for Adoption" 6th.Edition
2. All highway works to be to adoptable standards and to to comply fully with the Local Authority specification.
3. All private drainage works are to comply fully with part H of the Building Regulations
4. All existing invert levels to be checked by the Contractor at the start of works and any discrepancies notified to REFA.
   All levels are based on topographical survey information provided by others.
5. All materials to bear the relevant B.S.Kitemark and comply fully with the specifications.
   All concrete & concrete products must use Sulphate resistant cement (unless the site investigation report proves that sulphate attack from soils and groundwater will not occur)
6. All opening notices etc. as required under highways acts etc. are to be obtained prior to commencement of works.
   All works are to be inspected by L.A., NHBC or Relevant Water Authority as applicable.

C.D.M. REGULATIONS 2015

In line with the above regulations we are obliged to inform the Client of their responsibilities under section CDM 15/1, and residual risks that may be encountered in the construction of these works.
All design work has been carried out with Health and Safety aspects given full consideration.
Wherever possible risks have been eliminated from the design, however due to the very nature of this type of work it is not possible to remove all the risks from the design.
We would also respectfully remind the Client of his obligations to take all reasonable steps in ensuring that only competent Contractors who have a valid safety policy are employed.
They should also provide satisfactory responses at tender stage as to the manner in which they will deal with the elements of risk involved in this type of work and in particular those highlighted by REFA below:-

1. Support / treatment for ALL excavation work.
2. Guarding to edges of excavations to prevent people,materials and vehicles falling into excavation.
3. Guarding of excavations outside working hours to prevent unauthorised access.
4. Undermining to adjacent roads or structures.
5. Confined space operations.
6. Dealing with existing services.
7. Traffic management on existing highways.
8. Procedure to be followed in event of accident or emergency.
9. Method of working where contaminated ground is present on site.
10. Confirmation will be required that all operatives are adequately trained, copies of relevant training certificates to be supplied.

The above list is by no means exhaustive but it does highlight operations that present a risk to contractors and the general public.
For clarification on any item please contact REFA.

rev	Revision details	Rev.By	Date
A	FFLs REVISED FOLLOWING EXT. WORKS	PT	08.10.19

Drawing Stage		Drawing Status			
	Draft		Comments	●	Tender
●	Issued		Information		Construction
		●	Approval		As Built

Client
WAINHOMES LIMITED

Job title
KEYFOLD FARM BROUGHTON

Drawing title
ROAD AND MAIN DRAINAGE LAYOUT 3 OF 3

REFA
45 Bridgeman Terrace
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CONSULTING ENGINEERS
CIVIL• STRUCTURAL
GEOTECHNICAL•ENVIRONMENTAL

Date	Scale	Drawn
14.8.19	1/500	GWH

DRAWING No 16141/06/3 Rev A

A1 SHEET

SECTION 104 & 38 NOTES

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All pipes to have class "S" bed
and surround unless shown otherwise
All concrete pipes to be class 120
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BS EN 1401–1
structured wall upvc pipes to comply with
WIS 4–35–01
Max. pipe length to be 3.0m

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If contractor is unsure about any aspect of the above he should seek advice before commencing excavation work.

Contractor/client should note the existence of existing buried plant and or overhead power cable(s)
Before work commences contractor must undertake risk assessment and provide method statement for working in this area in accordance with HSE and power suppliers guidelines to satisfaction of the principle designer

To cater for any deviations in the as constructed road / footpath levels in relation to the design levels, the proposed floor levels shown must be checked on site by the site agent or engineer in relation to as built road levels to ensure compliance with part M of the Building Regulations

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All existing manhole invert levels are to located and surveyed prior to start on site to ensure that they are correct and also to ensure that level clashes are avoided and that interpolated invert levels are correct. Any discrepancy to be reported to REFA prior to start to enable any changes to be made to design that prove necessary

SCALE IN METRES

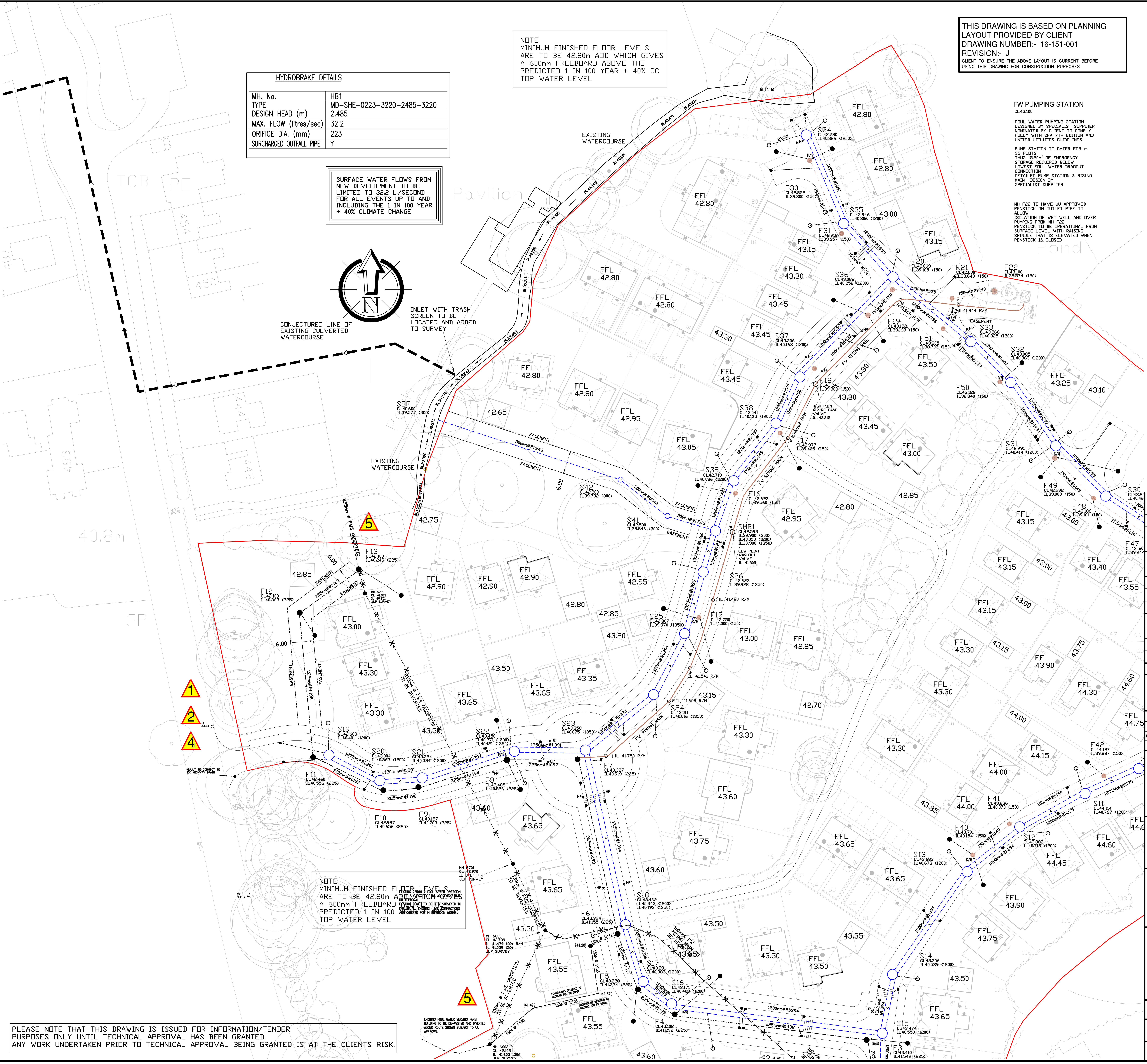
0 5 10 20 50

CIVILS DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:–

1. EXISTING SERVICES
2. WORKING ON EXISTING ROAD
3. DANGER OF COLLAPSE TO ALL EXCAVATIONS – RISK TO BE ASSSESED AND MANAGED BY CONTRACTOR IN ACCORDANCE WITH HSE GUIDANCE
4. WORKING IN AREAS WHERE MEMBERS OF THE PUBLIC HAVE ACCESS E.G. MAIN ROAD
5. WORKING ON LIVE FOUL / COMBINED SEWERS AND RISING MAIN

REFA Ltd has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing.
Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type



HYDROBRAKE DETAILS

MH. No.	HB1
TYPE	MD–SHE–0223–3220–2485–3220
DESIGN HEAD (m)	2.485
MAX. FLOW (litres/sec)	32.2
ORIFICE DIA. (mm)	223
SURCHARGED OUTFALL PIPE	Y

SURFACE WATER FLOWS FROM NEW DEVELOPMENT TO BE LIMITED TO 32.2 L./SECOND FOR ALL EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR + 40% CLIMATE CHANGE

NOTE
MINIMUM FINISHED FLOOR LEVELS ARE TO BE 42.80m AOD WHICH GIVES A 600mm FREEBOARD ABOVE THE PREDICTED 1 IN 100 YEAR + 40% CC TOP WATER LEVEL

THIS DRAWING IS BASED ON PLANNING LAYOUT PROVIDED BY CLIENT
DRAWING NUMBER:- 16-151-001
REVISION:- J
CLIENT TO ENSURE THE ABOVE LAYOUT IS CURRENT BEFORE USING THIS DRAWING FOR CONSTRUCTION PURPOSES

FOUL WATER PUMPING STATION DESIGNED BY SPECIALIST SUPPLIER NOMINATED BY CLIENT TO COMPLY FULLY WITH SFA 7TH EDITION AND UNITED UTILITIES GUIDELINES

PUMP STATION TO CATER FOR :- 95 PLOTS
THUS 15.20m³ OF EMERGENCY STORAGE REQUIRED BELOW LOWEST FOUL WATER DRAGOUT CONNECTION
DETAILED PUMP STATION & RISING MAIN DESIGN BY SPECIALIST SUPPLIER

MH F22 TO HAVE UU APPROVED PENSTOCK ON OUTLET PIPE TO ALLOW ISOLATION OF WET WELL AND OVER PUMPING FROM MH F22
PENSTOCK TO BE OPERATIONAL FROM SURFACE LEVEL WITH RAISING SPINDLE THAT IS ELEVATED WHEN PENSTOCK IS CLOSED

EXISTING 225MM ø FOUL SEWER DIVERSION TO BE SUBJECT TO S185 AGREEMENT AND UU APPROVAL
EXISTING SEWER TO BE CCTV SURVEYED TO ENSURE ALL EXISTING (LIVE) CONNECTIONS ARE CATERED FOR IN DIVERSION WORKS.

NOTE
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EXISTING FOUL WATER SERVING FARM BUILDING TO BE DE–VESTED AND DIVERTED ALONG ROUTE SHOWN SUBJECT TO UU APPROVAL

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C.D.M. REGULATIONS 2015

In line with the above regulations we are obliged to inform the Client of their responsibilities under section CDM 15/1, and residual risks that may be encountered in the construction of these works.
All design work has been carried out with Health and Safety aspects given full consideration.
Wherever possible risks have been eliminated from the design, however due to the very nature of this type of work it is not possible to remove all the risks from the design.
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The above list is by no means exhaustive but it does highlight operations that present a risk to contractors and the general public.
For clarification on any item please contact REFA.

rev	Revision details	Rev.By	Date
A	FFLs REVISED FOLLOWING EXT. WORKS	PT	08.10.19

Drawing Stage		Drawing Status			
	Draft		Comments	●	Tender
●	Issued		Information		Construction
		●	Approval		As Built

Client
WAINHOMES LIMITED

Job title
KEYFOLD FARM BROUGHTON

Drawing title
ROAD AND MAIN DRAINAGE LAYOUT 1 OF 3

REFA
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Wigan, Lancs
WN1 1TT
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CONSULTING ENGINEERS
CIVIL• STRUCTURAL
GEOTECHNICAL•ENVIRONMENTAL

Date	Scale	Drawn
14.8.19	1/500	GWH

DRAWING No 16141/06/1 Rev A

A1 SHEET

SECTION 104 & 38 NOTES

1. All adoptable drainage works have been designed and are to be constructed in accordance with "Sewers for Adoption, 6th Edition"
2. All clay pipe work shall be Extra Strength Clayware to B.S. EN 295:1991 Part 1
3. All precast concrete pipework shall be to the class stated on the drawings in accordance with BE EN 1916:2002.
   All manholes and chambers shall be to BS EN 1917:2002
4. All plastic pipes being offered for adoption under S104 must be structural wall and must comply with BS EN 13476–1 and WIS 4–35–01
   MAX. PIPE LENGTH TO BE 3.0m
5. All levels relate to an Ordnance Datum.
6. This drawing is to be read in conjunction with all other relevant drawings.
7. House drainage connections to sewers must be 150mm ø and unless otherwise stated laid to the dragout invert level shown.
8. Levels given on drag out chambers are incoming pipe levels.
9. House drainage runs to be kept within the curtilage of the plot they serve wherever possible.
10. The Contractor shall be responsible for ensuring that any existing invert levels indicated on drawings are correct before work commences.
11. The Contractor should satisfy himself as to the position and depth of any existing Statutory Undertakers plant which could effect the works before the works are commenced.
12. Road gully connections are to be 150mm ø connecting either directly to manholes shown, or to sewer runs using pre–formed junctions.
13. All connections to adoptable sewers shall be by manufactured junction pipes. Saddle connections will not be permitted.
14. All sewers for adoption with greater than 1.20 metres cover in roads or 0.9m metres cover in fields shall have Class S granular bed and surround.
15. Any sewer for adoption with less than 1.2 metres cover in roads or 0.9 metres cover in fields shall have a minimum of 150mm ST4 concrete surround. Flexibility shall be maintained by the provision of Flexcell or similar approved joint filler breaks in the concrete surround at each pipe joints
16. Pumping Station to be designed and constructed in accordance with Sewers for Adoption 7th Edition with United Utilities Pumping Station Addendum

All pipes to have class "S" bed
and surround unless shown otherwise
All concrete pipes to be class 120
All clay pipes to be extra strength vitrified clay
All upvc pipes to comply with BS 4660:2000 &
BS EN 1401–1
structured wall upvc pipes to comply with
WIS 4–35–01
Max. pipe length to be 3.0m

Foundations to be designed / constructed to take into account the proximity and depth of adjacent sewers and drains in accordance with SFA 7th edition part b

Contractor to be aware of and take appropriate action to ensure de–stabilization of any existing structures, trees, embankments or other features does not occur as a result of any excavation works undertaken in accordance with the designs shown on this drawing
If contractor is unsure about any aspect of the above he should seek advice before commencing excavation work.

Contractor/client should note the existence of existing buried plant and or overhead power cable(s)
Before work commences contractor must undertake risk assessment and provide method statement for working in this area in accordance with HSE and power suppliers guidelines to satisfaction of the principle designer

To cater for any deviations in the as constructed road / footpath levels in relation to the design levels, the proposed floor levels shown must be checked on site by the site agent or engineer in relation to as built road levels to ensure compliance with part M of the Building Regulations

All existing services to be located at commencement in accordance with undertakers requirements and protected accordingly during the works

All existing manhole invert levels are to located and surveyed prior to start on site to ensure that they are correct and also to ensure that level clashes are avoided and that interpolated invert levels are correct.
Any discrepancy to be reported to REFA prior to start to enable any changes to be made to design that prove necessary

SCALE IN METRES
0 5 10 20 50

CIVILS DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:–

1 EXISTING SERVICES

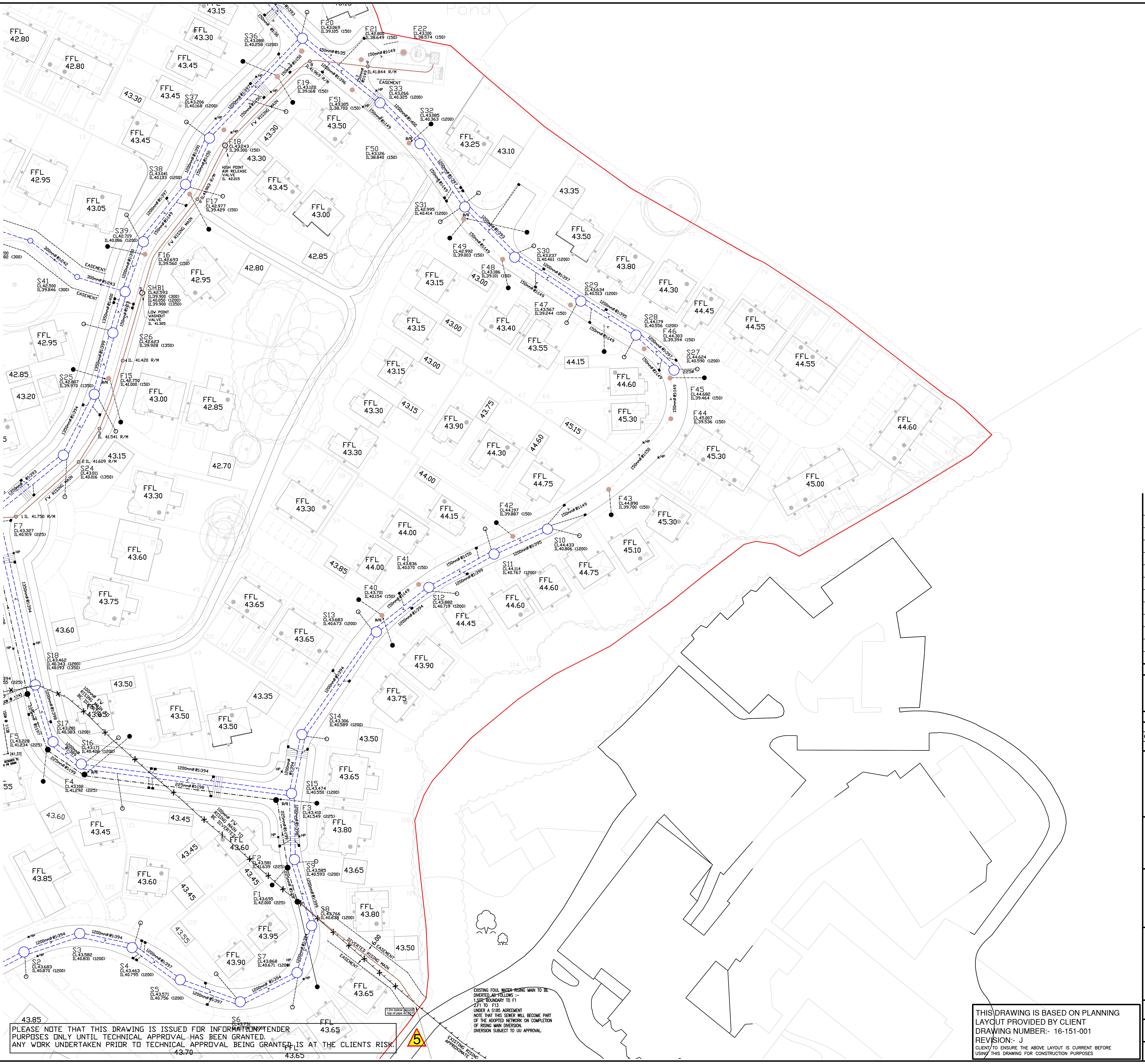
2 WORKING ON EXISTING ROAD

3 DANGER OF COLLAPSE TO ALL EXCAVATIONS – RISK TO BE ASSSESED AND MANAGED BY CONTRACTOR IN ACCORDANCE WITH HSE GUIDANCE

4 WORKING IN AREAS WHERE MEMBERS OF THE PUBLIC HAVE ACCESS E.G. MAIN ROAD

5 WORKING ON LIVE FOUL / COMBINED SEWERS AND RISING MAIN

REFA Ltd has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing.
Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type



PLEASE NOTE THAT THIS DRAWING IS ISSUED FOR INFORMATION/TENDER PURPOSES ONLY UNTIL TECHNICAL APPROVAL HAS BEEN GRANTED.
ANY WORK UNDERTAKEN PRIOR TO TECHNICAL APPROVAL BEING GRANTED IS AT THE CLIENTS RISK

THIS DRAWING IS BASED ON PLANNING LAYOUT PROVIDED BY CLIENT
DRAWING NUMBER:- 16-151-001
REVISION:- J
CLIENT TO ENSURE THE ABOVE LAYOUT IS CURRENT BEFORE USING THIS DRAWING FOR CONSTRUCTION PURPOSES

GENERAL

1. All adoptable sewers and associated works are to comply fully with "Sewers for Adoption" 6th.Edition
2. All highway works to be to adoptable standards and to to comply fully with the Local Authority specification.
3. All private drainage works are to comply fully with part H of the Building Regulations
4. All existing invert levels to be checked by the Contractor at the start of works and any discrepancies notified to REFA.
   All levels are based on topographical survey information provided by others.
5. All materials to bear the relevant B.S.Kitemark and comply fully with the specifications.
   All concrete & concrete products must use Sulphate resistant cement (unless the site investigation report proves that sulphate attack from soils and groundwater will not occur)
6. All opening notices etc. as required under highways acts etc. are to be obtained prior to commencement of works.
   All works are to be inspected by L.A., NHBC or Relevant Water Authority as applicable.

C.D.M. REGULATIONS 2015

In line with the above regulations we are obliged to inform the Client of their responsibilities under section CDM 15/1, and residual risks that may be encountered in the construction of these works.
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smas worksafe consultant www.smasltd.com as recognised by SSIP SAFETY SCHEMES IN PROCUREMENT

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Client
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Job title
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Date	Scale	Drawn
14.8.19	1/500	GWH

DRAWING No 16141/06/2 Rev A

A1 SHEET

Appendix 7 – Drainage Calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Diameter (mm)	Depth (m)
Attenuation Basin	1.018	100.000	1500	1.800

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	1 year (l/s)	16.8
Summer CV	0.750	Drain Down Time (mins)	1440	30 year (l/s)	32.9
Winter CV	0.840	Additional Storage (m³/ha)	20.0	100 year (l/s)	40.3
Analysis Speed	Normal	Check Discharge Rate(s)	✓	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 %)
2	0	0	0
30	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 years	1.70
Greenfield Method	FEH	Growth Factor 100 years	2.08
Positively Drained Area (ha)	1.850	Betterment (%)	0
SAAR (mm)	1015	QMed	18.0
Host	21	QBar	19.4
BFIHost	0.361	Q 1 year (l/s)	16.8
Region	10	Q 30 year (l/s)	32.9
QBar/QMed conversion factor	1.075	Q 100 year (l/s)	40.3
Growth Factor 1 year	0.87		

Node Attenuation Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	98.200	Product Number	CTL-SHE-0189-1940-1500-1940
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	19.4	Min Node Diameter (mm)	1500

Node Attenuation Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	98.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	304

Depth (m)	Area (m²)	Inf Area (m²)
0.000	205.1	0.0
1.500	622.8	0.0
1.800	733.5	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Attenuation Basin	86	98.504	0.304	50.1	79.1390	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	Attenuation Basin	Hydro-Brake®	18.9	144.6

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Attenuation Basin	116	99.028	0.828	130.6	276.0033	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	Attenuation Basin	Hydro-Brake®	19.4	376.9

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	Attenuation Basin	232	99.675	1.475	148.7	624.4825	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
240 minute winter	Attenuation Basin	Hydro-Brake®	19.4	850.9

Enzygo specialise in a wide range of technical services:

- Property and Sites
- Waste and Mineral Planning
- Flooding, Drainage and Hydrology
- Landscape Architecture
- Arboriculture
- Permitting and Regulation
- Waste Technologies and Renewables
- Waste Contract Procurement
- Noise and Vibration
- Ecology Services
- Contaminated Land and Geotechnical
- Traffic and Transportation
- Planning Services

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enzygo.com