

DRAINAGE STRATEGY AND FLOOD RISK ASSESSMENT

AT LAND OFF

HALIFAX ROAD

THURGOLAND

ON BEHALF OF

MR J ELMHIRST

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Drainage Strategy and Flood Risk Assessment at Land Off Halifax Road, Thurgoland 800/628r1				
Revision/Date	**Initial Issue** **9th January 2018**	**Revision A**	**Revision B**	**Revision C**
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CONTENTS

			Page
1.0	Introduction		4
2.0	Walkover Survey		
	General	2.1 - 2.2	5
	Current Use	2.3	5
	Boundaries	2.4	5
	Topography and Vegetation	2.5 - 2.7	5 – 6
	Drainage	2.8 – 2.9	6
3.0	Environment Agency Consultation		7
4.0	Water Authority Consultation		9
5.0	Land Drainage Authority Consultation		10
6.0	Material Consideration in Respect of NPPF and PPG		
	Flood Classification	6.1 - 6.2	11
	End Use	6.3 - 6.4	11
	Sequential Test	6.5 - 6.6	11
	Flood Sources	6.7 - 6.13	12 - 13
	Climate Change	6.14 - 6.18	13
	Flood Mitigation	6.19	14
	Sustainable Drainage	6.20	14
	Drainage	6.21	15
	Existing Surface Water Run-off	6.22 – 6.23	15
	Proposed Surface Water Drainage	6.24 – 6.28	15 - 16
	Foul Drainage	6.29	17
	Emergency Egress During Times of Flood	6.30 - 6.31	17
7.0	Comments		18 - 19

APPENDICES

Appendix A Site Location Plan
Appendix B Topographical Survey
Appendix C Environment Agency Consultation
Appendix D Water Authority Consultation
Appendix E Land Drainage Authority Consultation
Appendix F Indicative Greenfield Run-off Calculations
Appendix G Indicative Surface Water Drainage Calculations

1.0 INTRODUCTION

1.1 Mr J Elmhirst is proposing to develop a parcel of land off Halifax Road, Thurgoland within the Metropolitan Borough of Barnsley with new residential dwellings. As part of the viability of the site and to supplement a planning application, it was decided that a Flood Risk Assessment Report should be undertaken.

1.2 It is within the general development strategy of the country that development in areas where there is a risk of flooding are to be assessed to avoid unnecessary increase in the requirement for flood defence. Under the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG), consultation is required with the Environment Agency, Land Drainage Authority and Water Authority and a Flood Risk Assessment Report should be prepared considering the development proposals and make recommendations for any flood mitigation measures.

1.3 ARP Associates have been appointed to carry out an assessment of the site, implement appropriate consultations and prepare a Flood Risk Assessment Report, in accordance with NPPF, to satisfy the requirements of the Planning Authority.

1.4 The consultations and walkover survey have been undertaken in December 2017 and January 2018.

1.5 The report has been initially prepared for the use and reliance of the Client only. The report shall not be relied upon or transferred to any other parties without the written agreement of ARP Associates. For the avoidance of any doubt, where ARP Associates enters into a letter of reliance for the benefit of a third party, that third party will be permitted to rely on the report. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party without ARP Associates consent.

2.0 WALKOVER SURVEY

General

2.1 The site currently consists of several farm building ruins with a large area of undeveloped greenfield spread over two field boundaries. The site is irregular in shape, with a total area of approximately 1.0ha. The site is centred on Ordnance Survey Grid Reference SE 290 010.

2.2 A site location plan is presented in Appendix A.

Current Use

2.3 The site is presently un-used but would have been used for agricultural purposes.

Boundaries

2.4 The site is bound by a series of walls and timber fences. Abutting the Southern boundary is Halifax Road with Smithy Hill partly following the south-western boundary before several residential dwelling separate the site from the highway. Dense areas of residential dwellings are located further South, West and to the North. To the East and beyond are agricultural fields.

Topography and Vegetation

2.5 There is a prominent fall in a South-eastern direction across the site, with a high point of approximately 228.0m A.O.D in the Northwest corner, and an overall fall of approximately 7.6m. This equates to approximately a 1 in 15.5 fall. The low point is the Southeast corner, with a low point of approximately 220.40m A.O.D

2.6 The majority of the site is grass with several trees restricted to boundaries. A more substantial area of shrubs, bushes and trees follow the southern boundary.

2.7 A topographical survey is presented in Appendix B.

Drainage

2.8 There is no obvious positive drainage system on the site, with run-off clearly discharging in a South Easterly direction.

2.9 The nearest watercourse is an unnamed ordinary watercourse located approximately 400m to the South East of the site. The nearest main river is the River Don and is approximately 0.9km to the South West.

3.0 ENVIRONMENT AGENCY CONSULTATION

3.1 A consultation was not requested from the EA, however, the online EA flood map for planning shows the site to be situated in Flood Zone 1 with a 'Low Probability' of flooding. A copy of the flood map is presented in Appendix C.

3.2 The EA flood maps are defined as:-

3.2.1 Flood Zone 1 - 'Low Probability' is assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (less than 0.1%).

3.2.2 Flood Zone 2 - 'Medium Probability' is assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding in any year (1% - 0.1%) and between a 1 in 200 and 1 in 1,000 annual probability of flooding from the sea (0.5% - 0.1%).

3.2.3 Flood Zone 3 - 'High Probability' is assessed as having a 1 in 100 or greater annual probability of river flooding in any year (greater than 1%) and a 1 in 200 chance or greater annual probability of flooding from the sea (less than 0.5%).

3.3 The EA flood map for planning shows the site is located within Flood Zone 1 and the site, therefore, has a 1 in 1,000 annual risk of fluvial flooding.

3.4 The updated flood map for surface water, which shows areas where surface water only would be expected to flow or pond in England & Wales, is also available online. All land in England and Wales will be within 'one' of a possible 'four' categories. The four categories shown on the map are:-

3.4.1 High - This area has a chance of flooding greater than 1 in 30 in any given year (annual probability of flooding 3.3%).

3.4.2 Medium - This area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%) in any given year.

3.4.3 Low - This area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) in any given year.

3.4.4 Very low - This area has a chance of flooding of less than 1 in 1000 (0.1%) in any given year.

3.5 The proposed development is shown to be within a low risk area for surface water flooding. A copy of the surface water map is also presented in Appendix C.

4.0 WATER AUTHORITY CONSULTATION

4.1 A consultation was requested from Yorkshire Water, who is the Water Authority for this area and a copy of their response, reference R777623 dated 30th November 2017 is presented in Appendix D.

4.2 There are no existing public sewers recorded crossing the site.

4.3 Development of the site should take place with separate system for foul and surface water drainage. Separate systems should extend to the points of discharge to be agreed.

4.4 Foul water domestic waste should discharge to the 225mm diameter public combined sewer recorded in Crossways at a point to the South of the site.

4.5 In respect of surface water, reference is made to Requirement H3 of Building Regulations 2000 and Sustainable Drainage Systems. This establishes a hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration and watercourse in that priority order. Where appropriate, soakaways, swales and infiltration trenches (SuDS) may be adopted as part of the public sewer network.

4.6 The local public sewer network does not have capacity to accept any surface water from the proposed site. If SuDS are not viable, the Developer is advised to contact the Environment Agency/Local Land Drainage Authority/Internal Drainage Board, with a view to establishing a suitable watercourse for discharge.

5.0 LAND DRAINAGE AUTHORITY CONSULTATION

5.1 A consultation was requested from Barnsley Metropolitan District Council, who is the Land Drainage Authority for this area and a copy of their response, dated 15th and 18th December 2017 is presented in Appendix E for reference purposes.

5.2 It was confirmed that the Land Drainage Authority has no records of any culverted or open watercourses crossing the site indicated on the site location plan. The Land Drainage Authority confirmed that there was a watercourse located to the South East of the site.

5.3 The Land Drainage Authority will accept flows from the site based upon a maximum of 5l/s per hectare into the receiving watercourse.

5.4 There is no knowledge of any part of the site being affected by floodplains from major watercourses in the area, as shown in Appendix D.

5.5 There shall be no increase in surface water run-off from the new development. PPS25 recognises that the management of flood risk is not simply restricted to flood plains and that a catchment wide approach should be employed.

5.6 There are combined public sewers adjacent to the site and it was recommended that the Developer contact Yorkshire Water if they wish to discharge to sewers and discuss allowable discharge rates. It is recommended that a balancing facility would need to be designed to accommodate a 1 in 30 year flow from the site and 1 in 100 year flow retained within the site including an allowance for 30% for climate change, without causing any flooding to buildings. Alternative methods to conventional storage were recommended, providing ground conditions are suitable including sustainable urban drainage techniques, such as soakaways, permeable pavements, grassed swales, infiltration trenches, ponds and wetland to attenuate flood peak flows, produce water quality improvements and environmental enhancements.

5.7 The Authority seeks to promote the use of SuDS techniques to the site and expects the Developer of the site to submit detailed investigations such that the use of SuDS has been fully explored.

6.0 MATERIAL CONSIDERATION IN RESPECT OF NPPF AND PPG

Flood Classification

6.1 The Environment Agency website has identified that the site falls within land assessed as having less than a 1 in 1,000 annual probability of river or sea flooding in any year (less than 0.1%). In accordance with Table 1 of the PPG, the site falls within Flood Zone 1 "low probability".

6.2 Therefore, all uses of the land are appropriate within this zone, but an assessment of the effect of surface water run-off will need to be incorporated in any Flood Risk Assessment.

End Use

6.3 The development proposal is for the construction of residential developments on the site. At the time of writing the report no layout was available.

6.4 When applying Table 2 of the PPG, the flood risk vulnerability classification shows that the end use will fall into a "more vulnerable" classification.

Sequential Test

6.5 As set out in the NPPF, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding (Zone 1).

6.6 When the site is evaluated in accordance with Table 3 of the PPG, the development shows that the Sequential Test is satisfied.

Flood Sources

6.7 Flooding from Rivers – The River Don is located approximately 960m to the west, from the site boundary at its nearest location. Due to the topography of the intervening land between the site and the river, flooding from this source is considered highly unlikely.

6.8 Flooding from Local Watercourses – The nearest watercourse is an un-named watercourse located approximately 400m to the southeast of the site. Due to the site being approximately 5m higher than the watercourse flooding from this source is considered unlikely. No other watercourse is located within the vicinity of the site that would pose any risk of flooding the site.

6.9 Flooding from the Sea - The site is not located near enough to the sea to cause a problem of flooding from this source.

6.10 Flooding from Land – The Environment Agency Surface Water Flood Risk Map shows that the site is outside the risk of flooding. This is consistent with the topography of the land and surrounding area as levels fall prominently in a south easterly direction, with higher land to the north/northwest occupied by dwellings and highways that have positive drainage systems. Flooding from this source is therefore, considered to be low risk.

6.11 Flooding from Groundwater – Whilst there is no intrusive ground investigation, a review of the Geological Survey Map of Great Britain provided on the British Geological Survey website shows the site to be located on the Pennine Lower Coal Measures Formation – Mudstone, Siltstone and Sandstone. This indicates that the surface soils are likely to be impermeable, therefore, flooding from this source is considered to be low risk.

6.12 Flooding from Sewer – There are existing sewers located in adjacent built-up areas and there will be a new drainage system introduced onto the site. It is possible; therefore, that any blockage of the sewers will result in flooding from the lowest cover level of manholes or gullies and this will need to be considered as part of any proposed development.

6.13 Flooding from Reservoirs, Canals or Artificial Sources - There are no other reservoirs, canals or artificial sources which result in flooding on the site.

Climate Change

6.14 The NPPF and PPG have indicated that the Global sea level will continue to rise, depending on greenhouse gas emissions, and the sensitivity of the climate system and there will be an increase in rainfall across the country.

6.15 United Kingdom climate change guidance was revised in February 2016 for peak river flows and peak rainfall intensities. With regards to peak river flows, a regionalised approach has now been adopted to climate change impacts based upon the river basin district of the proposed development site, the flood risk vulnerability of the proposed development and the present day Flood Zone classification.

6.16 The proposed development site is situated within the River Humber river basin district, which based on an "upper end" climate change scenario, could see peak river flows increase by 50% by 2115. As the site is situated entirely within Flood Zone 1 an increase of 50% flows is deemed unlikely to affect the proposed development site.

6.17 In accordance with the revised climate change data, the published figures show that for an expected life of greater than 50 years for any new development, the anticipated increase in rainfall could be up to 40%, subject to the location within the country. However, the Barnsley Metropolitan Borough Council flood risk requirements for managing on and off-site flood risk from fluvial flooding is to assess the development using a 30% allowance for climate change for the 1 in 100 year event.

6.18 Due to the topography of the land and surrounding area, overland run-off from adjoining land is unlikely to be an issue. Therefore, any run-off from outside the site will be insignificant and on this basis, only rainfall falling within the site boundaries will need to be considered in respect of climate change.

Flood Mitigation

6.19 As the site falls within Flood Zone 1, the Sequential Test is satisfied and there are no requirements for flood mitigation measures for this particular site. However, in the event of a catastrophic storm, blockage of the existing or proposed drainage system, then it will be necessary to consider some precautionary flood mitigation measures, as follows:-

6.19.1 The finished floor levels to the properties shall be raised above external levels by a minimum of 150mm wherever possible.

6.19.2 Properties shall be designed without any basements and ground floors shall comprise solid concrete slabs or beam and block with screed construction.

6.19.3 Incoming electricity supplies shall be raised above ground floor level and ground floor electric sockets shall be served by loops from the first floor level.

6.19.4 In the unlikely event of flooding on the site from catastrophic storm, it would be appropriate to design external levels with falls to non-critical areas, such as landscaping, where the water can pond without causing flooding to buildings.

6.19.5 In the event of flooding of the site from any sewers, it will be necessary to ensure that there is a route for floodwater through the site without causing flooding of buildings or gardens.

Sustainable Drainage

6.20 In order to comply with the requirements of NPPF, it will be necessary to consider aspects of Sustainable Drainage techniques for the new development. Whilst no intrusive ground investigation has been carried out, a review of the Geological Survey Map of Great Britain provided on the British Geological Survey website shows the site to be located on the Pennine Lower Coal Measures Formation – Mudstone, Siltstone and Sandstone. This

material, along with the topography of the site and surrounding area is considered to be unsuitable for the disposal of surface water using infiltration techniques. It will be necessary to carry out appropriate infiltration tests in accordance with BRE Digest 365 'Soakaway Design' prior to construction on site and the results presented in a report for the approval of the Planning Authority. However, for the purposes of this report, a positive drainage system will be required for surface water drainage.

Drainage

6.21 It is a requirement to ensure that surface water run-off from any proposed development has negligible consequence on downstream areas either in sewer capacity or discharge to watercourse.

Existing Surface Water Run-Off

6.22 The site is greenfield and, therefore, in accordance with current guidelines and Regulations, indicative surface water calculations have been undertaken using the IH 124 method of calculating greenfield run-off rates. This shows that the site area of 1.0ha gives a discharge rate of 2.041l/s for the 1 in 1 year storm for the site. The indicative greenfield run-off calculations are presented in Appendix F.

6.23 Barnsley Metropolitan Borough Council policy is to calculate existing run-off using a figure of 5l/s/ha. Therefore, this equates to a rate of 5l/s.

Proposed Surface Water Drainage

6.24 Consideration of the proposed surface water drainage should firstly be given to infiltration techniques (to ground). However, based on information available, the disposal of surface water using infiltration techniques may not be feasible. It will be necessary to carry out appropriate infiltration tests in accordance with the BRE Digest 365 'Soakaway Design'

prior to construction on site, and the results presented in a report for the approval of the Planning Authority.

6.25 The nearest watercourse is located approximately 400m to the south east, from the site boundary at its nearest location. Due to the distance from the site any such connection is deemed impractical, therefore, a connection to sewer would be prudent.

6.26 An existing 225mm diameter public surface water sewer is located in Cote Lane and this would be the obvious disposal location for surface water, subject to infiltration techniques being discounted and agreement from Yorkshire Water.

6.27 The proposed surface water area should be designed to accommodate the 1 in 30 year storm event without flooding and the 1 in 100 year storm plus climate change should be retained within the site in an area that will not affect new buildings or third parties from flooding. Indicative calculations have been carried out using the WinDES Source Control Computer Program.

6.28 Based on a restricted discharge rate of 3l/s, using an impermeable area of 0.5ha, on-site storage of 166.7m^3 will need to be provided for the 1 in 30 year storm. This can be achieved by several methods, including oversize pipes or underground tanks, ponds and detention basins are deemed impractical due to the topography of the site. One such option would be to provide a 10m x 14m x 1.2m deep concrete underground tank. The drainage system will also need to accommodate the 1 in 100 year plus 30% climate change without causing flooding of property or third party land in the event that levels dictate that the 1 in 100 year plus climate change flood water will flow off-site and an additional or larger storage facility will be required. In these circumstances, on-site storage would increase to 318.9m^3. The indicative surface water calculations are presented in Appendix TBC. However, detailed calculations and proposals will need to be prepared and submitted to the Planning Authority for approval prior to construction.

Foul Drainage

6.29 Foul water domestic waste should discharge to the 225mm diameter public combined sewer recorded in Cross Ways/Cote Lane, at a point to the south of the site.

Emergency Egress During Times of Flood

6.30 It is a requirement under the PPG that occupants should be able to egress any building during times of flood, without being trapped by flood conditions.

6.31 As the site falls within Flood Zone 1, no special mitigation measures are required for emergency egress during times of flood.

7.0 COMMENTS

7.1 The site falls within Flood Zone 1 and the Sequential Test is satisfied. However, in order to accommodate the possibilities of flood from extreme storm or blocked sewers, the following precautionary flood mitigation measures are recommended:-

7.1.1 The finished floor levels to the properties shall be raised above external levels by a minimum of 150mm wherever possible.

7.1.2 Properties shall be designed without any basements and ground floors shall comprise solid concrete slabs or beam and block with screed construction.

7.1.3 Incoming electricity supplies shall be raised above ground floor level and ground floor electric sockets shall be served by loops from the first floor level.

7.1.4 In the unlikely event of flooding on the site from catastrophic storm, it would be appropriate to design external levels with falls to non-critical areas, such as landscaping, where the water can pond without causing flooding to buildings.

7.1.5 In the event of flooding of the site from any sewers, it will be necessary to ensure that there is a route for floodwater through the site without causing flooding of buildings or gardens.

7.2 A 30% increase in rainfall shall be incorporated into any new positive drainage system to satisfy the requirements of climate change.

7.3 Sustainable Drainage Systems of infiltration techniques are considered to be unsuitable on this particular site and for the purpose of the report a positive drainage system will be required. However, infiltration testing will need to be carried out in accordance with BRE Digest 365 ''Soakaway Design'' prior to construction on site and the results will be reported to the Planning Authority for approval.

7.4 Should infiltration techniques prove unsuccessful the surface water drainage shall discharge to either watercourse or sewer, subject to agreement with Yorkshire Water and the Lead Local Flood Authority.

7.5 The proposed surface water drainage system shall be designed for an allowance for climate change and restricted to the agreed discharge rate with appropriate attenuation incorporated into the design. A detailed design and calculations shall be submitted to the Planning Authority for approval prior to construction on site.

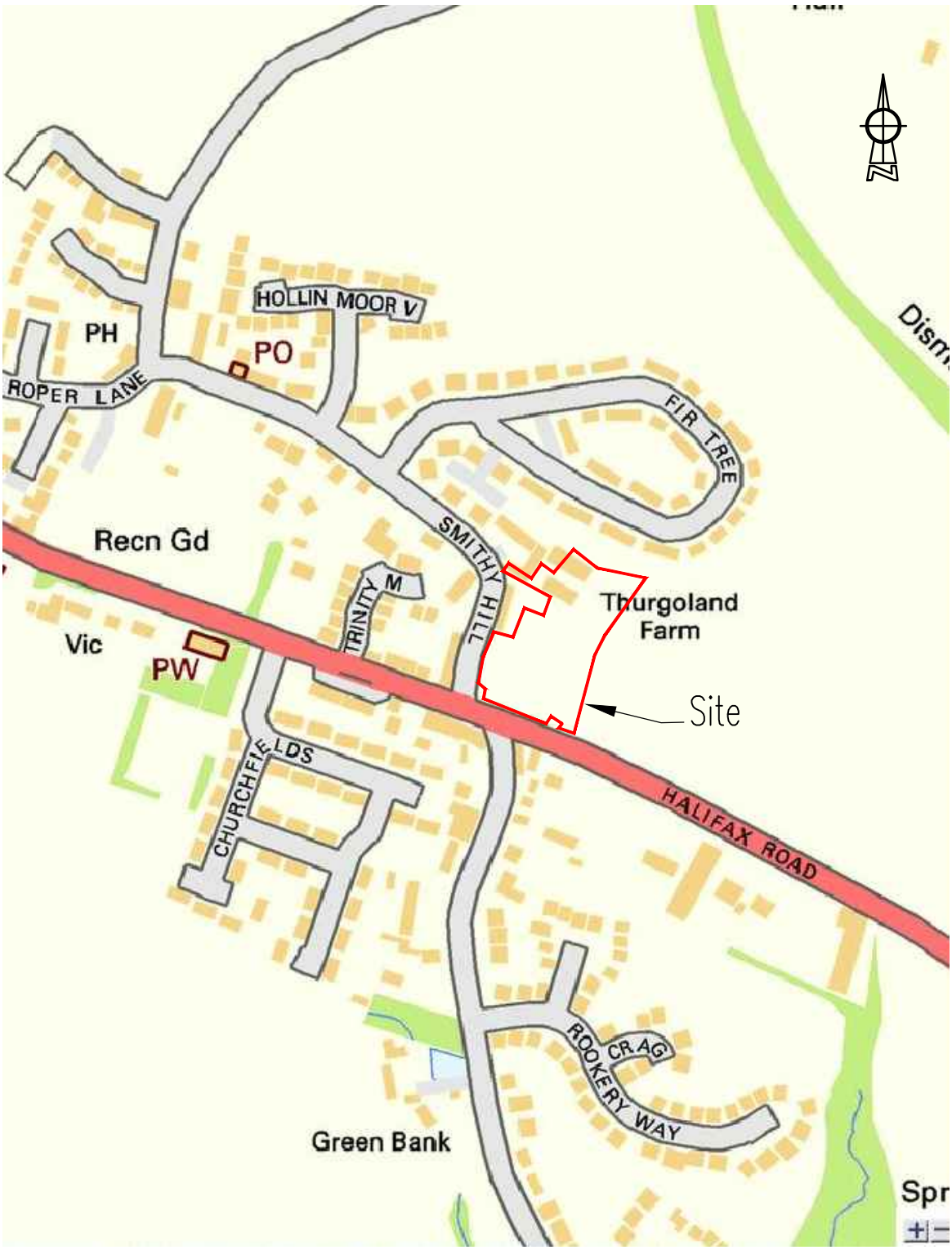
7.6 Foul water domestic waste should discharge to the 225mm diameter public combined sewer recorded in Cross Ways/Cote Lane, at a point to the south of the site.

7.7 No special mitigation measures are required for emergency egress during times of flood.

7.8 Subject to compliance with the above, the proposed development can satisfy the requirements of the National Planning Policy Framework and the Planning Practice Guidance in relation to flood risk.

APPENDIX A

SITE LOCATION PLAN



OS Grid Reference: SE 291 011

Rev	By	Date	Amendment	Chk
/	PSC	17.11.17	Issued for approval	WMW

Title

SITE LOCATION PLAN

Project/Client

SMITHY HILL, THURGOLAND, BARNSLEY

MR JAKE ELMHIRST

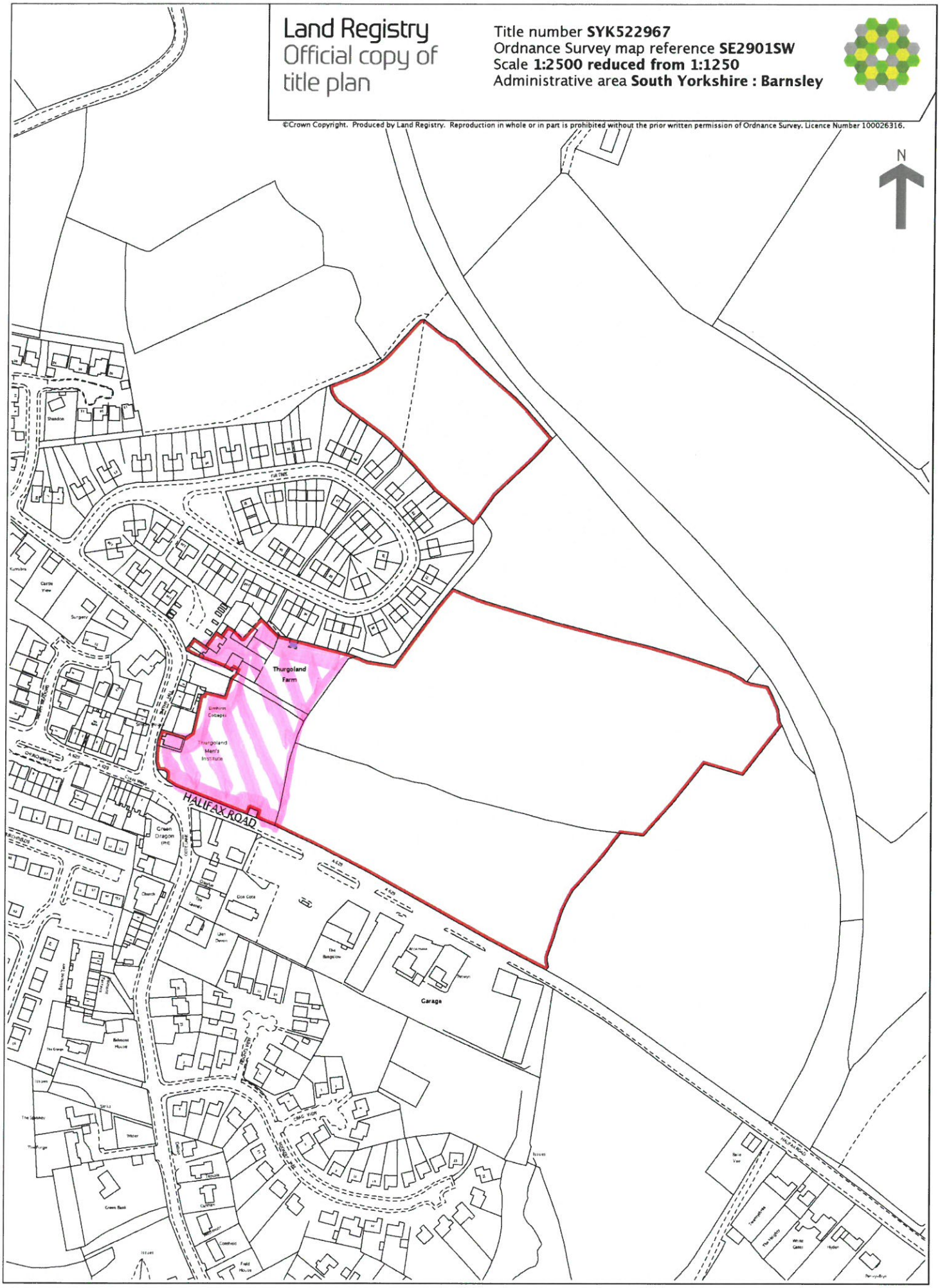
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Scale 1:5000 @ A4	Drawn PSC
Date NOV 17	Chk. WMW
Drg. No. 800/628/NA	Rev /

Land Registry
Official copy of title plan

Title number **SYK522967**
Ordnance Survey map reference **SE2901SW**
Scale **1:2500 reduced from 1:1250**
Administrative area **South Yorkshire : Barnsley**

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APPENDIX B

TOPOGRAPHICAL SURVEY



SYMBOL LEGEND

- Borehole
- Benchmark
- Bollard
- Bus Stop
- Electric Box
- Electricity Pole
- Fence Post
- Gas Stop Valve
- Gate Post
- Gas Marker
- Gully
- Gas Well
- Kerb Outlet
- Litter Bin
- Leachate Chamber
- Lamp Post
- Manhole Point
- MH Triangular
- Wooden Peg
- Ground Marker
- Marker Post
- Pylon
- Rodding Eye
- Sample Point
- Sign Post
- Spot Height
- Eave Level
- Ridge Level
- Stile
- Survey Station
- Traffic Camera
- Telephone Box
- Trial Pit
- Telegraph Pole
- Deciduous Tree
- Road Sign
- Valve
- Vent
- Water Meter
- Letter Box
- MH Circular
- Knockout Pot

LINETYPE LEGEND

- Bridge
- Bottom of Bank
- Building
- Canopy Edge
- Concrete Edge
- Ditch
- Drop Kerb
- Overhead Cable
- Fence
- Gate
- Kerb
- Path
- Pipe Line
- River
- Surface Water Drain
- Railway Line
- Road Centre Line
- Tarmac Edge
- Top of Bank
- Track
- Wall
- Verge
- Flagstone Paving
- Stone
- Hedgeline
- Grass Edge

ABBREVIATIONS

LP.	Lamp Post
TP.	Telegraph Pole
EP.	Electricity Pole
SP.	Sign Post
TS.	Tarffic Sign
BS.	Bus Stop
GM.	Gas Marker Monument
MH.	Manhole
GU.	Gully
FH.	Fire Hydrant
CATV.	Cable Television Point
WM.	Water Meter
WSV.	Water Stop Valve
GSV.	Gas Stop Valve
RE.	Rodding Eye
GU.	Gully
FH.	Fire Hydrant
CATV.	Cable Television Point
WM.	Water Meter
WSV.	Water Stop Valve
GSV.	Gas Stop Valve
RE.	Rodding Eye

MANHOLE LEGEND

MHCT	Cable Television
MHEL	Electricity
MHGA	Gas
MHSW	Surface Water
MHFW	Foul Water
MHBT	British Telecom
MHWT	Water

SURVEY IS ORIENTED TO ORDNANCE SURVEY NATIONAL GRID. POSITIONS FIXED BY GPS ACTIVE NETWORK TO CREATE A FLAT. PLANE LOCAL CO-ORDINATE SYSTEM. LEVELS TO OSGM15.

THIS SURVEY SHOWS PHYSICAL SITE BOUNDARIES ONLY. CONFIRMATION OF LEGAL OWNERSHIP BOUNDARIES SHOULD BE OBTAINED BY REFERENCE TO THE H.M. LAND REGISTRY TITLE PLAN

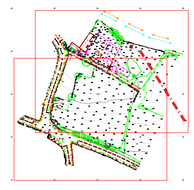
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REV.	DESCRIPTION	DATE

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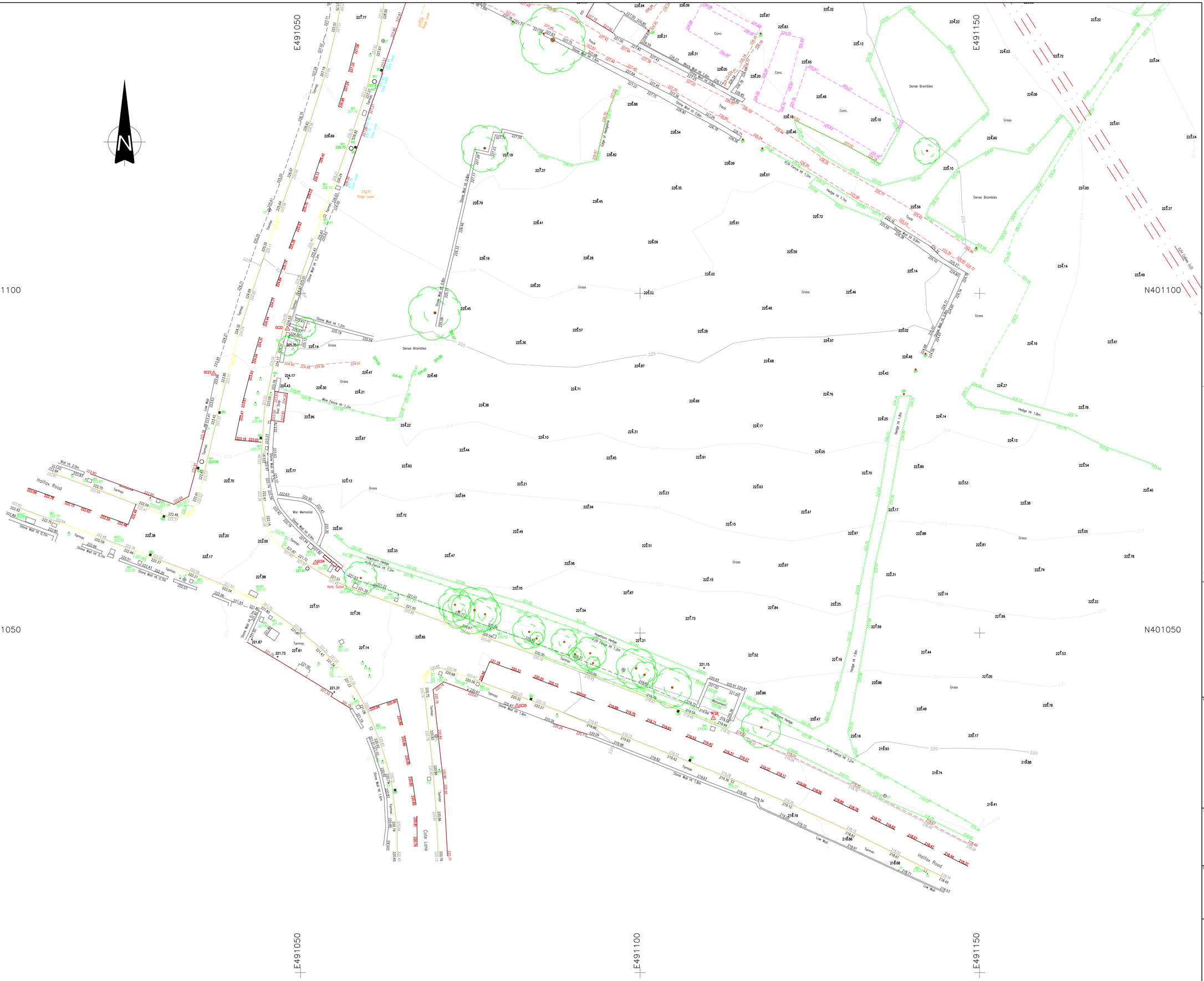
SMITHY HILL THURGOLAND

DRAWING TITLE

TOPOGRAPHIC SURVEY

DRAWN	SIGNATURE	DATE	STATUS
GC		15/11/2017	FOR COMMENT ☐
APPROVED	SIGNATURE	DATE	FOR APPROVAL ☐
			DRAFT ☐
			FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:250	A1	TC1010-001	



SYMBOL LEGEND

- Borehole
- Benchmark
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- Bus Stop
- Electric Box
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- Wooden Peg
- Ground Marker
- Marker Post
- Pylon
- Rodding Eye
- Sample Point
- Sign Post
- Spot Height
- Eave Level
- Ridge Level
- Stile
- Survey Station
- Traffic Camera
- Telephone Box
- Trial Pit
- Telegraph Pole
- Deciduous Tree
- Road Sign
- Valve
- Vent
- Water Meter
- Letter Box
- MH Circular
- Knockout Pot

LINETYPE LEGEND

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- Bottom of Bank
- Building
- Canopy Edge
- Concrete Edge
- Ditch
- Drop Kerb
- Overhead Cable
- Fence
- Gate
- Kerb
- Path
- Pipe Line
- River
- Surface Water Drain
- Railway Line
- Road Centre Line
- Tarmac Edge
- Top of Bank
- Track
- Wall
- Verge
- Flagstone Paving
- Stone
- Hedgeline
- Grass Edge

MANHOLE LEGEND

MHCT	Cable Television
MHEL	Electricity
MHGA	Gas
MHSW	Surface Water
MHFW	Foul Water
MHBT	British Telecom
MHWT	Water

ABBREVIATIONS

LP.	Lamp Post
TP.	Telegraph Pole
EP.	Electricity Pole
SP.	Sign Post
TS.	Tarffic Sign
BS.	Bus Stop
GM.	Gas Marker Monument
MH.	Manhole
GU.	Gully
FH.	Fire Hydrant
CATV.	Cable Television Point
WM.	Water Meter
WSV.	Water Stop Valve
GSV.	Gas Stop Valve
RE.	Rodding Eye
GU.	Gully
FH.	Fire Hydrant
CATV.	Cable Television Point
WM.	Water Meter
WSV.	Water Stop Valve
GSV.	Gas Stop Valve
RE.	Rodding Eye

SURVEY IS ORIENTED TO ORDNANCE SURVEY NATIONAL GRID. POSITIONS FIXED BY GPS ACTIVE NETWORK TO CREATE A FLAT. PLANE LOCAL CO-ORDINATE SYSTEM. LEVELS TO OSGM15.

THIS SURVEY SHOWS PHYSICAL SITE BOUNDARIES ONLY. CONFIRMATION OF LEGAL OWNERSHIP BOUNDARIES SHOULD BE OBTAINED BY REFERENCE TO THE H.M. LAND REGISTRY TITLE PLAN

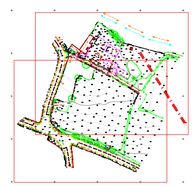
THE PLAN SCALE IS FOR GUIDANCE ONLY.
DO NOT SCALE DIRECTLY .
IF IN DOUBT, CONSULT LATITUDE SURVEYS

REV.	DESCRIPTION	DATE

LATITUDE SURVEYS | Chartered Land Surveyors

RICS the mark of property professionalism worldwide

CLIENT



JOB TITLE

SMITHY HILL THURGOLAND

DRAWING TITLE

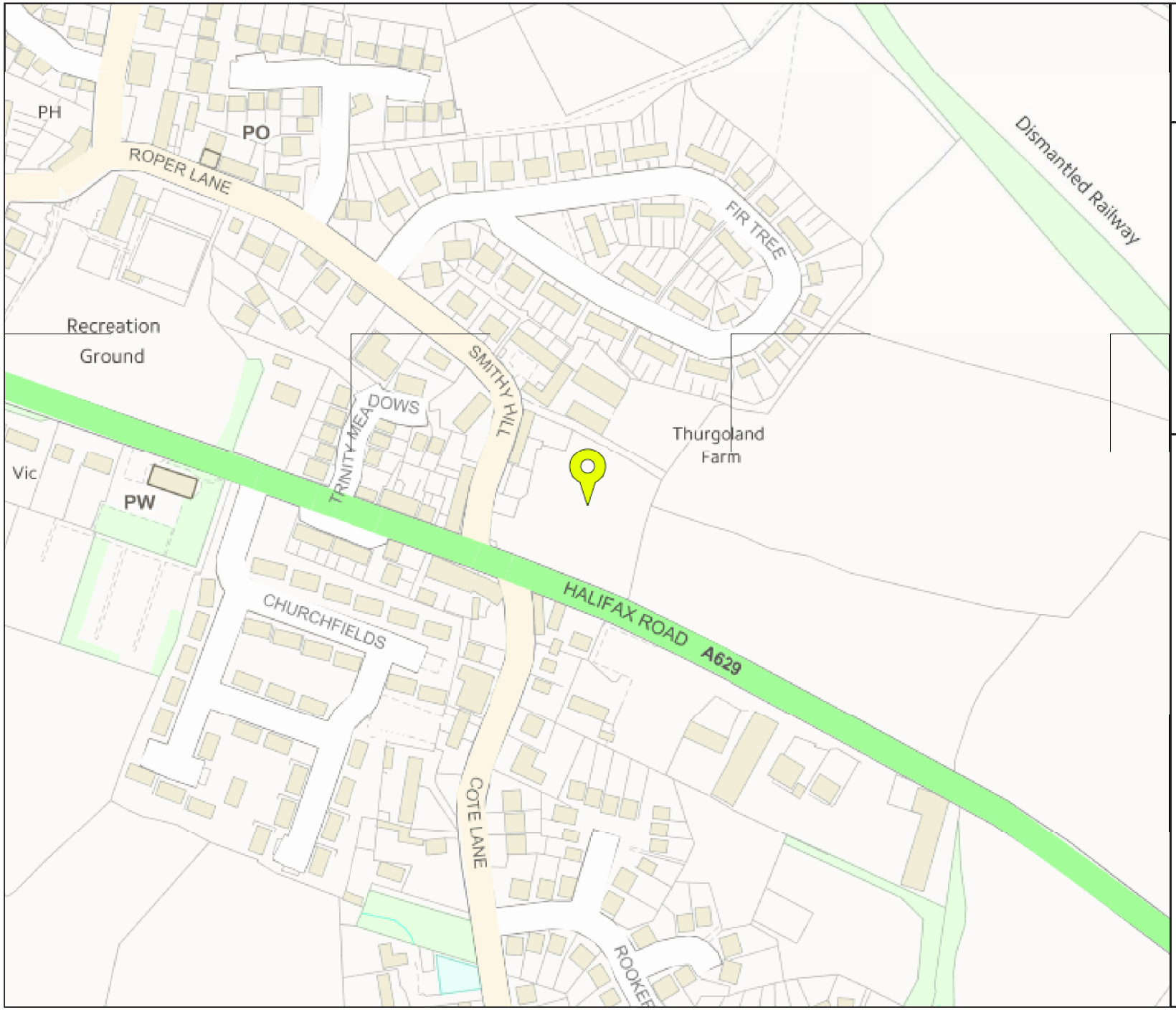
TOPOGRAPHIC SURVEY

DRAWN	SIGNATURE	DATE	STATUS
GC		15/11/2017	FOR COMMENT ☐
APPROVED	SIGNATURE	DATE	FOR APPROVAL ☐
			DRAFT ☐
			FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:250	A1	TC1010-002	

APPENDIX C

ENVIRONMENT AGENCY CONSULTATION



Environment Agency

Flood map for planning

Your reference
800/628

Location
429105/401089

Scale
1:3125

Created
8 Jan 2018 11:04

- Development location
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 50 100 150m

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Basic view Detailed view

Location thurgoland

Flood risk from rivers or the sea

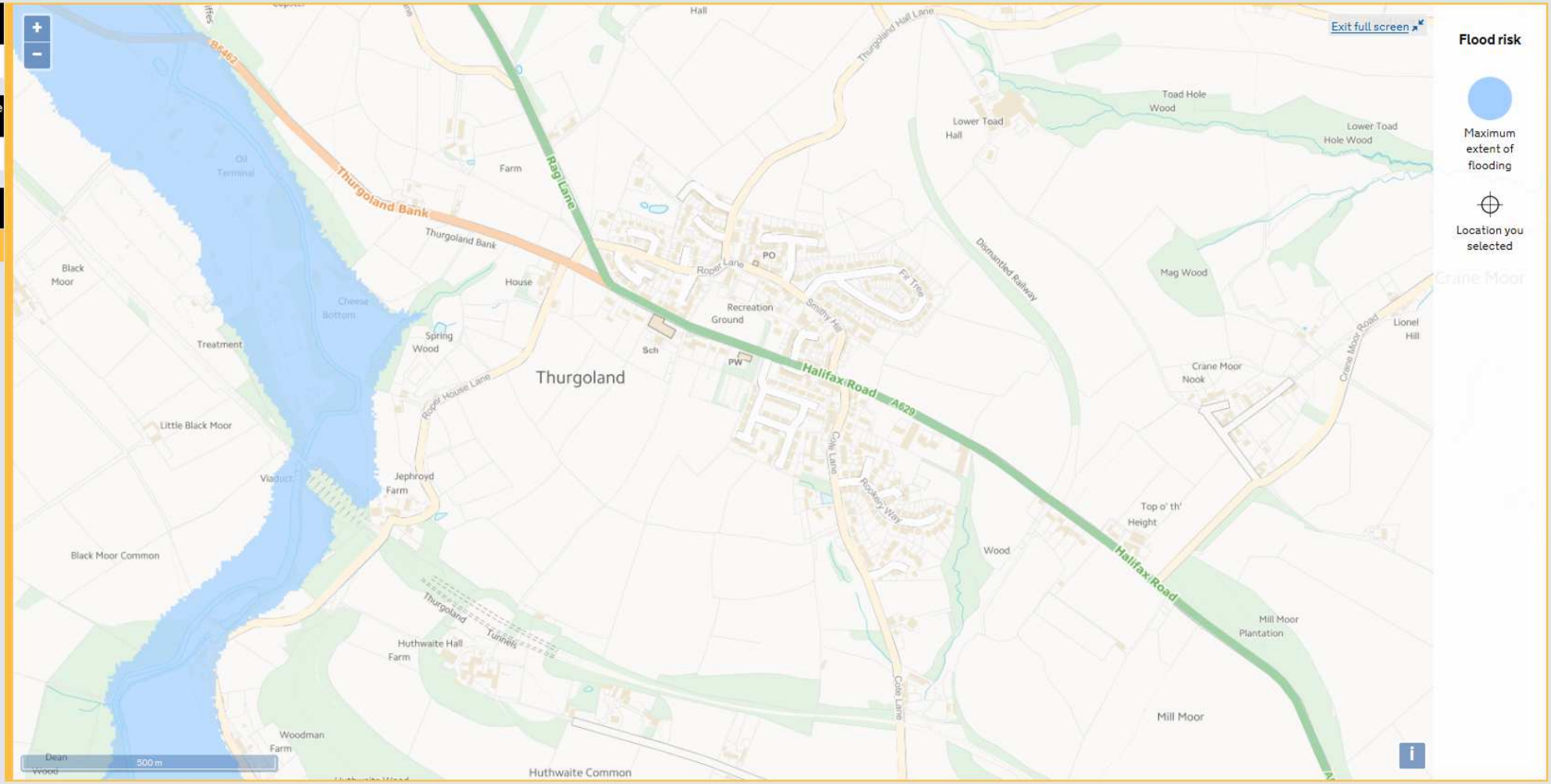
- Extent of flooding

Flood risk from surface water

- Extent of flooding

Flood risk from reservoirs

- Extent of flooding



Basic view Detailed view

Location thurgoland

Flood risk from rivers or the sea

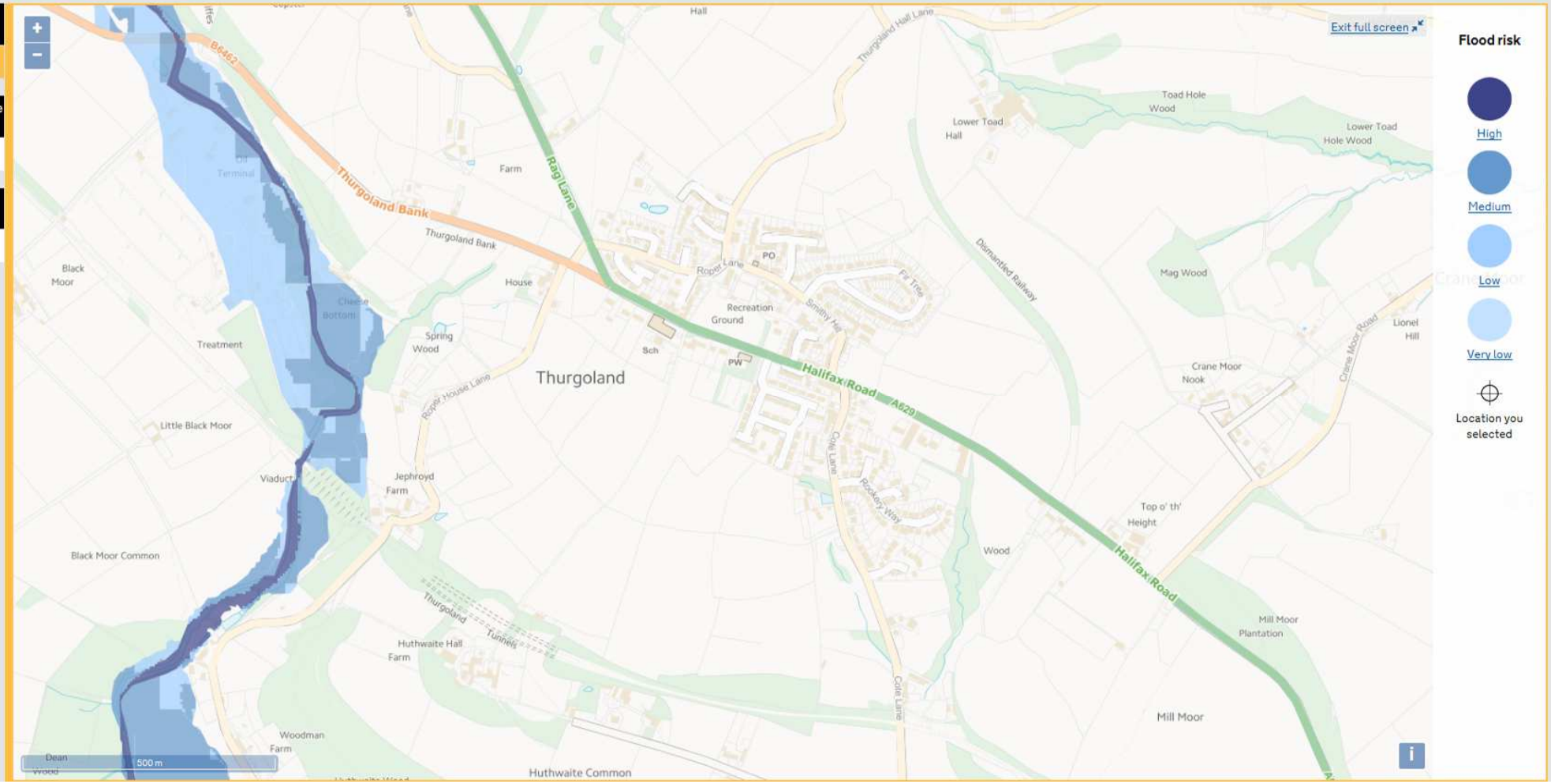
Extent of flooding

Flood risk from surface water

Extent of flooding

Flood risk from reservoirs

Extent of flooding



Basic view Detailed view

Location thurgoland

Flood risk from rivers or the sea

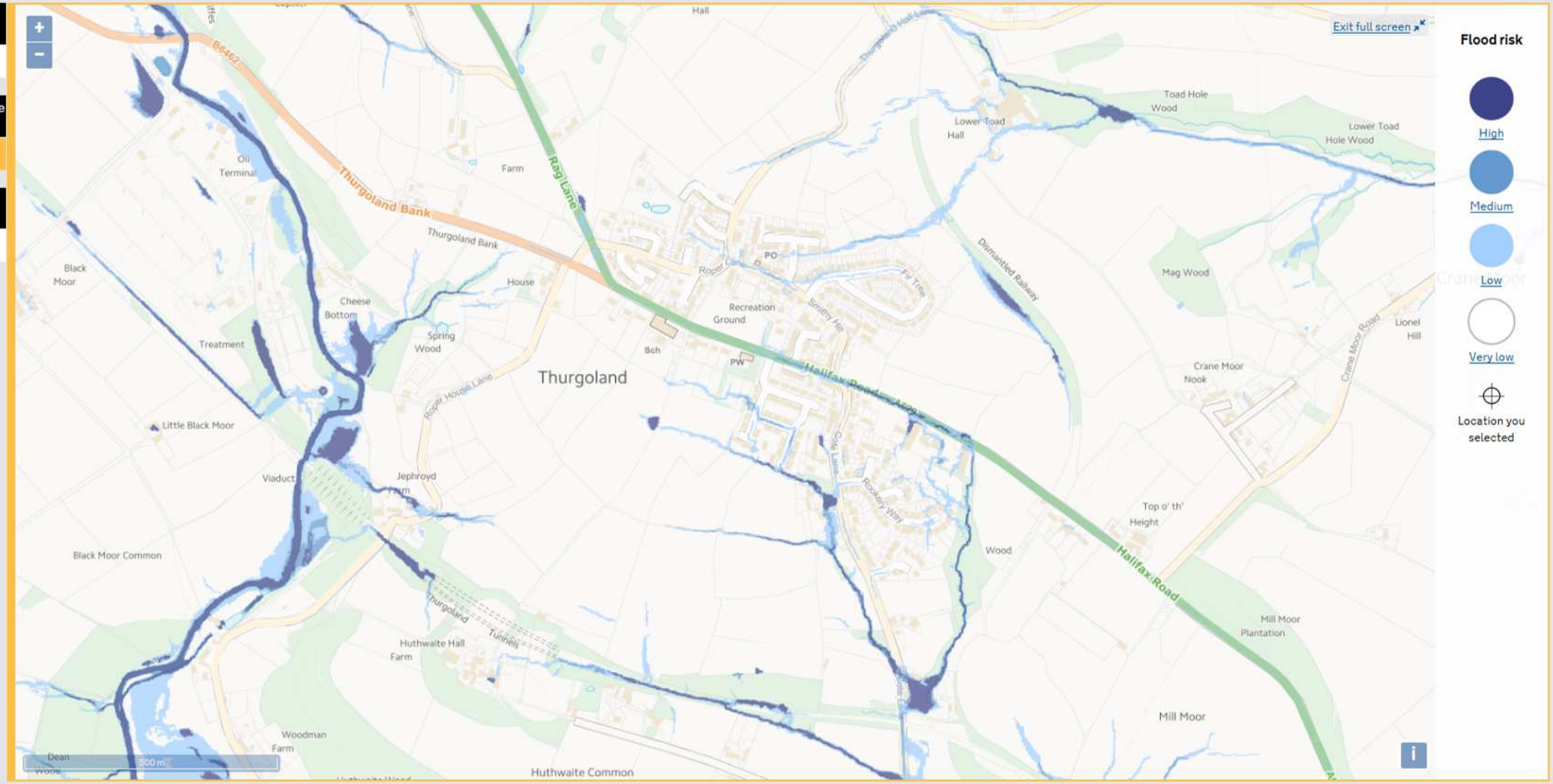
Extent of flooding

Flood risk from surface water

Extent of flooding

Flood risk from reservoirs

Extent of flooding



APPENDIX D

WATER AUTHORITY CONSULTATION

YorkshireWater

Mr P Carter
Arp Associates
Unit 5/6 Northwest Business Pk
1ST FLR Servia Hill
Woodhouse
Leeds
LS6 2QH

Yorkshire Water Services
Developer Services
Sewerage Technical Team
PO BOX 52
Bradford
BD3 7AY

Tel: 0345 120 8482
Fax: (01274) 372 834

Email:
Technical.Sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

Your Ref:
Our Ref: T019490

30th November 2017

Dear Mr Carter,

Land Off Smithy Hill, Thurgoland, Barnsley, S35 7EB - PPSE ON R777623, GREENFIELD

Thank you for your recent enquiry. Our charge of £153.00 (plus VAT) will be added to your account with us, reference ARP013. You will receive an invoice for your account in due course.

Please find enclosed a complimentary extract from the Statutory Sewer Map which indicates the recorded position of the public sewers. Please note that as of October 2011 and the private to public sewer transfer, there are many uncharted Yorkshire Water assets currently not shown on our records. The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site and are valid for a maximum period of twelve months.

Development of the site should take place with separate systems for foul and surface water drainage. The separate systems should extend to the points of discharge to be agreed.

Foul Water

Foul water domestic waste should discharge to the 225 mm diameter public combined sewer recorded in Crossways, at a point to the south of the site.

Surface Water

The developer's attention is drawn to Requirement H3 of the Building Regulations 2000. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order.

Sustainable Drainage Systems (SuDS), for example the use of soakaways and/or permeable hardstanding etc, may be a suitable solution for surface water disposal appropriate in this situation. You are advised to seek comments on the suitability of SuDS in this instance from the appropriate authorities.

It is understood that highway drains are located to the south of the site. This appears to be the obvious place for surface water disposal (if SuDS are not viable).

Please note further restrictions on surface water disposal from the site may be imposed by other parties. You are strongly advised to seek advice/comments from the Environment Agency/Land Drainage

YorkshireWater

Authority/Internal Drainage Board, with regard to surface water disposal from the site.

Other Observations

Any new connection to an existing public sewer will require the prior approval of Yorkshire Water. You may obtain an application form from our website (www.yorkshirewater.com) or by telephoning 0345 120 84 82.

An off-site foul and surface water sewer may be required which may be provided by the developer and considered for adoption under Section 104 of the Water Industry Act 1991. Please telephone 0345 120 84 82 for advice on sewer adoptions. Alternatively, the developer may in certain circumstances be able to requisition off-site sewers under Section 98 of the Water Industry Act 1991 for which an application must be made in writing. For further information, please telephone 0345 120 84 82.

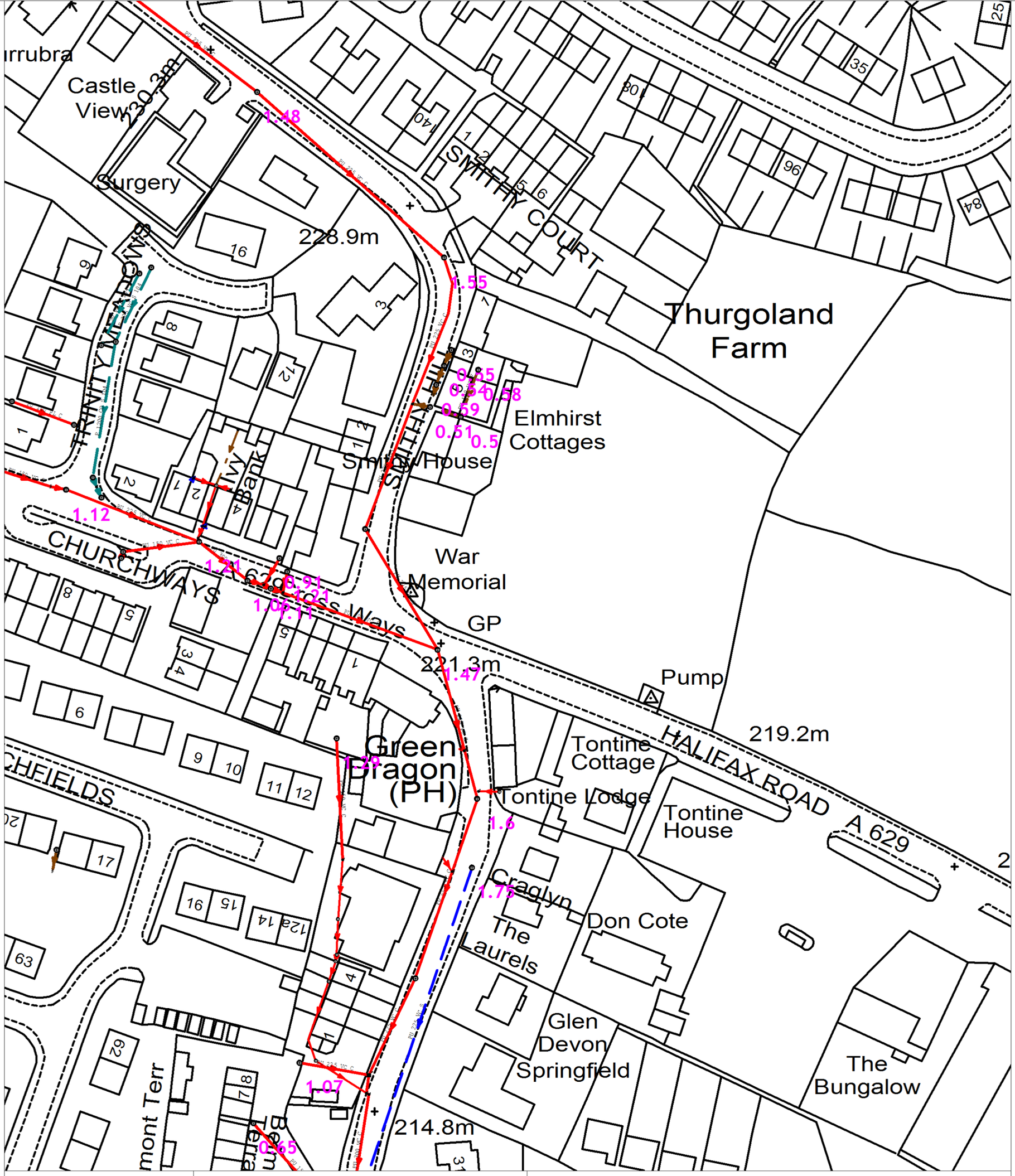
Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the WRc publication "Sewers for Adoption - a design and construction guide for developers" 6th Edition as supplemented by Yorkshire Water's requirements, pursuant to an agreement under Section 104 of the Water Industry Act 1991. An application to enter into a Section 104 agreement must be made in writing prior to any works commencing on site. Please contact our Developer Services Team (telephone 0345 120 84 82) for further information.

All the above comments are based upon the information and records available at the present time. The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith. Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

Yours sincerely

Chris Roberts
Sewerage Technician
Developer Services

INVESTING IN VOLUNTEERS FOR EMPLOYERS
CUSTOMER SERVICE EXCELLENCE CSE



428921 : 400890	Map Name : SE2800NE	Title
		Notes

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name :
YorMap Advisor C ROBERTS
Contact Tel : 87 2582

Partial Key

Foul Sewer = F

Combined Sewer = C

Surface Water Sewer = SW

Trade Sewer = TD

Partially Separate = PS

This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.

Date Req : 30/11/2017, 09:09:12

Date Gen : 30/11/2017, 09:09:53

Source : Sewer Network Enquiry

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UPN: Undefined Originator: C ROBERTS, YorMap, 87 2582

APPENDIX E

LAND DRAINAGE AUTHORITY CONSULTATION

Paul Carter

Subject: FW: 800/628 Land off Smithy Hill, Thurgoland, Barnsley
Attachments: Smithy Hill Watercourse.bmp

From: Atkins , Wayne [mailto:WayneAtkins@barnsley.gov.uk]
Sent: Friday 15 December, 2017 10:55am
To: Paul Carter
Subject: RE: 800/628 Land off Smithy Hill, Thurgoland, Barnsley

HI Paul,

The nearest available watercourse is shown coloured blue on the attached plan.

If the developer is to make discharge flows to the existing watercourse he must gain the written agreement of the Land Drainage Authority to discharge flows at an agreed rate – Contact highwaydrainage@barnsley.gov.uk

If the developer is to carry out works within or in the proximity of any watercourse he must gain the relevant permissions from the Lead Local Flood Authority – Contact highwaydrainage@barnsley.gov.uk

If you require any further information please let me know.

Regards

Wayne Atkins
Principal Engineer – Drainage
Environment & Transport
Place Directorate
Barnsley Metropolitan Borough Council

Telephone: 01226 772182
E-mail: wayneatkins@barnsley.gov.uk

Paul Carter

Subject: FW: 800/628 Land off Smithy Hill, Thurgoland, Barnsley

From: Atkins , Wayne [mailto:WayneAtkins@barnsley.gov.uk]
Sent: Friday 15 December, 2017 12:31pm
To: Paul Carter
Subject: RE: 800/628 Land off Smithy Hill, Thurgoland, Barnsley

Hi Paul,

The watercourse runs in a southerly direction. It is culverted under Halifax Road, however, the culvert is in poor condition with a service running through it and I am unaware of how much further it carries on to the North. I believe It would be feasible to connect downstream of the road as the watercourse is in a fairly deep valley at this point, however, this should be confirmed by yourselves on site.

Hope this helps.

Regards

Wayne Atkins
Principal Engineer – Drainage
Environment & Transport
Place Directorate
Barnsley Metropolitan Borough Council

Telephone: 01226 772182
E-mail: wayneatkins@barnsley.gov.uk

Paul Carter

From: HighwayDrainage <HighwayDrainage@barnsley.gov.uk>
Sent: Monday 18 December, 2017 8:58 am
To: Paul Carter
Subject: RE: 800/628 Land off Smithy Hill, Thurgoland, Barnsley

Paul,

BMBC as Lead Local Flood Authority will accept flows from the site based upon a maximum discharge of 5 litres per second per Hectare of site.

As the site is approximately 1 Hectare in size this equates to a maximum discharge rate of 5 litres per second from the site into the receiving watercourse.

Any balancing facility should be designed to accommodate a 1 in 30 year flow from the site and a 1 in 100 year flow retained within the site (including an allowance of 30% for climate change), without causing any flooding to buildings.

Regards

From: Paul Carter [mailto:PaulCarter@arpassociates.co.uk]
Sent: 15 December 2017 11:54
To: HighwayDrainage
Cc: Wayne Walker
Subject: FW: 800/628 Land off Smithy Hill, Thurgoland, Barnsley

Dear Sirs,

This morning we received the email below from Wayne Atkins, with reference to the attached a pre-planning letter and site location plan for the above development.

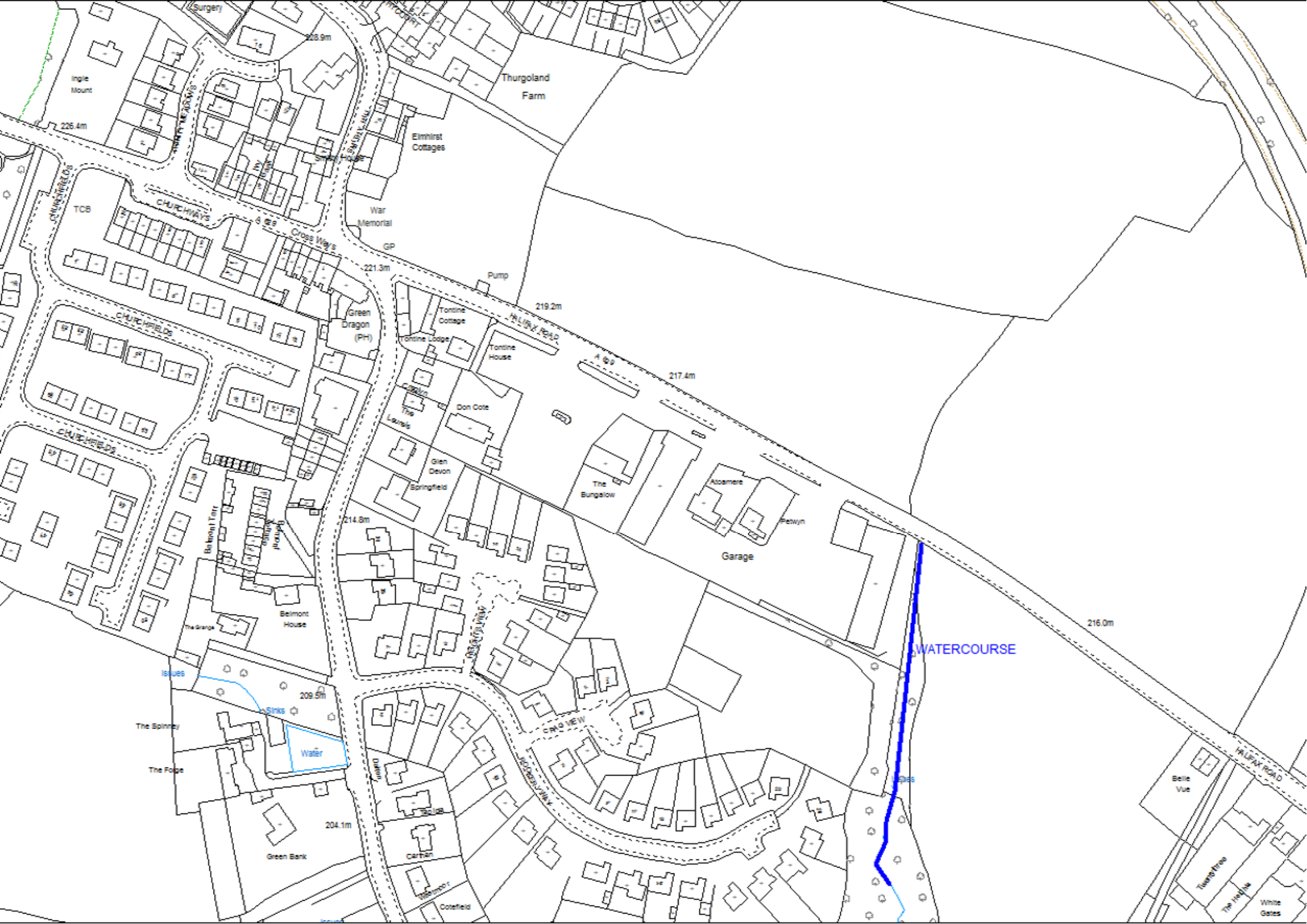
We would be very grateful if you are be able to advise of a discharge rate, should it be appropriate to discharge surface water into the nearby watercourse (as noted in the attached jpeg). Also, please could you let us know if you have any further details surrounding the watercourse? In particular, flow direction, whether it is culverted under Halifax Road, whether it is feasible for to receive surface water from the proposed development.

If at all possible, we would be very grateful to receive your very earliest attention to this. The timescale for the planning application is very urgent.

We trust this is sufficient, however, if you would like to discuss anything further, please do not hesitate to let us know.

Kind Regards

Paul Carter
0113 245 8498
paulcarter@arpassociates.co.uk


Surgery
228.9m
Ingle Mount
226.4m
Thurgoland Farm
Elmhirst Cottages
Smithy House
Ivy House
CHURCHWAYS
CHURCHFIELDS
TCB
Cross Ways
War Memorial
GP
221.3m
Pump
219.2m
Green Dragon (PH)
Tontine Cottage
Tontine Lodge
Tontine House
HALIFAX ROAD
217.4m
Don Cote
The Laurels
Glen Devon
Springfield
The Bungalow
Abbamere
Petwyn
Garage
214.8m
Belmont Terr
Belmont House
The Grange
Issues
Sinks
209.5m
Water
The Spinney
The Forge
Green Bank
204.1m
Carlton
Cotefield
CRAG VIEW
HOLLINSEND WAY
WATERCOURSE
216.0m
Belle Vue
Twentytrees
The Hedges
White Gates

APPENDIX F

INDICATIVE GREENFIELD RUN-OFF CALCULATIONS

Northwest House
Servia Hill
Leeds LS6 2QH

Date 08/01/2018 12:24pm | Designed by AdrianBottomley
File | Checked by
Elstree Computing Ltd | Source Control 2017.1.2

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.300
Area (ha)	50.000	Urban	0.000
SAAR (mm)	876	Region Number	Region 3

Results l/s

QBAR Rural	118.5
QBAR Urban	118.5
Q1 year	101.9
Q1 year	101.9
Q2 years	111.8
Q5 years	148.1
Q10 years	171.8
Q20 years	194.5
Q25 years	202.1
Q30 years	208.2
Q50 years	224.4
Q100 years	246.4
Q200 years	279.6
Q250 years	290.2
Q1000 years	360.1

It is unusual to use the IH124 method with an area of <50ha. The Interim Code of Practice recommends that the IH124 method is applied with 50ha and the resulting discharge is linearly interpolated for the required area.

Therefore:

1 year = 101.9l/s / 50ha = 2.038l/s/ha

2.038l/s/ha x 1.0ha = 2.04l/s

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APPENDIX G

INDICATIVE SURFACE WATER DRAINAGE CALCULATIONS

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.027	0.227	2.8	61.3	O K
30 min Summer	99.101	0.301	2.9	81.3	O K
60 min Summer	99.179	0.379	2.9	102.3	O K
120 min Summer	99.254	0.454	2.9	122.5	O K
180 min Summer	99.290	0.490	2.9	132.3	O K
240 min Summer	99.309	0.509	2.9	137.5	O K
360 min Summer	99.326	0.526	2.9	141.9	O K
480 min Summer	99.329	0.529	2.9	143.0	O K
600 min Summer	99.329	0.529	2.9	142.9	O K
720 min Summer	99.326	0.526	2.9	142.1	O K
960 min Summer	99.316	0.516	2.9	139.2	O K
1440 min Summer	99.284	0.484	2.9	130.8	O K
2160 min Summer	99.231	0.431	2.9	116.5	O K
2880 min Summer	99.180	0.380	2.9	102.7	O K
4320 min Summer	99.092	0.292	2.9	78.9	O K
5760 min Summer	99.027	0.227	2.8	61.3	O K
7200 min Summer	98.981	0.181	2.7	48.8	O K
8640 min Summer	98.947	0.147	2.6	39.8	O K
10080 min Summer	98.924	0.124	2.5	33.5	O K
15 min Winter	99.055	0.255	2.9	68.8	O K
30 min Winter	99.139	0.339	2.9	91.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	67.342	0.0	61.1	19
30 min Summer	45.312	0.0	82.7	33
60 min Summer	29.238	0.0	108.6	62
120 min Summer	18.313	0.0	136.2	122
180 min Summer	13.763	0.0	153.7	182
240 min Summer	11.176	0.0	166.4	240
360 min Summer	8.328	0.0	186.1	358
480 min Summer	6.751	0.0	201.1	412
600 min Summer	5.733	0.0	213.5	476
720 min Summer	5.014	0.0	224.1	540
960 min Summer	4.056	0.0	241.6	674
1440 min Summer	3.003	0.0	268.0	940
2160 min Summer	2.220	0.0	299.0	1344
2880 min Summer	1.790	0.0	321.4	1732
4320 min Summer	1.320	0.0	354.9	2468
5760 min Summer	1.062	0.0	382.1	3176
7200 min Summer	0.899	0.0	403.9	3888
8640 min Summer	0.784	0.0	422.4	4584
10080 min Summer	0.698	0.0	438.5	5248
15 min Winter	67.342	0.0	68.6	18
30 min Winter	45.312	0.0	92.8	33

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.227	0.427	2.9	115.3	O K
120 min Winter	99.314	0.514	2.9	138.7	O K
180 min Winter	99.358	0.558	2.9	150.7	O K
240 min Winter	99.383	0.583	2.9	157.5	O K
360 min Winter	99.409	0.609	2.9	164.5	O K
480 min Winter	99.417	0.617	2.9	166.7	O K
600 min Winter	99.415	0.615	2.9	166.0	O K
720 min Winter	99.407	0.607	2.9	163.9	O K
960 min Winter	99.391	0.591	2.9	159.5	O K
1440 min Winter	99.341	0.541	2.9	146.1	O K
2160 min Winter	99.255	0.455	2.9	122.9	O K
2880 min Winter	99.175	0.375	2.9	101.1	O K
4320 min Winter	99.048	0.248	2.9	67.0	O K
5760 min Winter	98.968	0.168	2.7	45.4	O K
7200 min Winter	98.922	0.122	2.5	32.9	O K
8640 min Winter	98.899	0.099	2.3	26.7	O K
10080 min Winter	98.888	0.088	2.0	23.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	29.238	0.0	121.7	62
120 min Winter	18.313	0.0	152.7	120
180 min Winter	13.763	0.0	172.2	178
240 min Winter	11.176	0.0	186.5	236
360 min Winter	8.328	0.0	208.4	348
480 min Winter	6.751	0.0	225.3	458
600 min Winter	5.733	0.0	239.1	560
720 min Winter	5.014	0.0	251.0	590
960 min Winter	4.056	0.0	270.5	732
1440 min Winter	3.003	0.0	300.1	1038
2160 min Winter	2.220	0.0	335.0	1468
2880 min Winter	1.790	0.0	360.1	1848
4320 min Winter	1.320	0.0	397.7	2592
5760 min Winter	1.062	0.0	428.0	3240
7200 min Winter	0.899	0.0	452.4	3896
8640 min Winter	0.784	0.0	473.2	4496
10080 min Winter	0.698	0.0	491.3	5240

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.328	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.500

Time (mins) From:	To:	Area (ha)
0	4	0.500

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	270.0	1.200	270.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0079-3000-1200-3000
Design Head (m)	1.200
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	79
Invert Level (m)	98.800
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	3.0
Flush-Flo™	0.348	2.9
Kick-Flo®	0.707	2.4
Mean Flow over Head Range	-	2.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.3	1.200	3.0	3.000	4.6	7.000	6.8
0.200	2.8	1.400	3.2	3.500	4.9	7.500	7.0
0.300	2.9	1.600	3.4	4.000	5.2	8.000	7.3
0.400	2.9	1.800	3.6	4.500	5.5	8.500	7.5
0.500	2.8	2.000	3.8	5.000	5.8	9.000	7.7
0.600	2.7	2.200	4.0	5.500	6.1	9.500	7.9
0.800	2.5	2.400	4.1	6.000	6.3		
1.000	2.8	2.600	4.3	6.500	6.6		

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.185	0.385	2.9	103.9	O K
30 min Summer	99.319	0.519	2.9	140.1	O K
60 min Summer	99.464	0.664	2.9	179.4	O K
120 min Summer	99.612	0.812	2.9	219.4	O K
180 min Summer	99.690	0.890	2.9	240.2	O K
240 min Summer	99.734	0.934	2.9	252.3	Flood Risk
360 min Summer	99.788	0.988	2.9	266.7	Flood Risk
480 min Summer	99.814	1.014	2.9	273.7	Flood Risk
600 min Summer	99.823	1.023	2.9	276.3	Flood Risk
720 min Summer	99.823	1.023	2.9	276.2	Flood Risk
960 min Summer	99.811	1.011	2.9	273.0	Flood Risk
1440 min Summer	99.779	0.979	2.9	264.2	Flood Risk
2160 min Summer	99.722	0.922	2.9	248.9	Flood Risk
2880 min Summer	99.663	0.863	2.9	232.9	O K
4320 min Summer	99.541	0.741	2.9	199.9	O K
5760 min Summer	99.399	0.599	2.9	161.6	O K
7200 min Summer	99.288	0.488	2.9	131.6	O K
8640 min Summer	99.197	0.397	2.9	107.3	O K
10080 min Summer	99.126	0.326	2.9	88.1	O K
15 min Winter	99.232	0.432	2.9	116.6	O K
30 min Winter	99.383	0.583	2.9	157.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	113.129	0.0	103.5	19
30 min Summer	76.900	0.0	140.9	34
60 min Summer	49.937	0.0	186.0	64
120 min Summer	31.293	0.0	233.2	124
180 min Summer	23.430	0.0	261.8	182
240 min Summer	18.928	0.0	282.0	242
360 min Summer	14.007	0.0	312.8	362
480 min Summer	11.299	0.0	336.2	482
600 min Summer	9.555	0.0	355.0	600
720 min Summer	8.327	0.0	370.8	718
960 min Summer	6.696	0.0	395.9	826
1440 min Summer	4.914	0.0	421.6	1082
2160 min Summer	3.597	0.0	484.7	1492
2880 min Summer	2.879	0.0	517.0	1904
4320 min Summer	2.099	0.0	564.9	2764
5760 min Summer	1.675	0.0	602.7	3464
7200 min Summer	1.408	0.0	633.3	4184
8640 min Summer	1.222	0.0	659.3	4848
10080 min Summer	1.084	0.0	681.8	5552
15 min Winter	113.129	0.0	116.0	19
30 min Winter	76.900	0.0	157.7	33

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.548	0.748	2.9	202.0	O K
120 min Winter	99.715	0.915	2.9	247.1	Flood Risk
180 min Winter	99.804	1.004	2.9	271.2	Flood Risk
240 min Winter	99.857	1.057	2.9	285.4	Flood Risk
360 min Winter	99.923	1.123	2.9	303.2	Flood Risk
480 min Winter	99.958	1.158	2.9	312.7	Flood Risk
600 min Winter	99.975	1.175	3.0	317.4	Flood Risk
720 min Winter	99.981	1.181	3.0	318.9	Flood Risk
960 min Winter	99.972	1.172	3.0	316.5	Flood Risk
1440 min Winter	99.928	1.128	2.9	304.4	Flood Risk
2160 min Winter	99.850	1.050	2.9	283.5	Flood Risk
2880 min Winter	99.763	0.963	2.9	260.0	Flood Risk
4320 min Winter	99.580	0.780	2.9	210.6	O K
5760 min Winter	99.359	0.559	2.9	150.8	O K
7200 min Winter	99.200	0.400	2.9	108.0	O K
8640 min Winter	99.088	0.288	2.9	77.8	O K
10080 min Winter	99.013	0.213	2.8	57.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	49.937	0.0	208.4	62
120 min Winter	31.293	0.0	261.1	122
180 min Winter	23.430	0.0	293.2	180
240 min Winter	18.928	0.0	315.7	238
360 min Winter	14.007	0.0	350.0	354
480 min Winter	11.299	0.0	375.9	468
600 min Winter	9.555	0.0	396.6	582
720 min Winter	8.327	0.0	413.5	692
960 min Winter	6.696	0.0	437.7	904
1440 min Winter	4.914	0.0	437.3	1138
2160 min Winter	3.597	0.0	542.8	1600
2880 min Winter	2.879	0.0	579.0	2072
4320 min Winter	2.099	0.0	632.4	2980
5760 min Winter	1.675	0.0	675.1	3696
7200 min Winter	1.408	0.0	709.4	4392
8640 min Winter	1.222	0.0	738.6	5016
10080 min Winter	1.084	0.0	763.9	5648

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.328	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.500

Time (mins) From:	To:	Area (ha)
0	4	0.500

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	270.0	1.200	270.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0079-3000-1200-3000
Design Head (m)	1.200
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	79
Invert Level (m)	98.800
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	3.0
Flush-Flo™	0.348	2.9
Kick-Flo®	0.707	2.4
Mean Flow over Head Range	-	2.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.3	1.200	3.0	3.000	4.6	7.000	6.8
0.200	2.8	1.400	3.2	3.500	4.9	7.500	7.0
0.300	2.9	1.600	3.4	4.000	5.2	8.000	7.3
0.400	2.9	1.800	3.6	4.500	5.5	8.500	7.5
0.500	2.8	2.000	3.8	5.000	5.8	9.000	7.7
0.600	2.7	2.200	4.0	5.500	6.1	9.500	7.9
0.800	2.5	2.400	4.1	6.000	6.3		
1.000	2.8	2.600	4.3	6.500	6.6		

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