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# FLOOD RISK ASSESSMENT

**ON**

## Land at

## BARNSLEY ROAD, FLOCKTON

**FOR**

## PERSIMMON HOMES WEST YORKSHIRE

**August 2016**

**E14/6164/R001b**

Prepared by

**T. Haigh B.Sc., C.Eng., M.I.C.E.**

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## 1.0 INTRODUCTION

1.1 This report is commissioned to investigate and report on the Flood Risk for this site in accordance Planning Practise Guidance- Flood Risk and Coastal Change April 2015 and the proposals for drainage of this site when redeveloped as residential land. The report is based on information supplied by the client and from relevant authorities in both written and verbal format. Some of this information is in verbal form only. No liability can be accepted for information supplied by third parties which is subsequently found to be inaccurate or incorrect.

## 2.0 THE SITE

2.1 The site is located to the north of Barnsley Road, Flockton. It is situated around Ordnance Survey grid reference 423494, 414932. A site location plan is included in Appendix A.

2.2 The site is approximately rectangular, with the south eastern corner missing. There is a vehicular access from Barnsley Road located centrally on the southern boundary. To the south, west and east are residential properties. To the north is open field. The overall site area is approximately 1.74ha.

2.3 The vehicular access located centrally on the southern boundary has a tarmac surface and leads onto a compacted gravel parking area. There is a collection of warehouses/barns surrounded by concrete hard standing in the south west area of the site. The buildings are a collection of timber and steel portal frames with low rise walls and metal/asbestos sheet cladding and roofing. Just inside the southern boundary is a stone farm cottage and outbuilding adjacent to Barnsley Road.

2.4 The north western quarter and eastern half of the site are fields used for the growing of crops. There is sparse tree growth on the southern and western boundary. Overheard telegraph lines run from south to north in the eastern half of the site.

2.5 The site is open to the adjacent fields to the north. The remaining boundaries are primarily formed by a stone wall. The stone wall retains the site up to approximately 1.0m above Barnsley Road in the south east.

2.6 The site generally falls from north west to south east at an average grade of 1 in 20. A high point of 174.11m AOD is located in the north west and a low point of 164.81m AOD in the south east.

2.7 The nearest watercourse is Flockton Beck which runs 180m to the south of the site frontage to Barnsley road. This beck then forms Mill Beck and runs away to the east to connect to the River Calder.

2.8 The BGS Digital Geological Map of Great Britain at 1:50,000 scale has been consulted and we would report as follows:-

2.8.1 There are no areas of made ground shown underlying the site, or within 250m of the site.

2.8.2 The site is shown to be underlain by the Birstall Rock formation consisting of sandstone. The Pennine Lower Coal Measures formation consisting of mudstone, siltstone and sandstone abuts the southern boundary.

2.8.3 A fault line is shown crossing the north western corner of the site from north east to south west.

2.8.4 Soakaway testing has been undertaken in the eastern half of the site, the western half was not accessible due to field crops etc. The excavations proved top soils overlying clays, sands and gravels and weathered sandstone. The results of the infiltration tests show that these were only partly acceptable, on only a small proportion of the site. There use on the site has therefore been discounted for the purpose of this report.

2.9 The bedrock strata underlying the site is classified as a Secondary (A) Aquifer. These are defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. There are no groundwater abstraction licences recorded within 250m of the site. There is a single recorded licensed discharge consent within 250m of the site located 28m east of the site. There are no recorded surface water abstractions within 250m of the site. There are no recorded pollution incidents in controlled waters within 250m of the site. The site is not in a source protection zone.

2.10 There are foul water systems that serve the residential developments to the south and west. These are close to the site frontage and Yorkshire Water have stated that there is capacity for foul water discharges in this system from the site.

2.11 Yorkshire Water have stated that there is no capacity for surface water discharges in this system from the site and that the current approved hierarchy of discharges to infiltration systems followed by discharges to watercourses should be utilised. There is a highway drain to the site frontage but this is in poor repair and may not be suitable for even a restricted discharge from the site. There is a culverted water course that runs beneath the highway some 180m to the east of the site in Barnsley Road that may be able to accept flows from the site.

2.12 Kirklees Land Drainage have also been approached regarding the drainage of this site. Whilst there is no history of flooding on the site they are aware of possible risks in the downstream catchment. They have indicated that an agricultural run off of 3 Lit/sec may be acceptable into the existing highway drain fronting the site. This was accepted to rise to 5lit/sec for extreme storm conditions. They would prefer the use of infiltration systems if possible but are also aware that the ground conditions are unlikely to support this. A slightly higher discharge, up to 3 lit/sec/ha may be acceptable to Kirklees MDC if the surface water drainage was to pass into the culverted watercourse that crosses Barnsley Road some 180m to the east of the site but this would be subject to negotiation.

## 3.0 PROPOSED DEVELOPMENT

3.1 It is proposed to develop the site for mixed residential development together with onsite open space. An illustrative layout is attached to this report and this shows the mix of housing types and tenures that is proposed. Approximately 41 dwellings are to be provided on the site.

## 4.0 IMPACT OF DEVELOPMENT

4.1 The site is currently a open pasture land with little hard paved or impermeable areas. The surface water run-off from the site is primarily to the south eastern corner of the site. The development of the site will introduce new impermeable surfaces in the form of roofs, roads, drives and other hard paved areas. This will increase the run-off from the site significantly if flows are not attenuated or controlled. In particular it would increase the speed of surface water discharge from the site.

4.2 The site itself, even in its current condition, could already generate small overland flows from the site dependent on the rainfall patterns falling on the site. There is currently research being carried out to evaluate the risk of storm water run-off from saturated agricultural sites. When these catchments have received significant rainfall over winter months they are not capable of absorbing any further rainfall and the water is discharged as an overland flow. In such instances the discharges from agricultural land can be close to the run off for a 100% impermeable area.

4.3 Whilst there are no reports of flooding on, or adjacent to the site, there are known flooding problems in the downstream catchment. It will therefore be necessary to attenuate these flows down to the current discharge rates or below. It will therefore be necessary to agree the allowable discharges from the site and the method of attenuation of these flows.

4.4 The current hierarchy for discharges of rainfall from new development sites are primarily the utilisation of infiltration methods, then connections to existing watercourses and then to public water sewer systems. The connections to watercourses should where ever possible maintain the existing watershed of the catchment and should not exceed current discharges rates.

4.5 Previous desktop studies and local knowledge of the area suggests that the site is underlain by a drift layer of glacial Till (clays) over a sandstone, silt stones or mudstone of the Lower Coal Measures. The use of infiltration systems would appear to be extremely doubtful based on the depth of overlying clay layers and the depth needed to reach a permeable strata. The on-site infiltration testing carried to date shows that the use of infiltration systems will not be viable for the majority of the site and has therefore been discounted for the purposes of this report. .

## 5.0 FLOOD RISK

5.1 The site is outside flood zones 2 and 3 as shown on the Environment Agency Websites. The development is classified as More Vulnerable in Table 2 of the **Planning Practise Guidance- Flood Risk and Coastal Change April 2015** and Table 3 of that document also states that the proposed residential development in this area is appropriate.

5.2 Due to the size of the development over 1Ha it is necessary to prepare this site Specific Flood risk Assessment for the site.

5.3 There are a number of potential flooding mechanisms that **Planning Practise Guidance- Flood Risk and Coastal Change April 2015** now requires are evaluated for each proposed development site. Each method of flooding requires an assessment to be made on its probability relative to the site development. The requirements of the document is; 1, No Flooding on the site for the 1 in 30 year storm; 2, No flooding of properties for storms up to a 1% probability (a once in a 100 years storm). The risk assessment also includes for possible flooding both on site and off site, and the effects of the development on the downstream catchment or the flow regime of the watercourse. **Planning Practise Guidance- Flood Risk and Coastal Change April 2015** also requires that the effects of severe storms above the normal 1% probability are reviewed together with the effects of climatic change relating to the design life of the development.

5.4 It also requires that the effects of climate change are taken into account together with the impacts of extreme events and flood defence failures. Prior to this the Sequential Test outlined in NPPF, must also be applied to each development site.

5.5 Based on the published Environment Agency Flood Risk Maps the site does not fall within the 0.1% Flood Risk, nor does it fall within the 1% Flood Risk area. The site therefore falls within the low probability zone 1. The proposed residential development falls within the More Vulnerable Classification in Table 02 Technical Guidance to Planning Practise Guidance- Flood Risk and Coastal Change April 2015. The sequential test is therefore considered passed and development is considered appropriate in accordance with Table 3 of that document.

5.6 **Planning Practise Guidance- Flood Risk and Coastal Change April 2015** requires that each flooding mechanism is addressed and levels of risk evaluated. We consider there are three main risks of flooding to the site the alternative mechanisms are not applicable to this site.

5.6.1 Inundation from floodwaters leaving watercourses or rivers entering the site. This can include the effects on culverted watercourses and where the risk of blockage can occur and from breach scenarios.

5.6.2 Rainwater falling on the site and not being able to leave the site at sufficient rate to prevent flooding on the site.

5.6.3 Overland flows from adjacent land sites or due to surcharging of sewerage systems or other watercourses.

5.6.4 The impact of the developed site on the existing drainage systems and off-site surface water systems must also be assessed as part of this flood risk assessment.

## 6.0 DISCUSSION OF FLOOD RISKS

### 6.1 Flood Risk from Watercourses, River & Tidal

6.1.1 The site does not to fall within the 1% probability Flood Risk Maps as published by the Environment Agency nor does it fall within the 0.1% Flood Risk Area. The site is therefore considered not at risk from fluvial flooding. The site levels are significantly higher that adjacent primary watercourses.

6.1.2 There are no recorded flood events on site or adjacent to the site but there are reported problems in the downstream catchment. The site is significantly above the bank levels to the watercourses to the south. It is not considered at risk from flooding from this source.

6.1.3 The site falls outside all recorded flood zones from fluvial sources. The risk of flooding from river or tidal water is therefore considered acceptable for the type of development.

### 6.2 Risk of Flooding from overland flows from adjacent land.

6.2.1 The site lies on a sloping hill side with some residential development to the southern and western side of the site. To the east of the site the development is sparse and the land is lower. To the north and west of the proposed development site the land is slightly higher. The land to the east of the site has a significant slope away from the site. The land to the north that falls towards the site is not particularly large and unlikely to produce any major overland flows. The existing developments to the west all have adopted sewerage systems that will ensure no flooding up to then 1 in 30 year storms or possibly higher. It would therefore not be possible to generate significant overland flows towards the site. Land beyond all other boundaries fall away from the site.

6.2.2 It will be prudent however to ensure there are flood routes across the site from north to south to ensure properties are protected from overland flows generated within the site due to the topography and from extreme storms in excess of the design criteria. The flood route will tend to follow the highways and the final layout should consider this as a design parameter. Ensuring floor levels are a minimum of 300mm above adjacent highway levels where possible will help to resolve this problem and bring the flood risk down to well below an acceptable level.

6.2.3 During the construction phase of the development it may be necessary to remove topsoil on sections of the site. This should be kept to a minimum as the stripped surface is likely to be less permeable and could result in overland flows. As a further measure permeable bunds should be installed to the lower boundaries of the site for the duration of the construction works. These will retain the overland flows and also act as a filtration to prevent off site siltation of drains or water courses.

### 6.3 Risk of Flooding from Rainwater Falling on Site

6.3.1 The risk of flooding from water falling on site and not being able to leave is considered to be very low due to the topography of the site. These flows would however need to be attenuated to ensure no surcharging of systems downstream.

6.3.2 The development of the site would increase the impermeable area of the site and hence surface water run-off from its current status. This in itself will increase the flood risk to adjacent properties and those in the downstream catchment if flows are not attenuated.

6.3.3 Storms up to the once in 100 year risk, and with allowances to be made for climatic change, can be managed by the use of storm water storage systems. The design of these systems would be dependent on the agreed discharge rate for the site (3 l/s) and the form of storage to be utilised. Current design requirements for basins is that the basin should not collect flows for the 1 in 2 year storm; that there should be no surcharging on the system for a 1 in 2 year storm; and that there is no flooding due to discharge from the system for a 1 in 30 year storm. The system should also ensure that storage can be provided to cater for storm up to the 100 year return period with an allowance made for climatic change. This would currently suggest a 20 to 30% increase in rainfall intensities and similarly in water storage volume requirements. With this system in place the flows from the site passing into the surface water or land drainage systems would be considered acceptable and not likely to increase flood risk downstream of the site.

6.3.4 If the underlying ground is not suitable for percolation then the system should be made to connect to the existing land drainage systems serving the land or by a requisition sewer to a suitable watercourse. The discharge from this system would have be limited to existing agreed agricultural discharge rates. If the discharge is limited to this level then it will be necessary to provide above or underground storm water attenuation tanks/basins on site. The storage systems could be catered for above ground in designated flood areas such as detention basins or shallow swales in public open spaces.

6.3.5 The storage volumes required for the adoptable system could also have been provided by the use of oversized pipes within the highways. The use of ponds, whilst being a better ecological area, can promote concerns for public safety and the use of detention basins is considered to be a better more sustainable concept for this site.

6.3.6 The flows would have to be controlled by a “Hydrobrake” or similar low maintenance flow control device. If these are provided the risk of onsite flooding from rainfall would be effectively controlled to acceptable levels.

6.3.7 We therefore consider the effects on flood risk to adjacent properties are not significantly affected by the proposed development if properly designed attenuation systems are employed.

## 7.0 PROPOSED SURFACE WATER DRAINAGE

7.1 In the first instance the use of soakaways and infiltration systems should be investigated further and if it appears to be unsuitable based on the testing carried out then attenuation of surface water flows would be necessary.

7.2 The un-attenuated surface water run-off from this site could overload the downstream sewers and/or land drainage catchment. Therefore discharges should be managed by the use of surface water storage systems. The site currently does not have any existing impermeable areas. The site would have to be designed to achieve agricultural discharge rates. Due to the sensitivity of the downstream catchment the agreed discharge rate of 3 lit/s can be acceptable to all parties. This could rise slightly when extreme storms i.e. 1 in 100 year or 100year plus 30% climate change are considered to approx. 5 lit/sec/ha.

7.3 The flows will be controlled by a hydraulic flow device such as a Hydrobrake or similar. This would mean that storm-water storage would have to be provided on site. Prior to this however a point of discharge to a surface water sewer, highway drain, or watercourse would have to be agreed with a right to discharge in perpetuity granted. This may entail making agreements with third parties, and riparian owners of the watercourses. The EA would /may also need to approve any such discharge rate and water quality.

7.4 It is proposed to provide some of the storage in slightly oversize pipes on the site, to ensure the 1 in 2 year storm does not surcharge the system, and a detention basin in the lower south eastern area of the site. This will be designed to cater for storms up to and including the 100year storm with due allowances for climate change. In accordance with NPPF this would mean an extra 20%-30% based on the site usage and possible duration of development. The levels of the outfall discharge points to the watercourse should allow gravitational discharges for the whole site. The connection to the watercourse may have to be requisitioned and an agreement to discharge in perpetuity obtained from the riparian owner of the watercourse.

7.5 The sizes of the storm water storage facilities would need to be accurately determined once a final layout is available for the final designs but preliminary calculations have been made and are attached to this report in appendix D. These show that the volumes of storage required would be 355cum for the 30 year storm, 478cum for the 100 year storm, and 674cu.m. for the 100 year storm with 30% allowance for climatic change. This is all in accordance with the Planning Practise Guidance- Flood Risk and Coastal Change April 2015 , the previous National Planning policy Framework Technical guidance issued in March 2012. The volumes of storage for the 100 year plus climate change can include flooding to roads and designated areas but must ensure that no buildings are flooded.

7.6 The most suitable location for surface water storage is in the south eastern corner of the development adjacent to the proposed outfall. A primarily dry detention basin or wet pond would generally provide the most economic method of providing the storage, however these do take up significant areas of land. There are two large mature trees adjacent to the southern boundary which we understand have Tree Protection Orders. Therefore the available space is extremely limited to accommodate the basin, especially when re-engineering and side slopes of the basin are considered to suit the existing ground profile. Therefore a buried storage tank is considered to be the most effective method

of providing the necessary attenuation for the surface water to the new development. Given the extremely low discharge rate of 3l/s the tank will need to be relatively shallow and encompass a larger plan area and therefore is sited partly beneath the private drive area to plots 42-44 (see attached plan in Appendix B).

7.7 If the measures outlined above are implemented we would consider that the site can be developed in accordance with current Water Authority and Land Drainage Authority requirements. The systems can also be adopted as part of the Public Sewer systems or by the Local Authority under the new Flood and Water Management Act arrangements, once they are fully implemented.

## 8.0 CONCLUSIONS

8.1 In our opinion the site is not at risk of flooding from river or tidal water up to a 1% return period nor is it at risk for storms in excess of the 0.1% risk level. The site is therefore not considered to be at risk of fluvial flooding from rivers or water courses.

8.2 The development of the site with the use of soakaways or other infiltration appears to be unfeasible and the use of attenuation methods will be required.

8.3 It would then be necessary to attenuate flows from the site and provide storm water attenuation facilities on the site. Discharges would have to be limited to the agreed agricultural rates of discharge of 3 lit/sec to the highway drain and to ensure flood risks downstream are not increased.

8.4 The risk of overland flows from adjacent land is considered to be low due to the topography of the site and the developed areas adjacent to the boundaries of the site. It would be prudent to design a flood route through the site to cater for extreme events.

8.5 If the measures outlined above are implemented we would consider that the requirements of Planning Practise Guidance- Flood Risk and Coastal Change April 2015 can be satisfied and development of the site could proceed.

**T.Haigh B.Sc., C.Eng., M.I.C.E.**

# APPENDIX A

# LOCATION PLAN


**SITE LOCATION PLAN**


## SCHEDULE OF ACCOMMODATION

| Housetype | Total |
|---|---|
| Marylebone<br>2 Storey<br>4 Bed<br>Detached | 3 No. |
| Fenchurch<br>2 Storey<br>4 Bed<br>Detached | 7 No. |
| Mayfair<br>2 Storey<br>4 Bed<br>Detached | 2 No. |
| Holborn<br>2 Storey<br>4/5 Bed<br>Detached | 2 No. |
| Picadilly<br>2 Storey<br>3 Bed<br>Semi Detached / Detached | 12 No. |
| Harley<br>2 Storey<br>4 Bed<br>Detached | 7 No. |
| Knightsbridge<br>2 Storey<br>4 Bed<br>Detached | 2 No. |
| Whitehall<br>2 Storey<br>3 Bed<br>Detached | 2 No. |
| Brampton<br>2 Storey<br>2 Bed<br>Semi Detached/ Terraced House | 3 No. |
| Hanbury<br>2 Storey<br>3 Bed<br>Semi Detached | 6 No. |

Total = 46

Rev N - 04-08-16 - SAC
Seperate farm access added layout adjusted
Rev M - 20-06-16 - CJB
Layout amended & visitor parking arrangement revised.
Rev L - 06-06-16 - CJB
Access road into site revised along with the farm access and mix amended, visitor parking amended.
Rev K - 08-01-16 - DRH
Timber farm gates shown to provide farm access.
Rev J - 14-09-15 - SAC
Turning Heads extended to 17m adj plot 13 & 37 at highways request
Rev H - 26-08-15 - CJB
Car port added over plots 8&9 car parking spaces, visability splays amended, shared surface extended adjacent plots 34 & 36 and Plot 34 handed
Rev G - 18-08-15 - CJB
Back edge of footpath adjacent plot 1 widened to 8.1m, Existing road & proposed junction markings added.
Rev F - 16-06-15 - CJB
Visability splays added to Barnsley Road.
Rev E - 05-06-15 - SAC
Plots 12 & 13 changed to affordable and plot 4 garage detached due to level issues, garage block revised.
Rev D - 13-04-15 - DRH
Layout amended due to comments from the planners
Rev C - 15-12-14 - CJB
Boundary line amended & Additional buffer planting added
Rev B - 4-12-14 - SAC
Internal radius revised following highway tracking
Rev A - 24-11-14
Regents replaced with Picadilly house types and layout reconfigured

KEY:

- DENOTES 1800 HIGH CLOSE BOARDED FENCE
- DENOTES 1500 HIGH CLOSE BOARDED FENCE
- DENOTES 1800 HIGH SCREEN WALL / FENCE
- DENOTES 900 HIGH RAILINGS
- DENOTES 450 HIGH KNEE RAIL
- SHARED SURFACE BLOCK PAVING
- TURF PLANTING AREA
- EXISTING TREE (RETAINED)
- ROOT PROTECTION AREA
- PROPOSED TREES
- DENOTES AFFORDABLE UNITS

FOR FULL LANDSCAPE DETAILS SEE LANDSCAPE ARCHITECTS PLANS

PARKING SPACES TO BE 5m X 2.5m

ALL DRIVEWAYS ARE A MIN OF 5.6m LONG
SINGLE DRIVES ARE 3m WIDE
DOUBLE DRIVEWAYS ARE 5m WIDE

0 10 20 30 40m
Scale 1:500

CHARLES CHURCH

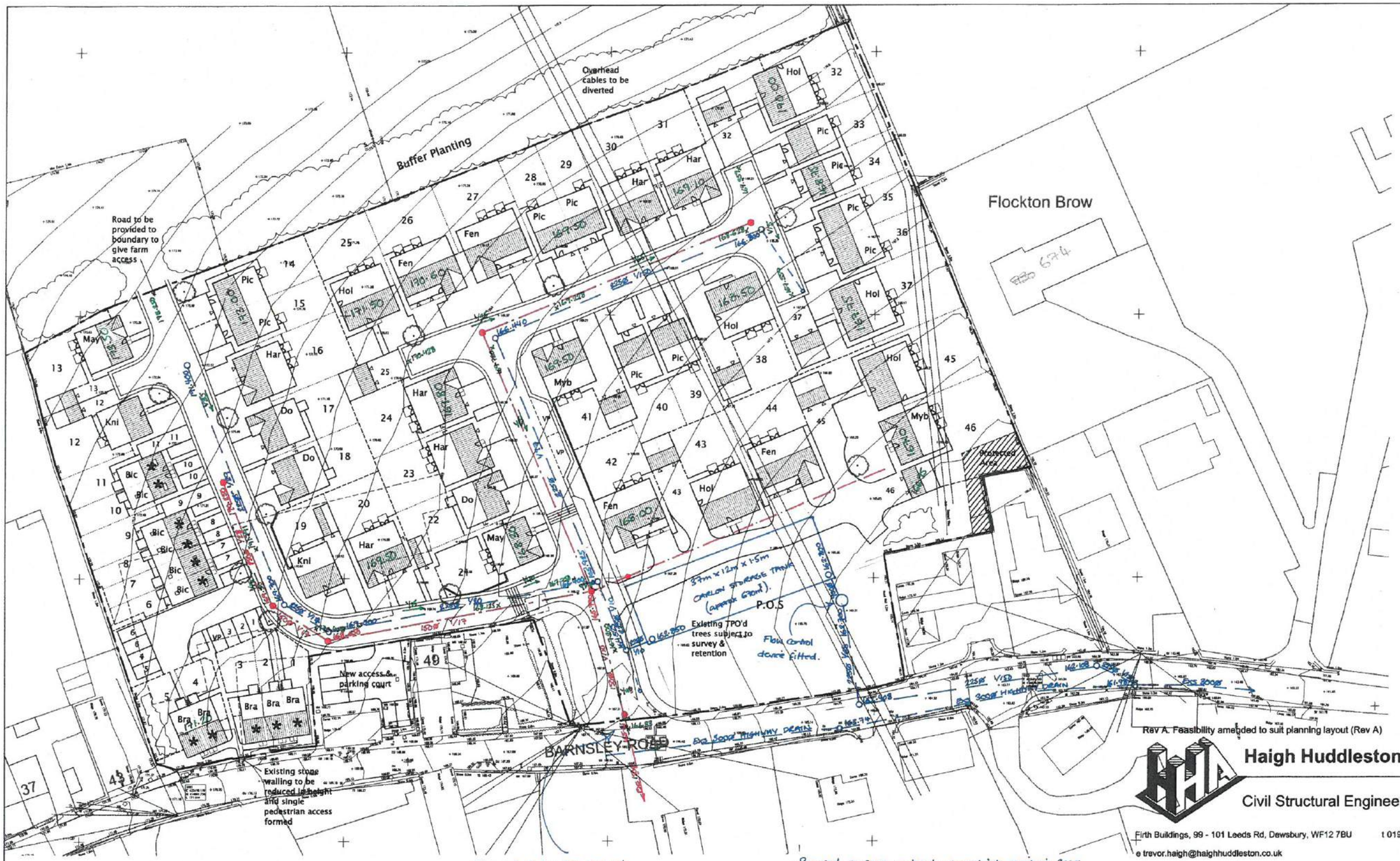
# BARNSLEY ROAD FLOCKTON

PLANNING LAYOUT

| | |
|---|---|
| Scale 1:500@A1 | Drawing Number FLO-2014-01N |
| Drawn By CJB | |
| Checked By SAC | NOV 14 |

# APPENDIX B

# DEVELOPMENT PLAN




Proposed Foul water sewer to connect into existing 150Ø public sewer located within site entrance.

Proposed surface water to connect into existing 300Ø Highway Drain along Barnsley Road with a maximum discharge rate of 3lit/sec.
Adequate underground storage to be provided to cater for up to and including 1 in 100yr Storm events + 30% increase in climate change.
Proposed SW connection to be laid parallel with Highway Drain and connected downstream to suit depth required.
* ALL SERVICE RECORDS TO BE OBTAINED FOR BARNSLEY ROAD TO CHECK FOR CLASHES *

Rev A. Feasibility amended to suit planning layout (Rev A) 04.12.14 HH

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Client
PERSIMMON HOMES

Project
BARNSLEY ROAD, FLOCKTON

Detail
PRELIMINARY DRAINAGE FEASIBILITY

| Dwn | Chkd | Date | Scale | Dwg No. |
|---|---|---|---|---|
| HH | | OCT-14 | 1:500@A2 | E14/6164/001 A. |

# APPENDIX C

# YORKSHIRE WATER RECORDS

YorkshireWater

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

Haigh Huddleston & Associates
Firth Buildings
99-101 Leeds Road
Dewsbury
WF12 7BU



For the attention of Jamie McBride

Your Ref:
Our Ref: Q012376

For telephone enquiries ring:

Kashif Khan on 0345 120 8482

4th August 2014

Dear Sir,

**Barnsley Road, Flockton, WF4 4 - Pre planning sewerage enquiry on P505241**

Thank you for your recent enquiry. Our charge of £150.00 (plus VAT) will be added to your account with us, reference MWA057. 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:

There is a 150 mm diameter public foul sewer recorded crossing the site. In this instance, building-over may take place under the control of Part H4 Building Regulations 2000.

The local Waste Water Treatment Works (WWTW) is Clayton West. It is understood that this WWTW may only have limited spare capacity, if any, available. We have contacted the respective treatment team for more information regarding the impact of proposed development and will contact you when an assessment has been made.

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 domestic waste should discharge to the 150 mm diameter public foul sewer recorded within the site.

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.

The local public sewer network does not capacity to accept any discharge of surface water from the proposal. If SuDS are not viable, the developer is advised to contact the Environment Agency/local Land Drainage Authority with a view to establishing a suitable watercourse for discharge.

It is understood that a culverted watercourse is located to the south-east of the site (adjacent to The Sun PH). 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 Authority/Internal Drainage Board, with regard to surface water disposal from the site.

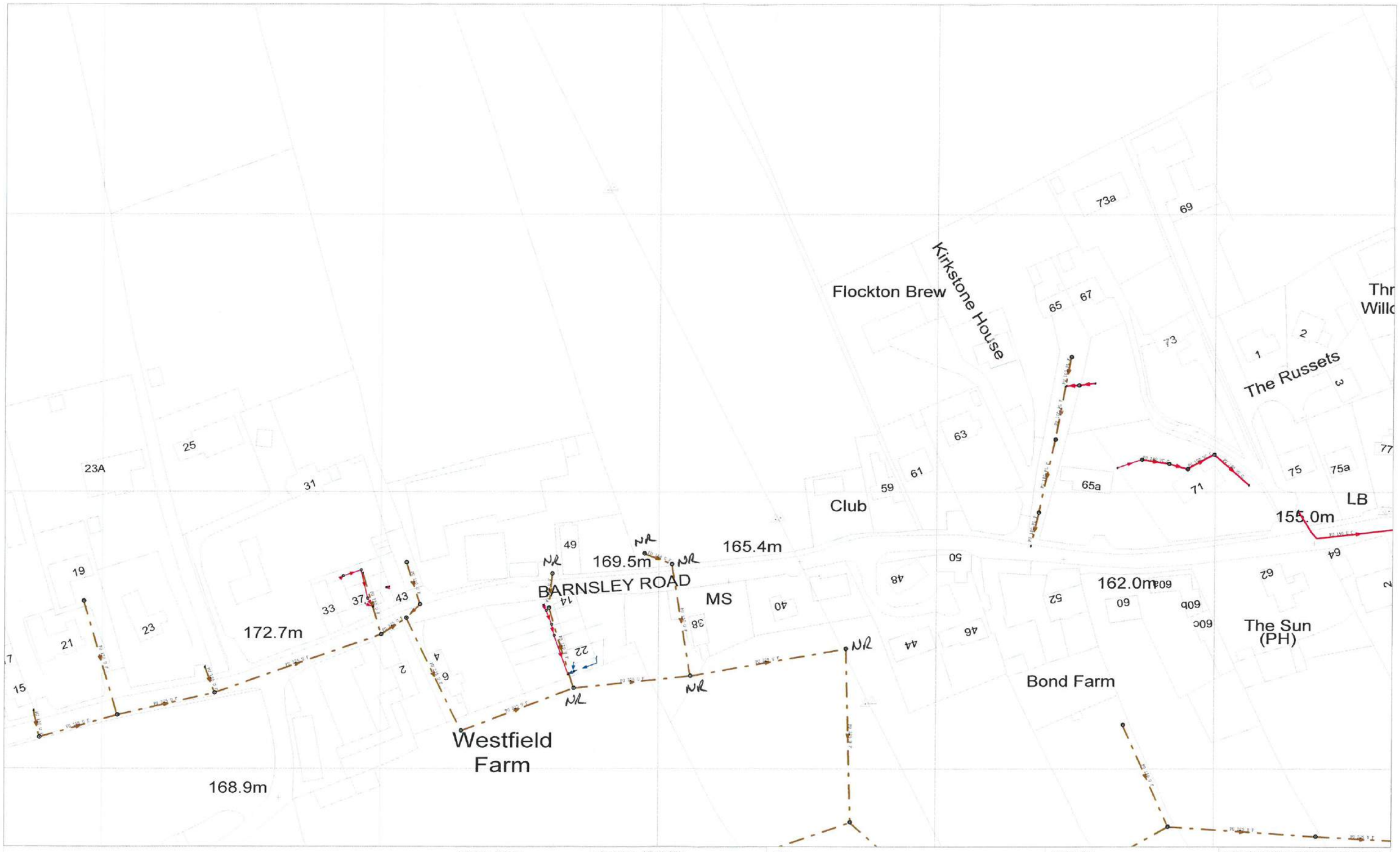
Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the WRc publication "Sewers for Adoption - a design and construction guide for developers" 6th Edition as supplemented by Yorkshire Water's requirements, pursuant to an agreement under Section 104 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.

The public sewer network is for domestic sewage purposes. This generally means foul water for domestic purposes and, where a suitable surface water or combined sewer is available, surface water from the roofs of buildings together with surface water from paved areas of land appurtenant to those buildings. Land and highway drainage have no right of connection to the public sewer network. No land drainage to be connected/discharged to public sewer.

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.

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 faithfully




423306 : 414797

Map Name : SE2314NW

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name :
K KHAN
Contact Tel :

Title

Notes

NR : No recorded depth.



Partial Key

Foul Sewer = F
Combined Sewer = C
Surface Water Sewer = SW
Trade Sewer = TD
Partially Separate = PS



Date Req : 04/08/2014, 10:01:52

Date Gen : 04/08/2014, 10:01:57

Source : Sewer Network Enquiry

UPN: Undefined

Originator: K KHAN, New Development - Waste Water,

# APPENDIX D

# FLOOD RISK MAPS

Environment Agency

Enter a postcode or place name: Other topics for this area...

Go | Risk of Flooding from Surface Water | View other Interactive Maps

## Risk of Flooding from Surface Water

Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the risk of flooding from surface water in this particular area.

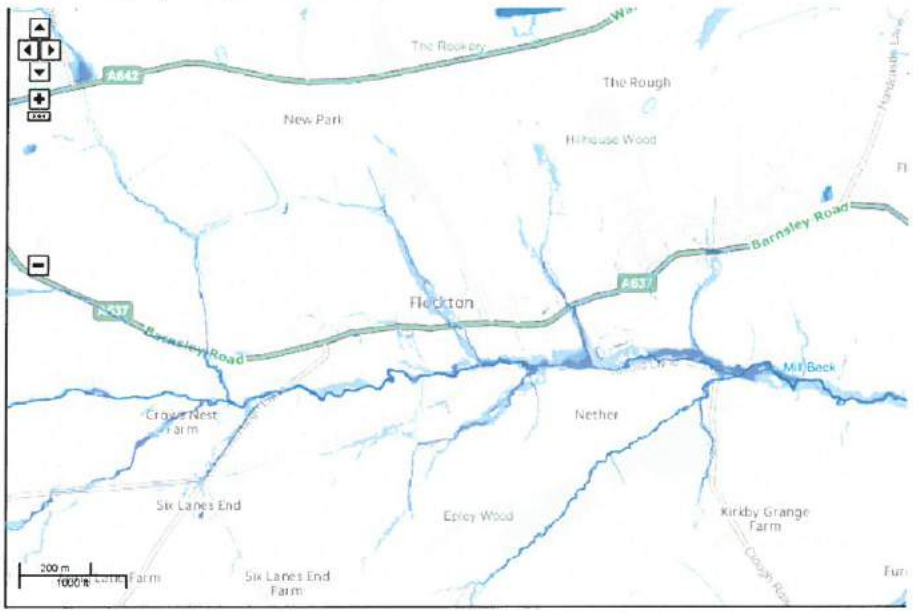
Click on the map for a more detailed explanation.

**Map of X: 423,752; Y: 414,937** at scale 1:10,000

**Map legend**

- Risk of Flooding from Surface Water
  - High
  - Medium
  - Low
  - Very Low

**Data search**



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Enter a postcode or place name: Other topics for this area...

Go | Risk of Flooding from Rivers and Sea | View other Interactive Maps

## Risk of Flooding from Rivers and Sea

River flooding happens when a river cannot cope with the amount of water draining into it from the surrounding land. Sea flooding happens when there are high tides and stormy conditions.

The shading on the map shows the risk of flooding from rivers and the sea in this particular area.

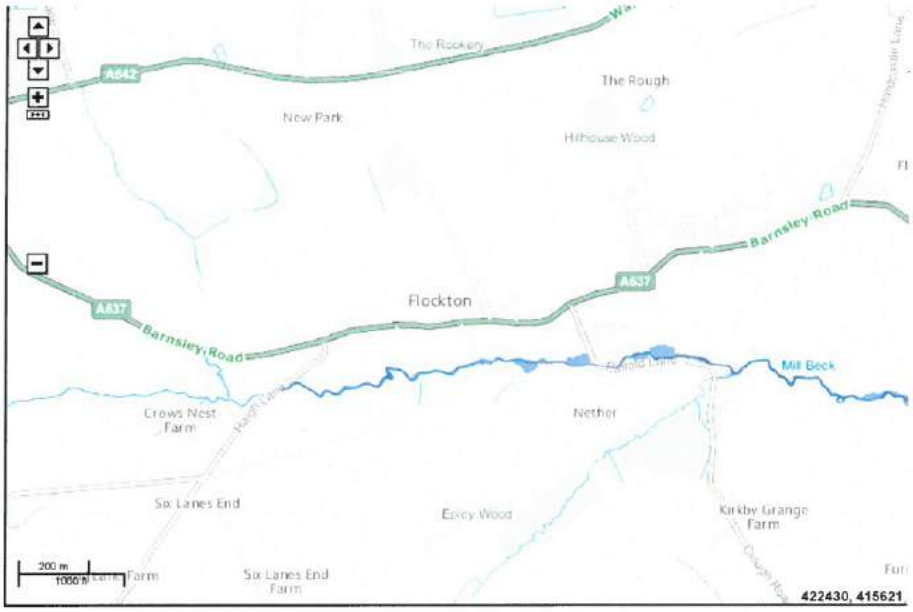
Click on the map for a more detailed explanation.

**Map legend**

- Risk of Flooding from Rivers and Sea
  - High
  - Medium
  - Low
  - Very Low

**Map of X: 423,752; Y: 414,937** at scale 1:10,000

**Data search**



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Enter a postcode or place name: Go

Other topics for this area... Groundwater

Groundwater

Map legend

X: 424,080;Y: 414,816 at scale 1:10,000

Other maps Data search Text only version

- Groundwater source protection zones
  - Inner zone (Zone 1)
  - Inner zone - subsurface activity only (Zone 1c)
  - Outer zone (Zone 2)
  - Outer zone - subsurface activity only (Zone 2c)
  - Total catchment (Zone 3)
  - Total catchment - subsurface activity only (Zone 3c)
  - Special interest (Zone 4)
- Aquifer Maps - Superficial Deposits Designation
  - Principal
  - Secondary A
  - Secondary B
  - Secondary (undifferentiated)
  - Unknown (lakes and landslip)
- Aquifer Maps - Bedrock Designation
  - Principal
  - Secondary A
  - Secondary B
  - Secondary (undifferentiated)
- Groundwater Vulnerability Zones
  - Major Aquifer High
  - Major Aquifer Intermediate
  - Major Aquifer Low
  - Minor Aquifer High
  - Minor Aquifer Intermediate
  - Minor Aquifer Low




## More about Groundwater

### Groundwater Source Protection Zones:

Groundwater provides a third of our drinking water. We ensure that your water is safe to drink defining Source Protection Zones. These zones help to monitor the risk of contamination from any activities that might cause pollution in the area.

The Source Protection Zones are not displayed at scales greater than 1:20,000 (Ordnance Survey 1:50,000 scale) as the data was only modelled to this level and is not accurate pass this. They should not be compared against field boundaries.

Understanding Groundwater Source Protection Zones maps

### British Geological Survey Aquifer Maps:

From 1st April 2010 new aquifer designations replace the old system of classifying aquifers as Major, Minor and Non-Aquifer. This new system is in line with our Groundwater Protection Policy (GP3) and the Water Framework Directive (WFD) and is based on British Geological Survey mapping.

The Aquifer Extents are not displayed at scales greater than 1:75,000 (Ordnance Survey 1:250,000 scale) as the data was only modelled to this level and is not accurate pass this.

Understanding Groundwater Source Protection Zones maps

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Enter a postcode or place name: Go

Other topics for this area... Groundwater

Groundwater

Map legend

X: 423,630;Y: 414,821 at scale 1:10,000

Other maps Data search Text only version


- Groundwater source protection zones
  - Inner zone (Zone 1)
  - Inner zone - subsurface activity only (Zone 1c)
  - Outer zone (Zone 2)
  - Outer zone - subsurface activity only (Zone 2c)
  - Total catchment (Zone 3)
  - Total catchment - subsurface activity only (Zone 3c)
  - Special interest (Zone 4)
- Aquifer Maps - Superficial Deposits Designation
  - Principal
  - Secondary A
  - Secondary B
  - Secondary (undifferentiated)
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- Aquifer Maps - Bedrock Designation
  - Principal
  - Secondary A
  - Secondary B
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- Groundwater Vulnerability Zones
  - Major Aquifer High
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  - Minor Aquifer High
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## More about Groundwater

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Understanding Groundwater Source Protection Zones maps

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# APPENDIX E

# STORMWATER STORAGE CALCULATIONS

**HAIGH HUDDLESTON ASSOCIATES** **Stormwater Storage Calculations**

**Client** **Persimmon Homes**

**Site** **Barnsley road Flockton**

Design storm 30 M5-60 19 mm
r 0.4
Site area sq m. 16650
Imp Area sq m. 8325
T of Conc min 4 Time to Flow
Allow Discharge 5 Lit / sec Imp Ratio 0.50

| | | | | | | | | 100 year storm | | | | | 100year plus 30% climate | | | | | 2 year storm | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Storm Duration** | **Intensity** | **Depth** | **Vol In** | **Vol Out** | **Storage** | **Q** | **t** | **Intensity** | **Depth** | **Vol In** | **Vol Out** | **Storage** | **Intensity** | **Depth** | **Vol In** | **Vol Out** | **Storage** | | **Depth** | **Vol In** | **Vol Out** | **Storage** |
| **Mins** | **mm/hr** | **mm** | **cu.m** | **cu.m** | **cu.m.** | | | **mm/hr** | **mm** | **cu.m** | **cu.m** | **cu.m.** | **mm/hr** | **mm** | **cu.m** | **cu.m** | **cu.m.** | **mm/hr** | **mm** | **cu.m** | **cu.m** | **cu.m.** |
| 10 | 81.8 | 13.63 | 113.50 | 4.17 | 109.33 | 189.31 | 0.1 | 101.27 | 16.88 | 140.51 | 4.17 | 136.34 | 131.65 | 21.94 | 182.66 | 4.17 | 178.49 | 35.17 | 5.86 | 48.80 | 4.17 | 44.64 |
| 20 | 59.8 | 19.93 | 165.95 | 7.16 | 158.79 | 138.40 | 0.1 | 74.03 | 24.68 | 205.44 | 7.16 | 198.28 | 96.24 | 32.08 | 267.07 | 7.16 | 259.92 | 25.71 | 8.57 | 71.36 | 7.16 | 64.20 |
| 30 | 47.6 | 23.80 | 198.14 | 10.15 | 187.99 | 110.16 | 0.2 | 58.93 | 29.46 | 245.29 | 10.15 | 235.15 | 76.61 | 38.30 | 318.88 | 10.15 | 308.73 | 20.47 | 10.23 | 85.20 | 10.15 | 75.05 |
| 50 | 34.4 | 28.67 | 238.65 | 16.12 | 222.53 | 79.61 | 0.3 | 42.59 | 35.49 | 295.45 | 16.12 | 279.32 | 55.36 | 46.14 | 384.08 | 16.12 | 367.96 | 14.79 | 12.33 | 102.62 | 16.12 | 86.49 |
| 60 | 30.3 | 30.30 | 252.25 | 19.11 | 233.13 | 70.12 | 0.3 | 37.51 | 37.51 | 312.28 | 19.11 | 293.17 | 48.76 | 48.76 | 405.97 | 19.11 | 386.85 | 13.03 | 13.03 | 108.47 | 19.11 | 89.35 |
| 120 | 18.7 | 37.40 | 311.36 | 37.06 | 274.29 | 43.28 | 0.5 | 23.15 | 46.30 | 385.46 | 37.06 | 348.40 | 30.10 | 60.19 | 501.09 | 37.06 | 464.03 | 8.04 | 16.08 | 133.88 | 37.06 | 96.82 |
| 180 | 14.1 | 42.30 | 352.15 | 55.02 | 297.13 | 32.63 | 0.6 | 17.46 | 52.37 | 435.96 | 55.02 | 380.94 | 22.69 | 68.08 | 566.75 | 55.02 | 511.73 | 6.06 | 18.19 | 151.42 | 55.02 | 96.41 |
| 240 | 11.5 | 46.00 | 382.95 | 72.97 | 309.98 | 26.62 | 0.8 | 14.24 | 56.95 | 474.09 | 72.97 | 401.12 | 18.51 | 74.03 | 616.32 | 72.97 | 543.35 | 4.95 | 19.78 | 164.67 | 72.97 | 91.69 |
| 300 | 9.8 | 49.00 | 407.93 | 90.94 | 316.99 | 22.68 | 0.9 | 12.13 | 60.66 | 505.01 | 90.94 | 414.08 | 15.77 | 78.86 | 656.51 | 90.94 | 565.58 | 4.21 | 21.07 | 175.41 | 90.94 | 84.47 |
| 360 | 8.7 | 52.20 | 434.57 | 108.90 | 325.66 | 20.13 | 1.0 | 10.77 | 64.62 | 537.99 | 108.90 | 429.09 | 14.00 | 84.01 | 699.39 | 108.90 | 590.49 | 3.74 | 22.45 | 186.86 | 108.90 | 77.96 |
| 420 | 7.9 | 55.30 | 460.37 | 126.87 | 333.50 | 18.28 | 1.1 | 9.78 | 68.46 | 569.94 | 126.87 | 443.07 | 12.71 | 89.00 | 740.92 | 126.87 | 614.05 | 3.40 | 23.78 | 197.96 | 126.87 | 71.09 |
| 480 | 7.5 | 60.00 | 499.50 | 144.85 | 354.65 | 17.36 | 1.2 | 9.29 | 74.28 | 618.38 | 144.85 | 473.53 | 12.07 | 96.56 | 803.90 | 144.85 | 659.04 | 3.23 | 25.80 | 214.79 | 144.85 | 69.93 |
| 540 | 6.9 | 62.10 | 516.98 | 162.82 | 354.16 | 15.97 | 1.3 | 8.54 | 76.88 | 640.02 | 162.82 | 477.20 | 11.10 | 99.94 | 832.03 | 162.82 | 669.21 | 2.97 | 26.70 | 222.30 | 162.82 | 59.48 |
| 600 | 6.38 | 63.80 | 531.14 | 180.79 | 350.34 | 14.77 | 1.4 | 7.90 | 78.98 | 657.55 | 180.79 | 476.75 | 10.27 | 102.68 | 854.81 | 180.79 | 674.02 | 2.74 | 27.43 | 228.39 | 180.79 | 47.59 |
| | | | | | **Storage** | **354.65** | | | | | **Storage** | **477.20** | | | | **Storage** | **674.02** | | | **Storage** | **96.82** |
| Length of 1800 | | 139.37 | | | | | | Length of 1800 | 187.527 | | | | Length of 1800 | 264.87 | | | | Length of 1800 | 38.0482 | | | |
| Length of 1500 | | 200.70 | Culvert | 2.4*1.5m | 98.51 | | | Length of 1500 | 270.0623 | | | | Length of 1500 | 381.446 | | | | Length of 1500 | 54.7942 | | | |
| Length of 1200 | | 313.57 | culvert | 3.6*1.8m | 54.73 | | | Length of 1200 | 421.9276 | | | | Length of 1200 | 595.946 | | | | Length of 1200 | 85.6068 | | | |
| Length of 1050 | | 409.52 | | | | | | Length of 1050 | 551.04 | | | | Length of 1050 | 778.308 | | | | Length of 1050 | 111.803 | | | |
| Length of 900 | | 557.62 | | | | | | Length of 900 | 750.31 | | | | Length of 900 | 1059.77 | | | | Length of 900 | 152.235 | | | |
| Length of 750 | | 802.37 | | | | | | Length of 750 | 1079.64 | | | | Length of 750 | 1524.92 | | | | Length of 750 | 219.053 | | | |
| Length of 600 | | 1253.16 | | | | | | Length of 600 | 1686.22 | | | | Length of 600 | 2381.68 | | | | Length of 600 | 342.125 | | | |

| | **Footprint Area (m)** | | | |
|---|---|---|---|---|
| Aquacell Storage Crates | 933.278 | 30 year | Pond 900mm deep | 394.051 30 year |
| (400mm deep) | 1255.790 | 100 year | | 530.222 100 year |
| | 1773.724 | 100 year plus climatic | | 748.906 100 year plus climatic |