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FLOOD RISK ASSESSMENT

ON

FORMER ST LUKES HOSPITAL

BLACKMOORFOOT ROAD

HUDDERSFIELD

WEST YORKSHIRE

FOR

AVANT HOMES WEST YORKS LTD.

&

PENNINE PROPERTY PARTNERSHIPS

E18/7232/FR01C

SEPTEMBER 2018

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



1.0 INTRODUCTION

1.1 The following report supports the following applications on the named development,

1. Reserved Matters Application for the residential development of 200 No. dwellings in pursuant of application Ref: 2016/91337; and
2. Full application for the residential development of 26 No. dwellings and onsite open space.

1.2 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 existing site comprises of a former hospital which has been demolished in recent years and forms a roughly rectangular shaped plot of land covering approximately 9.5 hectares. It is situated to the south of Blackmoorfoot Road approx. 1.5miles to the west of Huddersfield town centre. The eastern side of the site is formed by Nabcroft Lane; the southern boundary is formed by Sunningdale Road. To the west of the site is the grounds of a school and childrens centre.

2.2 The site levels vary from 164m AOD in the north west corner of then site to 140m AOD in the south west corner of the site. The site has previously been laid out with roadways and carparks so slopes are relatively shallow. There are a significant number of mature trees noted along the boundary of the site. The OS grid reference for the site is SE 12570 15434



2.3 There are no existing public sewers located on site, however there are adopted Yorkshire Water sewers located within Blackmoorfoot Road, Nabcroft Lane and Sunningdale Road which serve the site and the existing houses surrounding the site.

2.4 Ground conditions were found to comprise of Made Ground overlying weathered sandstone. The ground has been subjected to extensive re-modelling to accommodate the former hospital building. This has resulted in deeper areas of Made Ground onsite. The use of SUDs techniques has been investigated based on the BGs plans showing relatively shallow sandstone on site.

However due to the variable depth of made ground down to the underlying sandstone and the scale of the development the use of infiltration systems has been discounted for this site. This has been agreed with both the Environment Agency and Kirklees Council – Drainage Department. There are a number of properties with basements in close proximity to the site and the risk of flooding due to locally raised ground waters due to infiltration systems of the site leads us to recommend that infiltration methods are not suitable for the surface water disposal on this site.

2.5 Due to the topography of the site and to mimic the existing discharges from the site, the residential part of the development is to be divided into three areas each with its own separate attenuation system and point of discharge. Refer to HHA drawing E18/7232/002A details.

2.6 A new retail / commercial area is to be constructed at the site entrance and development by a third party. This area will have a separate attenuation system to the residential development, however the proposed flow rate for retail area will be incorporated into the overall discharge rate of the entire development.

2.7 Yorkshire Water have confirmed a maximum discharge rate of 190lit/sec to the existing 450mm public combined sewer on Blackmoorfoot Road and a maximum of 268.4lit/sec to the 225mm and 300mm public combined sewer in Nabcroft Lane for ALL storm events. This has also been accepted by Kirklees Council Drainage department as suitable discharge and route



for the site. The nearest watercourse is the River Colne which is some 600m to the north of the site but at a considerably lower level than the site.

3.0 PROPOSED DEVELOPMENT AND CONSTRAINTS

3.1 It is understood that the proposed development is for a series of detached and semi-detached, houses, totalling 226 units with associated car parking and access roads. A preliminary site layout is attached in the appendices.

3.3 As stated there are public combined sewers in Nabcroft Lane and Blackmoorfoot Road which are to be used for foul and surface water discharges from the site. These all appear to deep enough and have capacity to service the whole site, albeit via three different outfall positions.

3.4 Yorkshire Water have confirmed a maximum discharge rate of 190lit/sec to the existing 450mm public combined sewer on Blackmoorfoot Road and a maximum of 268.4lit/sec to the 225mm and 300mm public combined sewer in Nabcroft Lane for ALL storm events.

3.5 The surface water flows off-site will be controlled by a hydraulic flow control device. This would result in surface water attenuation being required for each Area of the development. Due to the topography of the site and the presence of the existing mature trees all the surface water storage will be provided entirely below ground in oversized pipes and / or tank systems.

Retail / Commercial Area – New surface water attenuation provided with a restricted flow rate to the existing 450mm combined public sewer in Blackmoorfoot Road.

Area 1 – New surface water attenuation to be provided with a restricted flow rate to existing 450mm combined public sewer in Blackmoorfoot Road. An overall maximum discharge rate of 190lit/sec into Blackmoorfoot Road with the inclusion of the Retail Area.

Area 2 – New surface water attenuation system provided with a maximum discharge rate of 230.8lit/sec to the existing 300mm public combined sewer in Nabcroft Lane.



Area 3 – New surface water attenuation provided with a maximum discharge rate of 37.6lit/sec to the existing 225mm combined public sewer in Nabcroft Lane. Overall maximum discharge rate of 268.4lit/sec into Nabcroft Lane**.

It is proposed to put forward the onsite drainage to be adopted by Yorkshire Water under a Section 104 agreement.

4.0 FLOOD RISK

4.1 On reviewing the Environment Agency websites flood risk maps, the site currently falls within flood zone 1: which is designated as low probability of flooding from sea or rivers less than 0.1% (ie 1 in 1000 year) probability of flooding. The site is therefore considered not to be at risk from fluvial flooding from rivers or sea for the 1 in 100 or 1 in 1000 year flood event. The proposed use of the site would be classified as More Vulnerable in Table 2: Flood Risk Vulnerability Classification in the Planning Practise Guidance- Flood Risk and Coastal Change April 2015. In accordance with that table the proposed development would be considered to be appropriate for the site.

4.2 The site does not fall within an area subject to major surface water flooding according to the EA maps. The surface water flooding maps show some minor flooding on site due to localised low spots on the site but this is less than 300mm deep even for the low risk scenario which is equivalent to the 1 in 100 year event. Floor levels in this area should be raised to mitigate any flood risk from events in excess of this requirement and to allow a flooding route through the site which will reduce the flood risk to the proposed buildings on site albeit very slight and less than a 1 in 100 year probability. The EA Flood Risk map for Planning for flooding from fluvial sources does not show flood waters encroaching onto the site.

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



- 4.4 Due to the size of the development being over 1Ha, it would be necessary to prepare a site Specific Flood Risk Assessment for the site.
- 4.5 There are a number of potential flooding mechanisms that the Planning Practise Guidance- Flood Risk and Coastal Change April 2015 now requires to be evaluated for each proposed development site. Each method of flooding requires an assessment to be made on its probability relative to the site development. The normal requirement of the document is for no flooding of properties for storms up to a 1% probability or a once in a 100 years storm. The risk assessment also includes for flooding both on site and off site, and the effects of the development on the downstream catchment or the flow regime of the watercourse. NPPG also requires that the effects of severe storms above the normal 1% probability are reviewed together with the effects of climatic change relating to the design life of the development.
- 4.6 It also requires that the effects of climate change are taken into account together with the impacts of extreme events and flood defence failures. Prior to this the Sequential Test, and where necessary, the Exception test as outlined in Planning Practise Guidance- Flood Risk and Coastal Change April 2015, must also be applied to each development site. These aspects are not covered in this report.
- 4.7 The 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.
- Inundation from floodwaters leaving watercourses or rivers entering the site. This can include the effects on culverted watercourses and where the risk of blockage can occur and from breach scenarios.
 - Rainwater falling on the site and not being able to leave the site at sufficient rate to prevent flooding on the site.
 - Overland flows from adjacent land sites due to surcharging of sewerage systems or other watercourses.
 - The impact of the developed site on the existing drainage systems and off-site surface water systems must also be assessed as part of this flood risk assessment.



5.0 **DISCUSSION OF FLOOD RISKS**

5.1 **Flood Risk from Watercourses, River & Tidal**

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

5.2 **Risk of Flooding from overland flows from adjacent land.**

5.2.1 The site lies on an area of sloping land, with residential development to the northern, southern, and eastern boundary. The remaining side of the development is open fields around a school and childrens centre. Except for the western boundary these all tend to fall away from the site. Only the area of land to the west falls towards the site but this has a very small catchment so any overland flows generated in extreme events would be limited. The area further to the west are intercepted by the public highway and are of very limited catchment. The highways will tend to convey any low level overland flows away from the site along the highways so that overland flows would not enter the site. To the south the land falls away and there is a residential development served by existing public drainage systems and as such the level of risk of flooding from surcharged sewers or drains is considered to be less than 3%. Even in extreme events any flood waters leaving this system would be channelled away from the site by the natural topography, and would not enter the site.

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



5.2.3 The site is shown not be at risk form flood waters due to reservoir failure upstream of the development.

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

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

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

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

5.3.3 There has been a site investigation made available and due to the variable depths of fills on site the use of infiltration systems has been discounted in agreement with Kirklees Council Drainage Department. It is not therefore proposed to do any further site investigations or soakaway tests. The site is considered to be un-suitable for the use of infiltration systems.

5.3.4 As infiltration systems are considered unfeasible for the site, then storm water attenuation systems should be utilised to ensure the flows from the site discharge to a suitable watercourse or surface water sewer.

5.3.5 The current discharge from the formerly developed area of the site are split into three separate connections to the north and east and all allowable discharge rates from the site have been agreed with Kirklees Council, Yorkshire Water and the Environment Agency. Therefore this has utilised as an option for the discharge of surface water from the site. The individual discharge points and allowable discharge rates have been utilised for the development of the site. Any run off from the site post development would have to be limited to previously agreed rates specified by Kirklees Council and Yorkshire Water. An initial



estimate of the volumes of storage required has been utilised to estimate the storm-water storage requirements. With attenuation of flows there would have to be a storm-water storage facility. The use of above storage systems such as swales, detention basins or ponds, would provide the most sustainable urban drainage system and possibly the most economic but this would entail significant land up take and possibly large commuted sums for their adoption if an authority can be found that is prepared to adopt these. The slope of the land would also make this proposal un-feasible. For the onsite sewerage system to be adopted there would still be a need for underground tanks to provide sufficient attenuation storage for the whole site so that sewers do not surcharge for the 1 in 30 year event. Based on this criteria, the estimated volumes of storage required are shown in the attached calculation sheets. An allowance of 30% extra for climatic change allowance has been made.

5.3.7 The use of below ground storage facilities on their own, may not provide a suitable level of treatment of the run off from the site and biological systems, at source, may be needed to ensure contaminants are dealt with prior to discharge of site. The use of open swales and ponds would have allowed the use of reed beds and other organic systems to be employed but are unlikely to be considered feasible in the final designs. Primary treatment for the roads would be the use of trapped gullies for all hard standings. Car park areas over 40 number cars may require the use of an interceptor to remove contaminants. The use of filter drains adjacent to private drives would also provide a first stage treatment of run off from drives and allow a small discharge into the top soils on site. Rain water butts may also be provided to enable some recycling of run off from the roofs and paved areas. The use of green roofs is not considered appropriate in this development. The use of permeable paving could also have been considered but the unfeasibility of the use of infiltration systems would preclude this. However, as discussed previously the ground conditions for this development are not suitable for the use of infiltration systems and in addition there are issues with highway authorities regarding the adoption of such schemes as public roads.

5.3.8 The size of the storm water storage facilities would need to be determined accurately in the final detailed designs. These should be all in accordance with the NPPF. The volumes of storage required for storms in excess of the 30 year storm can also include flooding to roads and designated areas such as carpark areas or public open space but not buildings. This is also



the case for the 100 year storm with due allowance for climate change and urban creep, but every system must ensure that no buildings are flooded.

5.3.9 The estimated volumes of storage required for each of the storm profiles are based on not exceeding the current proposed discharge rates for the portions of the whole site as agreed.

5.3.10 The proposed discharge point and discharge rates from the site have been formally agreed with Yorkshire Water, the Environment Agency and the Local Land Drainage Authority.

5.3.11 The location of the flow control device for future access and maintenance will need to be agreed with Yorkshire Water.

5.4 **Impact on existing drainage systems.**

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

5.4.2 The maintenance of the onsite storage tanks would be carried out by Yorkshire Water as part of the Section 104 Agreement and they would adopt the underground on site tanks if they are suitably sited and accessible.



6.0 CONCLUSIONS

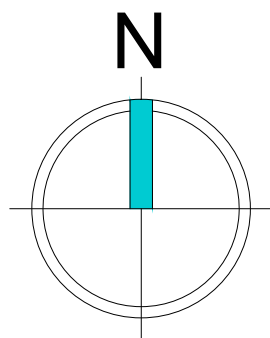
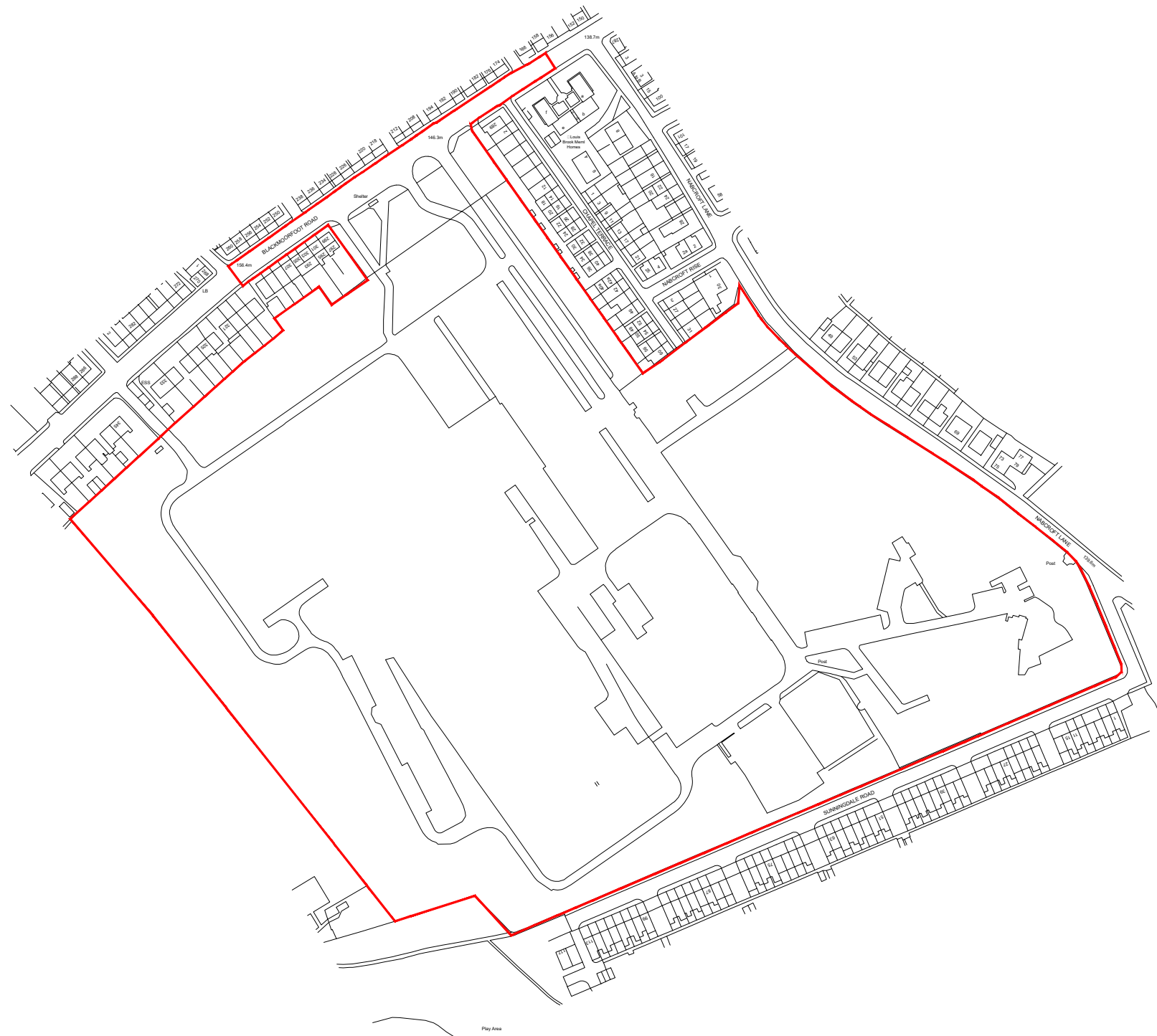
- 6.1 The area of the site to be developed currently falls within Flood Zone 1 as defined by the EA Flood maps. The area of the site to be developed is not at risk of flooding from river or tidal water up to a 1% return period. The flood risk is considered to be acceptable for residential development.
- 6.2 The allowable discharge rates for the proposed development have already been agreed with the Local Drainage Authority and Yorkshire Water. The development of the site utilising infiltration techniques is not considered feasible due to the near surface geology of the area. The use of attenuation systems to reduce the run-off to the agreed discharge rates would be required in the final site designs to ensure there is no increase in flood risk to the downstream catchment.
- 6.3 The risk of overland flows entering the site is considered to be low due to the topography of the area around the site and the drainage systems to the previously developed areas to the south. The risk can be further minimised by providing a flood water route through the site to ensure flood water flows are directed away from the existing and proposed housing. The floor levels of the proposed houses should be based on a minimum of 300mm above proposed road channel levels in the areas of flood routing.

Trevor Haigh B.Sc., C.Eng., M.I.C.E.

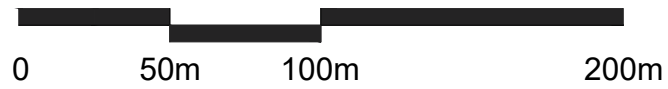
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APPENDIX A

LOCATION PLANS



Scaled @ 1:2500



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STATUS:			

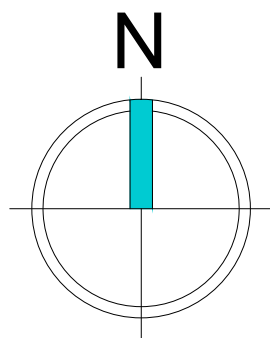
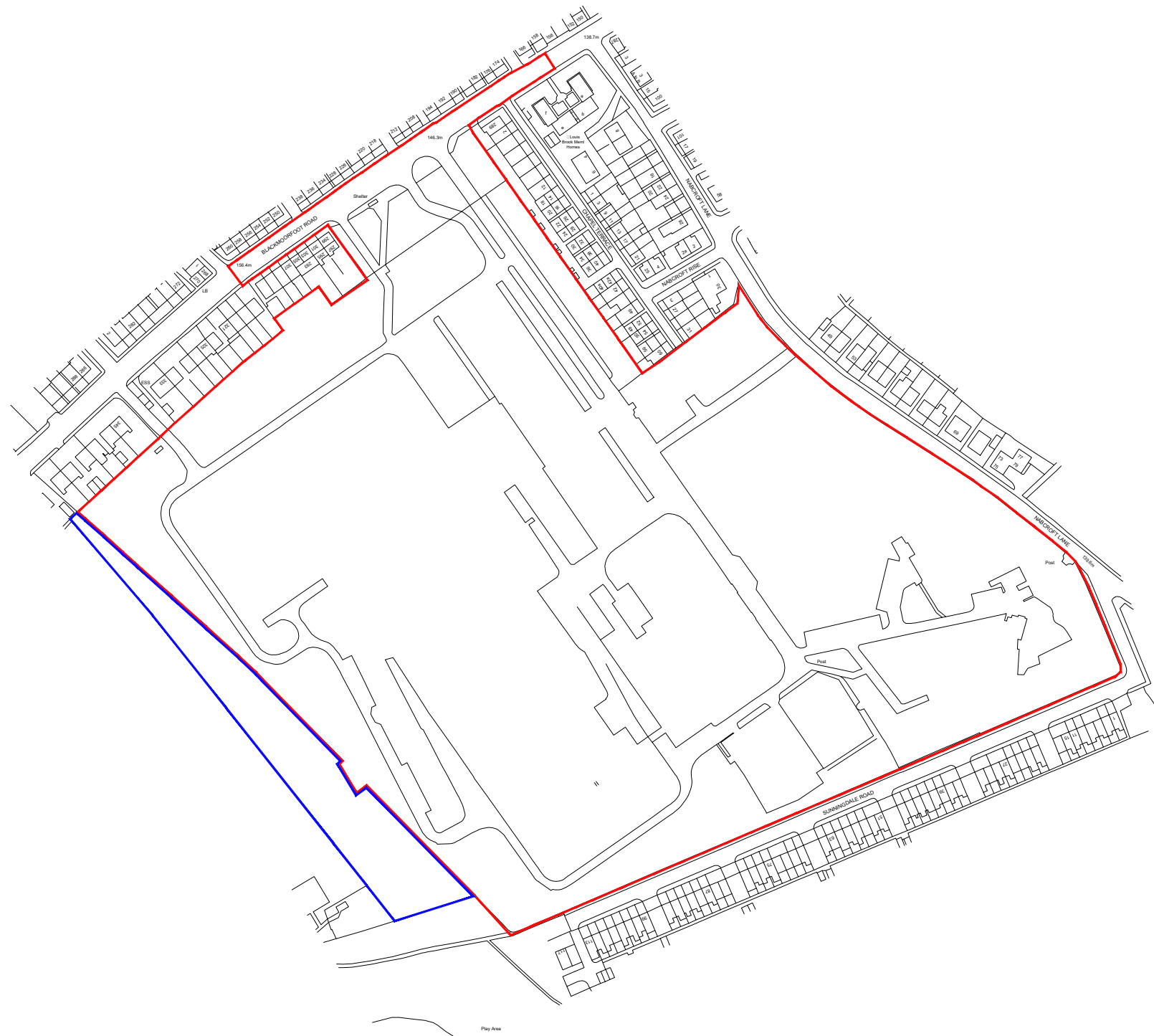
STEN

ARCHITECTURE

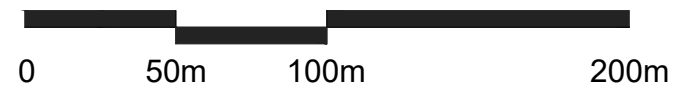
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LinkedIn: [Sten Architecture](https://www.linkedin.com/company/sten-architecture)

CLIENT:				TITLE:	Location plan		
SCALE AT A3:	1:2500	DATE:	20.08.18	DRAWN:	TS	CHECKED:	
PROJECT NO:	1835	DRAWING NO:	1835.202	REVISION:			
SITE:	Former St. Lukes Hospital Huddersfield						



Scaled @ 1:2500



REV.	DESCRIPTION:	BY:	DATE:
STATUS:			

STEN

ARCHITECTURE

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CLIENT:				TITLE:	Location plan		
SITE:	Former St. Lukes Hospital Huddersfield			SCALE AT A3:	DATE:	DRAWN:	CHECKED:
				1:2500	20.08.18	TS	
				PROJECT NO:	DRAWING NO:		REVISION:
				1835	1835.102		

APPENDIX B

PLANNING LAYOUTS

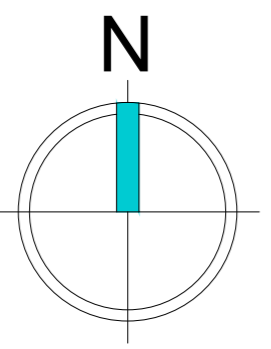


Commercial development to be determined through application by others.

Please refer to reserved matters application for the residential development of 200NO. dwellings (plots 1-200) in the pursuant of application ref 2016/91337 for further details

Proposed underground storage tank

Scaled @ 1:500
 0 10m 20m 50m



ACCOMMODATION SCHEDULE				
Name	Floor Area Sq Ft	Beds	Total Units	Total
Beckford	701	2	0	0
Bampton	862	3	2	1724
Easton	880	3	2	1760
Lorton	995	3	4	3980
Paington	1227	3	2	2454
Holbury	1226	4	0	0
Oxerbury	1463	4	6	8778
Sudbury	1503	4	7	10521
Ramsbury	1502	4	3	4506
Total			26	33723

- PLANNING LAYOUT KEY
- 1.8m Timber screen fence
 - 1.2m Post & rail divisional fence
 - 1.8m Brick & timber panel fence
 - Existing wall to be made good
 - Herringbone Block Pavers
 - Brindle and charcoal in colour
 - Timber gate location

REV.	DESCRIPTION	BY	DATE

STEN ARCHITECTURE
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 LinkedIn: Sten Architecture

CLIENT: **AVANT homes**

SITE: **Former St Lukes Hospital Huddersfield**

TITLE: **Planning Layout**

SCALE AT A3:	DATE:	DRAWN:	CHECKED:
1:500	11.09.18	TS	—
PROJECT NO:	DRAWING NO:	REVISION:	
1835	1835.200	—	



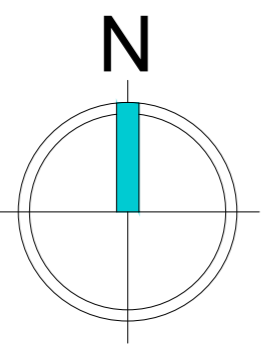
Please refer to full application for the residential development of 26 NO. dwellings (plots 201-226) and onsite open space for further details

Commercial development to be determined through application by others.

Proposed underground storage tank

Scaled @ 1:500
0 10m 20m 50m

ACCOMMODATION SCHEDULE				
Name	Floor Area Sq Ft	Beds	Total Units	Total
Beckbridge E	656	2	5	3280
Beckbridge M	656	2	4	2624
Beckbridge S	656	2	2	1312
Fenbridge E	773	3	8	6184
Fenbridge S	773	3	9	6957
Fenbridge M	773	3	5	3965
Ironbridge E	858	3	5	4290
Ironbridge S	858	3	3	2574
Ironbridge M	858	3	3	2574
Merebridge E	883	3	3	2649
Merebridge S	883	3	6	5298
Merebridge M	883	3	4	3532
Seabridge E	932	3	3	2796
Seabridge S	932	3	6	5592
Trowbridge	1073	4	10	10730
Ulbridge S	1148	4	14	16072
Bridge Range sub total		90	80329	
Beckford	701	2	11	7711
Bampton	862	3	7	6034
Easton	880	3	7	6160
Lorton	995	3	12	11940
Paignton	1227	3	10	12270
Holbury	1226	4	19	23294
Overbury	1463	4	14	20482
Sudbury	1503	4	19	28557
Ramsbury	1502	4	11	16522
Original Range sub total		110	132970	
Grand Total		200	213299	



- PLANNING LAYOUT KEY
- 1.8m Timber screen fence
 - 1.2m Post & rail divisional fence
 - 1.8m Brick & timber panel fence
 - Existing wall to be made good
 - Herringbone Block Pavers
Brindle and charcoal in colour
 - Timber gate location

REV. DESCRIPTION	BY. DATE
STEN ARCHITECTURE	
Suite 4, Unit 1, Sowerth Drive Park, Sowerth Avenue, Huddersfield, West Yorkshire, WF4 8BA, Tel: 01484 599424	
Website: www.sten-architecture.co.uk Twitter: @STEN_ARCH Facebook: StenArchitecture LinkedIn: Sten Architects	

CLIENT: **AVANT homes**

SITE: **Former St Lukes Hospital Huddersfield**

TITLE: **Planning Layout**

SCALE AT: 1:500	DATE: 11.09.18	DRAWN: TS	CHECKED: --
PROJECT NO: 1835	DRAWING NO: 1835.100	REVISION: --	

APPENDIX C

DRAINAGE STRATEGY & LAYOUT



E18/7232/HH/001B

18 September 2018

FAO Andrew Naylor

Avant Homes (Yorkshire)
Unit 2, Mariner Court
Peel Avenue
Wakefield
WF4 3FL

Dear Andrew,

Re: Proposed development of former St Lukes Hospital, Blackmoorfoot Road, Huddersfield

The following report supports the following applications on the named development,

1. *Reserved Matters Application for the residential development of 200 No. dwellings in pursuant of application Ref: 2016/91337; and*
2. *Full application for the residential development of 26 No. dwellings and onsite open space.*

1. Existing Drainage

The existing site comprises of a former hospital which has been demolished in recent years and forms a roughly rectangular shaped plot of land covering approximately 9.5 hectares. There are a significant number of mature trees noted along the boundary of the site.

Existing residential properties are located to the north, east and south. To the west there is a primary school.

The site decreases in elevation from south west (c. 164m AOD) to north east (c. 140m AOD).

There are no existing public sewers located on site, however there are adopted Yorkshire Water sewers located within Blackmoorfoot Road, Nabcroft lane and Sunningdale Road which serve the existing houses surrounding the site.

Ground conditions were found to comprise of Made Ground overlying weathered sandstone. The ground has been subjected to extensive re-modelling to accommodate the former hospital building. This has resulted in deeper areas of Made Ground onsite.

2. Drainage Proposals

Due to the topography of the site, the residential part of the development is to be divided into three areas each with its own separate attenuation system and point of discharge. Refer to HHA drawing E18/7232/002 details.

A new retail / commercial area is to be constructed at the site entrance and development by a third party. This area will have a separate attenuation system to the residential development, however the proposed flow rate for retail area will be incorporated into the overall discharge rate of the entire development.

a) Foul Water

Yorkshire Water have advised the proposed foul water can discharge unrestricted to the existing 450mm diameter combined public sewer along Blackmoorfoot Road and the 300mm & 225mm diameter combined public sewer in Nabcroft Lane.

The existing levels on site should enable the proposed foul drainage to drain via a gravity system.

Area 1 – New foul water unrestricted discharge to existing 450mm combined public sewer in Blackmoorfoot Road.

Area 2 – New foul water unrestricted discharge to existing 300mm combined public sewer in Nabcroft Lane approximately 50m south of the junction to Nabcroft Rise.

Area 3 – New foul water unrestricted discharge to existing 225mm combined public sewer in Nabcroft Lane approximately 30m north of the junction to Sunningdale Road.

All connections are subject to approval from Yorkshire Water.

b) Surface Water

Due to the presence of relatively shallow sandstone on site, the use of SUDS has been investigated. However due to the following reasons, we would recommend that infiltration methods are not suitable for the surface water disposal:

1. The variable depth of Made Ground.
2. Scale of development.
3. Flooding to basements of the properties adjacent to the site reported by local land drainage authority.

The current design requirement for a new development sites from the perspective of flood risk and sustainable drainage are to design the system to accommodate the following.

- i) No surcharging of any part of the system for the 1 in 2 year storm.
- ii) No above ground flooding up to the 1 in 30 years storm.
- iii) No flooding to property up to the 1 in 100 year storm.
- iv) No discharge of surface water off site for the 100 year storm with allowances for 30% climate change.

Yorkshire Water have confirmed a maximum discharge rate of 190lit/sec to the existing 450mm public combined sewer on Blackmoorfoot Road and a maximum of 268.4lit/sec to the 225mm and 300mm public combined sewer in Nabcroft Lane for ALL storm events.

The surface water flows off-site will be controlled by a hydraulic flow control device. This would result in surface water attenuation being required for each Area of the development. Due to the topography of the site and the presence of the existing mature trees all the surface water storage will be provided entirely below ground in oversized pipes and / or tank systems.

Retail / Commercial Area – New surface water attenuation provided with a restricted flow rate to the existing 450mm combined public sewer in Blackmoorfoot Road.

Area 1 – New surface water attenuation to be provided with a restricted flow rate to existing 450mm combined public sewer in Blackmoorfoot Road.

****Overall maximum discharge rate of 190lit/sec into Blackmoorfoot Road with the inclusion of the Retail Area**.**

Area 2 – New surface water attenuation system provided with a maximum discharge rate of 230.8lit/sec to the existing 300mm public combined sewer in Nabcroft Lane.

Area 3 – New surface water attenuation provided with a maximum discharge rate of 37.6lit/sec to the existing 225mm combined public sewer in Nabcroft lane.

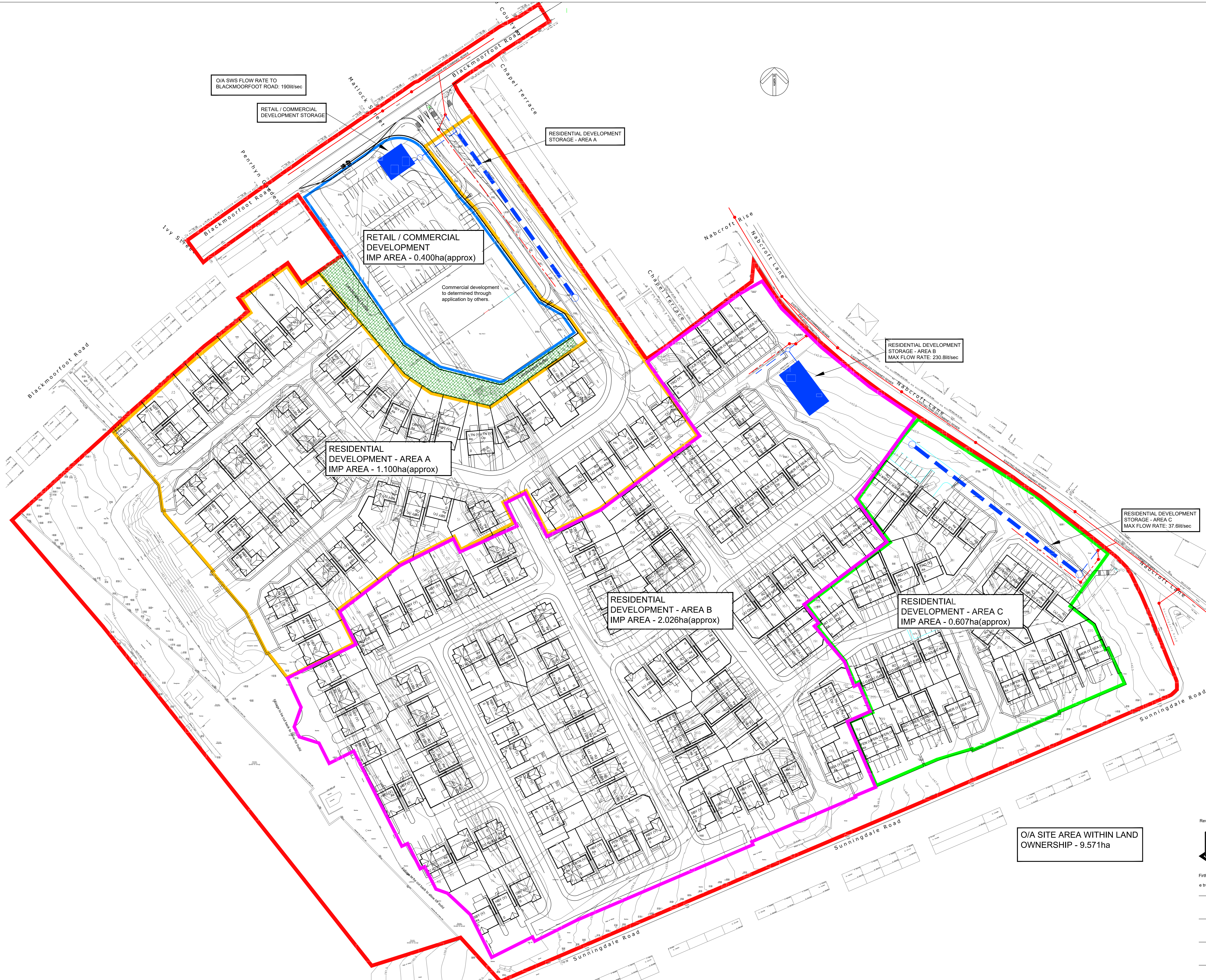
****Overall maximum discharge rate of 268.4lit/sec into Nabcroft Lane**.**

It is proposed to put forward the onsite drainage to be adopted by Yorkshire Water under a Section 104 agreement.

With the measures outlined above implemented the site will 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.

Yours sincerely

Helen Hossanee
h.hossanee@haighhuddleston.co.uk



APPENDIX D

FLOOD RISK MAPS

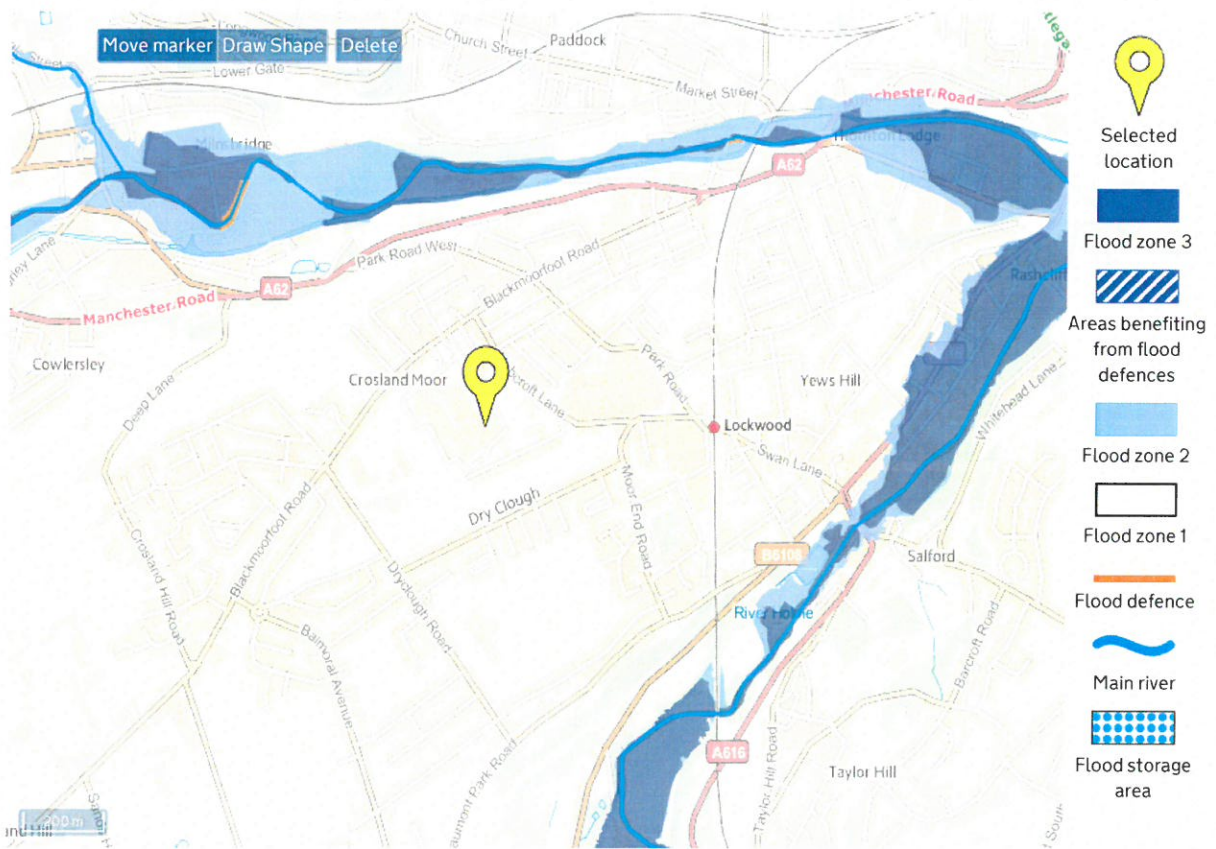
BETA This is a new service – your [feedback \(/feedback\)](#) will help us to improve it.

Likelihood of flooding in this area

You can move the marker on the map to identify a specific location. Alternatively draw a shape to identify an approximate site boundary.

► [How to draw a shape](#)

[Download printable map \(PDF\)](#)



Show flood zones

[View flood zone summary map and more guidance \(/summary?eastng=412640&northing=415357\)](#)

You can use this information as part of a [flood risk assessment for a planning application](#) (<https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications#when-you-need-an-assessment>)

Basic view Detailed view

Location

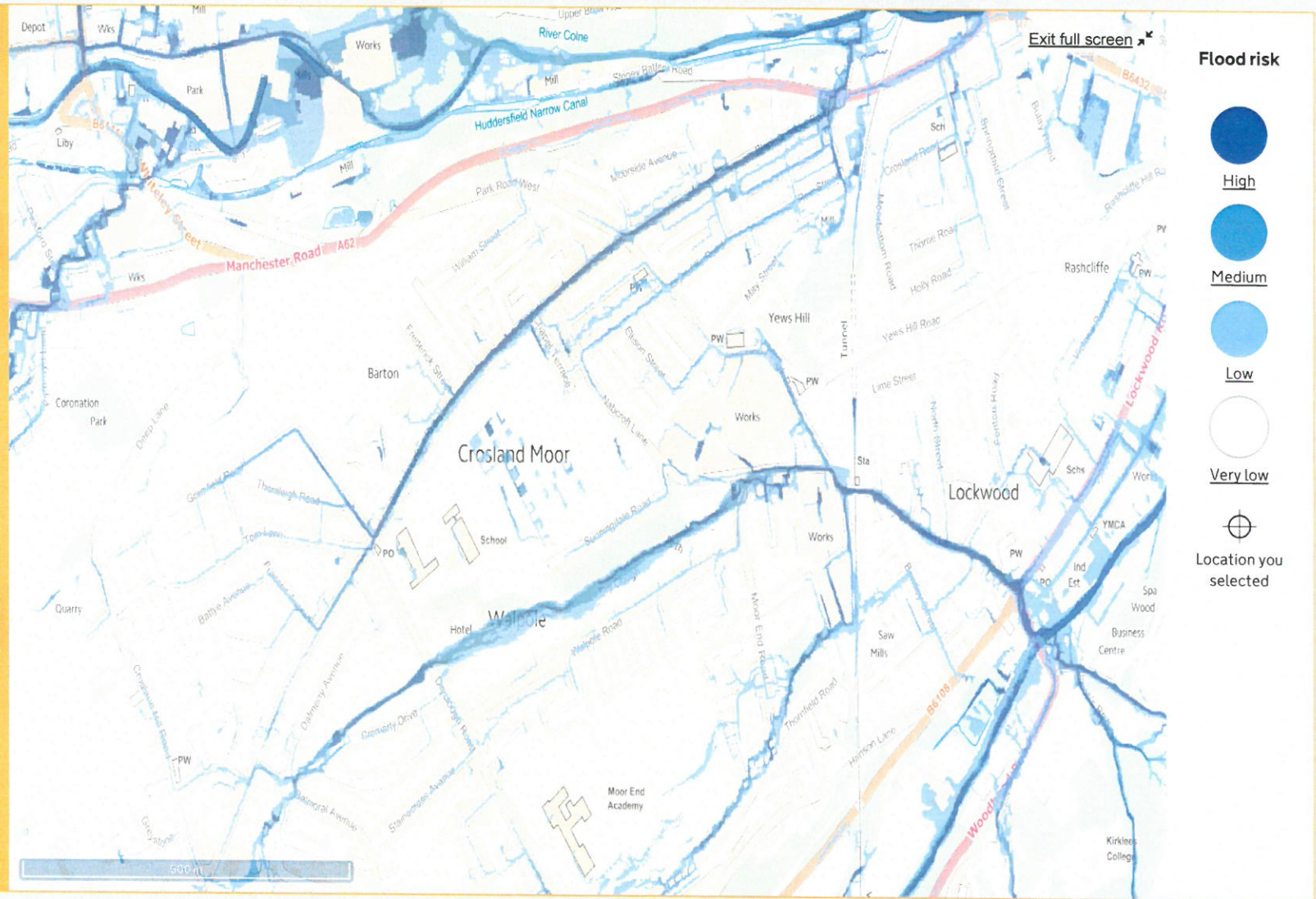


Basic view Detailed view

Location



- Extent of flooding
- Depth and flow estimates at monitoring stations
- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth
- Medium risk: velocity
- Low risk: depth
- Low risk: velocity
- Extent of flooding
- Flood depth
- Flood speed



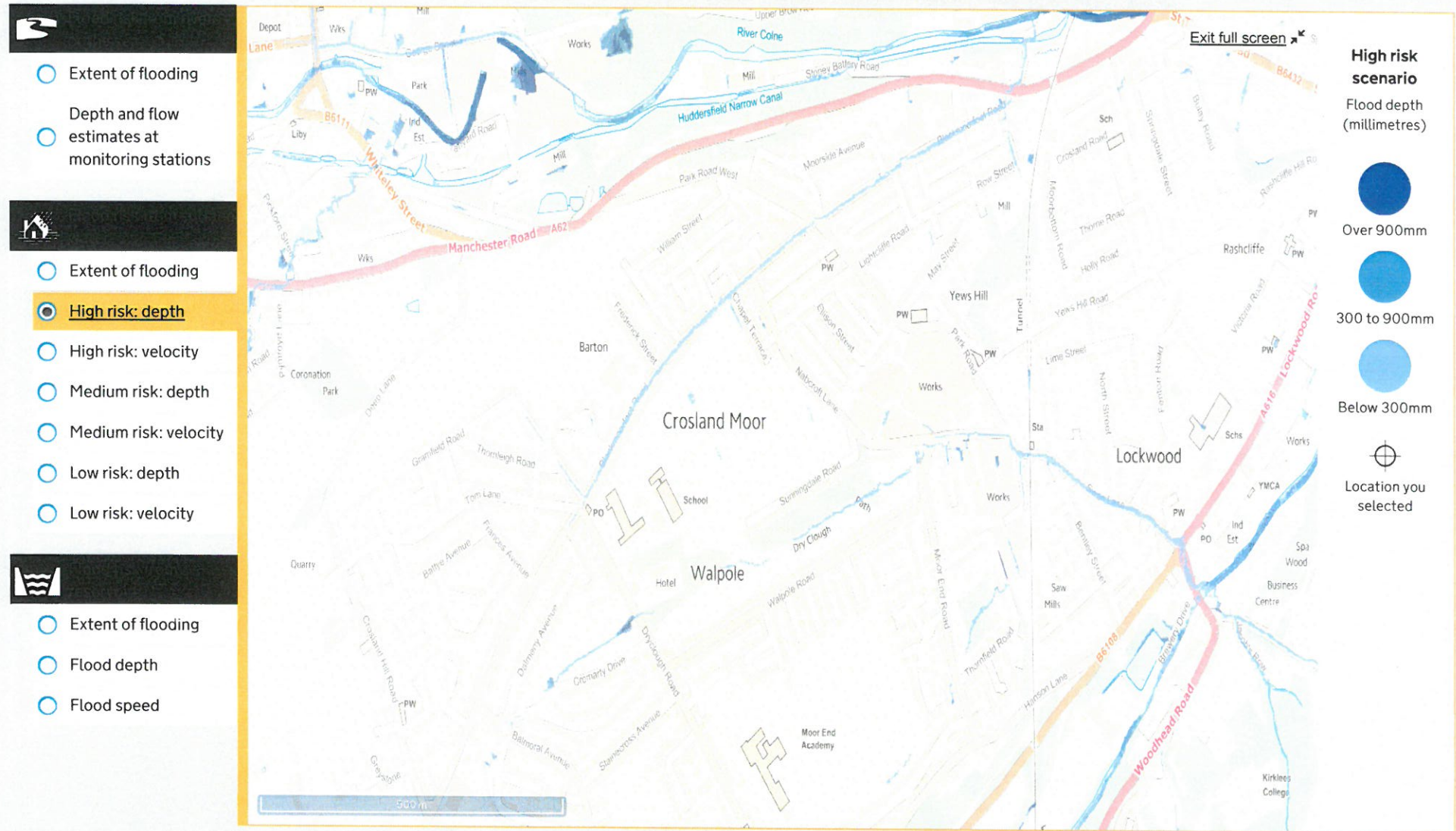
Flood risk

- High
- Medium
- Low
- Very low

Location you selected

Basic view Detailed view

Location

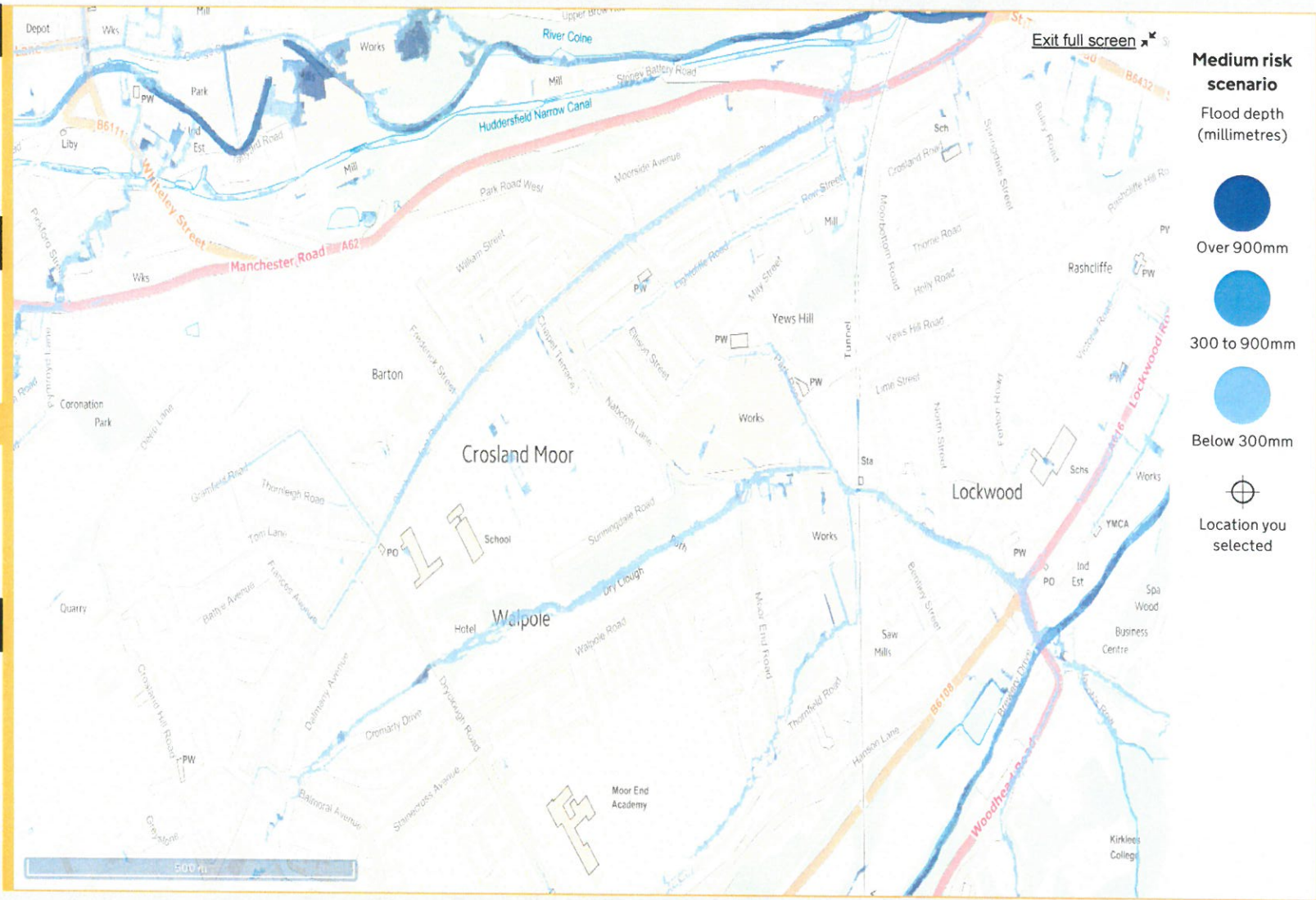


Basic view Detailed view

Location



- Extent of flooding
- Depth and flow estimates at monitoring stations
- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth**
- Medium risk: velocity
- Low risk: depth
- Low risk: velocity
- Extent of flooding
- Flood depth
- Flood speed

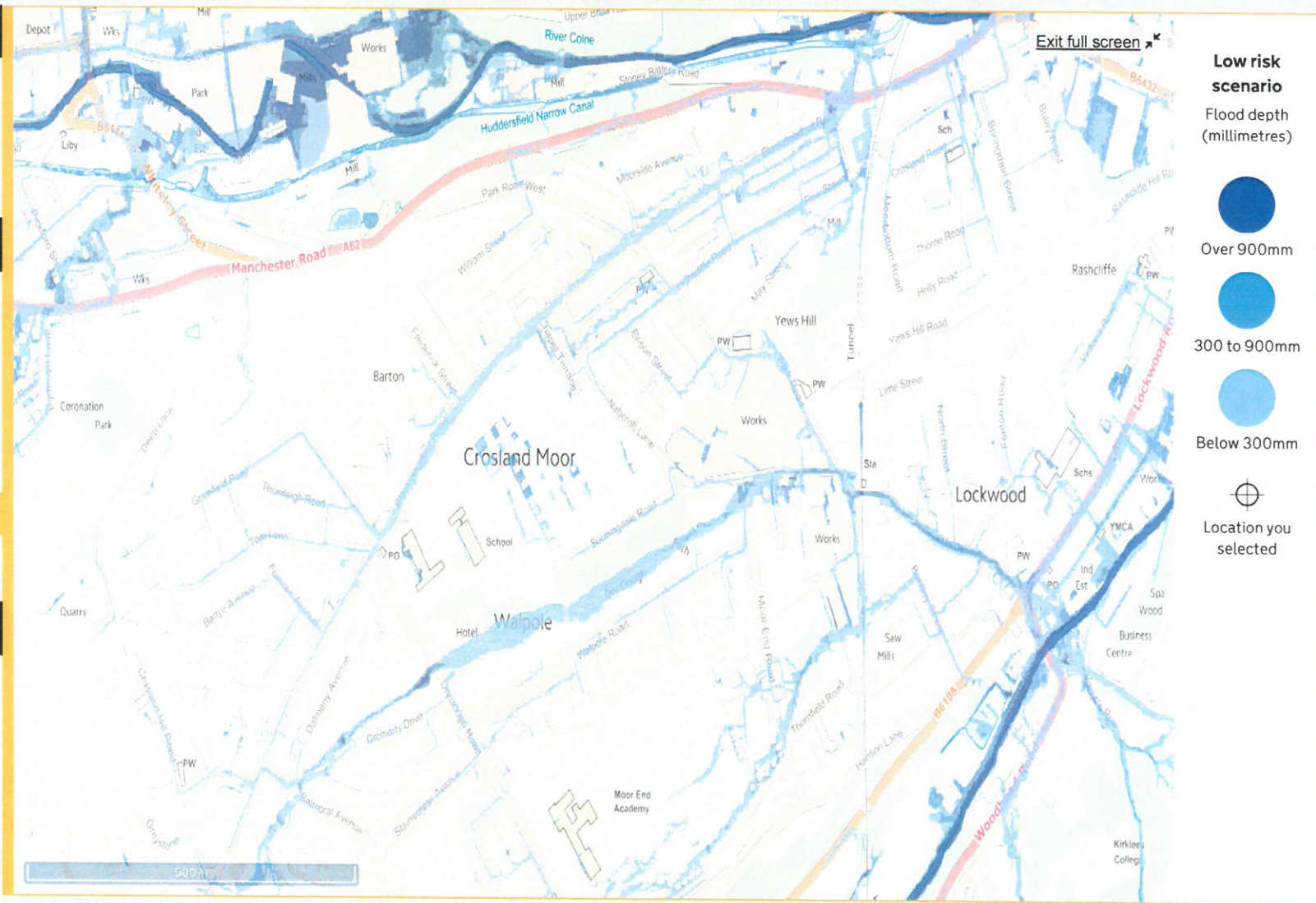


Basic view Detailed view

Location



- Extent of flooding
- Depth and flow estimates at monitoring stations
- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth
- Medium risk: velocity
- Low risk: depth**
- Low risk: velocity
- Extent of flooding
- Flood depth
- Flood speed



APPENDIX E

YORKSHIRE WATER CORRESPONDENCE

From: Kashif.Khan@yorkshirewater.co.uk
Sent: 18 May 2016 16:03
To: Martin Huddleston
Subject: Fw: St Lukes Hospital, Huddersfield, HD 4 5 - Pre planning sewerage enquiry on P433256

Martin

I can confirm the below is correct and stands.

I would slightly reword to say 230.8 l/s to 300/375 mm diameter public combined sewer recorded in Nabcroft Lane and 37.6 l/s to the 225 mm diameter public combined in Nabcroft Lane (at point it breaks its back).

Thanks

Kashif Khan
Sewerage Technical Team
Developer Services

T: 0345 120 8482
M: 07790 617219

----- Forwarded by Kashif Khan/Waste Water/YWS/Yorkshire Water on 18/05/2016 15:59 -----

	Yorkshire Water Services
	Developer Services
	Sewerage Technical Team
Mr R Leyland	PO BOX 52
BWB Consulting	Bradford
Whitehall Waterfront	BD3 7AY
2 Riverside Way	
Leeds	Tel: 0345 120 8482
LS1 4EH	Fax: (01274) 372 834

Email:
Technical.Sewerage@yorkshirewater
Your Ref: AJD/KMJ-LDS/1043 .co.uk
Our Ref: Q008305

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

16th May 2016

St Lukes Hospital, Huddersfield, HD 4 5 - Pre planning sewerage enquiry on P433256

After reviewing your drainage plans I can agree to your calculations.

A maximum surface water discharge of 190 l/s to the 450 mm public combined sewer in Blackmoorfoot Road over all storm events.

A maximum surface water discharge of 268 l/s to the 225 mm & 300 mm public combined sewer in Nabcroft Lane over all storm events.

Yours sincerely

Chris Roberts

Spotted a leak?

If you spot a leak please report it immediately. Call us on 0800 57 3553 or go to <http://www.yorkshirewater.com/leaks>

Get a free water saving pack

Don't forget to request your free water and energy saving pack, it could save you money on your utility bills and help you conserve water. <http://www.yorkshirewater.com/savewater>

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Yorkshire Water Services Limited

Registered Office Western House, Halifax Road, Bradford, BD6 2SZ Registered in England and Wales No 2366682

From: Chris.Roberts@yorkshirewater.co.uk
Sent: 20 June 2016 11:12
To: Martin Huddleston
Subject: St Lukes Hospital Huddersfield - P433256

Martin,

I carried out the desktop checks with my senior engineer using the information provided by Richard Leyland of BWB Consulting and the information on our systems.

Based on the evidence provided I can confirm we are ok with, 230.8 l/s to 300/375 mm diameter public combined sewer recorded in Nabcroft Lane and 37.6 l/s to the 225 mm diameter public combined in Nabcroft Lane (at point it breaks its back).

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, with regard to surface water disposal from the site.

Regards

Chris Roberts
Sewerage Technical Team

|----->
| From: |
|----->
>-----|
|Martin Huddleston <martin@haighhuddleston.co.uk> |
>-----|
|----->
| To: |
|----->
>-----|
|"Kashif.Khan@yorkshirewater.co.uk" <Kashif.Khan@yorkshirewater.co.uk>,
|
>-----|
|----->
| Cc: |
|----->
>-----|
|"Hull, Chris" <chris.hull@persimmonhomes.com>, "Follows, Karen" <karen.follows@persimmonhomes.com>,
"Atkinson, Kevin" |
|<kevin.atkinson@persimmonhomes.com>, "Peter Golightly (peter.golightly@yorkshirewater.co.uk)"
<peter.golightly@yorkshirewater.co.uk>, |
|"Chris.Roberts@yorkshirewater.co.uk" <Chris.Roberts@yorkshirewater.co.uk>
|
>-----|
|----->
| Date: |
|----->
>-----|

|16/06/2016 18:39

>-----|
|----->
| Subject: |
|----->
>-----|
|RE: St Lukes Hospital Huddersfield |
>-----|

Hi Kashif

Apologies, I appreciate that you did not agree the discharge rates for the site. However it was yourself I spoke to in relation to confirmation and the highway review panel in terms of soakaways.

I would be grateful if Chris Roberts could confirm likewise to enable our clients to proceed with the purchase of the site with some confidence.

Many thanks

Martin

-----Original Message-----

From: Kashif.Khan@yorkshirewater.co.uk [mailto:Kashif.Khan@yorkshirewater.co.uk]

Sent: 16 June 2016 11:07

To: Martin Huddleston <martin@haighhuddleston.co.uk>

Cc: Hull, Chris <chris.hull@persimmonhomes.com>; Follows, Karen <karen.follows@persimmonhomes.com>;

Atkinson, Kevin <kevin.atkinson@persimmonhomes.com>; Peter Golightly

(peter.golightly@yorkshirewater.co.uk)

<peter.golightly@yorkshirewater.co.uk>; Chris.Roberts@yorkshirewater.co.uk

Subject: Re: St Lukes Hospital Huddersfield

Hi Martin

I didn't agree the discharge rates, it was Chris Roberts, who I have cc'd into this email.

Thanks

Kashif Khan

Sewerage Technical Team

Developer Services

T: 0345 120 8482

M: 07790 617219

|----->
| From: |
|----->

>-----|

|Martin Huddleston <martin@haighhuddleston.co.uk>

|

>-----|

|----->

| To: |

|----->

>-----|

|"kashif.khan@yorkshirewater.co.uk" <kashif.khan@yorkshirewater.co.uk>,

|

>-----|

|----->

| Cc: |

|----->

>-----|

|"Technical_Sewerage@yorkshirewater.co.uk"
<Technical_Sewerage@yorkshirewater.co.uk>, "Peter Golightly
(peter.golightly@yorkshirewater.co.uk)" |

|<peter.golightly@yorkshirewater.co.uk>,
"wendy.mullaney@yorkshirewater.co.uk"
<wendy.mullaney@yorkshirewater.co.uk>, "Follows, Karen" |

|<karen.follows@persimmonhomes.com>, "Hull, Chris"
<chris.hull@persimmonhomes.com>, "Atkinson, Kevin"
<kevin.atkinson@persimmonhomes.com> |

>-----|

|----->

| Date: |

|----->

>-----|

|15/06/2016 17:56

|

>-----|

|----->

| Subject: |

|----->

>-----|

|St Lukes Hospital Huddersfield

|

>-----|

Hi Kashif

Many thanks for your confirmation in relation to the allowable discharge rates for the proposed development.

Further to our conversation I would like to confirm that Yorkshire Water would not pursue a soakaway discharge for the highways drainage through your highway review panel. The adoptable highway will be able to discharge to the combined sewer in Nabcroft Lane.

We have recently had a meeting with Kirklees land drainage who have confirmed that a soakaway discharge would not be suitable for the proposed development due to the gradient of the site, occasional excessive fill encountered and existing flooding to a number basements to the northern perimeter of the site.

Our clients are in detailed negotiations to purchase the site and any revision to the above would have serious implications to the layout and subsequent cost of the scheme. Therefore please can you confirm that the above is acceptable to yourselves in writing.

Should you have any queries please do not hesitate to contact me direct.

Regards

Martin

(Embedded image moved to file: pic27671.jpg)martinh

Martin Huddleston
Haigh Huddleston & Associates
mobile 07745 877798
martin@haighhuddleston.co.uk

(Embedded image moved to file: pic02047.jpg)Logo2d-3 Firth Buildings, 99 -
101 Leeds Road Dewsbury, West Yorkshire, WF12 7BU
t 01924 464342 f 01924 450662
e trevor.haigh@haighhuddleston.co.uk
w www.haighhuddleston.co.uk

Click here to report this email as spam.[attachment "image002.png" deleted
by Kashif Khan/Waste Water/YWS/Yorkshire Water]

----- Message from "Kashif.Khan@yorkshirewater.co.uk"
<Kashif.Khan@yorkshirewater.co.uk> on Wed, 18 May 2016 15:02:56 +0000 -----

To: Martin Huddleston <martin@haighhuddleston.co.uk>

Subject: Fw: St Lukes Hospital, Huddersfield, HD 4 5 - Pre planning sewerage enquiry
on P433256

Martin

I can confirm the below is correct and stands.

I would slightly reword to say 230.8 l/s to 300/375 mm diameter public combined sewer recorded in Nabcroft Lane
and 37.6 l/s to the 225 mm diameter public combined in Nabcroft Lane (at point it breaks its back).

Thanks

Kashif Khan
Sewerage Technical Team
Developer Services

T: 0345 120 8482
M: 07790 617219

----- Forwarded by Kashif Khan/Waste Water/YWS/Yorkshire Water on
18/05/2016 15:59 -----

Yorkshire Water Services
Developer Services
Sewerage Technical Team

Mr R Leyland
BWB Consulting
Whitehall Waterfront
2 Riverside Way
Leeds
LS1 4EH

PO BOX 52
Bradford
BD3 7AY

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

Email:

Technical.Sewerage@yorkshirewater

Your Ref: AJD/KMJ-LDS/1043 .co.uk
Our Ref: Q008305

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

16th May 2016

Dear Mr Leyland,

St Lukes Hospital, Huddersfield, HD 4 5 - Pre planning sewerage enquiry on

P433256

After reviewing your drainage plans I can agree to your calculations.

A maximum surface water discharge of 190 l/s to the 450 mm public combined sewer in Blackmoorfoot Road over all storm events.

A maximum surface water discharge of 268 l/s to the 225 mm & 300 mm public combined sewer in Nabcroft Lane over all storm events.

Yours sincerely

Chris Roberts

Spotted a leak?

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Get a free water saving pack

Don't forget to request your free water and energy saving pack, it could save you money on your utility bills and help you conserve water.

<http://www.yorkshirewater.com/savewater>

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Yorkshire Water Services Limited

Registered Office Western House, Halifax Road, Bradford, BD6 2SZ Registered in England and Wales No 2366682

[attachment "Proposed discharge points.pdf"

deleted by Kashif Khan/Waste Water/YWS/Yorkshire Water]

From: Martin Huddleston
Sent: 10 August 2018 17:45
To: Andy Naylor
Subject: Fwd: St Lukes Hospital Huddersfiled
Attachments: pic23811.jpg; ATT00001.htm; pic31322.jpg; ATT00002.htm; image002.png; ATT00003.htm; pic06559.jpg; ATT00004.htm; pic08932.jpg; ATT00005.htm; pic30333.jpg; ATT00006.htm; Proposed discharge points.pdf; ATT00007.htm

Hi Andy
Please find attached for your information

Regards

Martin

From: <technical.sewerage@yorkshirewater.co.uk>
Date: 10 August 2018 at 04:56:03 GMT-4
To: Martin Huddleston <martin@haighhuddleston.co.uk>
Subject: St Lukes Hospital Huddersfiled

Dear Mr Huddleston,

I can confirm the controlled surface water discharge rates would remain the same as per our 2016 response.

Kind Regards

Chris Roberts
Sewerage Technician
Yorkshire Water

*** Please note, all correspondence must be sent to technical.sewerage@yorkshirewater.co.uk and will be responded to within 10 working days ***

|----->
| From: |
|----->

-----|
|Martin Huddleston
<martin@haighhuddleston.co.uk>

|----->
| To: |
|----->

-----|
| Chris Roberts <Chris.Roberts@yorkshirewater.co.uk>, Robert Illingworth
<robert.illingworth@yorkshirewater.co.uk>,
| "Technical_Sewerage@yorkshirewater.co.uk"
<Technical_Sewerage@yorkshirewater.co.uk>, |

-----|

|----->
| Cc: |
|----->

-----|

| Andrew Naylor
<Andrew.Naylor@avanthomes.co.uk>
|

-----|

|----->
| Date: |
|----->

-----|

| 13/07/2018
16:21 |

-----|

|----->
| Subject: |
|----->

-----|

| St Lukes Hospital
Huddersfield |

-----|

EXTERNAL SOURCE - THINK BEFORE YOU CLICK

Afternoon Chris, Robert

Its been a couple of years since we last discussed the above site.

Further to the attached email I would like to reaffirm that YW would accept a controlled discharge rather than pursue a soakaway option for the site.

I would be grateful if you could confirm back to ourselves early next week to enable preliminary designs to proceed with confidence.

Should you have any queries please do not hesitate to contact me direct

Regards

Martin

(Embedded image moved to file: pic23811.jpg)

Martin Huddleston

Haigh Huddleston & Associates

mobile 07745 877798

martin@haighhuddleston.co.uk

(Embedded image moved to file: pic31322.jpg)
Firth Buildings, 99 - 101 Leeds Road

Dewsbury, West Yorkshire, WF12 7BU

t 01924 464342 f 01924 450662

e trevor.haigh@haighhuddleston.co.uk

w www.haighhuddleston.co.uk

(See attached file: image002.png)
To: Martin Huddleston <martin@haighhuddleston.co.uk>
CC: "Chris.Roberts@yorkshirewater.co.uk"
<Chris.Roberts@yorkshirewater.co.uk>
From: "Technical_Sewerage@yorkshirewater.co.uk"
<Technical_Sewerage@yorkshirewater.co.uk>
Date: Thu, 23 Jun 2016 11:22:21 +0000
Subject: Re: St Lukes Hospital Huddersfield

Hi Martin

We'll discount soakaway on account of risk to adjacent properties. The highway drainage can go to public sewer as part of the agreed rates of discharge.

Regards

Rob

Robert Illingworth
Engineer
Sewerage Technical
Yorkshire Water Developer Services

Tel: 0345 120 8482

|----->
| From: |
|----->

-----|

| Martin Huddleston <martin@haighhuddleston.co.uk>
|

-----|

|----->
| To: |

|----->

-----|

|"kashif.khan@yorkshirewater.co.uk" <kashif.khan@yorkshirewater.co.uk>,
|

-----|

|----->

| Cc: |

|----->

-----|

|"Technical_Sewerage@yorkshirewater.co.uk"
<Technical_Sewerage@yorkshirewater.co.uk>, "Peter Golightly
(peter.golightly@yorkshirewater.co.uk)" |
|<peter.golightly@yorkshirewater.co.uk>,
"wendy.mullaney@yorkshirewater.co.uk"
<wendy.mullaney@yorkshirewater.co.uk>, "Follows, Karen" |
|<karen.follows@persimmonhomes.com>, "Hull, Chris"
<chris.hull@persimmonhomes.com>, "Atkinson, Kevin"
<kevin.atkinson@persimmonhomes.com> |

-----|

|----->

| Date: |

|----->

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|15/06/2016 17:56

|

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|----->

| Subject: |

|----->

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| St Lukes Hospital Huddersfield

|

-----|

Hi Kashif

Many thanks for your confirmation in relation to the allowable discharge rates for the proposed development.

Further to our conversation I would like to confirm that Yorkshire Water would not pursue a soakaway discharge for the highways drainage through your highway review panel. The adoptable highway will be able to discharge to the combined sewer in Nabcroft Lane.

We have recently had a meeting with Kirklees land drainage who have confirmed that a soakaway discharge would not be suitable for the proposed development due to the gradient of the site, occasional excessive fill encountered and existing flooding to a number basements to the northern perimeter of the site.

Our clients are in detailed negotiations to purchase the site and any revision to the above would have serious implications to the layout and subsequent cost of the scheme. Therefore please can you confirm that the above is acceptable to yourselves in writing.

Should you have any queries please do not hesitate to contact me direct.

Regards

Martin

(Embedded image moved to file: pic06559.jpg)

Martin Huddleston

Haigh Huddleston & Associates

mobile 07745 877798

martin@haighhuddleston.co.uk

(Embedded image moved to file: pic08932.jpg)
Firth Buildings, 99 - 101 Leeds Road

Dewsbury, West Yorkshire, WF12 7BU

t 01924 464342 f 01924 450662

e trevor.haigh@haighhuddleston.co.uk

w www.haighhuddleston.co.uk

Click here to report this email as spam.

(See attached file: image002.png)

To: Martin Huddleston <martin@haighhuddleston.co.uk>

From: "Kashif.Khan@yorkshirewater.co.uk" <Kashif.Khan@yorkshirewater.co.uk>

Date: Wed, 18 May 2016 15:02:56 +0000

Subject: Fw: St Lukes Hospital, Huddersfield, HD 4 5 - Pre planning
sewerage enquiry on P433256

Martin

I can confirm the below is correct and stands.

I would slightly reword to say 230.8 l/s to 300/375 mm diameter public combined sewer recorded in Nabcroft Lane and 37.6 l/s to the 225 mm diameter public combined in Nabcroft Lane (at point it breaks its back).

Thanks

Kashif Khan
Sewerage Technical Team
Developer Services

T: 0345 120 8482

M: 07790 617219

----- Forwarded by Kashif Khan/Waste Water/YWS/Yorkshire Water on
18/05/2016 15:59 -----

	Yorkshire Water Services
	Developer Services
	Sewerage Technical Team
Mr R Leyland	PO BOX 52
BWB Consulting	Bradford
Whitehall Waterfront	BD3 7AY
2 Riverside Way	
Leeds	Tel: 0345 120 8482
LS1 4EH	Fax: (01274) 372 834

Email:
Technical.Sewerage@yorkshirewater
Your Ref: AJD/KMJ-LDS/1043 [.co.uk](http://www.yorkshirewater.co.uk)
Our Ref: Q008305

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

16th May 2016

Dear Mr Leyland,

St Lukes Hospital, Huddersfield, HD 4 5 - Pre planning sewerage enquiry on
P433256

After reviewing your drainage plans I can agree to your calculations.

A maximum surface water discharge of 190 l/s to the 450 mm public combined
sewer in Blackmoorfoot Road over all storm events.

A maximum surface water discharge of 268 l/s to the 225 mm & 300 mm public
combined sewer in Nabcroft Lane over all storm events.

Yours sincerely

Chris Roberts

Spotted a leak?

From: Paul Farndale <Paul.Farndale@kirklees.gov.uk>
Sent: 18 June 2016 10:16
To: Martin Huddleston
Subject: RE: St Lukes Hospital Huddersfield

Hello Martin,

I can confirm that we are aware of several accounts of cellar flooding immediately adjacent to the site which indicate a risk of groundwater flows causing problems if we concentrate surface water flows to soakaways within the site. We do not wish to make this situation worse and would discount soakaways as a result. The existing gradient appears to be much steeper in places and would also raise a question of re-emergence risk as stated in previous comments on this site.

Any discharge rates to public combined sewer that are accepted by Yorkshire Water would not be challenged by Kirklees Flood Management & Drainage as LLFA. This would not be the case however for a surface water sewer than subsequently discharged to watercourse. However for a combined sewer that leads to a treatment work where storm flows are regulated, we take the view that Yorkshire Water has assessed the risk as acceptable.

Kind regards,

Paul Farndale
Principal Engineer
Flood Management & Drainage
Investment & Regeneration Service
Kirklees Council
01484 221000

From: Martin Huddleston [mailto:martin@haighhuddleston.co.uk]
Sent: 15 June 2016 17:39
To: Paul Farndale
Cc: Follows, Karen; Hull, Chris; Atkinson, Kevin
Subject: St Lukes Hospital Huddersfield

Hi Paul
Thanks for todays meeting.

1. Please find attached a copy of the email received from YW confirming the allowable discharge rates for the proposed development, and our sketch plan indicating the proposed locations of each offsite surface water connection.
2. In addition we discussed the possible use of soakaways for the development given the initial site investigation results. Due to the gradient of the site (1in 17 approx), the depth of made ground found in some instances, and the reported localised flooding to some existing basements to the north east of the site, we concluded that a soakaway discharge for the disposal of surface water would not be pursued in this instance for this housing development.

I would be grateful if you could confirm in writing that you are able to accept these discharge rates through planning process and also that soakaways will not be required.

Regards

Martin



Martin Huddlestone
Haigh Huddlestone & Associates
mobile 07745 877798
martin@haighhuddlestone.co.uk



Haigh Huddlestone & Associates

Civil Structural Engineering Consultants

Firth Buildings, 99 - 101 Leeds Road
Dewsbury, West Yorkshire, WF12 7BU
t 01924 464342 f 01924 450662
e trevor.haigh@haighhuddlestone.co.uk
w www.haighhuddlestone.co.uk

Sign up for email newsletters and alerts - www.kirklees.gov.uk/stayconnected
Find us on Facebook - <https://www.facebook.com/liveinkirklees>
Follow us on Twitter - www.twitter.com/kirkleescouncil

This email and any attachments are confidential. If you have received it in error - notify the sender immediately, delete it from your system, and do not use, copy or disclose the information in any way. Kirklees Council monitors all emails sent or received.

From: Paul Farndale <Paul.Farndale@kirklees.gov.uk>
Sent: 16 July 2018 19:47
To: Martin Huddleston
Cc: Andrew Naylor
Subject: RE: St Lukes Hospital

Hello Martin,

I can confirm that my original statement stands.

Kind regards,

Paul Farndale
Lead Local Flood Authority

From: Martin Huddleston [mailto:martin@haighhuddleston.co.uk]
Sent: 13 July 2018 15:47
To: Paul Farndale <Paul.Farndale@kirklees.gov.uk>
Cc: Andrew Naylor <Andrew.Naylor@avanthomes.co.uk>
Subject: St Lukes Hospital

Hi Paul
The above site is moving forward again!

Initially I would like to seek your approval to previous email exchange in relation to soakaways on site.

I appreciate things have moved on 2 years but our opinion remains the same in relation to soakaways, in that we would not recommend for this development for the reasons set out in the attached email.

I would be grateful if you could confirm this would still be the case

Regards

Martin



Martin Huddleston
Haigh Huddleston & Associates
mobile 07745 877798
martin@haighhuddleston.co.uk



Haigh Huddleston & Associates

Civil Structural Engineering Consultants

Firth Buildings, 99 - 101 Leeds Road
Dewsbury, West Yorkshire, WF12 7BU
t 01924 464342 f 01924 450662

APPENDIX F

STORMWATER STORAGE CALCULATIONS

HIGH HDDL STOSSOTS

Storage Water Storage Calculations

Client: T HOM S

Site: St L S HOSITL R SID TIL R lit se

Design storm: 30 M5-60 19 mm
 Site area sq m: 21375
 Imp Area sq m: 11000
 T of Conc min: 4 Time to Flow

Allow Discharge: 148.1 Lit / sec Imp Ratio: 0.51
 30 YEAR STORM

100 year storm

100year plus 30% climate

2 year storm

Storage	Duration	Intensity	Depth	Inflow	Outflow	Storage	Time	Intensity	Depth	Inflow	Outflow	Storage	Intensity	Depth	Inflow	Outflow	Storage	Duration	Depth	Inflow	Outflow	Storage
Mins	hr	mm/hr	mm	lit	lit	lit	hr	mm/hr	mm	lit	lit	lit	mm/hr	mm	lit	lit	lit	hr	mm	lit	lit	lit
10	81.8	13.63	149.97	103.36	46.61	250.14	2.4	101.27	16.88	185.66	103.36	82.30	131.65	21.94	241.36	103.36	138.00	35.17	5.86	64.49	103.36	-38.87
20	59.8	19.93	219.27	184.48	34.79	182.87	3.2	74.03	24.68	271.45	184.48	86.97	96.24	32.08	352.89	184.48	168.41	25.71	8.57	94.28	184.48	-90.19
30	47.6	23.80	261.80	265.96	-4.16	145.56	4.1	58.93	29.46	324.11	265.96	58.15	76.61	38.30	421.34	265.96	155.38	20.47	10.23	112.57	265.96	-153.39
50	34.4	28.67	315.33	429.80	-114.47	105.20	5.6	42.59	35.49	390.38	429.80	-39.42	55.36	46.14	507.50	429.80	77.69	14.79	12.33	135.59	429.80	-294.21
60	30.3	30.30	333.30	511.89	-178.59	92.66	6.4	37.51	37.51	412.63	511.89	-99.27	48.76	48.76	536.41	511.89	24.52	13.03	13.03	143.32	511.89	-368.57
120	18.7	37.40	411.40	1009.81	-598.41	57.18	10.4	23.15	46.30	509.31	1009.81	-500.50	30.10	60.19	662.11	1009.81	-347.70	8.04	16.08	176.90	1009.81	-832.91
180	14.1	42.30	465.30	1512.94	-1047.64	43.12	13.7	17.46	52.37	576.04	1512.94	-936.90	22.69	68.08	748.85	1512.94	-764.08	6.06	18.19	200.08	1512.94	-1312.86
240	11.5	46.00	506.00	2018.50	-1512.50	35.17	16.8	14.24	56.95	626.43	2018.50	-1392.07	18.51	74.03	814.36	2018.50	-1204.14	4.95	19.78	217.58	2018.50	-1800.92
300	9.8	49.00	539.00	2525.69	-1986.69	29.97	19.8	12.13	60.66	667.28	2525.69	-1858.41	15.77	78.86	867.47	2525.69	-1658.22	4.21	21.07	231.77	2525.69	-2293.92
360	8.7	52.20	574.20	3036.64	-2462.44	26.60	22.3	10.77	64.62	710.86	3036.64	-2325.78	14.00	84.01	924.12	3036.64	-2112.52	3.74	22.45	246.91	3036.64	-2789.73
420	7.9	55.30	608.30	3549.76	-2941.46	24.16	24.5	9.78	68.46	753.08	3549.76	-2796.69	12.71	89.00	979.00	3549.76	-2570.77	3.40	23.78	261.57	3549.76	-3288.20
480	7.5	60.00	660.00	4071.30	-3411.30	22.94	25.8	9.29	74.28	817.08	4071.30	-3254.22	12.07	96.56	1062.20	4071.30	-3009.10	3.23	25.80	283.80	4071.30	-3787.50
540	6.9	62.10	683.10	4584.50	-3901.40	21.10	28.1	8.54	76.88	845.68	4584.50	-3738.83	11.10	99.94	1099.38	4584.50	-3485.12	2.97	26.70	293.73	4584.50	-4290.77
600	5.38	53.80	591.80	5047.18	-4455.38	16.45	36.0	6.66	66.60	732.65	5047.18	-4314.53	8.66	86.59	952.44	5047.18	-4094.74	2.31	23.13	254.47	5047.18	-4792.71
900	4.00	60.00	660.00	7602.59	-6942.59	12.23	48.4	4.95	74.28	817.08	7602.59	-6785.51	6.44	96.56	1062.20	7602.59	-6540.39	1.72	25.80	283.80	7602.59	-7318.79
1200	3.16	63.20	695.20	10153.99	-9458.79	9.66	61.3	3.91	78.24	860.66	10153.99	-9293.34	5.09	101.71	1118.85	10153.99	-9035.14	1.36	27.18	298.94	10153.99	-9855.06
1440	2.74	65.76	723.36	12203.13	-11479.77	8.38	70.7	3.39	81.41	895.52	12203.13	-11307.61	4.41	105.83	1164.18	12203.13	-11038.96	1.18	28.28	311.04	12203.13	-11892.09
2880	1.63	78.24	860.64	24571.15	-23710.51	4.98	118.8	2.02	96.86	1065.47	24571.15	-23505.67	2.62	125.92	1385.11	24571.15	-23186.03	0.70	33.64	370.08	24571.15	-24201.07

Storage	Duration	Depth	Inflow	Outflow	Storage	Duration	Depth	Inflow	Outflow	Storage	Duration	Depth	Inflow	Outflow	Storage	Duration	Depth	Inflow	Outflow	Storage	
Mins	hr	mm	lit	lit	lit	hr	mm	lit	lit	lit	hr	mm	lit	lit	lit	hr	mm	lit	lit	lit	
Length of 1800		18.32				Length of 1800		34.17858			Length of 1800		66.1806			Length of 1800		-15.277			
Length of 1500		26.38	Culvert	2.4*1.5m	12.95	Length of 1500		49.22141			Length of 1500		95.3084			Length of 1500		-22			
Length of 1200		41.21	culvert	3.6*1.8m	7.19	Length of 1200		76.90029			Length of 1200		148.904			Length of 1200		-34.372			
Length of 1050		53.82				Length of 1050		100.43			Length of 1050		194.469			Length of 1050		-44.889			
Length of 900		73.28				Length of 900		136.75			Length of 900		264.795			Length of 900		-61.123			
Length of 750		105.45				Length of 750		196.77			Length of 750		381.018			Length of 750		-87.951			
Length of 600		164.69				Length of 600		307.33			Length of 600		595.088			Length of 600		-137.36			

Foot print area

Aquacell Storage Crates (400mm deep)	122.649 30 year	Pond 900mm deep	51.8 30 year
	228.880 100 year		96.6 100 year
	443.184 100 year plus climatic		187.1 100 year plus climatic

HAIGH HUDDLESTON ASSOCIATES

Stormwater Storage Calculations

Client AVANT HOMES

Site St LUKES HOSPITAL - RESIDENTIAL AREA 2 230.8lit-sec

Design storm 30 M5-60 19 mm
r 0.4

Site area sq m. 37337
Imp Area sq m. 20260
T of Conc min 4 Time to Flow

Allow Discharge 230.8 Lit / sec Imp Ratio 0.54
30 YEAR STORM

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	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.	mm	cu.m	cu.m	cu.m.
10	81.8	13.63	276.21	166.12	110.09	460.72	2.0	101.27	16.88	341.95	166.12	175.83	131.65	21.94	444.53	166.12	278.41	35.17	5.86	118.77	166.12					-47.35
20	59.8	19.93	403.85	294.39	109.45	336.81	2.7	74.03	24.68	499.97	294.39	205.57	96.24	32.08	649.96	294.39	355.56	25.71	8.57	173.66	294.39					-120.74
30	47.6	23.80	482.19	423.15	59.04	268.10	3.4	58.93	29.46	596.95	423.15	173.80	76.61	38.30	776.03	423.15	352.89	20.47	10.23	207.34	423.15					-215.81
50	34.4	28.67	580.79	681.81	-101.02	193.75	4.8	42.59	35.49	719.01	681.81	37.21	55.36	46.14	934.72	681.81	252.91	14.79	12.33	249.74	681.81					-432.07
60	30.3	30.30	613.88	811.36	-197.48	170.66	5.4	37.51	37.51	759.98	811.36	-51.38	48.76	48.76	987.98	811.36	176.62	13.03	13.03	263.97	811.36					-547.39
120	18.7	37.40	757.72	1595.77	-838.05	105.32	8.8	23.15	46.30	938.06	1595.77	-657.71	30.10	60.19	1219.48	1595.77	-376.29	8.04	16.08	325.82	1595.77					-1269.95
180	14.1	42.30	857.00	2387.05	-1530.05	79.42	11.6	17.46	52.37	1060.96	2387.05	-1326.09	22.69	68.08	1379.25	2387.05	-1007.80	6.06	18.19	368.51	2387.05					-2018.54
240	11.5	46.00	931.96	3181.53	-2249.57	64.77	14.3	14.24	56.95	1153.77	3181.53	-2027.77	18.51	74.03	1499.90	3181.53	-1681.64	4.95	19.78	400.74	3181.53					-2780.79
300	9.8	49.00	992.74	3978.17	-2985.43	55.20	16.7	12.13	60.66	1229.01	3978.17	-2749.16	15.77	78.86	1597.72	3978.17	-2380.46	4.21	21.07	426.88	3978.17					-3551.00
360	8.7	52.20	1057.57	4779.77	-3722.20	49.00	18.8	10.77	64.62	1309.27	4779.77	-3470.49	14.00	84.01	1702.06	4779.77	-3077.71	3.74	22.45	454.76	4779.77					-4325.01
420	7.9	55.30	1120.38	5584.23	-4463.85	44.50	20.7	9.78	68.46	1387.03	5584.23	-4197.20	12.71	89.00	1803.14	5584.23	-3781.09	3.40	23.78	481.76	5584.23					-5102.47
480	7.5	60.00	1215.60	6399.78	-5184.18	42.24	21.9	9.29	74.28	1504.91	6399.78	-4894.87	12.07	96.56	1956.39	6399.78	-4443.40	3.23	25.80	522.71	6399.78					-5877.08
540	6.9	62.10	1258.15	7204.35	-5946.20	38.86	23.8	8.54	76.88	1557.58	7204.35	-5646.76	11.10	99.94	2024.86	7204.35	-5179.49	2.97	26.70	541.00	7204.35					-6663.34
600	5.38	53.80	1089.99	7942.29	-6852.30	30.30	30.5	6.66	66.60	1349.41	7942.29	-6592.88	8.66	86.59	1754.23	7942.29	-6188.06	2.31	23.13	468.69	7942.29					-7473.59
900	4.00	60.00	1215.60	11951.13	-10735.53	22.53	41.0	4.95	74.28	1504.91	11951.13	-10446.21	6.44	96.56	1956.39	11951.13	-9994.74	1.72	25.80	522.71	11951.13					-11428.42
1200	3.16	63.20	1280.43	15954.68	-14674.25	17.80	51.9	3.91	78.24	1585.17	15954.68	-14369.51	5.09	101.71	2060.73	15954.68	-13893.96	1.36	27.18	550.59	15954.68					-15404.10
1440	2.74	65.76	1332.30	19168.10	-17835.80	15.43	59.8	3.39	81.41	1649.38	19168.10	-17518.71	4.41	105.83	2144.20	19168.10	-17023.90	1.18	28.28	572.89	19168.10					-18504.10
2880	1.63	78.24	1585.14	38545.08	-36959.94	9.18	100.6	2.02	96.86	1962.41	38545.08	-36582.68	2.62	125.92	2551.13	38545.08	-35993.95	0.70	33.24	681.61	38545.08					-37863.47

Length of 1800	Storage	110.09	Length of 1800	Storage	205.57	Length of 1800	Storage	355.56	Length of 1800	Storage	-47.35
Length of 1800	43.26		Length of 1800	80.78397		Length of 1800	139.726		Length of 1800	-18.6082	
Length of 1500	62.30 Culvert	2.4*1.5m	30.58	Length of 1500	116.339	Length of 1500	201.223		Length of 1500	-26.7961	
Length of 1200	97.34 culvert	3.6*1.8m	16.99	Length of 1200	181.7604	Length of 1200	314.377		Length of 1200	-41.8676	
Length of 1050				Length of 1050	237.38	Length of 1050	410.578		Length of 1050	-54.6793	
Length of 900				Length of 900	323.22	Length of 900	559.058		Length of 900	-74.4532	
Length of 750				Length of 750	465.09	Length of 750	804.436		Length of 750	-107.132	
Length of 600				Length of 600	726.40	Length of 600	1256.4		Length of 600	-167.322	

Aquacell Storage Crates (400mm deep)	Footprint Area (m)	Pond 900mm deep
	289.706 30 year	122.3 30 year
	540.976 100 year	228.4 100 year
	935.686 100 year plus climatic	395.1 100 year plus climatic

