

**Land off Higham Lane,
Dodworth, Barnsley**

Flood Risk Assessment

September 2012

Redrow Homes Yorkshire

JBA Project Manager

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Revision History

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Contract

This report describes work commissioned by Andrew Calvert, on behalf of Redrow Homes Yorkshire, by an email dated 11 September 2012. Chris Wright of JBA Consulting carried out this work.

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Executive Summary

This report describes the flood risk assessment carried out for the proposed housing development off Higham Lane, Dodworth, Barnsley for which Redrow Homes Yorkshire proposes to submit a planning application to Barnsley MBC.

The site covers approximately 1.2ha. The majority of the site is occasionally used as grazing land by the current owner, the remainder of the site is occupied by the owner's dwelling.

The site drains to a watercourse crossing the site which drains to Dodworth Dike, a tributary of the River Dove. Maintenance of the watercourse is the responsibility of the riparian owners. Barnsley MBC is the land drainage authority.

The report describes the requirement for a flood risk assessment.

The report describes the area including drainage to watercourse and sewer systems. Reference to the Soil Map of Great Britain is included.

The topography and drainage of the site is described together with the results of trial pit investigations.

Consultations with the following are described:-

Yorkshire Water

Barnsley MBC

Environment Agency

Mr & Mrs Metcalfe, current owners of the site

Flood risk from watercourses, sewers, adjacent land and groundwater are described and assessed and mitigation measures are suggested *where appropriate*.

Impacts on flood risk from watercourses, sewers and adjacent land are also described and again, mitigation measures are suggested.

The report concludes that providing mitigation measures described are carried out, the risk of flooding of the development is low or very low and that the impact the development will have on flood risk will also be low.

The required consents and approvals are described.

The following mitigation measures are recommended

- Foul and surface water sewer design should be carried out according to Sewers for Adoption and Yorkshire Water requirements
- Peak surface water discharge to the watercourse in Higham Lane should be based on 3l/s/ha of the greenfield part of the development site plus the existing brownfield run off rate from the existing dwelling and buildings, less 30%
- There should be no increase in overall discharge to the watercourse crossing the site
- The watercourse on the northern boundary should be retained to convey run off from the railway embankment to the watercourse crossing the site
- A field drainage system should be constructed along the southern boundary discharging into the watercourse crossing the site

- The proposed crossing of the development access road of the watercourse crossing the site should be a pipe with a diameter no less than the culvert downstream of the site
- There should be no buildings constructed over or within a distance to be agreed with Yorkshire Water of the existing surface water sewer in the north east corner of the site.
- Levels on the site access road and floor levels of dwellings adjacent to Higham Lane should be set 300mm above the adjacent level of Higham Lane

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Abbreviations

BMBC..... Barnsley Metropolitan Borough Council

AOD Above Ordnance Datum

NPPF National Planning Policy Framework

1 Background

1.1 Development Proposals

Redrow Homes Yorkshire (Redrow) is promoting the development of approximately 1.2ha (2.9 acres) of land off Higham Lane, Dodworth, Barnsley. The site location is shown on Appendix A and a feasibility layout plan is attached at Appendix E.

Encia Group Ltd has carried out consultations and these are included in this report.

1.2 Requirement for a Flood Risk Assessment

Guidance on the requirement for and the assessment of flood risk is provided in the National Planning Policy Framework (NPPF) published by the Department for Communities and Local Government in March 2012.

A Technical Guidance to the NPPF was also published in March 2012 by the Department for Communities and Local Government.

All development sites in Flood Zones 2 and 3 and those covering more than 1ha should have flood risk assessed.

In this case, the development site lies within Flood Zone 1 (see flood map at appendix B) and covers 2.9ha.

The NPPF defines Flood Zones as follows:-

Zone 1 – Low Probability – less than 1 in 1000 annual probability (< 0.1%) of river or sea flooding in any year

Zone 2 – Medium Probability – between a 1 in 100 and 1 in 1000 annual probability (1% - 0.1%) of river flooding or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year

Zone 3a – High Probability – 1 in 100 or greater annual probability (> 1%) of river flooding or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year

Zone 3b – Functional Floodplain – 1 in 20 or greater annual probability (5%) of river flooding in any year. This is land on which water has to flow or be stored in times of flood.

The NPPF recommends that a risk based sequential test should be applied at all stages of planning particularly where part of the proposed development lies within Flood Zone 3a.

The development site lies within Flood Zone 1 and therefore a sequential test is not required.

This report makes recommendations for the mitigation of flood risk to and as a result of the development as well as proposals for disposal of surface water.

1.3 Consultations

Consultations were carried out in 2008 with the following:-

- Yorkshire Water
- Barnsley MBC
- Environment Agency

New consultations are currently being carried out.

In addition, a site visit was made on 15 May 2008 and discussions with the current owners, Mr & Mrs Metcalfe are described below.

Details of the responses from consultees are given below and are attached at Appendix C.

2 General Description of the Area

2.1 Description of the Area

The site lies on the north east side of Dodworth and 3km west of Barnsley town centre.

Existing housing fronting on to Hawthorne Crescent lies to the south of the site, the Barnsley to Penistone railway on an embankment lies adjacent to the site to the north beyond which is a new road, commercial development and the former waste tip of Dodworth Colliery.

The site lies on a hillside, ground levels above Ordnance Datum (AOD) on Higham Lane being:-

400m to the north	156m AOD
Opposite the site	133m AOD
200m to the south, junction of Barnsley Road	126m AOD

2.2 Drainage of the Area

The area drains surface water to Dodworth Dike which drains to Worsborough Reservoir and to the River Dove. The Dike runs in a combination of open and culverted sections within the urban area.

Upstream of Barnsley Road, the watercourse is mostly culverted. The main branch is culverted in Higham Lane and drains the former waste tip of Dodworth Colliery.

The industrial estate north west of the site drains via a surface water sewer into the culverted watercourse in Higham Lane. We understand from Barnsley MBC that the culverted watercourse in Higham Lane is 1050mm diameter.

We also understand from Barnsley MBC that part of the new road to the north of the railway drains to the culverted watercourse in Higham Lane via flow restriction and storage facilities.

2.3 Sewer Systems

The Yorkshire Water sewer map (included at Appendix C) shows a 150mm diameter public foul sewer in Higham Lane and a 225mm diameter public foul sewer in Hawthorne Crescent. These join and a 225mm diameter foul sewer runs downstream towards Barnsley Road.

The only public surface water sewer shown is that serving the industrial estate north west of the site which discharges into the culverted watercourse in Higham Lane.

2.4 Soil Map of Great Britain

The Soil Map of Great Britain shows the area to be underlain by soil type 712a Dale series, described as slowly permeable, seasonally waterlogged clayey, fine loamy over clayey and fine silty soils on soft rock. The rock is described as Carboniferous or Jurassic clay and shale.

This description suggests that infiltration drainage will not be feasible and also explains the tendency to waterlogging as discussed below.

3 Description of the Site

3.1 General Description

The site covers approximately 1.2ha. It is bounded to the north by the raised railway embankment, track level being approximately 5m above site ground levels.

To the south lie rear gardens of properties on Hawthorne Crescent. Land falls away from the site and floor levels on Hawthorne Crescent properties are approximately 1.0m to 1.5m below ground levels on the site boundary.

Higham Lane forms the eastern site boundary.

At the western end of the site, a garden of a property in Hawthorne Crescent has been extended to the base of the railway embankment.

A watercourse crosses the site running from north to south.

The site survey plan at Appendix D shows the existing site.

The site slopes generally north to south and west to east as far as the watercourse and from east to west between Higham Lane and the watercourse. The highest ground level towards the west end of the site is 138m AOD, the ground level at the watercourse is 130m AOD and the level adjacent to Higham Lane is 133m AOD.

The site is occupied by one dwelling adjacent to Higham Lane. From there to both sides of the watercourse was maintained as gardens and the remainder was rough grass, having been used for grazing horses.

Generally, during the site walkover, ground conditions were dry and firm.

3.2 Watercourses and Field Drainage

The site generally drains to the watercourse crossing the site.

A shallow watercourse runs within the northern boundary of the site. The majority of this watercourse will drain to the watercourse crossing the site with a short section at the western end draining to the west. There is no evidence of the watercourse continuing under the garden on that boundary. The shallow watercourse was dry at the time of the site visit although the current owner said that it does carry small flows during periods of heavy rainfall.

It is possible that the field contains field drainage systems. However, there was no evidence of such systems during the site visit.

The watercourse crossing the site was flowing at the time of the site visit. It enters the site from a brick culvert under the railway embankment and leaves the site in a culvert of approximately 600mm diameter. The water level within the site is retained approximately 300mm above the downstream culvert invert level by a steel plate. This is for ornamental purposes to create a small ponded area.

It is likely that the majority of the flow in the watercourse crossing the site will be groundwater from land north of the railway. The surface run off from the development north of the railway together with that from the new road drains into the 1050mm diameter culverted watercourse in Higham Lane and this will have reduced the peak flows in the watercourse across the site.

3.3 Site Investigation

A site investigation consisting of the excavation of trial pits was carried out for Redrow by Encia Consulting. The sub soil below the top soil was described as firm, becoming stiff, gravely clay to depths of between 2.3 and 2.6m below ground level underlain by weak mudstone. It was reported that the soils would not be suitable for infiltration drainage techniques.

4 Consultations

4.1 General

Consultation responses have been supplied by Redrow and are described below. New consultations are taking place to update and confirm the responses described below.

Discussions have been held with the Drainage Engineer at Barnsley MBC and these are also described below.

4.2 Yorkshire Water

A pre planning sewerage enquiry has been obtained by Encia Consulting. The response which is attached at Appendix C is dated April 2007.

Yorkshire Water will allow discharge of foul sewage to the existing foul sewer in Higham Lane.

Yorkshire Water will not permit discharge of surface water from the development to the public sewers. They have commented that surface water should be discharged to one of the existing watercourses.

There is a potential for the proposed on site sewers to be adopted as public sewers by Yorkshire Water. Design and construction should be carried out in accordance with 'Sewers for Adoption' 6th Edition published by WRc, supplemented by Yorkshire Water's requirements. Land drainage will not be accepted into the public sewers and the agreement of Yorkshire Water will need to be obtained for the discharge of highway drainage into the proposed adoptable site surface water sewers.

Yorkshire Water pointed out that a public sewer crosses the extreme north east corner of the site and there are restrictions regarding building close to the line of the sewer. Discharge of surface water from the development site to this sewer will not be permitted by Yorkshire Water.

A new pre planning enquiry is being made to Yorkshire Water.

4.3 Barnsley MBC

We have had discussions with the Drainage Engineer at Barnsley MBC.

Barnsley MBC is the Land Drainage Authority and the Lead Local Flood Authority (LLFA) for the development and their consent will be required for any works affecting a watercourse. This includes discharge of surface water drainage from the development.

The Drainage Engineer commented that during prolonged rainfall events, ground water springs are evident within the site and the nature of the soils results in waterlogging.

He also reported that problems have been experienced with the receiving culverted watercourse downstream of the development site at the junction of Barnsley Road and Higham Lane. The Council has carried out maintenance on the culverted watercourse in this area to remove encrustation resulting from drainage from the former colliery waste tip.

In view of the above, the Drainage Engineer is likely to place a greenfield run off restriction on the surface water discharge rate from the development of 3 l/s/ha.

A further consultation is being pursued with Barnsley MBC.

4.4 Environment Agency

An extract from the Environment Agency Flood Map obtained from the Agency is attached at Appendix B. It shows the site to be outside Flood Zone 2 and therefore within Flood Zone 1.

A brief discussion with Roger Dixon confirmed that the Environment Agency will expect there to be no increase in discharge rate to the watercourse. He is aware that Barnsley MBC is the land drainage authority which will consent the proposed discharge.

A further consultation is being carried out with the Environment Agency.

4.5 **Mr & Mrs Metcalfe**

During the site visit, discussions were had with Mr & Mrs Metcalfe, the current site owners.

They have lived at the single dwelling on the site adjacent to Higham Lane for 26 years. They recalled that the watercourse across the site has flooded once due to a blockage in the culverted section downstream. The blockage was cleared by the Council and there has been no further flooding, including during the June 2007 flood event.

5 Flood Risk

5.1 Flood Risk Mechanisms

The mechanisms from which flooding of the development could occur are as follows:-

- Rivers and watercourses
- Existing and proposed sewers
- Adjacent land
- Groundwater

5.2 Rivers and Watercourses

The site lies within Flood Zone 1 as described in the NPPF as having less than 1 in 1000 annual probability of river flooding in any year.

The relevant watercourses are tributaries of Dodworth Dike.

The culverted watercourse in Higham Lane is maintained by Barnsley MBC as highway authority. It receives surface water run off from the industrial development as well as the new road north of the railway. Both these discharges are restricted. The diameter is 1050mm and the gradient is relatively steep with an approximate fall of 7m in 200m from opposite the site downstream to Barnsley Road. There was no flooding from this watercourse at or near the site during the June 2007 flood event. It is therefore considered that the risk of flooding of the development from this watercourse is low.

The watercourse passing through the site takes run off from the former colliery waste tip and the development site. It joins the culverted watercourse referred to above at the junction of Higham Lane and Hawthorne Crescent. The culverted section downstream of the development site is approximately 600mm diameter. There was no flooding from this watercourse at the site during the June 2007 flood event. If a blockage occurred in the culverted section downstream of the site, any overflow from the culvert inlet would be routed by existing ground levels between houses in Hawthorne Crescent to Higham Lane and Barnsley Road where it would flow back into the watercourse. It is therefore considered that the risk of flooding of the development from this watercourse is low.

5.3 Existing and Proposed Sewers

The existing foul sewer in Higham Lane is likely to take domestic sewage flows from dwellings on Higham Lane. The gradient of this sewer will be similar to that of the culverted watercourse as described above (7m in 200m). The risk of flooding of the site from this sewer is therefore considered to be very low.

The existing surface water sewer crossing the north east corner of the site joins the culverted watercourse at a manhole in Higham Lane. The next manhole upstream on the sewer will be to the north of the railway and any flooding from that manhole would be directed into Higham Lane and past the development site. The risk of flooding of the site from this sewer is therefore considered to be very low.

Proposed foul sewers within the development site will discharge to the public foul sewer in Higham Lane, as recommended by Yorkshire Water. Sewers will be designed in accordance with Yorkshire Water requirements. The risk of flooding of the site from these sewers is therefore considered to be very low.

Proposed surface water sewers within the development will be designed according to the requirements of Yorkshire Water and will discharge to the 1050mm diameter culverted watercourse in Higham Lane. The discharge rate will be restricted according to the requirements of Barnsley MBC as described below and the system will be designed to retain the 1 in 30 year rainfall event with no surface flooding and the 1 in 100 year (plus a 30% allowance for the effects of future climate change) rainfall event within the development. Care will need to be taken due to the sloping nature of the site that all local drainage systems are set above the predicted 1 in 30

year water level in the system. Providing these requirements are met, the risk of flooding of the site from these sewers is therefore considered to be very low.

5.4 Adjacent Land

Flooding from adjacent land will only be possible from Higham Lane to the east and the railway to the north.

The gradient of Higham Lane is such that any flood water running in the Lane will pass downhill past the site. In addition, the site access road will rise as it enters the site and dwelling floor levels of properties adjacent to Higham Lane will be set above the road level. These proposals will further reduce the risk of flood water entering the site and flooding of dwellings from Higham Lane.

The railway embankment to the north of the site will drain to the existing shallow watercourse running along the northern site boundary. It is proposed that this watercourse is restored and improved to run from the western end of the site to discharge to the watercourse crossing the site and will be kept separate from the surface water sewer system. It will be necessary to inform relevant house owners the purpose of the improved watercourse to reduce the risk of flooding of their properties.

Providing the proposals described above are carried out, it is considered that the risk of flooding of the development from adjacent land will be low.

5.5 Groundwater

As described in previous sections, there is a risk that groundwater probably results in waterlogging of the field in winter months. Although flooding of dwellings is unlikely to result from this waterlogging, it is undesirable to have waterlogging of gardens. It is therefore proposed that a field drainage system should be constructed along the southern boundary of the site. This will provide a discharge for ground water seepage within restored topsoil and reduce the risk of waterlogging. The field drain would discharge to the watercourse crossing the site.

Providing the proposal described above is carried out, the risk of flooding from ground water will be low.

6 Impact on Flood Risk

6.1 General

The proposed development could impact on flood risk as follows:-

- Existing watercourses
- Existing sewer systems
- Adjacent land

6.2 Existing Watercourses

It is proposed to drain the development to the 1050mm diameter culverted watercourse in Higham Lane. The proposed peak discharge rate from the development has been determined in accordance with current legislation and guidance and is based on run off from the existing dwelling area (brownfield) and the grassland to the west (greenfield).

The peak discharge rate has been calculated as follows:-

Greenfield run off = $3\text{l/s/ha} \times 1.15\text{ha} = 3.5\text{l/s}$

Brownfield run off based on 50mm/hr rainfall rate = $2.78 \times 50 \times 322/1000 = 4.5\text{l/s}$ which has been reduced by 30% to give 3.2l/s.

Total proposed peak discharge rate = $3.5 + 3.2 = 6.7\text{l/s}$.

The proposed drainage system is to be designed to ensure there will be no surface flooding in up to the 1 in 30 year rainfall event and that in up to the 1 in 100 year plus 30% climate change allowance rainfall event, surface water will be retained within the development site. This will be attained using oversized pipework within the highway and an underground storage tank as shown on the Drainage Strategy Drawing at Appendix F.

WINDES software has been used to calculate the approximate storage volumes required as follows

- 1 in 1 year rainfall event - 85 cu.m.
- 1 in 30 year rainfall event - 220 cu.m.
- 1 in 100 year + 30% climate change rainfall event - 400 cu.m

The WINDES results are included in Appendix F.

The on site foul and surface water drainage systems will be offered to Yorkshire Water for adoption under Section 104 of the Water Industry Act 1991.

In order to allow access to the development, the existing watercourse crossing the site will be diverted and culverted. The pipe diameter will be no less than the existing culvert at the downstream end of the existing open section.

The use of sustainable drainage systems has been considered. The use of infiltration is ruled out by the low permeability of the sub soils in the area.

The existing shallow watercourse on the northern boundary will be retained and improved as appropriate to ensure it will accommodate any run off from the railway embankment.

The removal of the drainage of the existing field from the watercourse crossing the site will reduce the risk of flooding from that watercourse downstream of the site.

It is therefore considered that the impact of the development on existing watercourses will be low.

6.3 Existing Sewer Systems

Yorkshire Water has stated that foul sewage can be discharged into the 150mm diameter public sewer in Higham Lane. The gradient of this sewer is such that the impact of the development foul sewage discharge will be minimal.

There will be no discharge from the site into the public surface water sewer in the north east corner of the site. There will therefore be no impact on this sewer.

6.4 Adjacent Land

Adjacent land to the south, the back gardens of houses on Hawthorne Crescent, is lower than levels at the boundary of the development site. There is therefore a risk that in extreme flood conditions surface water could flow from the development on to that land. It is therefore recommended that consideration is given to finished levels on the proposed development road system such that surface water on those roads will not readily overflow on to the adjacent land.

There is also a possibility that seepage could occur from the development site on to the adjacent land. It has been recommended above that a field drain is constructed along the southern boundary of the site to intercept this seepage.

Providing these proposals are carried out, the impact of the development on adjacent land will be low.

7 Conclusions

7.1 Flood Risk to the Development

Providing the recommendations are followed, the risks of flooding of the development are considered to be as follows:-

- Rivers and watercourses – low
- Existing and proposed sewers – very low
- Adjacent land – low
- Groundwater - low

7.2 Drainage Impact of the Development

Providing the recommendations are followed, the impact the development will have on existing drainage systems is considered as follows:-

- Existing watercourses – low
- Existing sewer systems - minimal
- Adjacent land – low

7.3 Consents and Approvals Required

The following consents and approvals will be required:-

- Environment Agency – none specifically required but their recommendations should be followed with regard to reduction in pollution risk during construction
- Yorkshire Water – agreement to adopt on site foul and surface water sewer systems including storage and flow restriction as well as connection to the existing foul sewer.
- Barnsley MBC – through the planning process, approval of design of drainage scheme including storm water storage and flow restriction and consent under the Land Drainage Act 1991 to discharge surface water into the watercourse crossing the site.
- Barnsley MBC – consent under the Land Drainage Act 1991 for the access road culvert in the watercourse crossing the site.

8 Recommendations

8.1 Design of Mitigation Works

The following should be carried out in order to minimise flood risk to and from the development:-

- Foul and surface water sewer design should be carried out according to Sewers for Adoption and Yorkshire Water requirements
- Peak surface water discharge to the watercourse in Higham Lane should be based on 3l/s/ha of the greenfield part of the development site plus the existing brownfield run off rate from the existing dwelling and buildings, less 30%
- There should be no increase in overall discharge to the watercourse crossing the site
- The watercourse on the northern boundary should be retained to convey run off from the railway embankment to the watercourse crossing the site
- A field drainage system should be constructed along the southern boundary discharging into the watercourse crossing the site
- The proposed crossing of the development access road of the watercourse crossing the site should be a pipe with a diameter no less than the culvert downstream of the site
- There should be no buildings constructed over or within a distance to be agreed with Yorkshire Water of the existing surface water sewer in the north east corner of the site.
- Levels on the site access road and floor levels of dwellings adjacent to Higham Lane should be set 300mm above the adjacent level of Higham Lane

Appendices

A Site Location Plan

Development Off Higham Lane
Dodworth
Barnsley
2008s3274

Appendix A
Location Plan

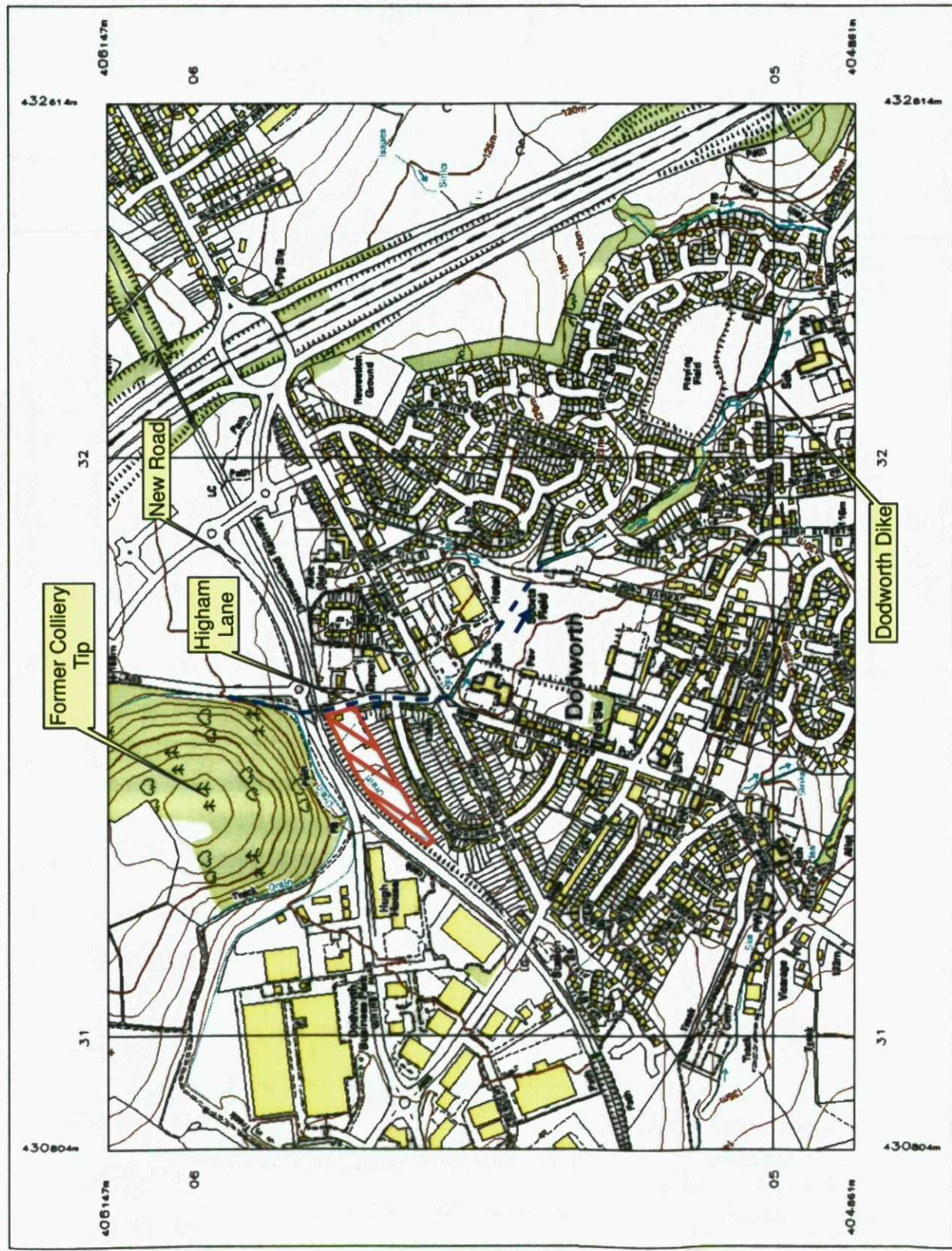
OS Reference 415403

Legend



Development Site

-- -- Culverted Watercourse



B Environment Agency Flood Map

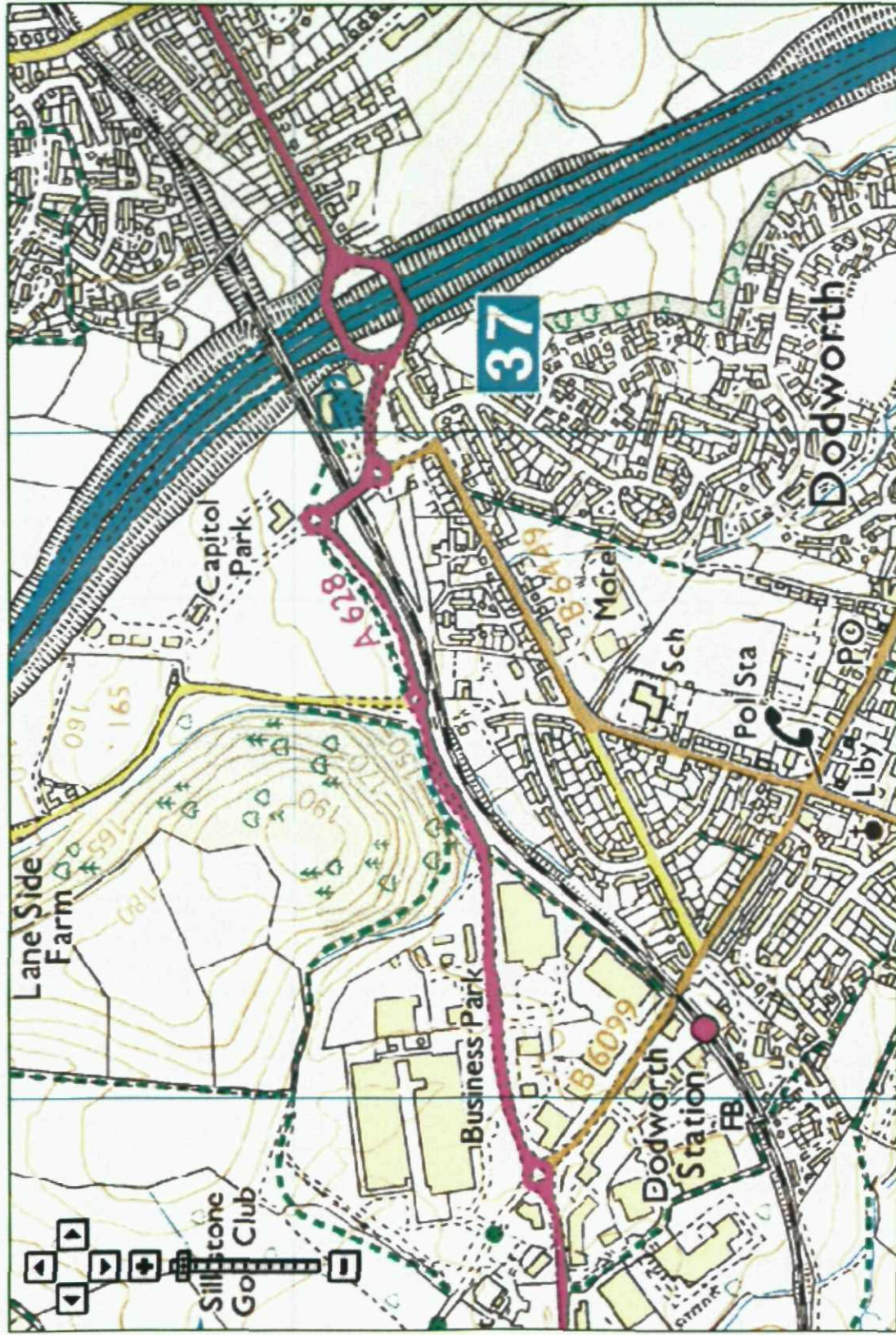
Dodworth, Barnsley at scale 1:10,000

Map legend

Click on the map to see what is the Risk of Flooding at a particular location.

Flood Maps

- Flooding from rivers or sea without defences
- Extent of extreme flood
- Flood defences (Not all may be shown*)
- Areas benefiting from flood defences (Not all may be shown*)
- Main rivers



C Consultation Response



YorkshireWater

16 APR 2007

Encia Group Limited
7 Eggleston Court
Riverside Park
MIDDLESBROUGH
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Yorkshire Water
Waste Water - Sewerage
New Development Team
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LS9 0PJ

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For the attention of Darren Linklater

Email:
Planning.Sewerage@yorkshirewater.co.uk

Your Ref:
Our Ref: H003426 /sew/ndt/peh

For telephone enquiries ring:

Philip Hoffmann on (0113) 235 4148

13th April 2007

Dear Sir,

Land at Higham Lane, Dodworth, Barnsley - Pre-Planning Sewerage Enquiry - Residential Development

Thank you for your enquiry of 29th March 2007. Our charge of £60.00 (plus VAT) will be added to your account with us, reference AIG 025. You will receive an invoice for your account in due course.

Please find enclosed a complimentary extract from the Statutory Sewer Map. This indicates the recorded position of the public sewers. The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site:

There is a 1050mm diameter public surface water sewer recorded crossing the north-east corner of the site. No buildings are to be erected within 4 (four) metres, nor trees planted within 5 (five) metres of this public sewer. It may not be acceptable to raise or lower ground levels over the sewer, nor to restrict access to the manholes on the sewer. If you wish to have this sewer diverted under Section 185 of the Water Industry Act 1991 an application should be made in writing. To discuss this matter, please telephone 0845 124 24 29.

Development of the site should take place with separate systems for foul and surface water drainage. The separate system should extend to the public sewer.

Foul water should discharge to the 150mm diameter public foul sewer recorded in Higham Lane, at a point adjacent to 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.



Where appropriate, soakaways, swales and infiltration trenches (SUDS) may be adopted as part of the public sewer network. For general conditions for the adoption of SUDS please see the attached sheet. Further information may be seen in the DEFRA publication 'Interim Code of Practice for Sustainable Drainage Systems' (ISBN 0-86017-904-4). If the developer is considering adoption of SUDS he should contact our New Development Team at Sheffield on 0845 124 24 29.

The local public sewer network does not have capacity to accept any discharge of surface water from the proposal site. The developer is advised to contact the local Land Drainage Authority with a view to establishing a suitable watercourse for discharge. It is noted that a watercourse is shown crossing the site and it is understood that a culverted watercourse is located in Higham Lane, adjacent to the site. These appear to be the obvious place for surface water disposal.

Off-site foul and surface water sewers may be required which may be provided by the developer and considered for adoption under Section 104 of the Water Industry Act 1991. Please telephone 0845 124 24 29 for advice on sewer adoptions. Alternatively, the developer may in certain circumstances be able to requisition off-site sewers under Section 98 of the Water Industry Act 1991 for which an application must be made in writing. For further information, please telephone 0845 124 24 29.

Prospectively adoptable sewers 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 New Development Team at Sheffield (telephone 0845 124 24 29) 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. Land drainage will not be allowed into a public sewer. Highway drainage, however, may be accepted under certain circumstances; for instance, if SUDS are not a viable option and there is no highway drain available and if capacity is available within the public sewer network. In this event, the developer will be required to enter into a formal agreement with Yorkshire Water Services under Section 115 Water Industry Act 1991 to discharge non-domestic flows into the public sewer network.

Any new connection to an existing public sewer will require the approval of Yorkshire Water. You may obtain an application form by telephoning 0845 124 24 29.

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,



New Development Team

Estire Water

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

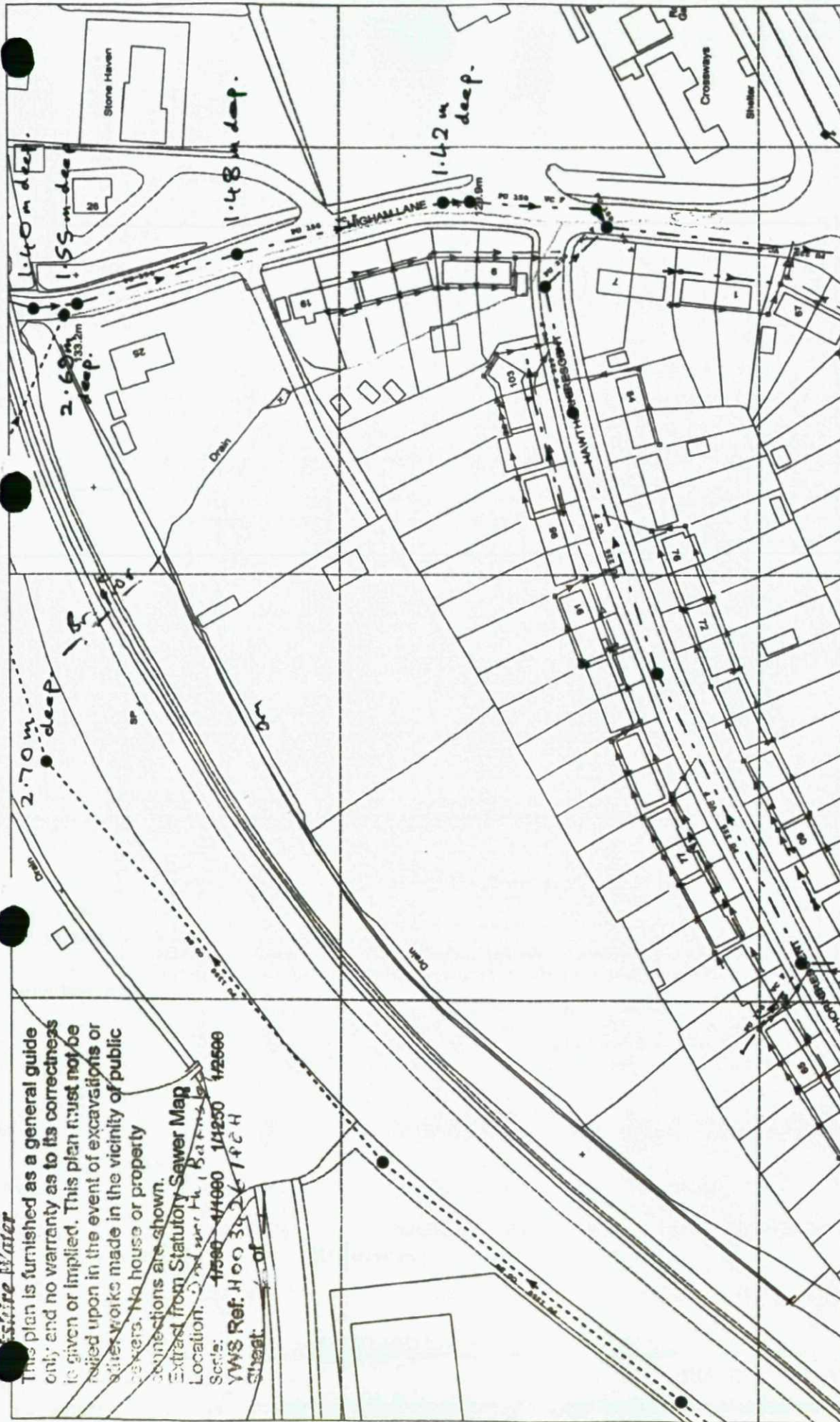
Extract from Statutory Sewer Map

Location: *Stone Haven, Barking*

Scale: 1:500 1:1000 1:1250 1:2500

YWS Ref: H003926 1PCH

Sheet



(Only) Based upon Ordnance Survey maps sold with the permission of the Controller of Her Majesty's Stationery Office. (c) Crown Copyright. License No. WJ000001.

Date Requested: 13/04/2007, 11:43:54

Date Generated: 13/04/2007, 11:44:31

Source:

UPN: Undefined

Originator:

D Site Survey Plan

Benchmark Land Surveys Drawing BM2131/01

E Feasibility Layout Plan

Redrow Homes Drawing 4707-16-02-01 Planning Layout



Lot	Area	Area Type	Area
1	105	105	105
2	104	104	104
3	103	103	103
4	102	102	102
5	101	101	101
6	100	100	100
7	99	99	99
8	98	98	98
9	97	97	97
10	96	96	96
11	95	95	95
12	94	94	94
13	93	93	93
14	92	92	92
15	91	91	91
16	90	90	90
17	89	89	89
18	88	88	88
19	87	87	87
20	86	86	86
21	85	85	85
22	84	84	84
23	83	83	83
24	82	82	82
25	81	81	81
26	80	80	80
27	79	79	79
28	78	78	78
29	77	77	77
30	76	76	76
31	75	75	75
32	74	74	74
33	73	73	73
34	72	72	72
35	71	71	71
36	70	70	70
37	69	69	69
38	68	68	68
39	67	67	67
40	66	66	66
41	65	65	65

Legend

- Existing house with chimney
- Existing house with chimney - to be demolished
- Proposed house with chimney
- Proposed house with chimney - to be demolished
- Existing house to be retained
- Existing house to be demolished

All existing rights to be retained by the owner of the property. The owner of the property shall be responsible for the retention of the property. The owner of the property shall be responsible for the retention of the property.

Lot	Area	Area Type	Area
1	105	105	105
2	104	104	104
3	103	103	103
4	102	102	102
5	101	101	101
6	100	100	100
7	99	99	99
8	98	98	98
9	97	97	97
10	96	96	96
11	95	95	95
12	94	94	94
13	93	93	93
14	92	92	92
15	91	91	91
16	90	90	90
17	89	89	89
18	88	88	88
19	87	87	87
20	86	86	86
21	85	85	85
22	84	84	84
23	83	83	83
24	82	82	82
25	81	81	81
26	80	80	80
27	79	79	79
28	78	78	78
29	77	77	77
30	76	76	76
31	75	75	75
32	74	74	74
33	73	73	73
34	72	72	72
35	71	71	71
36	70	70	70
37	69	69	69
38	68	68	68
39	67	67	67
40	66	66	66
41	65	65	65

Lot	Area	Area Type	Area
1	105	105	105
2	104	104	104
3	103	103	103
4	102	102	102
5	101	101	101
6	100	100	100
7	99	99	99
8	98	98	98
9	97	97	97
10	96	96	96
11	95	95	95
12	94	94	94
13	93	93	93
14	92	92	92
15	91	91	91
16	90	90	90
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28	78	78	78
29	77	77	77
30	76	76	76
31	75	75	75
32	74	74	74
33	73	73	73
34	72	72	72
35	71	71	71
36	70	70	70
37	69	69	69
38	68	68	68
39	67	67	67
40	66	66	66
41	65	65	65

REDROW HOMES

Andrew James Verbiest
 100 Hawthorne Crescent
 Hawthorne NSW 2122
 Tel: 02 9611 1111
 Fax: 02 9611 1112
 Email: info@redrow.com.au

Redrow Homes is a registered company in Australia. The company is registered with the Australian Securities and Investments Commission (ASIC) under the Corporations Act 2001.

F Drainage Strategy

James Eaton Design Drawing 12/569/6019 - Drainage Strategy Plan
Windes Outline Storage Results

1

Design Consultant
Development • Highways • Drainage
Stoneycroft, Bucklebury, Ascot, Wokingham
Reading RG7 7PG.
Tel: 01777 686336 Fax: 01777 629164
e-mail: enquiries@hobbs.co.uk

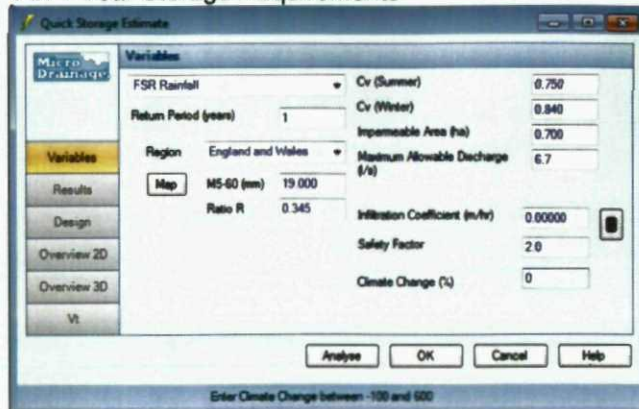
Mr. Higham Lane,
Doodworth, Barnsley.

Date	Seafan	Shipping No.
Sept 2012	1/500	12/569/6019



Project Higham Lane, Dodworth			Status Information			
Date 11/09/2012 By GCL Checked ADC		Job no.		Sheet no. 1		Rev
Rev	Date	Details				
					Tel 01924 822 566 Fax 01924 821 901	
Part Preliminary Quick Storage Estimates						

1 in 1 Year Storage Requirements

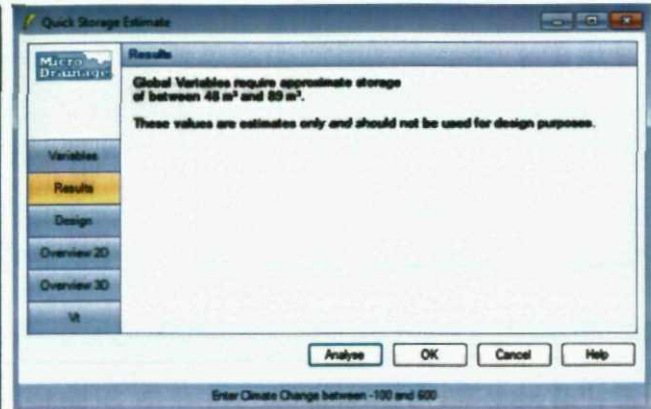


Micro Drainage Quick Storage Estimate - Variables

FSR Rainfall	Cv (Summer)	0.750
Return Period (years)	Cv (Winter)	0.840
Region	Impervious Area (ha)	0.700
Map	Maximum Allowable Discharge (\$/s)	6.7
MS-60 (mm)	Infiltration Coefficient (m/hr)	0.00000
Ratio R	Safety Factor	2.0
0.345	Climate Change (%)	0

Buttons: Analyse, OK, Cancel, Help

Enter Climate Change between -100 and 500



Micro Drainage Quick Storage Estimate - Results

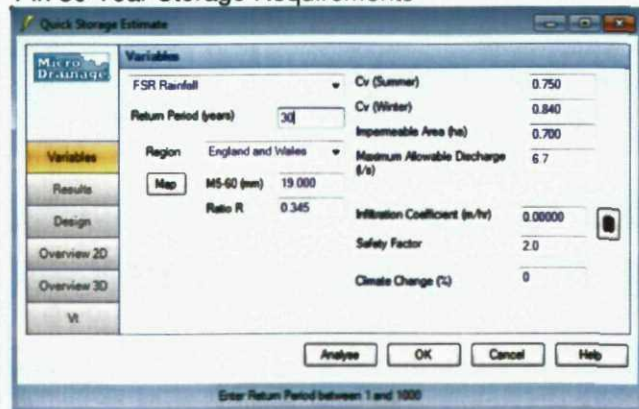
Global Variables require approximate storage of between 48 m³ and 89 m³.

These values are estimates only and should not be used for design purposes.

Buttons: Analyse, OK, Cancel, Help

Enter Climate Change between -100 and 500

1 in 30 Year Storage Requirements

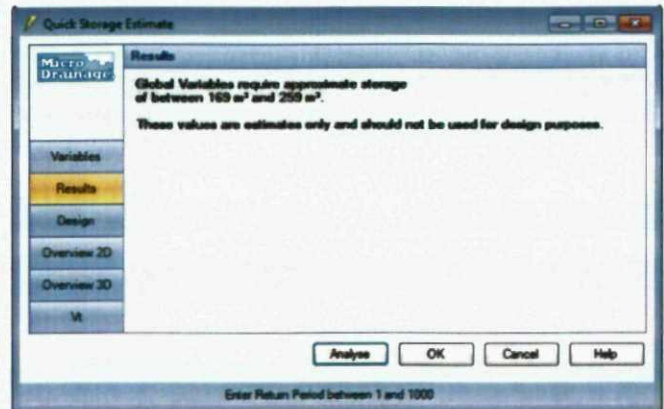


Micro Drainage Quick Storage Estimate - Variables

FSR Rainfall	Cv (Summer)	0.750
Return Period (years)	Cv (Winter)	0.840
Region	Impervious Area (ha)	0.700
Map	Maximum Allowable Discharge (\$/s)	6.7
MS-60 (mm)	Infiltration Coefficient (m/hr)	0.00000
Ratio R	Safety Factor	2.0
0.345	Climate Change (%)	0

Buttons: Analyse, OK, Cancel, Help

Enter Return Period between 1 and 1000



Micro Drainage Quick Storage Estimate - Results

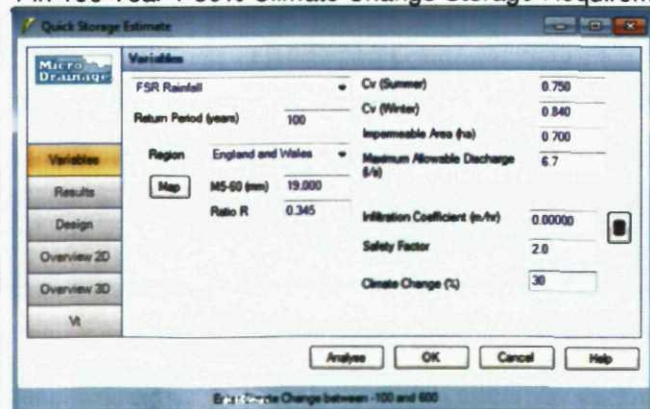
Global Variables require approximate storage of between 169 m³ and 259 m³.

These values are estimates only and should not be used for design purposes.

Buttons: Analyse, OK, Cancel, Help

Enter Return Period between 1 and 1000

1 in 100 Year + 30% Climate Change Storage Requirements

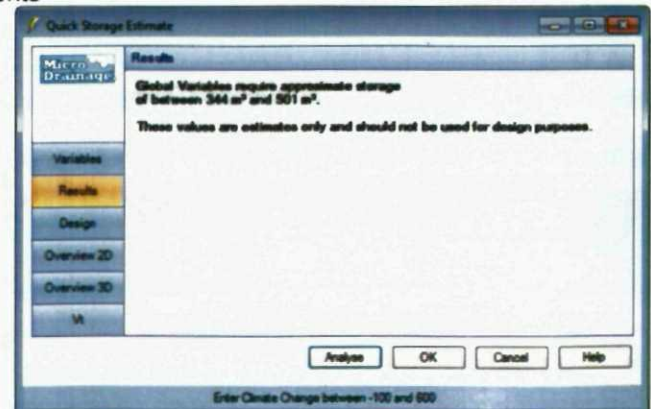


Micro Drainage Quick Storage Estimate - Variables

FSR Rainfall	Cv (Summer)	0.750
Return Period (years)	Cv (Winter)	0.840
Region	Impervious Area (ha)	0.700
Map	Maximum Allowable Discharge (\$/s)	6.7
MS-60 (mm)	Infiltration Coefficient (m/hr)	0.00000
Ratio R	Safety Factor	2.0
0.345	Climate Change (%)	30

Buttons: Analyse, OK, Cancel, Help

Enter Climate Change between -100 and 500



Micro Drainage Quick Storage Estimate - Results

Global Variables require approximate storage of between 364 m³ and 561 m³.

These values are estimates only and should not be used for design purposes.

Buttons: Analyse, OK, Cancel, Help

Enter Climate Change between -100 and 500

Redrow Homes (Yorkshire Ltd)		Page 1
Redrow House	Higham Lane	
Brunel Road	Dodworth	
Wakefield WF2 0XG	SW Drainage Calculations	
Date -	Designed by Gary Little	
File 120911 QSE - 1 Year.srcx	Checked by	
Micro Drainage	Source Control W.12.6	

Summary of Results for 1 year Return Period

Stern Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	130.635	0.135	3.6	34.3	0 K
30 min Summer	130.673	0.173	4.0	44.2	0 K
60 min Summer	130.716	0.216	4.0	55.0	0 K
120 min Summer	130.756	0.256	4.0	65.3	0 K
180 min Summer	130.775	0.275	4.0	70.1	0 K
240 min Summer	130.787	0.287	4.0	73.1	0 K
360 min Summer	130.797	0.297	4.0	75.7	0 K
480 min Summer	130.798	0.298	4.0	76.1	0 K
600 min Summer	130.796	0.296	4.0	75.4	0 K
720 min Summer	130.790	0.290	4.0	74.0	0 K
960 min Summer	130.775	0.275	4.0	70.2	0 K
1440 min Summer	130.738	0.238	4.0	60.6	0 K
2160 min Summer	130.687	0.187	4.0	47.6	0 K
2880 min Summer	130.657	0.157	3.9	40.0	0 K
4320 min Summer	130.627	0.127	3.4	32.5	0 K
5760 min Summer	130.612	0.112	2.9	28.5	0 K
7200 min Summer	130.602	0.102	2.6	26.0	0 K
8640 min Summer	130.595	0.095	2.3	24.1	0 K
10080 min Summer	130.589	0.089	2.1	22.7	0 K
15 min Winter	130.651	0.151	3.8	38.5	0 K
30 min Winter	130.696	0.196	4.0	49.9	0 K
60 min Winter	130.745	0.245	4.0	62.6	0 K
120 min Winter	130.793	0.293	4.0	74.8	0 K
180 min Winter	130.816	0.316	4.0	80.5	0 K
240 min Winter	130.826	0.326	4.0	83.2	0 K

Stern Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	27.977	24
30 min Summer	18.596	37
60 min Summer	12.084	64
120 min Summer	7.712	122
180 min Summer	5.908	164
240 min Summer	4.886	198
360 min Summer	3.711	264
480 min Summer	3.046	334
600 min Summer	2.613	404
720 min Summer	2.306	472
960 min Summer	1.893	608
1440 min Summer	1.435	864
2160 min Summer	1.087	1208
2880 min Summer	0.892	1552
4320 min Summer	0.676	2252
5760 min Summer	0.556	2952
7200 min Summer	0.478	3680
8640 min Summer	0.420	4408
10080 min Summer	0.378	5144
15 min Winter	27.977	24
30 min Winter	18.596	38
60 min Winter	12.084	66
120 min Winter	7.712	122
180 min Winter	5.908	176
240 min Winter	4.886	228

Redrow Homes (Yorkshire Ltd)		Page 2
Redrow House	Higham Lane	
Brunnel Road	Dodworth	
Wakefield WF2 0XG	SW Drainage Calculations	
Date -	Designed by Gary Little	
File 120911 QSE - 1 Year.srcx	Checked by	
Micro Drainage	Source Control W.12.6	

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	130.833	0.333	4.0	85.0	0 K
480 min Winter	130.831	0.331	4.0	84.5	0 K
600 min Winter	130.824	0.324	4.0	82.6	0 K
720 min Winter	130.813	0.313	4.0	79.8	0 K
960 min Winter	130.785	0.285	4.0	72.6	0 K
1440 min Winter	130.717	0.217	4.0	55.4	0 K
2160 min Winter	130.655	0.155	3.9	39.4	0 K
2880 min Winter	130.629	0.129	3.4	32.9	0 K
4320 min Winter	130.605	0.105	2.7	26.9	0 K
5760 min Winter	130.593	0.093	2.3	23.7	0 K
7200 min Winter	130.585	0.085	1.9	21.6	0 K
8640 min Winter	130.579	0.079	1.7	20.1	0 K
10080 min Winter	130.574	0.074	1.5	19.0	0 K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
360 min Winter	3.711	284
480 min Winter	3.046	362
600 min Winter	2.613	440
720 min Winter	2.306	514
960 min Winter	1.893	660
1440 min Winter	1.435	904
2160 min Winter	1.087	1220
2880 min Winter	0.892	1560
4320 min Winter	0.676	2256
5760 min Winter	0.556	3000
7200 min Winter	0.478	3688
8640 min Winter	0.420	4416
10080 min Winter	0.378	5152

Higham Lane
Dodworth
SW Drainage Calculations



Designed by Gary Little
Checked by

Source Control W.12.6

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.345	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Total Area (ha) 0.700

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.233	4-8	0.233	8-12	0.233

Redrow Homes (Yorkshire Ltd)		Page 4
Redrow House	Higham Lane	
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Wakefield WF2 0XG	SW Drainage Calculations	
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Micro Drainage	Source Control W.12.6	

Model Details

Storage is Online Cover Level (m) 133.000

Tank or Pond Structure

Invert Level (m) 130.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	255.0	0.700	255.0	1.400	255.0	2.100	0.0
0.100	255.0	0.800	255.0	1.500	255.0	2.200	0.0
0.200	255.0	0.900	255.0	1.600	0.0	2.300	0.0
0.300	255.0	1.000	255.0	1.700	0.0	2.400	0.0
0.400	255.0	1.100	255.0	1.800	0.0	2.500	0.0
0.500	255.0	1.200	255.0	1.900	0.0		
0.600	255.0	1.300	255.0	2.000	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.500 Hydro-Brake® Type Md4 Invert Level (m) 130.500
Design Flow (l/s) 6.7 Diameter (mm) 83

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.5	1.200	5.9	3.000	9.3	7.000	14.2
0.200	3.9	1.400	6.4	3.500	10.0	7.500	14.7
0.300	3.3	1.600	6.8	4.000	10.7	8.000	15.2
0.400	3.4	1.800	7.2	4.500	11.4	8.500	15.7
0.500	3.8	2.000	7.6	5.000	12.0	9.000	16.1
0.600	4.2	2.200	8.0	5.500	12.6	9.500	16.5
0.800	4.8	2.400	8.3	6.000	13.1		
1.000	5.4	2.600	8.7	6.500	13.7		

Redrow Homes (Yorkshire Ltd)		Page 1
Redrow House	Higham Lane	
Brunnel Road	Dodworth	
Wakefield WF2 0XG	SW Drainage Calculations	
Date -	Designed by Gary Little	
File 120911 QSE - 30 Year.srcx	Checked by	
Micro Drainage	Source Control W.12.6	

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	130.839	0.339	4.0	86.5	0 K
30 min Summer	130.949	0.449	4.0	114.4	0 K
60 min Summer	131.060	0.560	4.0	142.8	0 K
120 min Summer	131.162	0.662	4.4	168.7	0 K
180 min Summer	131.207	0.707	4.5	180.3	0 K
240 min Summer	131.228	0.728	4.6	185.6	0 K
360 min Summer	131.239	0.739	4.6	188.5	0 K
480 min Summer	131.242	0.742	4.6	189.1	0 K
600 min Summer	131.239	0.739	4.6	188.3	0 K
720 min Summer	131.232	0.732	4.6	186.7	0 K
960 min Summer	131.214	0.714	4.5	182.0	0 K
1440 min Summer	131.168	0.668	4.4	170.3	0 K
2160 min Summer	131.097	0.597	4.1	152.3	0 K
2880 min Summer	131.032	0.532	4.0	135.6	0 K
4320 min Summer	130.914	0.414	4.0	105.6	0 K
5760 min Summer	130.800	0.300	4.0	76.4	0 K
7200 min Summer	130.691	0.191	4.0	48.6	0 K
8640 min Summer	130.653	0.153	3.9	39.0	0 K
10080 min Summer	130.635	0.135	3.6	34.5	0 K
15 min Winter	130.881	0.381	4.0	97.2	0 K
30 min Winter	131.004	0.504	4.0	128.5	0 K
60 min Winter	131.130	0.630	4.3	160.7	0 K
120 min Winter	131.248	0.748	4.6	190.7	0 K
180 min Winter	131.303	0.803	4.8	204.8	0 K
240 min Winter	131.330	0.830	4.9	211.7	0 K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	68.502	26
30 min Summer	45.713	40
60 min Summer	29.238	68
120 min Summer	18.156	126
180 min Summer	13.585	184
240 min Summer	11.001	242
360 min Summer	8.154	318
480 min Summer	6.589	382
600 min Summer	5.582	444
720 min Summer	4.872	512
960 min Summer	3.928	652
1440 min Summer	2.896	928
2160 min Summer	2.132	1340
2880 min Summer	1.714	1736
4320 min Summer	1.259	2516
5760 min Summer	1.010	3288
7200 min Summer	0.852	3824
8640 min Summer	0.741	4488
10080 min Summer	0.659	5152
15 min Winter	68.502	26
30 min Winter	45.713	40
60 min Winter	29.238	68
120 min Winter	18.156	124
180 min Winter	13.585	180
240 min Winter	11.001	236

Redrow Homes (Yorkshire Ltd)		Page 2
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Wakefield WF2 0XG	SW Drainage Calculations	
Date -	Designed by Gary Little	
File 120911 QSE - 30 Year.srcx	Checked by	
Micro Drainage	Source Control W.12.6	

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	131.349	0.849	4.9	216.4	0 K
480 min Winter	131.346	0.846	4.9	215.8	0 K
600 min Winter	131.342	0.842	4.9	214.7	0 K
720 min Winter	131.332	0.832	4.9	212.3	0 K
960 min Winter	131.304	0.804	4.8	205.0	0 K
1440 min Winter	131.233	0.733	4.6	187.0	0 K
2160 min Winter	131.126	0.626	4.2	159.7	0 K
2880 min Winter	131.028	0.528	4.0	134.7	0 K
4320 min Winter	130.842	0.342	4.0	87.2	0 K
5760 min Winter	130.661	0.161	3.9	41.1	0 K
7200 min Winter	130.629	0.129	3.4	33.0	0 K
8640 min Winter	130.615	0.115	3.0	29.2	0 K
10080 min Winter	130.605	0.105	2.7	26.8	0 K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
360 min Winter	8.154	344
480 min Winter	6.589	398
600 min Winter	5.582	470
720 min Winter	4.672	548
960 min Winter	3.928	702
1440 min Winter	2.896	1002
2160 min Winter	2.132	1436
2880 min Winter	1.714	1856
4320 min Winter	1.259	2688
5760 min Winter	1.010	3112
7200 min Winter	0.852	3752
8640 min Winter	0.741	4416
10080 min Winter	0.659	5144

Redrow Homes (Yorkshire Ltd)		Page 3
Redrow House	Higham Lane	
Brunnel Road	Dodworth	
Wakefield WF2 0XG	SW Drainage Calculations	
Date -	Designed by Gary Little	
File 120911 QSE - 30 Year.srx	Checked by	
Micro Drainage	Source Control W.12.6	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.345	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time / Area Diagram

Total Area (ha) 0.700

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.233	4-8	0.233	8-12	0.233

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Brunnel Road	Dodworth	
Wakefield WF2 0XG	SW Drainage Calculations	
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Micro Drainage	Source Control W.12.6	

Model Details

Storage is Online Cover Level (m) 133.000

Tank or Pond Structure

Invert Level (m) 130.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	255.0	0.700	255.0	1.400	255.0	2.100	0.0
0.100	255.0	0.800	255.0	1.500	255.0	2.200	0.0
0.200	255.0	0.900	255.0	1.600	0.0	2.300	0.0
0.300	255.0	1.000	255.0	1.700	0.0	2.400	0.0
0.400	255.0	1.100	255.0	1.800	0.0	2.500	0.0
0.500	255.0	1.200	255.0	1.900	0.0		
0.600	255.0	1.300	255.0	2.000	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.500 Hydro-Brake® Type Md4 Invert Level (m) 130.500
Design Flow (l/s) 6.7 Diameter (mm) 83

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.5	1.200	5.9	3.000	9.3	7.000	14.2
0.200	3.9	1.400	6.4	3.500	10.0	7.500	14.7
0.300	3.3	1.600	6.8	4.000	10.7	8.000	15.2
0.400	3.4	1.800	7.2	4.500	11.4	8.500	15.7
0.500	3.8	2.000	7.6	5.000	12.0	9.000	16.1
0.600	4.2	2.200	8.0	5.500	12.6	9.500	16.5
0.800	4.8	2.400	8.3	6.000	13.1		
1.000	5.4	2.600	8.7	6.500	13.7		

Redrow Homes (Yorkshire Ltd)			Page 1			
Redrow House		Higham Lane				
Brunnel Road		Dodworth				
Wakefield WF2 0XG		SW Drainage Calculations				
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File 120911 QSE - 100 Year.srcx		Checked by				
Micro Drainage		Source Control W.12.6				
<u>Summary of Results for 100 year Return Period (+30%)</u>						
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status	
15 min Summer	131.076	0.576	4.1	147.0	0 K	
30 min Summer	131.270	0.770	4.7	196.5	0 K	
60 min Summer	131.472	0.972	5.3	247.9	0 K	
120 min Summer	131.662	1.162	5.8	296.4	0 K	
180 min Summer	131.752	1.252	6.0	319.4	0 K	
240 min Summer	131.798	1.298	6.1	330.9	0 K	
360 min Summer	131.833	1.333	6.2	339.9	0 K	
480 min Summer	131.838	1.338	6.2	341.1	0 K	
600 min Summer	131.835	1.335	6.2	340.5	0 K	
720 min Summer	131.828	1.328	6.2	338.6	0 K	
960 min Summer	131.804	1.304	6.1	332.6	0 K	
1440 min Summer	131.741	1.241	6.0	316.4	0 K	
2160 min Summer	131.642	1.142	5.7	291.1	0 K	
2880 min Summer	131.549	1.049	5.5	267.4	0 K	
4320 min Summer	131.386	0.886	5.1	225.9	0 K	
5760 min Summer	131.250	0.750	4.6	191.3	0 K	
7200 min Summer	131.136	0.636	4.3	162.3	0 K	
8640 min Summer	131.041	0.541	4.0	137.9	0 K	
10080 min Summer	130.957	0.457	4.0	116.4	0 K	
15 min Winter	131.147	0.647	4.3	164.9	0 K	
30 min Winter	131.365	0.865	5.0	220.6	0 K	
60 min Winter	131.594	1.094	5.6	278.9	0 K	
120 min Winter	131.812	1.312	6.1	334.7	0 K	
180 min Winter	131.919	1.419	6.4	362.0	0 K	
240 min Winter	131.976	1.476	6.5	376.3	0 K	
Storm Event	Rain (mm/hr)		Time-Peak (mins)			
15 min Summer	115.149		26			
30 min Summer	77.603		41			
60 min Summer	49.937		70			
120 min Summer	31.030		128			
180 min Summer	23.141		186			
240 min Summer	18.655		244			
360 min Summer	13.733		360			
480 min Summer	11.045		424			
600 min Summer	9.320		486			
720 min Summer	8.108		550			
960 min Summer	6.502		682			
1440 min Summer	4.754		958			
2160 min Summer	3.468		1368			
2880 min Summer	2.769		1772			
4320 min Summer	2.013		2560			
5760 min Summer	1.603		3344			
7200 min Summer	1.343		4112			
8640 min Summer	1.163		4848			
10080 min Summer	1.030		5648			
15 min Winter	115.149		26			
30 min Winter	77.603		40			
60 min Winter	49.937		68			
120 min Winter	31.030		126			
180 min Winter	23.141		182			
240 min Winter	18.655		240			
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Micro Drainage	Source Control W.12.6	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	132.033	1.533	6.6	389.5	0 K
480 min Winter	132.053	1.553	6.7	392.5	0 K
600 min Winter	132.036	1.536	6.7	390.1	0 K
720 min Winter	132.023	1.523	6.6	387.7	0 K
960 min Winter	131.990	1.490	6.6	380.0	0 K
1440 min Winter	131.899	1.399	6.4	356.8	0 K
2160 min Winter	131.751	1.251	6.0	319.0	0 K
2880 min Winter	131.614	1.114	5.7	283.9	0 K
4320 min Winter	131.383	0.883	5.0	225.1	0 K
5760 min Winter	131.200	0.700	4.5	178.5	0 K
7200 min Winter	131.051	0.551	4.0	140.4	0 K
8640 min Winter	130.913	0.413	4.0	105.2	0 K
10080 min Winter	130.688	0.188	4.0	47.9	0 K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
360 min Winter	13.733	352
480 min Winter	11.045	458
600 min Winter	9.320	550
720 min Winter	8.108	574
960 min Winter	6.502	728
1440 min Winter	4.754	1034
2160 min Winter	3.468	1476
2880 min Winter	2.769	1904
4320 min Winter	2.013	2728
5760 min Winter	1.603	3520
7200 min Winter	1.343	4328
8640 min Winter	1.163	5192
10080 min Winter	1.030	5456

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File 120911 QSE - 100 Year.srx	Checked by	
Micro Drainage	Source Control W.12.6	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.345	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

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Total Area (ha) 0.700

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Model Details

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Tank or Pond Structure

Invert Level (m) 130.500

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0.100	255.0	0.800	255.0	1.500	255.0	2.200	0.0
0.200	255.0	0.900	255.0	1.600	0.0	2.300	0.0
0.300	255.0	1.000	255.0	1.700	0.0	2.400	0.0
0.400	255.0	1.100	255.0	1.800	0.0	2.500	0.0
0.500	255.0	1.200	255.0	1.900	0.0		
0.600	255.0	1.300	255.0	2.000	0.0		

Hydro-Brake® Outflow Control

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0.400	3.4	1.800	7.2	4.500	11.4	8.500	15.7
0.500	3.8	2.000	7.6	5.000	12.0	9.000	16.1
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0.800	4.8	2.400	8.3	6.000	13.1		
1.000	5.4	2.600	8.7	6.500	13.7		

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