



**FLOOD RISK ASSESSMENT
AT
TOWN STREET/OSSETT LANE
EARLSHEATON, DEWSBURY**



**ON BEHALF OF
VFM COATINGS**

MAY 2017 (Initial Issue)

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CHARTERED CONSULTING ENGINEERS

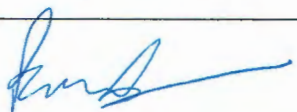
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Flood Risk Assessment at Town Street/Ossett Lane, Earlsheaton, Dewsbury

800/540r1

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1.0 INTRODUCTION

- 1.1 VFM Coatings is proposing to develop a parcel of land at the junction of Town Street and Ossett Lane, Earlsheaton, Dewsbury for residential development. As part of the Planning Application, a Flood Risk Assessment Report is required.
- 1.2 It is within the general development strategy of the country for development in areas where there is a risk of flooding to be assessed to avoid unnecessary increase in the requirement for flood defence. Under the National Planning Policy Framework (NPPF) and the new Planning Practice Guidance (PPG), consultation is required with the Environment Agency, Land Drainage Authority and Water Authority and a Flood Risk Assessment Report should be prepared considering the development proposals and make recommendations for any flood mitigation measures.
- 1.3 ARP Associates have been appointed by to carry out an assessment of the site, implement appropriate consultations and prepare a Flood Risk Assessment Report, in accordance with NPPF, to satisfy the requirements of the Planning Authority.
- 1.4 The consultations and walkover survey were undertaken in April and May 2017.
- 1.5 The report has been initially prepared for the use and reliance of the Client only. The report shall not be relied upon or transferred to any other parties without the written agreement of ARP Associates. For the avoidance of any doubt, where ARP Associates enters into a letter of reliance for the benefit of a third party, that third party will be permitted to rely on the report. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party without ARP Associates consent.



2.0 WALKOVER SURVEY

General

- 2.1 The proposed site is an irregular shaped piece of land equating to an area of approximately 0.55ha and is situated in the settlement of Earlsheaton, near Dewsbury. The site is centred on Ordnance Survey Grid Reference SE 257 211.
- 2.2 A site location plan is presented in Appendix A.

Current Use

- 2.3 The site is presently brownfield, occupied by a commercial building previously used in manufacturing of steel components.

Site Features and Boundaries

- 2.4 The site is located in a densely populated area of both residential and commercial properties, and abuts Town Street to the north and Ossett Lane to the east. To the south, there are existing residential properties, flats and associated gardens. The western boundary is formed by a large grassed garden with the flats of Chatsworth Court and further houses beyond.

Topography and Vegetation

- 2.5 The site has a prominent slope in a southeasterly direction with levels falling from Town Street at an average of approximately 91m A.O.D. to 89.2m A.O.D. along the southern boundary. The lowest level is in the southeastern corner that is 88.70m A.O.D. A small highway retaining wall is located along the northern boundary which is approximately 1m in height.
- 2.6 A topographical survey is presented Appendix B.



- 2.7 No vegetation is present on the site itself with several trees located along the boundaries in the adjacent properties. Land cover over the site is a bituminous surfaced covered car parking and disused commercial buildings.

Drainage

- 2.8 The existing site has evidence of a positive drainage system with rainwater downpipes discharging to an underground drainage system most likely connected into the adjacent public sewer network which is located to the east of the site. Any surface water run-off falling onto the site that is not intercepted by gullies would follow the topography of the site and drain in a southwest direction and outfall into the highway gullies located in Ossett Lane.
- 2.9 No open watercourses are located within the immediate vicinity of the site and the nearest watercourse is Chickenley Beck located approximately 220m south at its nearest location.



3.0 ENVIRONMENT AGENCY CONSULTATION

- 3.1 A consultation was requested from the Environment Agency and a copy of the response, reference RFI/2017/43727 dated 3rd May 2017, is presented in Appendix C for reference.
- 3.2 The Environment Agency has provided a Flood Map, which shows areas of land that could flood from rivers or the sea and are shaded blue. These areas do not take into account flood defences as water can overtop or fail in extreme conditions. The Zone classifications are:-
- 3.2.1 Flood Zone 1 - 'Low Probability' is assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (less than 0.1%).
- 3.2.2 Flood Zone 2 - 'Medium Probability' is assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding in any year (1% - 0.1%) and between a 1 in 200 and 1 in 1,000 annual probability of flooding from the sea (0.5% - 0.1%).
- 3.2.3 Flood Zone 3 - 'High Probability' is assessed as having a 1 in 100 or greater annual probability of river flooding in any year (greater than 1%) and a 1 in 200 chance or greater annual probability of flooding from the sea (less than 0.5%).
- 3.3 The Environment Agency Flood Map for planning shows the site is located entirely within Flood Zone 1 and therefore has a low risk of fluvial flooding.
- 3.4 The Environment Agency website provides a Flood Map for surface water, which shows areas where surface water only would be expected to flow or pond in England and Wales. All land in England and Wales will be one of a possible four categories. The four categories shown on the map are:-



- 3.4.1 High - This area has a chance of flooding greater than 1 in 30 in any given year (annual probability of flooding 3.3%).
- 3.4.2 Medium - This area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%) in any given year.
- 3.4.3 Low - This area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) in any given year.
- 3.4.4 Very low - This area has a chance of flooding of less than 1 in 1000 (0.1%) in any given year.
- 3.5 Although minor flow routes are shown to exist immediately north of the site on Town Street, the site itself is entirely within a very low risk area of surface water flooding with the flow route going west and down Chatsworth Terrace.
- 3.6 The Environment Agency confirmed that, to the best of their knowledge, there is no known flood history for the site. A Flood History Map has been provided, which shows recorded flood levels from December 2015 floods adjacent to the River Calder. The maximum recorded level was 36.357m A.O.D.
- 3.7 Flood defence asset location information for flood defences adjacent to the River Calder have also been provided.
- 3.8 No information has been provided relating to restrictions on surface water run-off, but this should be set to the existing brownfield 1 in 1 year run-off rate from the site, less 30% to meet planning requirements.



4.0 WATER AUTHORITY CONSULTATION

- 4.1 A consultation was requested from Yorkshire Water, who is the Water Authority for this area, and a copy of their response, reference T005636 or R535863 dated 12th April 2017, is presented in Appendix D for reference purposes.
- 4.2 Due to the change in legislation on the 1st October 2011, there may be public services within the site boundary which are not recorded on the statutory sewer map, the presence of which shall be taken into account of the scheme.
- 4.3 The Yorkshire Water consultation states that there is a 225mm diameter public combined sewer recorded crossing the site. No buildings or other obstructions are to be erected within 3 (three) metres nor trees planted within 5 (five) metres of the 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 the sewer needs to be diverted under Section 185 of the Water Industry Act 1981 an application needs to be made in writing.
- 4.4 Development of the site should take place with separate systems for foul and surface water drainage. The separate system should extend to the points of discharge to be agreed.
- 4.5 Foul water domestic waste should discharge to the 225mm diameter public combined sewer recorded through the site.
- 4.6 In respect of surface water, reference is made to Requirement H3 of Building Regulations 2000 and Sustainable Drainage Systems. This establishes a hierarchy of surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order, before connection to sewer will be considered. Where appropriate, soakaways, swales and infiltration trenches (SuDS) may be adopted as part of the public sewer network.



- 4.7 If other methods of surface water disposal are not viable and, subject to providing satisfactory evidence as to why they have been discounted, curtilage surface water discharges to the public sewer will be restricted to the level of run-off i.e. same rate of discharge to that from the existing use of the site less a 30% reduction in the existing discharge. Any discharge of surface water from the site should discharge to similar points of connection to that of the existing use of site. The design will need to demonstrate positive drainage based on a 1 in 1 year storm, to the public sewer to Yorkshire Water by means of investigation and calculation carried out at the Developer's expense. To do this, Yorkshire Water requires to see existing and proposed drainage layouts with pipe sizes, gradients and connection points. Measured impermeable areas of the present and proposed use of the site, along with the calculations that show the existing and proposed discharge rate from the site to the public sewer.
- 4.8 The public sewer network is for domestic sewage purposes, this generally means foul water for domestic purposes and, where a suitable surface of combined sewers is available, surface water from the roofs of buildings, together with surface water from paved areas of land pertinent to those buildings. Land and highway drainage have no right of connection to the public sewer network. No land drainage is to be connected/discharged to public sewer.
- 4.9 As a last resort, highway drainage may be accepted under certain circumstances. If it can be demonstrated through satisfactory evidence that SuDS are not a viable option, that there are no watercourses or highway drains available and if capacity is available within a public sewer network, highway drainage discharges to the public sewer network may be connected.



5.0 LAND DRAINAGE AUTHORITY CONSULTATION

- 5.1 A consultation was requested from Wakefield Metropolitan District Council who are the Local Lead Flood Authority for this area but, at the time of writing this report, a response was still to be received.
- 5.2 However, it is anticipated that the Authority will confirm that the site falls within Flood Zone 1 and surface water discharge should be restricted to the existing rate of run-off less 30% to meet the requirements of planning.



6.0 MATERIAL CONSIDERATION IN RESPECT OF NPPF AND PPG

Flood Classification

- 6.1 The Environment Agency mapping confirms that the existing site falls within Flood Zone 1, which is land assessed as having a less than a 0.1% annual probability of flooding from Environment Agency main rivers. The proposed development site is, therefore, situated wholly within a "low risk" area of fluvial flooding.

End Use

- 6.2 The development proposal is for the construction of residential development on site. A proposed development site plan is included in Appendix E.
- 6.3 When applying Table 2 of the PPG, the flood risk vulnerability classification shows that the proposed end use will fall into a "*More Vulnerable*" classification under the general classification "*dwelling*s". With reference to NPPF, the citing of More Vulnerable development within Flood Zone 1 is deemed appropriate and the Sequential Test is satisfied.

Flood Sources

- 6.4 Flooding from Rivers - There are no rivers maintained by the Environment Agency within the immediate vicinity of the site and an assessment of the Flood Map for Planning confirms that the site is located in Flood Zone 1. Therefore, the fluvial flood risk from the Environment Agency main rivers is considered to be low.
- 6.5 Flooding from Local Watercourses - The nearest open watercourse to the site is Chickenley Beck, situated approximately 220m south of the site boundary at its nearest location. This watercourse presents no fluvial flood risk to the site, due to the topography of the land and distance from the east.



- 6.6 Flooding from Land - The Environment Agency on-line surface water Flood Map shows a very low surface water risk across the entire site. A thin swathe of low risk surface water flooding affects Town Lane to the north. The risk of surface water flooding to the site is considered to be low.
- 6.7 Whilst no surface water flow paths are present through the development and the risk of surface water flooding is low, overland flows onto the site will still need to be considered during the development stage.
- 6.8 Flooding from Groundwater - ARP Geotechnical Ltd are in the process of undertaking an intrusive geotechnical investigation, but, at the time of writing this report, this was still to be received. However, ARP Geotechnical Ltd have received an Envirocheck Report, which details BGS groundwater flooding susceptibility. The report states that there is limited potential for groundwater flooding to occur at the site. The nearest location, which has potential for groundwater flooding or properties situated below ground level, is at a distance of 93m from the site. The Calder Catchment SFRA has investigated groundwater flooding in the Wakefield area. This shows that "the risk of groundwater flooding is high in parts of Wolley, southern Wakefield, Altofts, Castleford and Knottingley, though the risk on the whole is minimal across the district. There could be, however, localised problems in other areas, which are not identified on this strategic map. Wakefield Council has not specified any significant issues associated with groundwater flooding", and the area of Earlsheaton is not shown to be within an area of risk of groundwater emergence. Based on the above, and the topography of the surrounding area, the risk of groundwater flooding to the site is considered to be low risk.
- 6.9 Flooding from Sewer - Yorkshire Water records indicate existing public sewers present within the adjacent highways. A new drainage system will also be introduced for residential development on the site and it is possible, therefore, that any blockage of the existing or proposed sewers could result in flooding from the lowest cover level of manholes or gullies. This would need to be considered as part of any proposed development.



- 6.10 Flooding from Reservoirs, Canals or Artificial Sources - The Environment Agency produce maps, which show the expected inundation area should a reservoir fail and release its capacity. It should be noted, however, that reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925.
- 6.11 The proposed development site is outside of any area affected by reservoir flooding. There are no canals within the vicinity of the proposed development site. Therefore, risk from this source is considered to be low.

Climate Change

- 6.12 The NPPF and PPG have indicated that the Global sea level will continue to rise, depending on greenhouse gas emissions, and the sensitivity of the climate system and there will be an increase in rainfall across the country.
- 6.13 Due to the topography of the land and surrounding area, overland run-off from land north of the site may be an issue. Therefore, any run-off from outside the site would need to be considered in respect of climate change. However, an appropriate solution to this is to deal with any overland run-off from third party land at the site boundary. On this basis, only rainfall falling within the site boundaries needs to be considered in respect of climate change
- 6.14 In accordance with PPG, the published figures show that for an expected life of greater than 50 years of any development, the anticipated increase in rainfall would be around 40% and the drainage system should be designed in accordance with this. In terms of impact of climate change or fluvial flows of up to a maximum of 50% uplift applicable to the River Humber basin district, the site is well outside of the Environment Agency flood zones and a significant distance from Chickenley Beck. Therefore, the development properties are unlikely to be affected by the increase of flood extents due to long-term climate change.



Flood Mitigation

6.15 The site is shown as being situated entirely within Flood Zone 1. Therefore, flood mitigation measures are only required in the event of a catastrophic storm, overland run-off or blockage of the existing or proposed drainage system. The following precautionary mitigation measures are therefore, recommended:-

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

6.15.2 Properties shall be designed without any basements and ground floors shall be constructed with solid concrete or beam and block with screed construction.

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

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

6.15.5 In the event of flooding of the site from overland run-off from land to the north, it will be necessary to ensure there is a route for floodwater through the site without causing flood of buildings.

Sustainable Drainage

6.16 In order to comply with the requirements of NPPF, it will be necessary to consider aspects of Sustainable Drainage techniques for new development. Whilst no intrusive ground investigation has been undertaken to date, the Soilscales Research website indicates that soils types in this area are loamey and clayey with impeded drainage. Therefore, the site may not be suitable for infiltration based techniques for disposal of surface water. It will be necessary to carry out appropriate infiltration tests in accordance with BRE Digest 365, but for the purposes of this report, it is assumed that soakaways will not be practical on this site.



Existing Surface Water Run-Off

- 6.17 The site is a currently brownfield and, therefore, in accordance with current Guidelines and Regulations, indicative existing surface water run-off calculations have been undertaken using the Modified Rational Method of calculating run-off rates. The existing site has been assessed to be 100% impermeable and has an approximate area of 0.05ha, this assumption is subject to further drainage investigation. The average rainfall intensity for the 1 in 1 year storm is estimated to be 50mm/hr. Using the Rational Method, applying an area of 0.05ha (A) and assuming an average rainfall intensity (i) of 50mm/hr existing run-off from the impermeable area of the site is estimated as shown below:-

$$Q = 2.78 \times C : A$$

$$Q = 2.78 \times 0.055 \times 50$$

$$Q = 7.65\text{l/s}$$

- 6.18 A reduction of 30% to comply with current guidance would result in a proposed discharge rate of 5.4l/s. This would be subject to a CCTV/connectivity survey and agreement with both Yorkshire Water and the Lead Local Flood Authority.

Proposed Surface Water Drainage

- 6.19 Consideration for the proposed drainage should firstly be given to infiltration techniques (to ground). However, based on information available, disposal of surface water using infiltration techniques is unlikely to be feasible on site. It will be necessary to carry out appropriate infiltration tests in accordance with BRE Digest 365 'Soakaway Design' prior to construction on site and the results presented in a report for the approval of the Planning Authority. However, for the purpose of this report, a positive drainage system to sewer will be required for surface water drainage.



- 6.20 The proposed layout has been assessed as having an impermeable area of approximately 50% of the site area for semi-detached and detached properties. Indicative calculations have been carried out using the WinDES Source Control Computer Program. The proposed surface water system should be designed to accommodate the 1 in 30 year storm event without flooding and the 1 in 100 year storm plus climate change event should be retained within the site in an area which will not affect the new buildings or third parties from flooding.
- 6.21 Restricting the discharge rate to no greater than 5.4l/s, on-site storage of 4.8m³ will need to be provided for a 1 in 30 year storm. The drainage system will also need to accommodate the 1 in 100 year storm plus 40% climate change event without causing flooding of property of third party land. In the event that levels dictate that the 1 in 100 year plus climate change flood water would flow off-site, an additional or larger storage will be required. In these circumstances, on-site storage could increase to 12m³. This can be achieved by several methods including oversize pipes or underground tanks. However, this will need to be assessed in more detail as part of the drainage strategy for the site. The indicative surface water calculations are presented in Appendix F. However, detailed calculations and proposals will need to be prepared and submitted to the Planning Authority for approval prior to construction.

Proposed Foul Water Drainage

- 6.22 Foul water domestic waste should discharge to the 225mm diameter public combined sewer recorded through the site.

Emergency Egress During Times of Flood

- 6.23 It is a requirement under the PPG that occupants should be able to egress any building during times of flood, without being trapped by flood conditions.
- 6.24 As the site falls within Flood Zone 1, no special mitigation measures are required for emergency egress during times of flood.



7.0 COMMENTS

7.1 The site is located in Flood Zone 1 and the Sequential Test is deemed satisfied. However, in order to accommodate the possibility of flooding from a catastrophic storm, overland run-off or blockage of the existing or proposed drainage systems, the following precautionary flood mitigation measures are required:-

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

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

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

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

7.1.5 In the event of flooding of the site from overland run-off from land the north, it will be necessary to ensure there is a route for floodwater through the site without causing flood of buildings.

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

7.3 Sustainable Drainage Systems of infiltration techniques have been assumed to be unsuitable on this particular site, for the purpose of the report. It will be necessary to carry out appropriate infiltration tests in accordance with BRE Digest 365 'Soakaway Design' prior to construction on site and the results presented in a report for the approval of the Planning Authority.



- 7.4 If soakaways are proved to be unsuitable, surface water discharge shall be restricted to the existing brownfield run-off rate, less 30%, with outfall to sewer (subject to approval and CCTV/Connectivity investigation).
- 7.5 The proposed surface water drainage system shall be designed with an allowance for climate change and restricted to the agreed discharge rate with appropriate attenuation incorporated into the design. A detailed design and calculations shall be submitted to the Planning Authority for approval prior to construction on site.
- 7.6 Foul water domestic waste should discharge to 225mm diameter public combined sewer recorded through the site.
- 7.7 As the site is within Flood Zone 1, no special mitigation measures are required for emergency egress during times of flood.
- 7.8 Subject to compliance with the above, the proposed development can satisfy the requirements of the National Planning Policy Framework and the Planning Practice Guidance in relation to flood risk.



A P P E N D I X A

S I T E L O C A T I O N P L A N



NOTES
DO NOT SCALE FROM THIS DRAWING.

It is the Contractor's responsibility to check all governing dimensions and verify all dimensions on site before commencing any work or making any shop drawings.

This drawing is to be read in conjunction with schedules of work, specifications, bills of quantities and other relevant information. Any discrepancies are to be reported to the Project Architect.

Work and materials are to be in accordance with the Building Regulations and to comply with the relevant British Standards.

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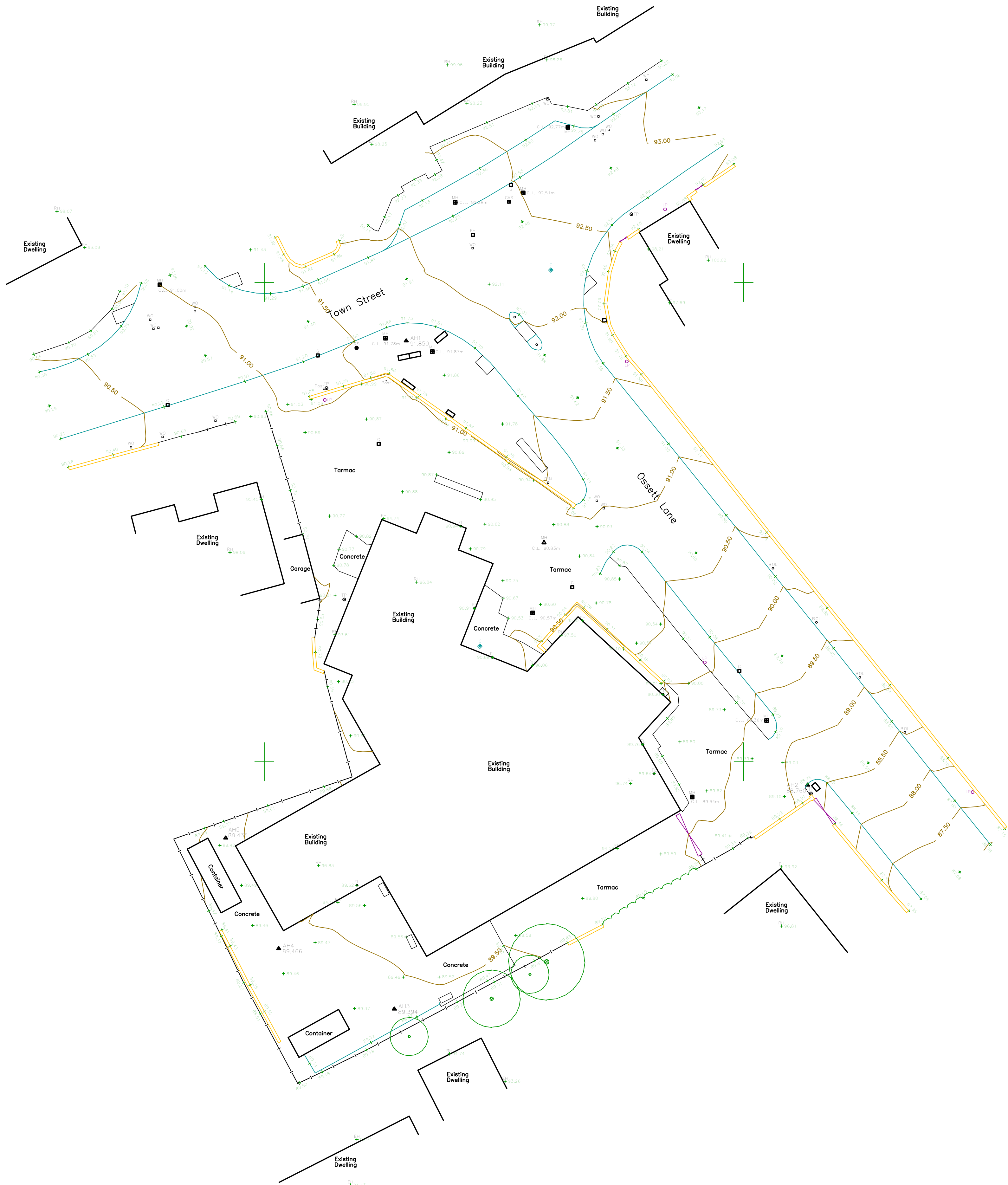
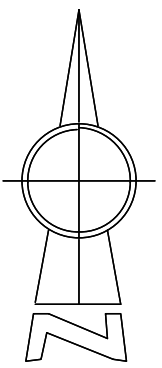


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Client: Mr R Slater		
Project: Former Anglo Stainless Steel Site		
Drawing: Existing Site Layout & Location		
Date: Feb 2015	Scale: 1:1250, 1:500@A3	
Drawing No: 1649/SK100		Rev:

A P P E N D I X B

TOPOGRAPHICAL SURVEY



Rev	By	Date	Revision	Issued for approval	WMW
					Chk

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TITLE
TOPOGRAPHICAL SURVEY

PROJECT
DONCASTER ROAD, BRAYTON

CLIENT
THE STANLEY MIDDLEBROOK TRUST

Scale
1:250 @ A1

Date
APRIL, 17

Drawn
AP

Chk.
WMW

Drg. No.
800/540/SK.02

Rev

SUBJECT TO THE
APPROVAL OF
ALL RELEVANT
AUTHORITIES

A P P E N D I X C

ENVIRONMENT AGENCY CONSULTATION

From: Beech, Cheryl [<mailto:Cheryl.Beech@environment-agency.gov.uk>]
Sent: Wednesday 3 May, 2017 10:41am
To: Wayne Walker
Subject: Your Enquiry: RFI/2017/43727

Our Ref: RFI/2017/43727

Your Ref:

Dear Wayne

Provision of Product 3 for Ossett Lane, Dewsbury

Thank you for your request of 7 April 2017 to use Environment Agency data, in the development of the above stie. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments.

Supporting Information

The Flood Map for Planning

The Environment Agency provides the Flood Map (see enclosed extract).

What is the Flood Map for Planning?

The Flood Map for Planning provides information on flooding from rivers and the sea for England and Wales. The Flood Map also has information on flood defences and the areas benefiting from those flood defences.

The Flood Map for Planning shows the following:

1. Flood Zone 3 (dark blue area on the enclosed map): natural flood plain area that could be affected by flooding from rivers and/or the sea – not taking into account the presence of any flood defences
 - For flooding from rivers the map indicates the extent of a flood with a 1% (1 in 100) chance of happening each year;
 - For flooding from the sea the map shows the extent of a flood with a 0.5% (1 in 200) chance of happening each year.
2. Flood Zone 2 (light blue area): natural flood plain area that could be affected by flooding from rivers and/or the sea – not taking into account the presence of any flood defences. Flood Zone 2:
 - indicates the extent of a flood with a 0.1% (1 in 1000) chance of happening each year.
 - and/or indicates the greatest recorded historic flood, whichever is greater.
3. Flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, together with some natural or constructed entities which retain, store or channel water and which may protect against smaller floods.

4. Areas benefiting from flood defences - areas that benefit from the flood defences shown, in the event of a river flood with a 1% (1 in 100) chance of happening each year, or a flood from the sea with a 0.5% (1 in 200) chance of happening each year. If the defences were not there, these areas would flood.

Flood History

To the best of our knowledge there is no known flood history for this site. However, in close proximity to this location we do have some flood history available (see enclosed map).

2015 Draft Flood Extents Data Warning

For Yorkshire as a whole there are some areas that are missing, this is because of a lack of data or low confidence. We will continue to review data and evidence throughout the summer, with a deadline of the end of September to upload the extents for a November publication date. These extents should therefore still be viewed as a draft output.

Water causing flooding can come from different places, for example from rivers or the sea; surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system); overflowing or backing up of sewers or drainage systems which have been overwhelmed or from groundwater rising up from underground aquifers.

Currently the Environment Agency can only supply flood risk data relating to the risk of flooding from rivers or the sea. However you should be aware that in recent years, there has been an increase in flood damage caused by surface water flooding or drainage systems that have been overwhelmed. Local Authorities and/or Water Companies may be able to provide some knowledge on the risk of flooding from sources other than rivers and the sea and we are working with these organisations to improve knowledge and understanding of surface water flooding.

Assets

Asset Location Map

Please find attached asset map(s) showing location of all (Agency and non Agency maintained) flood defences and channels.

Description of Works

See attached table with description of the defences and structures shown on the above drawing, including condition ratings, upstream and downstream crest levels, where available.

Risk of Flooding – Environment Agency Defences

The risk of flooding in this area is now reduced by the presence of flood defences that we maintain, but there still is a residual risk of flooding if these were to breach or be overtopped by a flood greater than that for which they were designed.

Risk of Flooding – Privately Maintained Defences

You will see that the Environment Agency does not maintain any of those defences. However we undertake regular risk based visual inspections. We do not hold design levels and have no height information on these defences or structures.

Asset Condition Ratings

The performance of a flood defence asset is recorded as the condition of the asset. Our asset inspectors subjectively assess the conditions of assets (during visual inspection site visits) with reference to a national standard template. Each asset is given a rating between one and five with one being very good condition and five being very poor. A condition rating

of 3, or 'fair' is the minimal acceptable standard for a critical asset, such as a defence wall that protects properties. We are striving to improve all assets below 'fair' to an acceptable standard.

Asset inspections are done on average every six months, although some critical assets are assessed on a more regular basis. It is possible that adjacent assets are inspected on different dates, which may result in two assets of a similar state of repair having different condition ratings.

Condition ratings of assets may also be affected by the time of year the surveys are conducted, as vegetation may obscure the asset in the summer months, or accessibility may be an issue during winter months. These factors would not usually affect the recorded condition rating of an asset unless the asset is on a borderline between two ratings.

Asset Standard of Protection

Please note that the provided Design Standard of Protection is an estimate and should not be relied on. Please note that where available the defended flood extents provide more reliable information relating to the protection offered by the defence (i.e. at which return period the water levels are likely to overtop the defence). If available and required the defended flood extents can be provided on request.

Modelling

River Calder, Walsden Water and Canals Study 2015

We are providing you with the results from the 2015 study, with extents from which our Flood Map has been updated.

Please see attached extracts:

- Results for peak water levels for and flows for the 0.1% (1 in 1000yr), 0.5% (1 in 200yr) 1% (1 in 100yr), 1.3% (1 in 75yr), 2% (1 in 50yr), 3.3% (1 in 30yr), 4% (1 in 25yr), 10% (1 in 10), 20% (1 in 5), 50% (1 in 2yr) annual chance events for the defended scenario;
- results for peak water levels for and flows for the 0.1% (1 in 1000yr) and 1% (1 in 100yr) annual chance events for the undefended scenario
- results for the 1% (1 in 100yr) peak water levels for the Climate Change Scenario (+20% Flow), for both the defended and undefended scenarios;
- depth grids for 3 return periods: 100yr, 100yr+CC and 1000yr.

Flood depth, velocity and hazard grids for all return periods are available on request.

Climate Change

Please note that new guidance on climate change allowances for Flood Risk Assessments has been published in February 2016.

The new guidelines are available from:

<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Risk of Flooding from Reservoirs Map

Outlines and simplified depth and velocity maps can be viewed on our website:

<http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=reservoir&scale=1&textonly=off&ep=map&layerGroups=default&lang=en&y=355134&x=357683#x=438988&y=406600&scale=2>

Please, zoom into the location of interest, and then click on the inundated location for details. As a result a list of reservoirs will be provided with supporting information and a links to other data, such as estimated depths and speed of flooding, at the bottom of the result page.

A map of showing the outlines can also be provided on request.

Flood Warning

The site is not covered by a Flood Warning.

LIDAR Data

Please note that our LiDAR data is now available free of charge (Open Data) from <http://environment.data.gov.uk/ds/survey/index.jsp#/survey> (once zoomed to the relevant location the available LiDAR products will be listed below the map).

Two LIDAR products are available:

1. Tiled LIDAR data - The full tiled dataset consists of historic LIDAR data which has been gathered since 1998. For some areas we have carried out repeat surveys and data is available in a range of resolutions.
2. Composite LIDAR data - The composite dataset is derived from a combination of our full tiled dataset which has been merged and re-sampled to give the best possible spatial coverage.

Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. This technique results in the production of an accurate, cost-effective terrain model suitable for assessing flood risk and other environmental applications.

The Environment Agency owns two LIDAR systems, which are installed in a survey aircraft along with its other operational remote sensing instruments.

The aircraft is positioned and navigated using Global Positioning System (GPS) corrected to known ground reference points. The aircraft typically flies at a height of about 800 metres above ground level and a scanning mirror allows a swath width of about 600 metres to be surveyed during a flight.

The Rights & Responsibilities of a Riverside Owner

The owner of property adjacent to a watercourse is usually deemed to be the riparian owner and, as such, has both riparian rights and responsibilities with regard to the watercourse within their ownership.

The responsibility for general maintenance and repair of the watercourse and its banks rests with the riparian owner. For more information on Rights and Responsibilities of a riverside owner, you can visit our website at: <https://www.gov.uk/government/organisations/environment-agency> go to the Flooding and coastal change section and click on 'Riverside ownership: rights and responsibilities ('living on the edge') under the River maintenance section and download the 'Living on the Edge' booklet.

Alternatively type the following address into your web browser:

<https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities>

Ordnance Survey Data

Under the terms of our licence agreement with the Ordnance Survey, we are unable to supply the OS data. Under this agreement we can only supply OS data to consultants/contractors carrying out work on our behalf.

Flood Portal

It's a new 'one-stop shop' web portal providing guidance and information on flood risk management in the UK. Arup have written and designed the site, in conjunction with CIRIA, the Local Government Association, the EA and Defra, primarily as a resource for local authority officers, flood risk management professionals, and others with an interest in flood risk. It's a part of the Capacity Building Strategy.

<http://www.local.gov.uk/floodportal>

This information is provided subject to the Open Government Licence ([here](#)) - please read for details of permitted use.

If you have any queries or would like to discuss the content of this letter further please contact us on the telephone number below.

We would be really grateful if you could spare five minutes to help us improve our service. Please click on the link below and fill in our survey – we use every piece of feedback we receive:

<http://www.smartsurvey.co.uk/s/EnvironmentAgencyCustomerSurvey/?a=Y>

Yours sincerely

Cheryl Beech

Customers and Engagement Team

✉ **Environment Agency, Lateral, 8 City Walk, Leeds. LS11 9AT**

☎ **General Enquiries Team 020 847 48174**

☎ **Direct 020 3025 6412 (*internal 56412*)**

✉ neyorkshire@environment-agency.gov.uk

Please note my working days are Tuesday, Wednesday and Thursday

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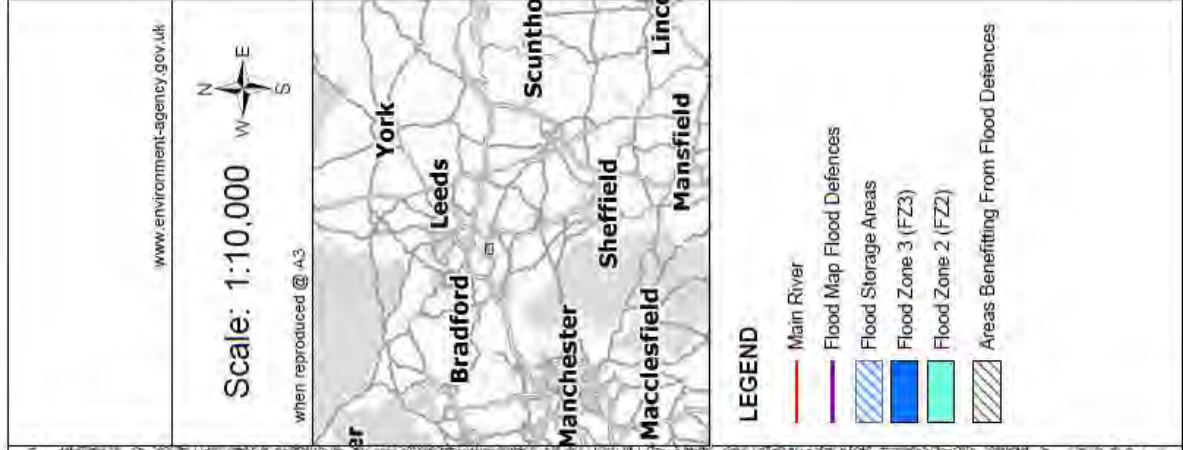
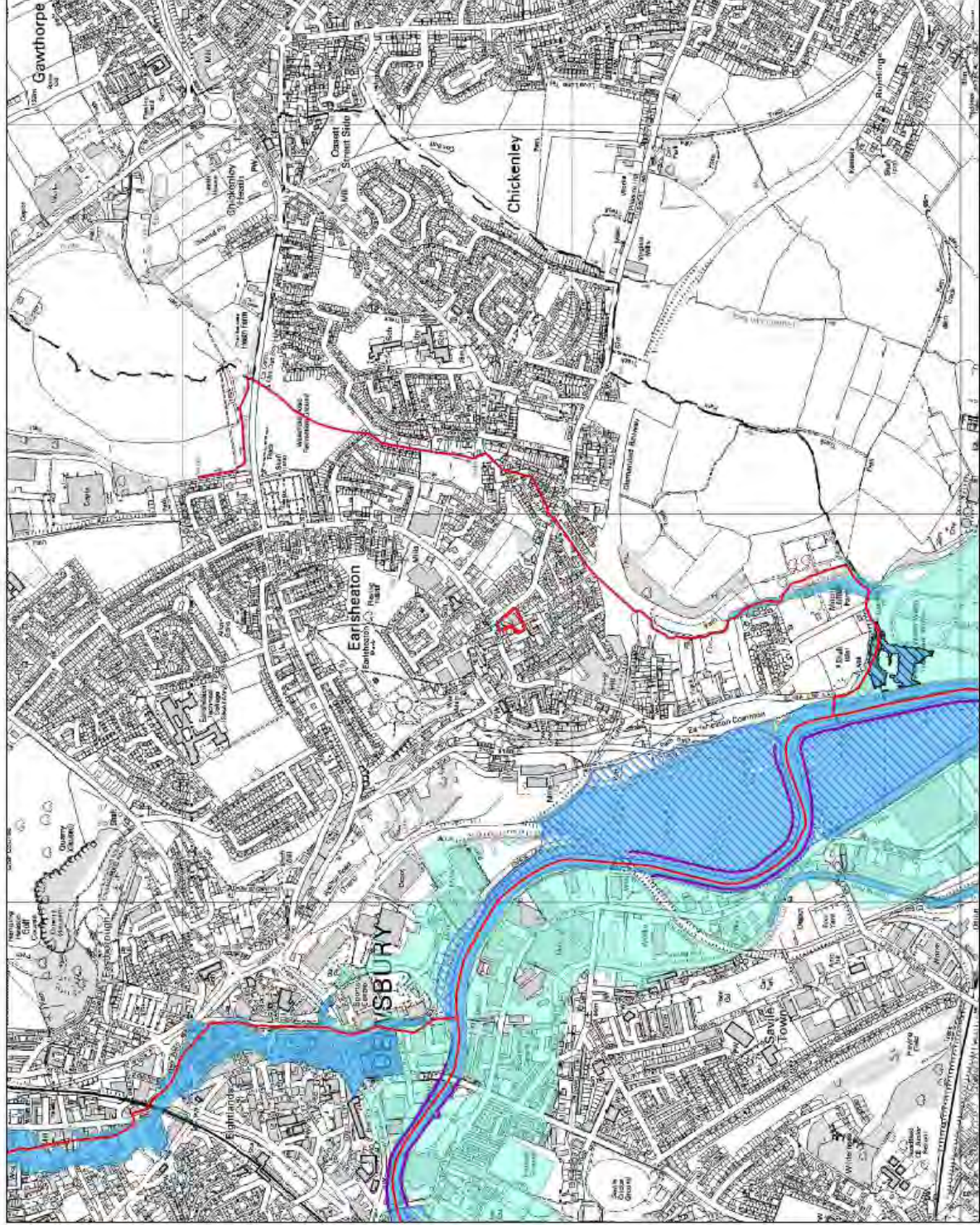
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RFI: 43727

Flood Map for Planning for Dewsbury

Date: 25/04/2017

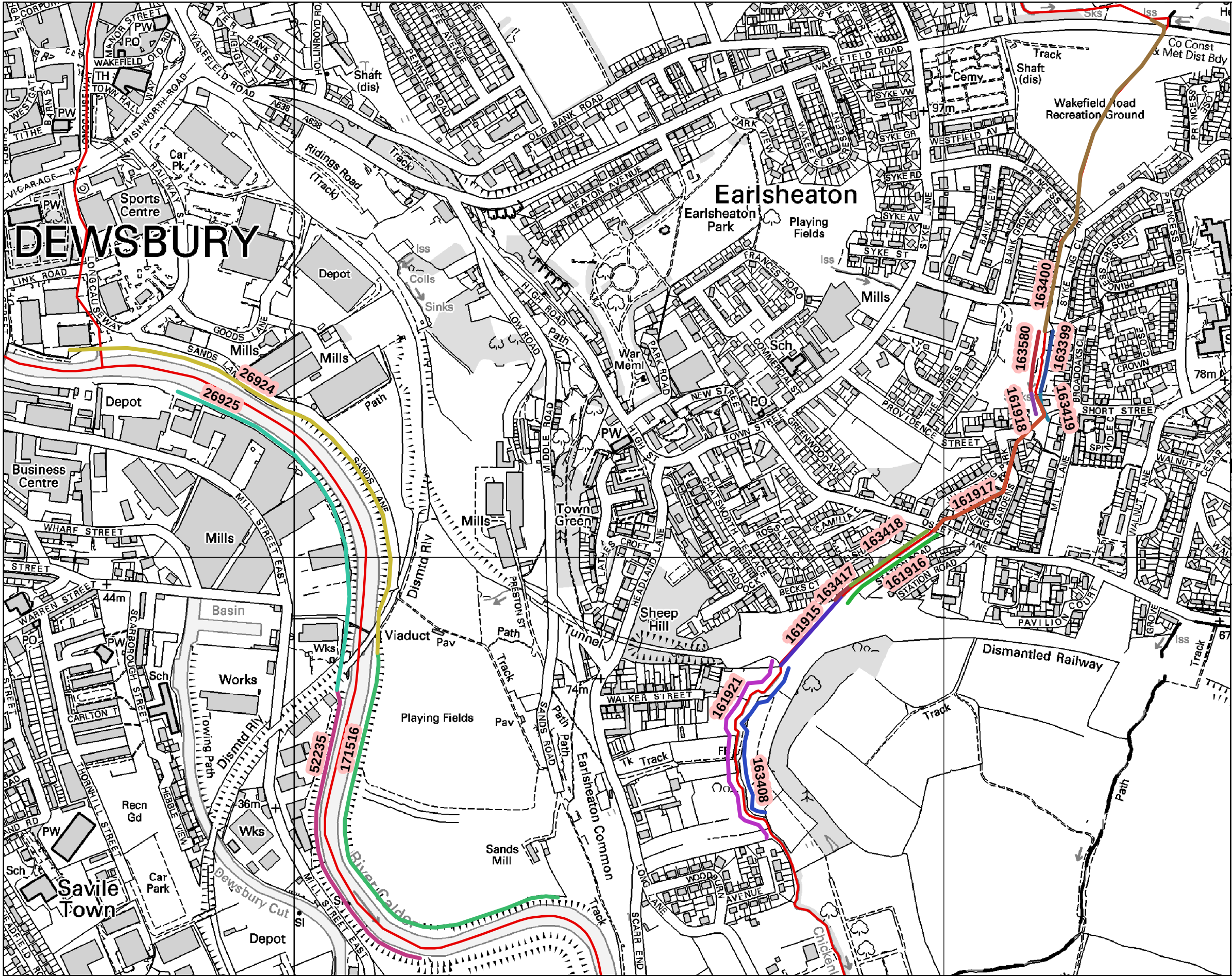


LEGEND

- Main River
- Flood Map Flood Defences
- Flood Storage Areas
- Flood Zone 3 (FZ3)
- Flood Zone 2 (FZ2)
- Areas Benefiting From Flood Defences

RFI 43727 Flood History

Name	Comments	Start Date	End Date	Flood Source	Flood Cause	Data Source
River Calder: Brighouse to Dewsbury		10/02/2002	13/02/2002	Main River	Channel Capacity Exceeded	Aerial Photograph
December 2015 Flood Event	CH2M Data for Mirfield to Dewsbury. Anecdotal evidence from consultation with Kirklees and Wakefield Local Authorities. CH2M data amended and only used where LA's have confirmed.	25/12/2015	29/12/2015	Main River	Channel Capacity Exceeded	Local Authority
River Calder. Horbury		10/02/2002	13/02/2002	Main River	Channel Capacity Exceeded	Aerial Photograph
December 2015 Flood Event	Aerial photography flown on 27, 28 and 30 Dec 2015	25/12/2015	29/12/2015	Main River	Channel Capacity Exceeded	Aerial Photograph



www.environment-agency.gov.uk

Scale: 1:6,000

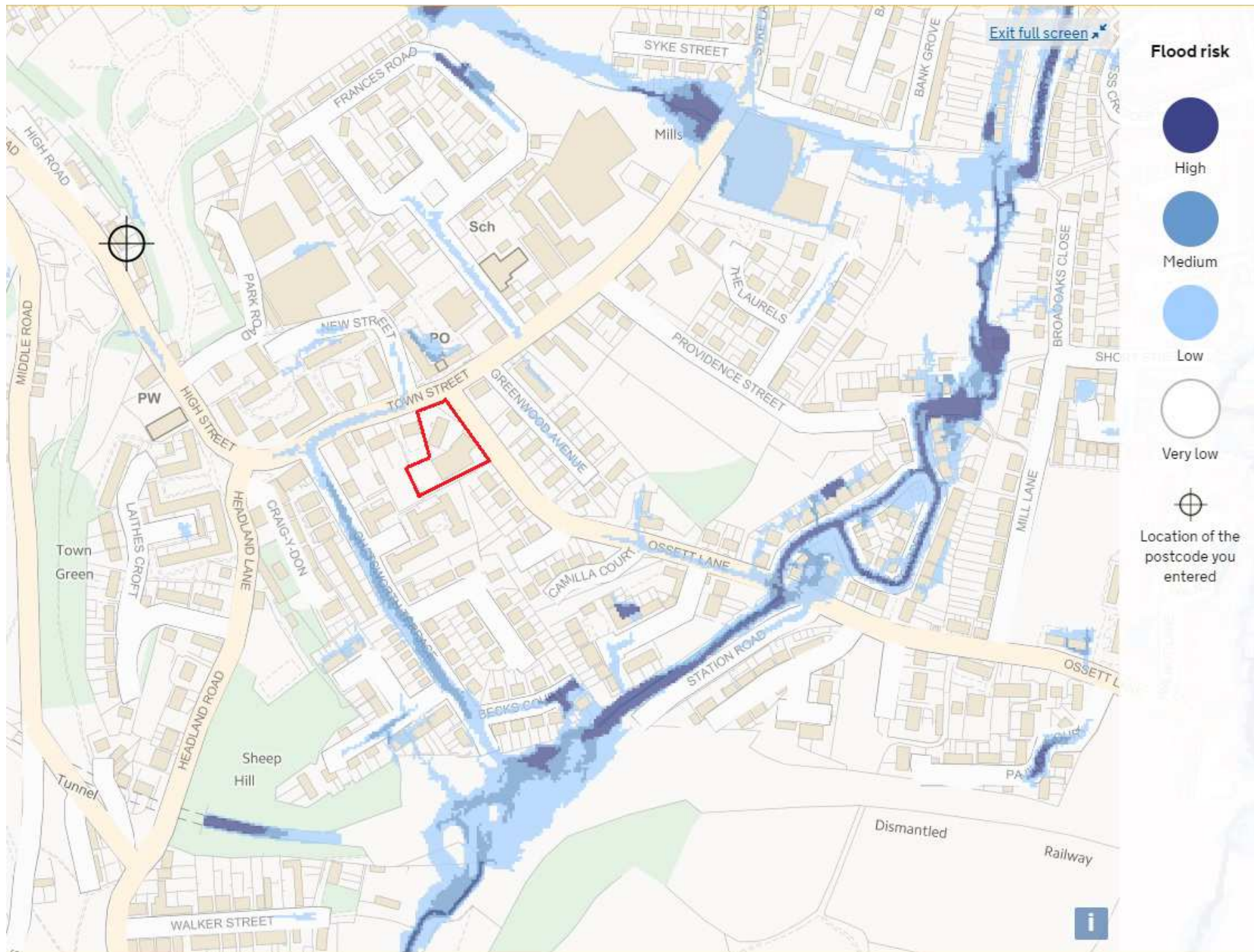
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LEGEND

Defences	
	163399
	163400
	163408
	163417
	163418
	163419
	163580
	171516
	161921
	Main River

RFI No: 43727 Asset Information

Asset ID	Asset Type	Asset Subtype	Maintainer	Description	Bank	Design Standard of Protection (yrs)	Actual Downstream Crest Level (mAOD)	Actual Upstream Crest Level (mAOD)	Actual Condition Rating
163580	Defence	High_Ground	Private	Open Channel	Right	50	N/A	N/A	3
163419	Defence	High_Ground	Private	Open Channel	Right	50	N/A	N/A	4
161918	Defence	High_Ground	Private	Open Channel	Left	50	N/A	N/A	4
163399	Defence	High_Ground	Private	Natural Open Channel	Left	50	N/A	N/A	3
163400	Channel	Simple_Culvert	Private	Culvert		50	N/A	N/A	3
52235	Defence	Embankment	Environment Agency	Floodbank - Query Data And Maintainer	Right	50	36.81	40.20	3
171516	Defence	Embankment	Environment Agency	Flood Bank To High Ground	Left	50	35.27	35.23	3
161921	Defence	High_Ground	Private	Natural Open Channel	Right	50	N/A	N/A	3
163408	Defence	High_Ground	Private	Natural Open Channel	Left	50	N/A	N/A	3
26925	Defence	High_Ground	Private	Factory Walls	Right	50	N/A	N/A	4
161915	Channel	Simple_Culvert	Private	Arched Culvert		50	N/A	N/A	5
26924	Defence	High_Ground	Environment Agency	Flood Bank To High Ground	Left	50	35.27	37.77	3
161916	Defence	High_Ground	Private	Natural Open Channel	Left	50	N/A	N/A	3
163417	Defence	High_Ground	Private	Natural Open Channel	Right	50	N/A	N/A	3
163418	Defence	High_Ground	Private	Open Channel	Right	50	N/A	N/A	3
161917	Channel	Simple_Culvert	Private	Box Culvert		50	N/A	N/A	5



A P P E N D I X D

WATER AUTHORITY CONSULTATION



Arp Associates
Unit 5/6 Northwest Business Pk; 1ST FLR
Servia Hill
Woodhouse
Leeds
LS6 2QH
FAO A Poiser

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

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

Your Ref: 500/540
Our Ref: T005636

Email:
Technical.Sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
John Wellham on 0345 120 8482

12th April 2017

Dear Sir/Madam,

Ossett Lane/Town Street, Earlsheaton - Pre Planning Sewerage Consultation on R535863 - Commercial

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

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

> EXISTING INFRASTRUCTURE

There is a 225mm diameter public combined sewer recorded crossing the site. No buildings, or other obstructions, are to be erected within 3 (three) 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 0345 120 84 82.

> FOUL WATER

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

Foul water domestic waste should discharge to the 225mm diameter public combined sewer recorded through the site.



Please note that as a result of the Water Industry (Scheme for Adoption of Private Sewers) Regulations 2011, there are public sewers not shown on our mapping records. It may be the case that there are unmapped sewers capable of accommodating the proposed foul water discharge in the vicinity of the site. It is recommended that the developer investigates this by visiting the site to establish the location of any transferred public sewers.

Foul water from kitchens and/or food preparation areas of any restaurants and/or canteens etc. must pass through a fat and grease trap of adequate design before any discharge to the public sewer network.

> SURFACE WATER

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

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

If other methods of surface water disposal are not viable and subject to providing satisfactory evidence as to why they have been discounted, curtilage surface water discharges to the public sewer will be restricted to the level of run-off - i.e. same rate of discharge - to that from the existing use of the site less a 30% reduction in the existing discharge. Any discharge of surface water from the site should discharge to similar points of connection to that of the existing use of the site. You will need to demonstrate positive drainage, based on a 1 in 1 year storm, to the public sewer to Yorkshire Water by means of investigation and calculation carried out at your expense.

To do this, Yorkshire Water requires to see existing and proposed drainage layouts with pipe sizes, gradients and connection points, measured impermeable areas of the present and proposed use of the site, along with the calculations that show the existing and proposed discharge rate from the site to the public sewer.

Surface water run-off from communal parking (greater than 800 sq metres or more than 50 car parking spaces) and hardstanding must pass through an oil, petrol and grit interceptor/separator of adequate design before any discharge to the public sewer network. Roof water should not pass through the traditional 'stage' or full retention type of interceptor/separator. It is good drainage practice for any interceptor/separator to be located upstream of any on-site balancing, storage or other means of flow attenuation that may be required.

> GENERAL

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



As a last resort, highway drainage may be accepted under certain circumstances. If it can be demonstrated, through satisfactory evidence, that SUDS are not a viable option, there are no watercourses or highway drains available and if capacity is available within the public sewer network, highway drainage discharges to the public sewer network may be permitted. In this event, the developer may 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.

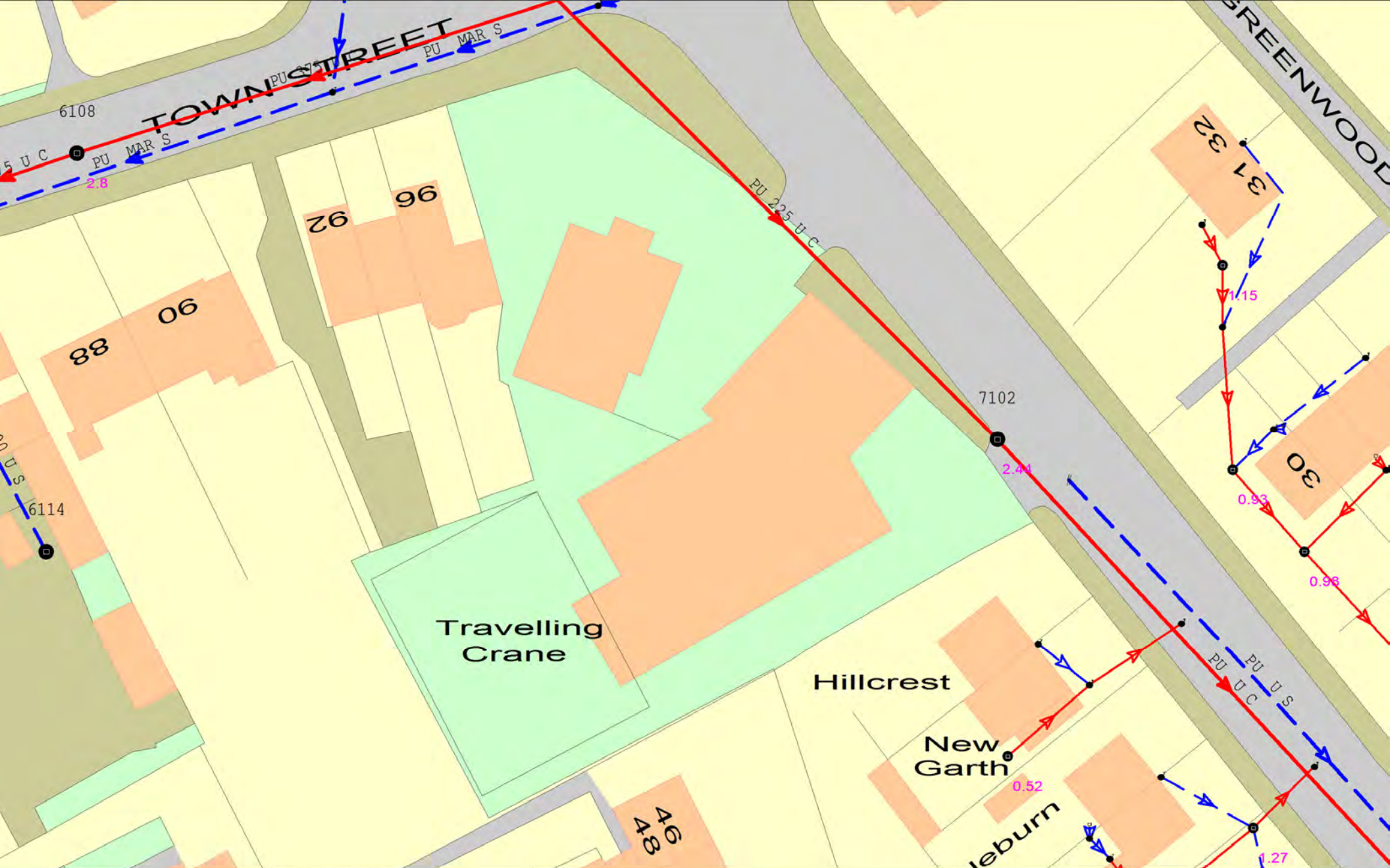
Any new connection to an existing public sewer will require the prior approval of Yorkshire Water. You may obtain an application form from our website (www.yorkshirewater.com) or by telephoning 0345 120 84 82.

Yorkshire Water's Trade Effluent team must be consulted in respect of any proposed trade effluent discharge to the public sewer.

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

Developer Services Team

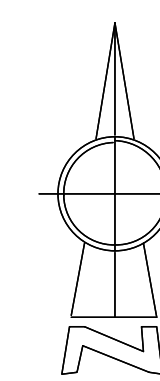


425637 : 421104	Map Name : SE2521SE	Title	Partial Key	This plan is furnished as a general guide only and to its correctness is given or implied. This plan may be used in the event of excavations or other works in the vicinity of public sewers. No house or property is shown.
	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Wellham Contact Tel :	Notes (Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS	
			Date Req : 12/04/2017, 13:51:40 Source : Sewer Network Enquiry	

A P P E N D I X E

PROPOSED DEVELOPMENT LAYOUT

N O T E S



Rev	AP	By	Date	Issued for approval	Revision	Chk



ARP ASSOCIATES
CHARTERED CONSULTING ENGINEERS

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Telephone: 0113 2458498 • Fax: 0113 2443864 • E-Mail: leeds@arpassociates.co.uk
ARP Associates is a trading division of ARP Geotechnical Ltd, a company registered in England and Wales with company number 3377811, whose registered office is at 5/6 Northwest Business Park, Servia Hill, Leeds LS6 2QH

TITLE
TOPOGRAPHICAL SURVEY

PROJECT
DONCASTER ROAD, BRAYTON

CLIENT
THE STANLEY MIDDLEBROOK TRUST

Scale	Date	Drawn	AP
1:250 @ A1	APRIL, 17	Chk.	WMW

Drg. No.	Rev
800/540/SK.01	

SUBJECT TO THE
APPROVAL OF
ALL RELEVANT
AUTHORITIES

A P P E N D I X F

INDICATIVE SURFACE WATER DRAINAGE CALCULATIONS

ARP Associates				Page 1	
Northwest House Servia Hill Leeds LS6 2QH		Town Street, Earlsheaton VFM Coatings 800/540 - 30yr			
Date 01/05/2017 File 800-540 Preliminary Sto...		Designed by W.Walker Checked by			
Elstree Computing Ltd		Source Control 2017.1			
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	0.409	0.409	5.4	4.1	0 K
30 min Summer	0.433	0.433	5.4	4.3	0 K
60 min Summer	0.375	0.375	5.4	3.8	0 K
120 min Summer	0.246	0.246	5.3	2.5	0 K
180 min Summer	0.166	0.166	4.9	1.7	0 K
240 min Summer	0.126	0.126	4.6	1.3	0 K
360 min Summer	0.098	0.098	3.5	1.0	0 K
480 min Summer	0.083	0.083	2.9	0.8	0 K
600 min Summer	0.075	0.075	2.5	0.7	0 K
720 min Summer	0.069	0.069	2.2	0.7	0 K
960 min Summer	0.060	0.060	1.7	0.6	0 K
1440 min Summer	0.051	0.051	1.3	0.5	0 K
2160 min Summer	0.043	0.043	1.0	0.4	0 K
2880 min Summer	0.038	0.038	0.8	0.4	0 K
4320 min Summer	0.032	0.032	0.6	0.3	0 K
5760 min Summer	0.029	0.029	0.5	0.3	0 K
7200 min Summer	0.026	0.026	0.4	0.3	0 K
8640 min Summer	0.024	0.024	0.3	0.2	0 K
10080 min Summer	0.023	0.023	0.3	0.2	0 K
15 min Winter	0.467	0.467	5.4	4.7	0 K
30 min Winter	0.478	0.478	5.4	4.8	0 K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	68.836	0.0	7.1	13	
30 min Summer	45.828	0.0	9.4	22	
60 min Summer	29.238	0.0	12.1	38	
120 min Summer	18.112	0.0	14.9	68	
180 min Summer	13.534	0.0	16.7	98	
240 min Summer	10.952	0.0	18.1	126	
360 min Summer	8.106	0.0	20.1	186	
480 min Summer	6.544	0.0	21.6	246	
600 min Summer	5.539	0.0	22.8	306	
720 min Summer	4.832	0.0	23.9	366	
960 min Summer	3.892	0.0	25.7	488	
1440 min Summer	2.866	0.0	28.4	734	
2160 min Summer	2.108	0.0	31.3	1096	
2880 min Summer	1.693	0.0	33.5	1468	
4320 min Summer	1.242	0.0	36.9	2180	
5760 min Summer	0.996	0.0	39.4	2920	
7200 min Summer	0.839	0.0	41.5	3544	
8640 min Summer	0.730	0.0	43.3	4288	
10080 min Summer	0.648	0.0	44.9	5072	
15 min Winter	68.836	0.0	7.9	14	
30 min Winter	45.828	0.0	10.6	23	
©1982-2017 XP Solutions					

ARP Associates		Page 2
Northwest House Servia Hill Leeds LS6 2QH	Town Street, Earlsheaton VFM Coatings 800/540 - 30yr	
Date 01/05/2017 File 800-540 Preliminary Sto...	Designed by W.Walker Checked by	
Elstree Computing Ltd	Source Control 2017.1	

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.369	0.369	5.4	3.7	0 K
120 min Winter	0.185	0.185	5.0	1.8	0 K
180 min Winter	0.118	0.118	4.3	1.2	0 K
240 min Winter	0.097	0.097	3.5	1.0	0 K
360 min Winter	0.078	0.078	2.6	0.8	0 K
480 min Winter	0.068	0.068	2.1	0.7	0 K
600 min Winter	0.061	0.061	1.8	0.6	0 K
720 min Winter	0.057	0.057	1.6	0.6	0 K
960 min Winter	0.050	0.050	1.3	0.5	0 K
1440 min Winter	0.042	0.042	0.9	0.4	0 K
2160 min Winter	0.036	0.036	0.7	0.4	0 K
2880 min Winter	0.032	0.032	0.6	0.3	0 K
4320 min Winter	0.027	0.027	0.4	0.3	0 K
5760 min Winter	0.024	0.024	0.3	0.2	0 K
7200 min Winter	0.022	0.022	0.3	0.2	0 K
8640 min Winter	0.021	0.021	0.2	0.2	0 K
10080 min Winter	0.019	0.019	0.2	0.2	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	29.238	0.0	13.5	40
120 min Winter	18.112	0.0	16.7	70
180 min Winter	13.534	0.0	18.8	96
240 min Winter	10.952	0.0	20.2	126
360 min Winter	8.106	0.0	22.5	184
480 min Winter	6.544	0.0	24.2	246
600 min Winter	5.539	0.0	25.6	306
720 min Winter	4.832	0.0	26.8	364
960 min Winter	3.892	0.0	28.8	480
1440 min Winter	2.866	0.0	31.8	732
2160 min Winter	2.108	0.0	35.0	1092
2880 min Winter	1.693	0.0	37.5	1416
4320 min Winter	1.242	0.0	41.3	2160
5760 min Winter	0.996	0.0	44.2	2832
7200 min Winter	0.839	0.0	46.5	3560
8640 min Winter	0.730	0.0	48.5	4448
10080 min Winter	0.648	0.0	50.3	5024

ARP Associates		Page 4
Northwest House Servia Hill Leeds LS6 2QH	Town Street, Earlsheaton VFM Coatings 800/540 - 30yr	
Date 01/05/2017 File 800-540 Preliminary Sto...	Designed by W.Walker Checked by	
Elstree Computing Ltd	Source Control 2017.1	

Model Details

Storage is Online Cover Level (m) 1.200

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	10.0	0.700	10.0	1.400	10.0	2.100	10.0
0.100	10.0	0.800	10.0	1.500	10.0	2.200	10.0
0.200	10.0	0.900	10.0	1.600	10.0	2.300	10.0
0.300	10.0	1.000	10.0	1.700	10.0	2.400	10.0
0.400	10.0	1.100	10.0	1.800	10.0	2.500	10.0
0.500	10.0	1.200	10.0	1.900	10.0		
0.600	10.0	1.300	10.0	2.000	10.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0106-5400-1200-5400
Design Head (m)	1.200
Design Flow (l/s)	5.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.4
Flush-Flo™	0.355	5.4
Kick-Flo®	0.749	4.3
Mean Flow over Head Range	-	4.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.3	7.000	12.4
0.200	5.1	1.400	5.8	3.500	8.9	7.500	12.8
0.300	5.4	1.600	6.2	4.000	9.5	8.000	13.2
0.400	5.4	1.800	6.5	4.500	10.0	8.500	13.6
0.500	5.3	2.000	6.9	5.000	10.6	9.000	14.0
0.600	5.1	2.200	7.2	5.500	11.1	9.500	14.3
0.800	4.5	2.400	7.5	6.000	11.5		
1.000	5.0	2.600	7.8	6.500	12.0		

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Northwest House Servia Hill Leeds LS6 2QH		Town Street, Earlsheaton VFM Coatings 800/540 - 100yr + 40%				
Date 01/05/2017 File 800-540 Preliminary Sto...		Designed by W.Walker Checked by				
Elstree Computing Ltd		Source Control 2017.1				
Summary of Results for 100 year Return Period (+40%)						
Storm Event		Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer		0.919	0.919	5.4	9.2	Flood Risk
30 min Summer		1.040	1.040	5.4	10.4	Flood Risk
60 min Summer		1.047	1.047	5.4	10.5	Flood Risk
120 min Summer		0.902	0.902	5.4	9.0	Flood Risk
180 min Summer		0.683	0.683	5.4	6.8	0 K
240 min Summer		0.482	0.482	5.4	4.8	0 K
360 min Summer		0.256	0.256	5.3	2.6	0 K
480 min Summer		0.160	0.160	4.9	1.6	0 K
600 min Summer		0.122	0.122	4.4	1.2	0 K
720 min Summer		0.106	0.106	3.9	1.1	0 K
960 min Summer		0.088	0.088	3.1	0.9	0 K
1440 min Summer		0.071	0.071	2.3	0.7	0 K
2160 min Summer		0.059	0.059	1.7	0.6	0 K
2880 min Summer		0.052	0.052	1.3	0.5	0 K
4320 min Summer		0.043	0.043	1.0	0.4	0 K
5760 min Summer		0.038	0.038	0.8	0.4	0 K
7200 min Summer		0.035	0.035	0.7	0.3	0 K
8640 min Summer		0.032	0.032	0.6	0.3	0 K
10080 min Summer		0.030	0.030	0.5	0.3	0 K
15 min Winter		1.055	1.055	5.4	10.6	Flood Risk
30 min Winter		1.198	1.198	5.4	12.0	Flood Risk
Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer		124.633	0.0	12.8	16	
30 min Summer		83.789	0.0	17.3	25	
60 min Summer		53.779	0.0	22.2	42	
120 min Summer		33.337	0.0	27.5	76	
180 min Summer		24.832	0.0	30.7	110	
240 min Summer		20.006	0.0	33.0	138	
360 min Summer		14.706	0.0	36.4	192	
480 min Summer		11.818	0.0	39.0	250	
600 min Summer		9.966	0.0	41.1	306	
720 min Summer		8.665	0.0	42.9	366	
960 min Summer		6.943	0.0	45.8	488	
1440 min Summer		5.071	0.0	50.2	726	
2160 min Summer		3.696	0.0	54.9	1100	
2880 min Summer		2.949	0.0	58.4	1456	
4320 min Summer		2.142	0.0	63.6	2152	
5760 min Summer		1.705	0.0	67.5	2872	
7200 min Summer		1.427	0.0	70.6	3544	
8640 min Summer		1.235	0.0	73.4	4264	
10080 min Summer		1.093	0.0	75.8	4968	
15 min Winter		124.633	0.0	14.4	16	
30 min Winter		83.789	0.0	19.4	26	
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Northwest House Servia Hill Leeds LS6 2QH	Town Street, Earlsheaton VFM Coatings 800/540 - 100yr + 40%	
Date 01/05/2017 File 800-540 Preliminary Sto...	Designed by W.Walker Checked by	
Elstree Computing Ltd	Source Control 2017.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.178	1.178	5.4	11.8	Flood Risk
120 min Winter	0.932	0.932	5.4	9.3	Flood Risk
180 min Winter	0.566	0.566	5.4	5.7	0 K
240 min Winter	0.318	0.318	5.4	3.2	0 K
360 min Winter	0.135	0.135	4.7	1.4	0 K
480 min Winter	0.105	0.105	3.8	1.1	0 K
600 min Winter	0.091	0.091	3.2	0.9	0 K
720 min Winter	0.082	0.082	2.8	0.8	0 K
960 min Winter	0.071	0.071	2.3	0.7	0 K
1440 min Winter	0.058	0.058	1.6	0.6	0 K
2160 min Winter	0.049	0.049	1.2	0.5	0 K
2880 min Winter	0.043	0.043	1.0	0.4	0 K
4320 min Winter	0.036	0.036	0.7	0.4	0 K
5760 min Winter	0.032	0.032	0.6	0.3	0 K
7200 min Winter	0.029	0.029	0.5	0.3	0 K
8640 min Winter	0.027	0.027	0.4	0.3	0 K
10080 min Winter	0.025	0.025	0.4	0.3	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	24.8	46
120 min Winter	33.337	0.0	30.8	82
180 min Winter	24.832	0.0	34.4	114
240 min Winter	20.006	0.0	37.0	140
360 min Winter	14.706	0.0	40.8	190
480 min Winter	11.818	0.0	43.7	246
600 min Winter	9.966	0.0	46.0	306
720 min Winter	8.665	0.0	48.0	364
960 min Winter	6.943	0.0	51.3	490
1440 min Winter	5.071	0.0	56.2	732
2160 min Winter	3.696	0.0	61.5	1084
2880 min Winter	2.949	0.0	65.4	1456
4320 min Winter	2.142	0.0	71.2	2180
5760 min Winter	1.705	0.0	75.6	2872
7200 min Winter	1.427	0.0	79.1	3632
8640 min Winter	1.235	0.0	82.2	4264
10080 min Winter	1.093	0.0	84.9	4960

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Northwest House Servia Hill Leeds LS6 2QH	Town Street, Earlsheaton VFM Coatings 800/540 - 100yr + 40%	
Date 01/05/2017 File 800-540 Preliminary Sto...	Designed by W.Walker Checked by	
Elstree Computing Ltd	Source Control 2017.1	

Model Details

Storage is Online Cover Level (m) 1.200

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	10.0	0.700	10.0	1.400	10.0	2.100	10.0
0.100	10.0	0.800	10.0	1.500	10.0	2.200	10.0
0.200	10.0	0.900	10.0	1.600	10.0	2.300	10.0
0.300	10.0	1.000	10.0	1.700	10.0	2.400	10.0
0.400	10.0	1.100	10.0	1.800	10.0	2.500	10.0
0.500	10.0	1.200	10.0	1.900	10.0		
0.600	10.0	1.300	10.0	2.000	10.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0106-5400-1200-5400
Design Head (m)	1.200
Design Flow (l/s)	5.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.4
Flush-Flo™	0.355	5.4
Kick-Flo®	0.749	4.3
Mean Flow over Head Range	-	4.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.3	7.000	12.4
0.200	5.1	1.400	5.8	3.500	8.9	7.500	12.8
0.300	5.4	1.600	6.2	4.000	9.5	8.000	13.2
0.400	5.4	1.800	6.5	4.500	10.0	8.500	13.6
0.500	5.3	2.000	6.9	5.000	10.6	9.000	14.0
0.600	5.1	2.200	7.2	5.500	11.1	9.500	14.3
0.800	4.5	2.400	7.5	6.000	11.5		
1.000	5.0	2.600	7.8	6.500	12.0		