Lubrizol Ltd

# FLOOD RISK ASSESSMENT



LBZ-WSP-XX-ZZ-RP-C-001
APRIL 2021

PUBLIC

## Lubrizol Ltd

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**FRA (REV 02) PUBLIC**

**PROJECT NO. 70081327**

**OUR REF. NO. LBZ-WSP-XX-ZZ-RP-C-001**

**DATE: APRIL 2021**

Lubrizol Ltd

# FLOOD RISK ASSESSMENT

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# 1. INTRODUCTION

## 1.1. APPOINTMENT AND BRIEF

1.1.1. WSP has been commissioned by Lubrizol Ltd to undertake this Flood Risk Assessment (FRA) to accompany the planning application for the construction of a new building and associated storage yard (hereafter referred to as the 'Proposed Development') to supplement their existing operations. The Proposed Development, located within the Syngenta site on Leeds Road, Huddersfield, HD2 1YU, is shown in **Appendix A** (hereafter referred to as the 'Site'). This report relates solely to the above Site.

1.1.2. This report is intended for the sole benefit of the parties named above and shall not be capable of assignment. WSP shall not be liable for any use of the report for any reasons other than that for which the report was originally prepared and provided.

1.1.3. Although this report was prepared using the degree of skill and care ordinarily exercised by engineers practicing under similar circumstances please note that WSP cannot take responsibility for errors in the information provided by third parties.

## 1.2. OBJECTIVE OF STUDY & METHODOLOGY

1.2.1. This report investigates flood risk on Site and in the area and establishes the mitigation measures required to ensure the sustainability and safety of the Proposed Development over its lifetime.

1.2.2. The report has been produced in line with the requirements of the NPPF and the Environment Agency (EA) Standing Advice, as well as through consultation with the EA and Kirklees Council as the Lead Local Flood Authority (LLFA).

1.2.3. The following documents and policies have been reviewed to inform this report:

- Calder Strategic Flood Risk Assessment (SFRA) (2016);
- Kirklees Preliminary Flood Risk Assessment (PFRA) (2011);
- Kirklees Surface Water Management Plan (SWMP) (2011);
- Kirklees Local Flood Risk Management Strategy (LFRMS) (2013);
- Calder Catchment Flood Management Plan (CFMP) (2010);
- Kirklees Council Local Plan (2019);
- West Yorkshire Combined Authority (WYCA) Flood Risk and Sustainable Drainage Guidance;
- Lubrizol Huddersfield Flood Procedures document;
- WSP (Syngenta) Huddersfield Manufacturing Centre Flood Risk Assessment (2013);
- Holden Surveys Ltd – Topographical Survey (2020);
- EA enquiry response with site-specific flood risk modelling data;
- British Geological Society (BGS) Online Viewer, 1:50,000 Bedrock and Superficial deposits;
- DEFRA's online Magic Map; and
- GOV.UK's online Long Term Flood Maps.

1.2.4. This report makes use of third party information and contains EA information © Environment Agency.

# 2. EXISTING SITE

## 2.1. SITE LOCATION

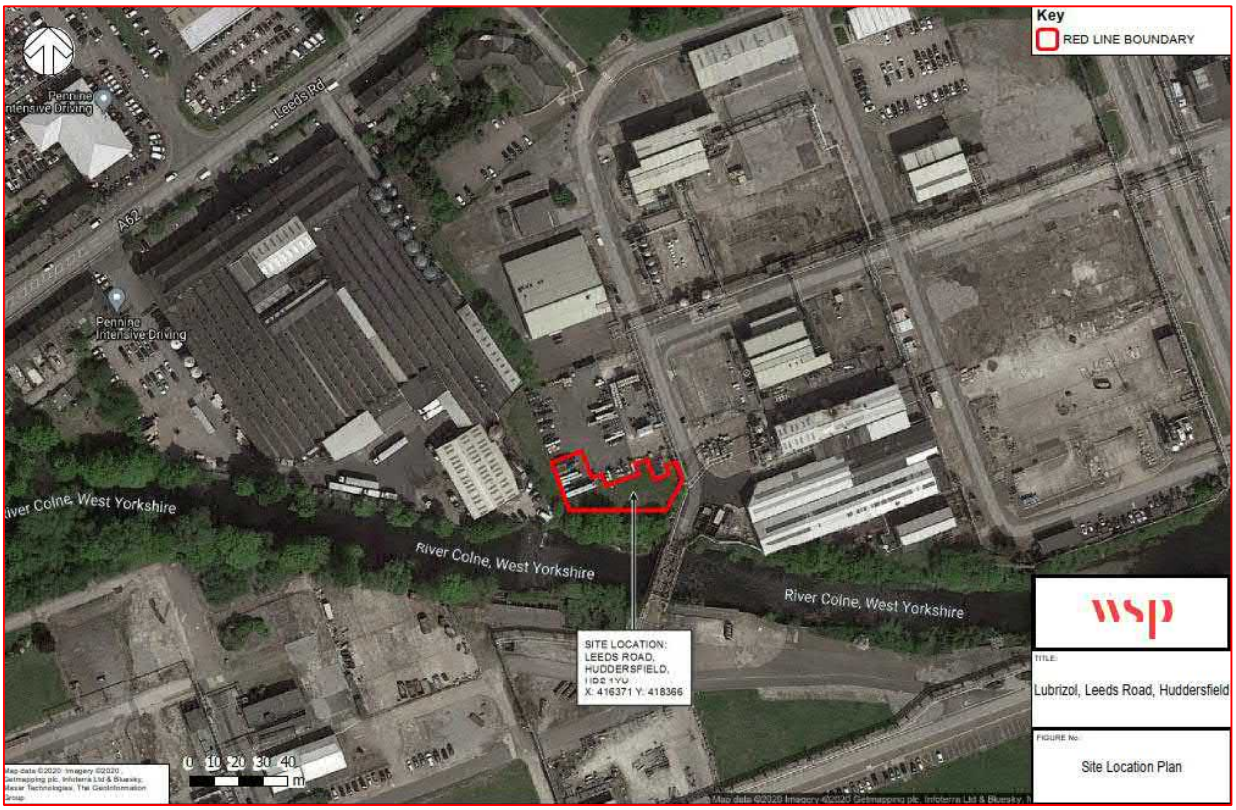
2.1.1. The Proposed Development is located beside the existing Lubrizol operation site within the Syngenta Huddersfield Manufacturing Centre on Leeds Road, Huddersfield. The Site is bound by existing buildings to the east and west and the River Colne lies to the south. There is an access road to the east and hardstanding storage area to the north. The OS Grid Reference for the approximate centre of the Site is National Grid Reference 416370, 418365.

## 2.2. SITE DESCRIPTION

2.2.1. The Site comprises an area of 0.094 hectares (ha) and currently consists of a hardstanding storage area and undeveloped landscape. Refer to **Figure 1** and **Appendix A** for an Indicative Site Location Plan.

2.2.2. The Site is generally flat with levels along the eastern boundary ranging from approximately 54.42 m AOD to 54.57m AOD. Levels in the centre of the Site are approximately 54.30m AOD. Levels in the west of the Site are approximately 53.96m AOD. Refer to **Appendix B** for a copy of the Topographical Survey.

**Figure 1 - Indicative Site Location Plan**



## 2.3. FLOOD RISK

2.3.1. From the EA online flood mapping and Kirklees Council's SFRA, the Site is located in Flood Zone 3a (**Figure 2**).

2.3.2. Flood modelling results from the River Colne & Holme Flood Mapping Study were provided by the EA (**Appendix D**) and are summarised in the table below. Depth grids for the model were not available and modelled levels with climate change were not provided by the EA.

**Table 2-1 – Modelled Flood Levels**

| Node Point | Flood Levels (2010 ASM Colne and Holme Undefended Model Results) | | |
|---|---|---|---|
| | 10% AEP (1 in 10) | 4% AEP (1 in 25) | 1% AEP (1 in 100) |
| COLN02_3373 | 55.33m AOD | 55.67m AOD | 55.94m AOD |

Flood levels taken from the River Colne & Holme Flood Mapping Study, Flood Estimation, Modelling and Floodplain Mapping report, produced by Jeremy Ben Associates in March 2006. Report was updated in 2010 to incorporate bank level data surveyed in 2009. The levels are for node COLN02_3373 which is the node nearest the site.
AEP – Annual Exceedance Probability

## 2.4. GEOLOGY AND HYDROGEOLOGY

2.4.1. The British Geological Survey (BGS) 'Geology of Britain' online maps indicate that the Site is situated on a bedrock of Pennine Lower Coal Measures Formation of mudstone, siltstone and sandstone. The Site is overlaid with superficial deposits of alluvium (clay, silt, sand and gravel).

2.4.2. Aquifer designation has been obtained from DEFRA's online Magic Map. Both the superficial deposits and bedrock for the entire Site are classified as Secondary A Aquifers. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

2.4.3. Source Protection Zones (SPZs) are defined around large and public potable groundwater abstraction sites. The purpose of SPZs is to provide additional protection to safeguard drinking water quality. According to the DEFRA's online Magic Map, the Site is not located within 500m of a Source Protection Zone.

2.4.4. Based on online Groundwater Vulnerability mapping, the Site is located within a medium-high risk category, based on the likelihood of a pollutant reaching the groundwater, the types of aquifer present and the potential impact.

## 2.5. EXISTING WATERCOURSES, FLOOD DEFENCES AND STRUCTURES

2.5.1. The River Colne, classed as a 'Main River' by the EA, flows west to east adjacent to the northern boundary of the Site. OS mapping identifies a weir upstream and a bridge crossing on the downstream end of the River Colne as it passes the Site.

2.5.2. The Lees Beck / Fenay Beck, classed as a 'Main River' by the EA, flows south to north discharging into the River Colne downstream of the Site. Sections of the beck are culverted upstream of its discharge point to the Colne.

2.5.3. Blackhouse Dike, classed as a 'Main River' by the EA, flows north to south discharging into the River Colne upstream of the Site. Sections of the river are culverted before its discharge to the Colne.

2.5.4. A covered "service reservoir" is located to the south of the Site, within the wider Syngenta Manufacturing Centre site.

2.5.5. The Huddersfield Broad Canal flows west to east to the north of Leeds Road.

2.5.6. A pond is located to the northeast of the Site, where the A62 highway crossed over the canal.

2.5.7. The online EA Flood Zone map indicates there are no EA maintained flood defences located within the vicinity of the Site. EA asset records (**Appendix D**) identify an EA maintained flood control gate structure downstream of the point where Fenay Beck joins the River Colne A length of third party maintained flood defence high ground is identified on the assets map on the northern riverbank of the river as it passes the site.

## 2.6. EXISTING SEWERS/ DRAINAGE

2.6.1. The topographical survey identifies on-site drainage information and private drainage within the wider Syngenta site. The existing drainage is identified on the Catchment Area Plan in **Appendix E**.

- The existing hardstanding area is drained by a channel drain running along its eastern edge. This connects to a 300mm diameter surface water sewer located below the access road which discharges to the River Colne.
- There is a 225mm diameter combined water drain running south to north below the access road, connected to the wider site private drainage network.
- The two bunded sump areas and a storage area to the east are connected to the existing combined water site wide drainage network.

2.6.2. There are no Yorkshire Water public sewers in the vicinity of the Site.

## 2.7. HISTORIC FLOODING

2.7.1. Historic Flood Mapping (SFRA) does not identify any DG5 Register incidents (Yorkshire Water Services) or Breaches/Overtopping (Canal & River Trust) in the vicinity of the site.

2.7.2. The EA response confirmed no known flood history for the site but included some flood history information for areas both upstream and downstream of the site along the River Colne. The historic flood map and data is included in Appendix D.

2.7.3. Syngenta and Lubrizol maintain a register of flood warnings and events and the Syngenta FRA identifies records from nine incidents between November 2000 and July 2012. Although the wider site is prone to flooding, the Site has not experienced any flooding due to its location on higher ground. In the last ten years Lubrizol recorded four major flood events (classed as 1 in 100 year floods) and confirmed that not one affected the Site.

2.7.4. The existing Lubrizol site Flood Procedures document lists the following historical flood data:

- Lubrizol Huddersfield last flooded in July 2012
- The highest water level recorded was 54.4 (3.4) metres
- It took 7 hours to reach full flood warning at 53.0 (2.0) metres.
- It took 11 hours to rise from 51.4 (0.4) metres to its peak of 54.4 (3.4) metres.
- Its peak rate rise was 0.5 metres/hour

## 2.8. EXISTING FLOOD RISK MANAGEMENT MEASURES

2.8.1. Lubrizol lies within the Syngenta Huddersfield Manufacturing Centre which operates and maintains the wider site's private drainage infrastructure and flood risk management measures. The wider site lies in flood zone 3 and Syngenta have implemented a number of active and passive mitigation measures over the years to make the site resilient to flooding.

2.8.2. Linked to this, Lubrizol have an established range of specific measures in place to manage flood risk:

**Early Warning System**

2.8.3. The early warning system is based on EA monitored river levels for the River Colne found at https://flood-warning-information.service.gov.uk/station/8105. The following key information is included in the Lubrizol Flood Procedures document:

- Station name: ICI Colne (ID 8105)
- Site Datum = 50.98m AOD (figure in brackets should be added to the EA river level)
- Typical Range / Level = 0.15m to 1.97m (+50.98m)
- Syngenta will raise an Initial Flood warning at 52.50m AOD (1.5m)
- Syngenta will initiate a Full Flood warning at 53.00m AOD (2.0m)
- Lubrizol will flood at >54.00m AOD (3.0m)

2.8.4. Lubrizol Huddersfield are signed up to the Environment Agency Flood Alert email system with Shift Leaders receiving updates directly.

**Emergency Procedures**

2.8.5. The levels above trigger actions to ensure critical infrastructure is protected, flood sensitive stored materials are protected or moved to safer locations, and staff are evacuated before the flood waters reach the affected areas.

2.8.6. The procedures have been developed by Lubrizol, in collaboration with Syngenta, drawing upon their experience of operating with this flood risk over many years and are continually reviewed and updated with lessons learned. Protocols from the Lubrizol Flood Procedures document (June 2020) will be applied to the proposed development and extracts are summarised in the table below.

**Table 2-2 - Extract from Lubrizol Flood Procedures document (June 2020)**

| **Initial Flood Warning at 52.50m (1.5m)** | |
|---|---|
| Tasks | ▪ Lift raw materials<br>▪ Lift Cardboard Kegs<br>▪ Check materials on compound are secure, tape empty drums together<br>▪ Lift finished goods, load onto trailer<br>▪ Check (chemical) storage, move all bags to top shelves (or 1st floor)<br>▪ Empty effluent sump<br>▪ Review current batches and ensure no new batches are started<br>▪ Elevate lab equipment<br>▪ Consult with office staff about electrical equipment<br>▪ Liaise with Syngenta staff (on radio)<br>▪ Ensure relevant flood defence barriers are fitted |

| Syngenta issue Full Flood Warning at 53.0m (2.0m) | |
|---|---|
| Tasks | ▪ Ensure all non-essential staff & visitors are evacuated from site<br>▪ Move remaining cars to Syngenta external car park<br>▪ Power down plant<br>▪ Stop and depressurise packing lines<br>▪ Close plant doors<br>▪ Isolate electrical equipment<br>▪ Essential staff to move to a safe area and wait for further instructions via Syngenta |
| **Flood Handover for Oncoming Shift** | |
| Tasks | Ensure flood handover documentation is completed for oncoming shift with status of plant and details of flood information:<br>▪ time of initial flood warning<br>▪ time of full flood warning<br>▪ time the plant flooded<br>▪ highest flood level reached<br>▪ time Syngenta removed flood warnings |
| **Flood Warning All Clear** | |
| Notes | ▪ Flooding will leave behind a lot of debris and contamination. It is important consideration is given to the potential hazards of the materials left behind.<br>▪ Floodwater can be contaminated with chemicals and sewage as a result of effluent drains overflowing. Contaminated floodwater can create risks to health. Protective clothing should be worn during the clean-up operation and other hygiene precautions should be taken.<br>▪ After the floodwater has subsided no attempt must be made to restart electric motors, which have been submerged. Before re-starting any of the processes the Process Engineer and Production Manager must be consulted |

# 3. THE PROPOSED DEVELOPMENT

## 3.1. SUMMARY

3.1.1. The Proposed Development comprises the construction of a new industrial building and associated storage yard for Lubrizol Ltd. The proposed development plan is included in **Appendix C.**

3.1.2. The Site is identified in an area of the Local Plan allocated as “Priority Employment Area” and does not fall within a Critical Drainage Area (CDA).

## 3.2. VULNERABILITY CLASSIFICATION

3.2.1. Considering the scale of the Site and based on Table 2 in the PPG, the Proposed Development will have uses which are classified as ‘less vulnerable’.

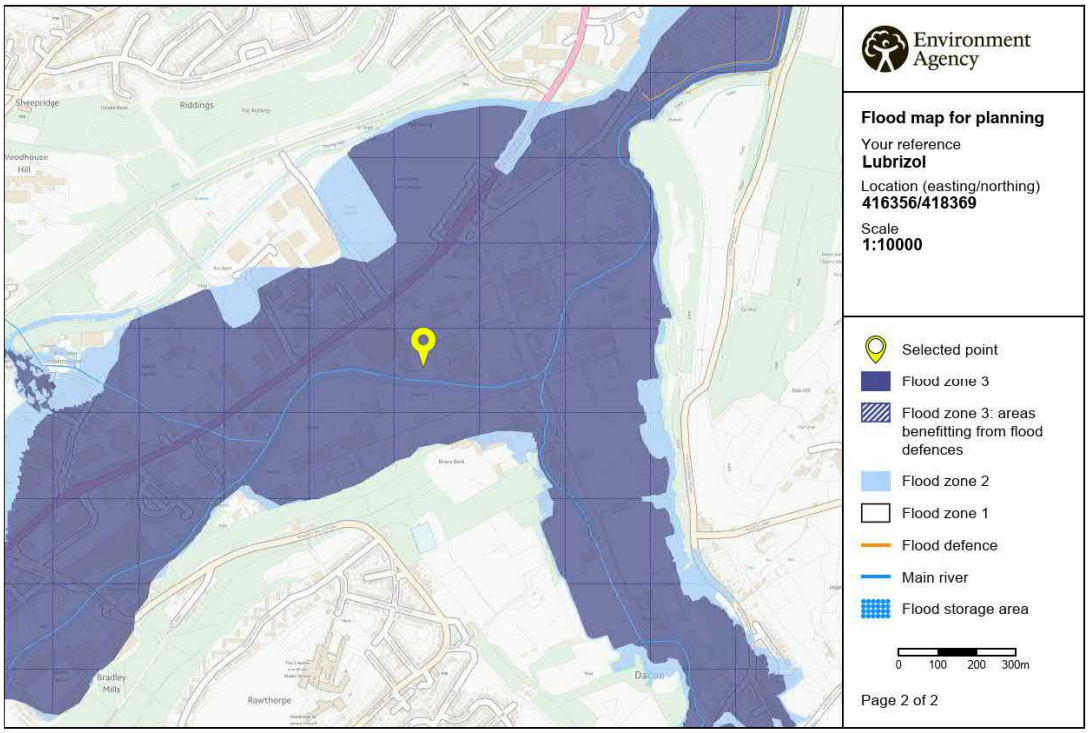
## 3.3. SEQUENTIAL AND EXCEPTION TESTS

3.3.1. As stated in the NPPF, a sequential risk-based approach to determine the suitability of land for development in flood risk areas should be applied at all stages of the planning process giving precedence to low flood risk areas wherever possible.

3.3.2. The wider site lies within Flood Zone 3 and the Proposed Development has been sited on an area of land which is slightly higher and at lower risk of flooding.

3.3.3. The Site is in Flood Zone 3a (**Figure 2**) and based on the NPPF flood risk vulnerability and flood zone compatibility table, Table 3 in the PPG, the development is considered appropriate and automatically meets the requirements of the sequential test.

**Figure 2 - Flood Map for Planning**

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# 4. DEFINITION OF FLOOD HAZARD

## 4.1. SOURCES AND MECHANISMS OF FLOODING

4.1.1. Reference to Kirklees Council's SFRA, SWMP, LFRMS and the PFRA is made, where appropriate, in the following sections and relevant maps are included in **Appendix D**.

4.1.2. References to correspondence with Kirklees Council and the EA are made in the following sections and copies are included in **Appendix D**.

## 4.2. FLUVIAL FLOODING

4.2.1. Based on the online GOV.UK Flood Map for Planning and Flood Risk Map J of Kirklees SFRA (**Appendix D**), the Site is located in Flood Zone 3a (high probability) where the probability of river flooding is greater than 1% (1 in 100 or greater chance) in any given year.

**Table 4-1 – Modelled Flood Depths**

| | 10% AEP (1 in 10) | 4% AEP (1 in 25) | 1% AEP (1 in 100) |
|---|---|---|---|
| Flood Levels COLN02_3373 | 55.33m AOD | 55.67m AOD | 55.94m AOD |
| Flood Depth at 54.50m AOD (building entrance) | 0.83m | 1.17m | 1.44m |

Flood levels taken from the River Colne & Holme Flood Mapping Study, Flood Estimation, Modelling and Floodplain Mapping report.
AEP – Annual Exceedance Probability
Climate change modelled levels not available

4.2.2. A formal flood risk enquiry response from the EA has been received as well as consultation comments from the EA and LLFA, which have been addressed in this report.

4.2.3. Any construction within 8m of a main river will require permission from the EA but no works are proposed within this zone.

4.2.4. Based on the information available, the probability of fluvial flooding is assessed as **high**.

## 4.3. GROUNDWATER FLOODING

4.3.1. Groundwater flooding is caused by the emergence of water originating from underground.

4.3.2. The Environment Agency's national dataset, Areas Susceptible to Groundwater Flooding (AStGWF), is used to assess the future risk of groundwater flooding. The AStGWF map uses four susceptible categories to show the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. From the AStGWF Map J of Kirklees SFRA (**Appendix D**) the risk of groundwater emergence is between 50% and 75%.

4.3.3. Based on the information available and the assessment undertaken, it is considered that the risk from groundwater flooding is **low to medium** as there are no records of groundwater flooding occurring on the Site.

## 4.4. SEWER AND DRAINAGE FLOODING

4.4.1. The risk of flooding to the site from overloaded sewers and surrounding drainage is dependent on the hydraulic capacity, operational / maintenance requirements and topography in relation to the site.

4.4.2. There are no Yorkshire Water public sewers within the vicinity of the site.

4.4.3. The wider Syngenta site is served by a private network of surface water and combined water drainage which is operated and well-maintained by Syngenta. The surface water system outfalls to the River Colne while the combined water network discharges to the public sewers on Leeds Road via a pumped system.

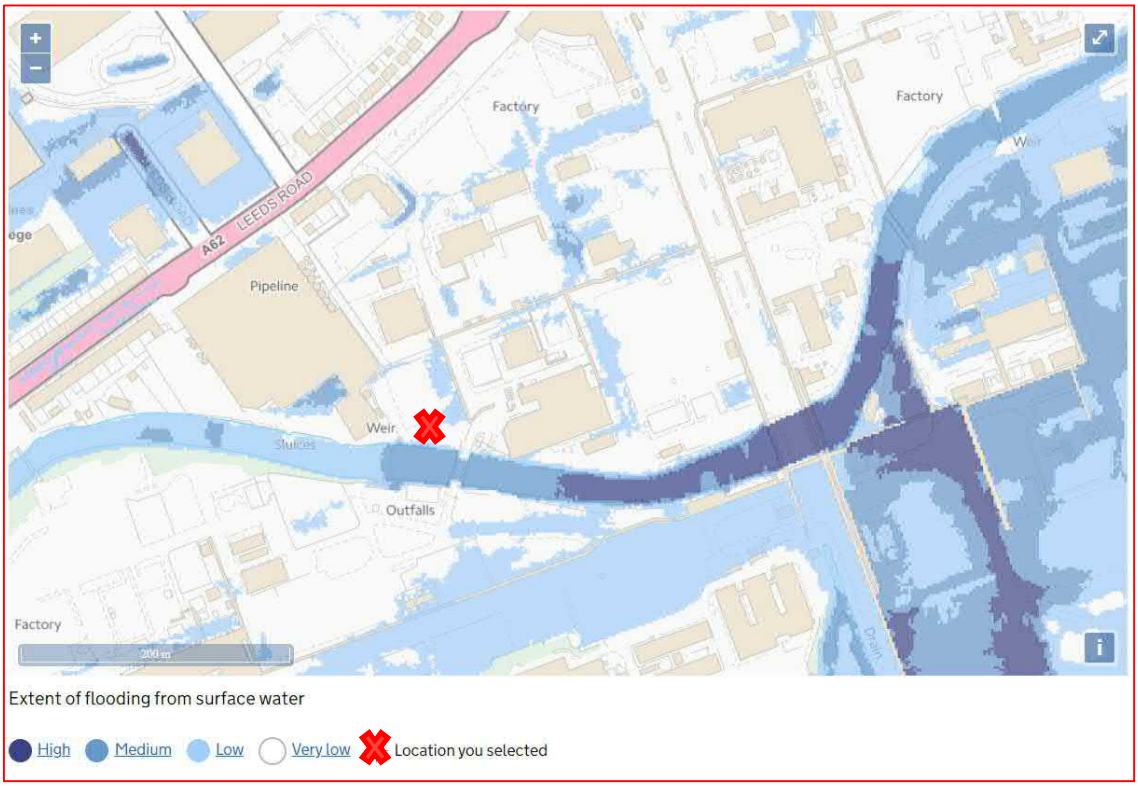
4.4.4. There are minor flood issues associated with capacity of the sewers and pumping station identified in the Syngenta FRA and the probability of sewer flooding impacting the Site is assessed as **medium**.

## 4.5. SURFACE WATER FLOODING

4.5.1. The online GOV.UK Long Term Flood Risk Map (**Figure 3**) corresponds with the updated Flood Map for Surface Water (uFMfSW) Map J from Kirklees SFRA (**Appendix D**). The Proposed Development is in an area at very low risk (less than 0.1%) of surface water flooding. There are two small localised areas of low risk (between 0.1% and 1%) to the east of the Site which are associated with nearby existing bunded storage areas.

4.5.2. Based on the available information, the probability of surface water flooding is assessed as **very low.**

**Figure 3 - Flood Risk from Surface Water extract**



## 4.6. FLOODING FROM OTHER SOURCES

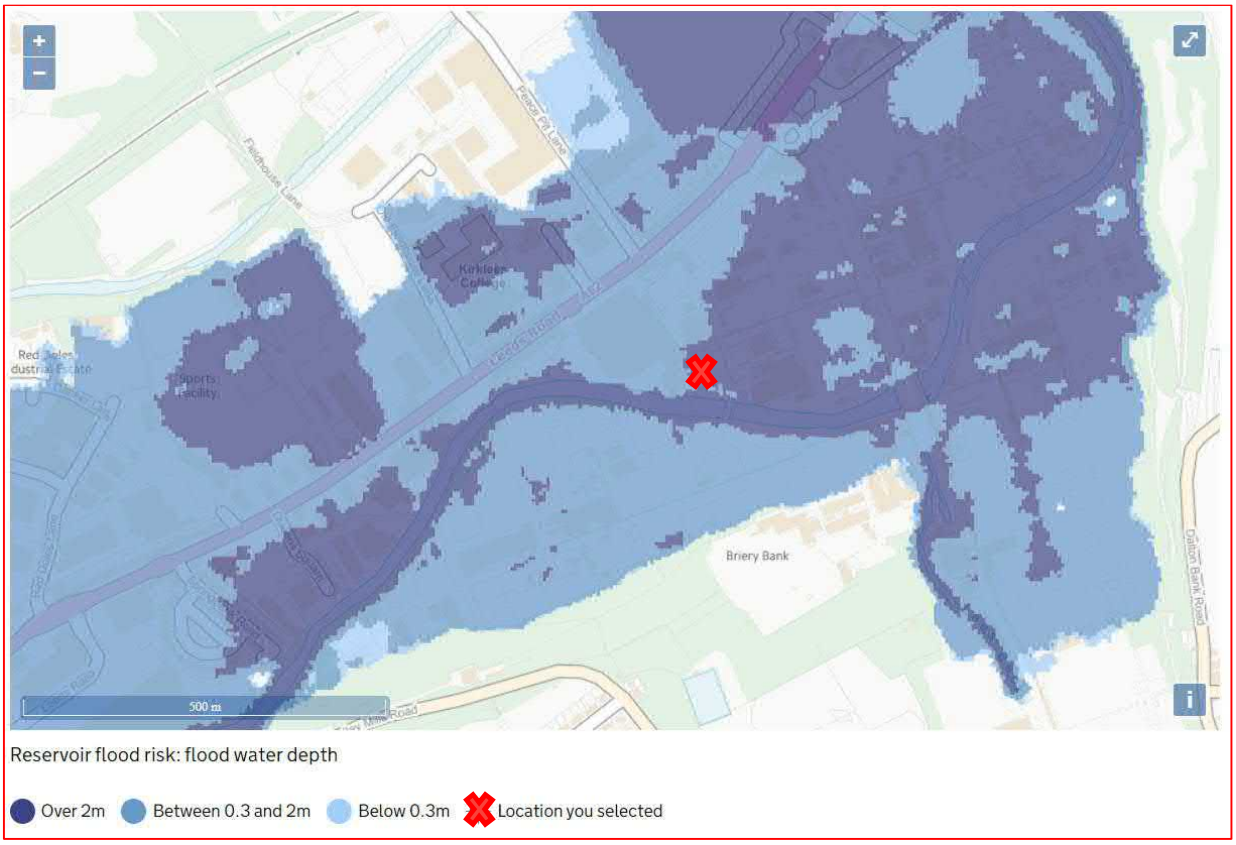
4.6.1. Non-natural or artificial sources of flooding can include reservoirs, lakes, canals, bridges, etc. The potential effects of flood risk management infrastructure and other structures also needs to be considered.

4.6.2. According to the online GOV.UK's Long Term Flood Risk Map, the Site lies within the maximum extent of flooding from reservoirs (**Figure 4**). This mapping shows the largest area that might be flooded if a reservoir were to fail and release the water it holds.

4.6.3. The likelihood of reservoir flooding is much lower than other forms of flooding. The mapping displays the effects of catastrophic failure from reservoirs that hold at least 25,000m$^3$ of water and illustrate a worst-case scenario (i.e. consequence based) rather than a prediction of what will happen (i.e. risk based reflecting both consequence and hazard).

4.6.4. All the larger surrounding reservoirs are controlled, maintained and inspected by a regulated body in the form of either Yorkshire Water Services or the Canal & River Trust. Current reservoir regulation aims to make sure that all reservoirs are properly maintained and monitored in order to detect and repair any problem. These reservoirs are therefore not considered likely to provide a significant flood risk to the site.

**Figure 4 - Extent of Flooding from Reservoirs**




4.6.5. Other artificial sources of flooding which have the potential to cause flooding on the Site are culvert and structural blockages. The culverted sections of the EA main rivers, Lees Beck and Blackhouse

Dike, and the foot and road bridges that cross the river have the potential to become blocked and cause the rivers to “back-up” and flood the Site.

4.6.6. Based on the available information, the probability of flooding from artificial sources can be assessed as **low.**

# 5. CLIMATE CHANGE

## 5.1. BACKGROUND INFORMATION

5.1.1. The Climate Change Adaptation Sub-Committee Progress Report 2014 explained that increased flood risk is the greatest threat to the UK from climate change. More frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. Sea levels are also expected to continue to rise.

5.1.2. New EA guidance "Flood risk assessments: climate change allowances" issued in 2016 and updated on 15th February 2019 provides up to date information on expected changes in rainfall, river flows and sea level rise as a consequence of climate change.

5.1.3. A key change from the previous guidance is that the climate change allowances for peak river flows now are shown as variable on a regional basis. These allowances are detailed in Table 1 (peak river flow allowances by river basin district) of the EA guidance.

5.1.4. For peak rainfall the EA guidance provides an upper end and central allowance depending on epoch; the guidance recommends assessing both the central and upper end allowances to understand the range of possible impacts. These allowances are detailed in Table 2 (Peak rainfall intensity allowance in small and urban catchments) of the EA guidance.

## 5.2. DEVELOPMENT LIFESPAN

5.2.1. A typical lifespan for a commercial development is 60 years.

5.2.2. Based on this and Table 2 of the EA guidance, the contingency peak rainfall allowances for climate change that are potentially applicable to this Site are:

- Upper End – 40% increase in peak rainfall by 2115;
- Central – 20% increase in peak rainfall by 2115.

5.2.3. Kirklees Council's minimum requirement for peak rainfall intensity is a 30% allowance.

5.2.4. In terms of peak river flows, the upper limit 65% climate change is applicable, following the EA's advice.

5.2.5. For less vulnerable development, the higher central allowance of 30% is used as the basis for designing safe access, escape routes and places of refuge. This ensures the safety of people using the Proposed Development.

## 5.3. IMPACT OF CLIMATE CHANGE ON THE PROPOSED DEVELOPMENT

5.3.1. The Site is located within Flood Zone 3a where the probability of fluvial and tidal flooding is greater than 1% in any year.

5.3.2. Surface water runoff could represent a risk to the Proposed Development, especially when the effects of climate change are considered. A drainage strategy has been produced as part of this application which takes into account the potential impact of climate change.

5.3.3. The drainage strategy demonstrates that the drainage network at the Site is designed to accommodate runoff during all events up to and including the 100 year plus 30% climate change allowance.

# 6. FLOOD RISK MANAGEMENT AND MITIGATION MEASURES

6.1.1. This section of the report details the flood risk mitigation measures required to manage the identified risk of flooding from different sources. As discussed in the previous sections, the main potential source of flooding identified that has a reasonable probability of affecting the Site, based on the information collected, is fluvial flooding.

6.1.2. The measures below include a range of design and management solutions including providing safe access and egress and implementing a drainage strategy in line with best practice.

## 6.2. EXISTING FLOOD RISK MITIGATION MEASURES

6.2.1. The wider site lies in flood zone 3 and already operates an established protocol to manage flood risk. Lubrizol has developed their own Flood Procedures document specific to their site detailing a number of flood risk measures which are outlined in section 2.8. It is proposed that these measures will be developed to extend to the Proposed Development.

6.2.2. The specific measures outlined below are based on current practice on the existing Lubrizol site and will also be adopted for the Proposed Development:

- The building will have kerb height bunding to the perimeter, but the lower part of the clad wall elevations will stop short of this kerb leaving free ventilation and a potential flow route.
- Internal storage will be on pallets, similar to the existing external storage of the same products.
- The office area will have all worktops, fittings and power supply fixed at higher levels for the protection of the limited items needed for the management of the building.
- Robust flood procedures to mitigate the possibility of chemicals reaching the river are in place.

## 6.3. FLOOD RESILIENCE

6.3.1. Flood resistance, or dry proofing, stops water entering a building. Flood resilience, or wet proofing, accepts that water will enter the building but, through careful design, will minimise damage and allow the re-occupancy of the building quickly.

6.3.2. The Proposed Development is classed as less vulnerable and is proposed to be developed with flood resilience measures in place to allow water entry. The scheme where applicable will aim to comply with the Defra guidance on Improving the Flood Performance of New Buildings, so that the ground level, can quickly recover from flood events. The measures already in place at the existing Lubrizol site will be applied at the proposed building.

## 6.4. FLOOD COMPENSATION AND DISPLACEMENT

6.4.1. Raising finished floor levels, which is primarily a flood resistance measure applied to residential uses, would require levels to be raised to the design storm level (including climate change allowance) plus a freeboard allowance. In flood plain developments, this practice has the effect of displacing flood water which potentially causes more flooding in downstream locations.

6.4.2. To ensure the development does not increase the risk of flooding elsewhere, the proposed ground levels on site will not be altered with any land raising, this is to ensure flood waters will continue to convey as they currently do.

6.4.3. All ground level walls will have openings/grills at the base to allow water to freely enter the building which consists of storage areas.

6.4.4. The proposed ground level footprint will then have a minor effect on displacement of flood water with no adverse effect on downstream flooding.

## 6.5. INTERNAL AND EXTERNAL EVACUATION ROUTES

6.5.1. As part of the site-specific flood measures in place, Lubrizol is already signed up to the EA flood warning service in order to be alerted when flooding on site may be possible. Following the flood procedures guidance for the site, which has systems in place, will ensure that occupants and managers on site can take the necessary actions to ensure people remain safe.

**FLOOD HAZARD RATING**

6.5.2. Flood Hazard describes the flood conditions in which people are likely to be swept over in a flood with the possibility of drowning and is a combination of flood depth, velocity and the presence of debris. Danger to people is assessed using flood hazard in accordance with the methodology and guidance set out by Defra (FD 2321/TR2 (2006)) and supplementary guidance note by the Environment Agency and HR Wallingford (May 2008). The following equation is used with categorisations in the table below:

**HR = [ d x (v + n) ] + DF**

where:-

HR = (flood) hazard rating

d = depth of flooding (m);

v = velocity of floodwaters (m/sec); and

DF = debris factor = 0.5 (conservative approach for urban environment)

n = a constant of 0.5

**Table 6-1 - Hazard to People**

| Hazard Rating | Hazard Category | Description |
|---|---|---|
| <0.75 | Low | Caution |
| 0.75–1.25 | Moderate | Dangerous for some (including children, the elderly and the infirm) |
| 1.25–2.5 | Significant | Dangerous for most people – includes the general public |
| >2.5 | Extreme | Dangerous for all – includes the emergency services |

Table 3.2 in FD2321/TR1

6.5.3. Based on the above and interpolated model values, the hazard rating at the site ranges from significant to extreme. However, with the established procedures in place, the risk is mitigated as all non-essential staff and visitors will be evacuated from site when a full flood warning is issued and essential staff are moved to a safe area.

## 6.6. SURFACE WATER DRAINAGE STRATEGY

6.6.1. The development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and a consequent potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure. It is essential for any new development that surface water is managed effectively to limit the risk off-site as well as on site.

6.6.2. Best practise for the management of surface water based on Building Regulations 2010 Part H states that surface water runoff from a site shall discharge to one of the following in order of priority:

- An adequate soakaway or some other adequate infiltration system;
- A watercourse; and
- Sewer.

6.6.3. In the absence of a ground investigation being carried out, the feasibility of draining the surface water via infiltration is strictly unknown. The choice of system will be determined by local ground conditions (including groundwater levels). Whilst infiltration SuDS may be the most suitable for new development, the risk of contamination to underlying aquifers must also be considered.

6.6.4. Kirklees Council Flood Risk team have confirmed that due to its proximity to the watercourse and BGS rating of level 4 (severe constraints for infiltration), it is considered unlikely that infiltration will be suitable for the Site. Discharge will therefore be to the River Colne.

6.6.5. As the Site was previously developed, the drainage strategy will aim for a reduction in surface water runoff rate of at least 30% for Brownfield sites up to a 1 in 100 year storm event, considering climate change. A Catchment Area Plan identifying existing drainage and calculating the allowable discharge rate is included in **Appendix E**. Based on an existing positively drained area of 406m$^2$, an allowable discharge rate of 4.0 l/s has been calculated and agreed with Kirklees Council.

6.6.6. Attenuation storage will be required to control surface water runoff from the Site. Based on a proposed impermeable area of 943m$^2$, the storage required for the 100 year + 30% climate change critical storm event is approximately 33m$^3$ (**Appendix E**). Outfall will be via a connection to the existing on-site drainage network discharging to the River Colne.

6.6.7. The Proposed Development surface water drainage will be designed so that there is no flooding to the development in a 1 in 30 year event and so that there is no property flooding in a 1 in 100 year plus climate change event.

6.6.8. Although the above strategy identifies the general principles of surface water drainage management at the Site, assumptions and design solutions proposed will need to be re-assessed at the detailed design stage and any necessary approvals sought.

# 7. OFFSITE EFFECTS

## 7.1. INTRODUCTION

7.1.1. The surface water drainage strategy has been developed to demonstrate that the drainage network at the Site can accommodate runoff during all events up to and including the 100 year plus 30% climate change allowance and therefore prevents potential exceedance flows off-site.

## 7.2. PRIVATE DRAINAGE NETWORK

7.2.1. Lubrizol Ltd have confirmed that the private drainage networks will be able to accommodate the proposed flows for both foul and surface water discharge from the Proposed Development.

## 7.3. FLUVIAL EFFECT

7.3.1. The development will not cause effects elsewhere in terms of fluvial flood risk due to its flood resilient construction.

7.3.2. Any local detrimental impact would only affect the existing Lubrizol manufacturing plant located downstream of the Proposed Development.

# 8. CONCLUSIONS

8.1.1. This FRA and ODS has been prepared on behalf of Lubrizol Ltd to support the planning application for a new building and associated storage yard.

8.1.2. The Kirklees Council SFRA and the online GOV.UK Flood Map for Planning identify that the Site is located in Flood Zone 3a where the probability of river or sea flooding is greater than 1% (1 in 100) chance in any given year. The probability of or fluvial flooding can therefore be assessed as high.

8.1.3. Other potential sources of flooding have been investigated and based on the available information it is considered that the most significant flood risks to the Site are from fluvial flooding (from the River Colne and Lees Beck) and surcharged sewer flooding.

8.1.4. Surface Water could in theory be a source of flood risk due to the localised flood risk spots present to the east of the Site. This however will be mitigated by the design of a drainage strategy which demonstrates the ability to accommodate surface water runoff during all events up to and including the 100 year plus an appropriate climate change allowance to prevent potential exceedance flows off-site.

8.1.5. Based on the high risk of fluvial flooding, Lubrizol need to ensure that the site is resilient to flooding; flooding will not lead to contamination of the River Colne, staff and visitors accessing the site will be safe and production is not unduly disrupted by flooding.

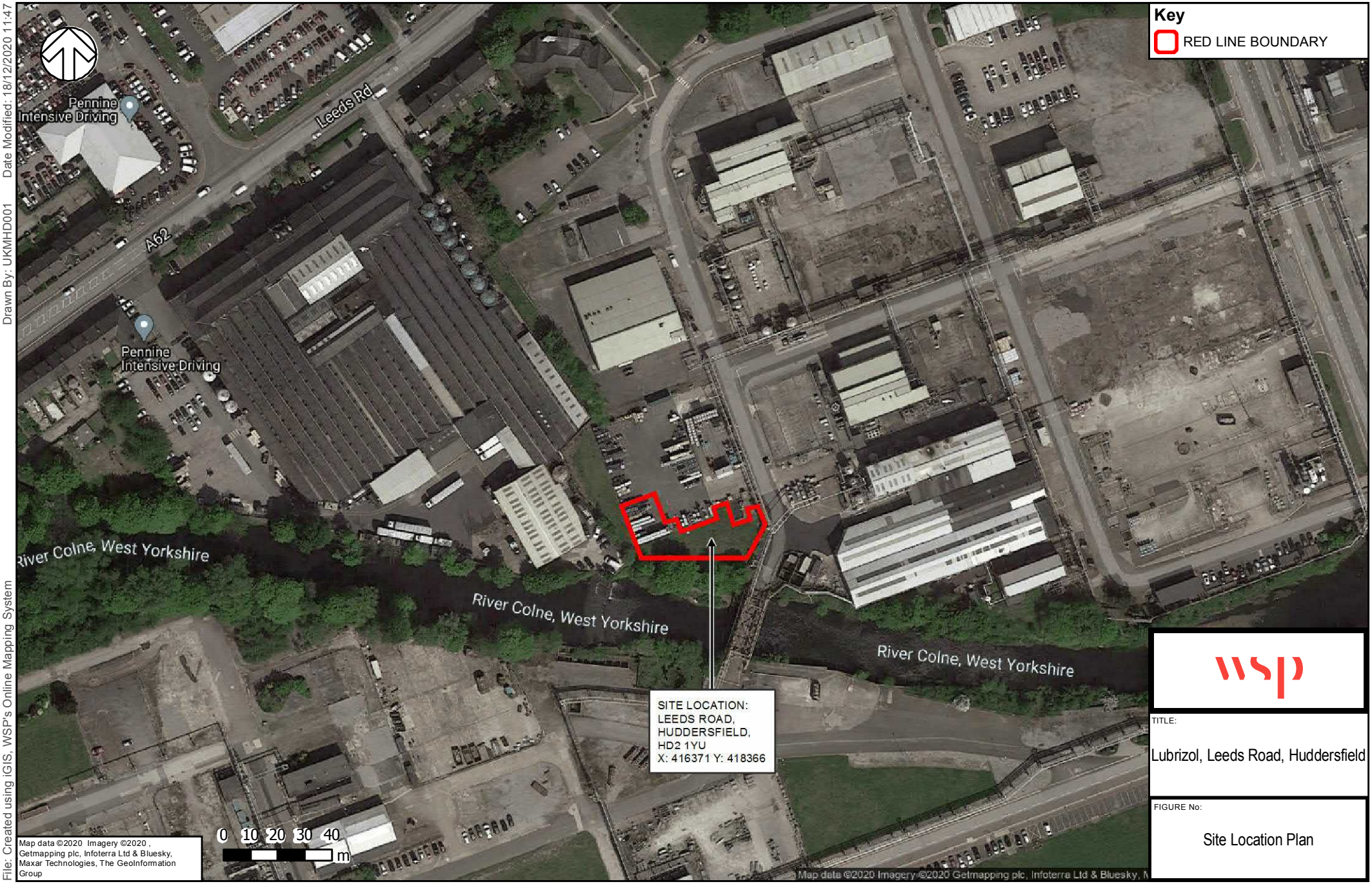
8.1.6. Provision of defences to contain flood water from the River Colne and Lees Beck is not an option due to the consequential increase in risk of flooding off-site. Therefore, Lubrizol have adopted the existing site strategy established across the wider site to manage the on-site flood risk to ensure the site is resilient to flooding which includes:

- An early warning system to provide sufficient notice of flooding to take appropriate action.
- Identification of the level of risk in areas of the site.
- Established emergency procedures to protect vulnerable infrastructure and materials from damage or causing contamination.
- Relocation of vulnerable infrastructure and materials out of flood zones if practicable.
- Ensuring the evacuation and safe access/egress of staff and visitors to the site.
- Flood resilience in the form of raised infrastructure above the highest flood level and flood resilient forms of construction.

8.1.7. Incorporating these measures in the proposals will ensure that the facility is suitably resilient to flooding with no off-site impacts.

# Appendix A

## SITE LOCATION PLAN




wsp

TITLE:

Lubrizol, Leeds Road, Huddersfield

FIGURE No:

Site Location Plan

File: Created using iGIS, WSP's Online Mapping System Drawn By: UKMHD001 Date Modified: 18/12/2020 11:47

# Appendix B

## TOPOGRAPHICAL SURVEY




## Location Plan

Scale 1:1000

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Survey Control Co-ordinates

| Reference | East | North | Elevation | Description |
|---|---|---|---|---|
| GPS106 | 416398.751 | 418363.763 | 54.12 | Survey Station |
| GPS107 | 416375.278 | 418419.984 | 54.20 | Survey Station |
| H01 | 416352.648 | 418408.268 | 54.21 | Survey Station |
| H02 | 416354.715 | 418361.260 | 54.37 | Survey Station |
| H03 | 416345.957 | 418357.634 | 54.56 | Survey Station |
| H04 | 416335.446 | 418385.126 | 54.48 | Survey Station |
| H05 | 416397.840 | 418379.780 | 53.98 | Survey Station |
| H06 | 416404.055 | 418355.956 | 54.14 | Survey Station |
| H06A | 416420.796 | 418370.357 | 54.04 | Survey Station |
| H06B | 416419.735 | 418349.186 | 53.97 | Survey Station |
| H07 | 416387.689 | 418334.895 | 55.41 | Survey Station |
| H08 | 416381.726 | 418316.246 | 55.42 | Survey Station |
| STN107 | 416367.692 | 418267.770 | 55.23 | Survey Station |

## Site Control Information

Grid Orientation:

Survey related to Ordnance Survey "OSGB36" at control point GPS01 realtime correction received via Leica Geosystems "Smart Net" service.

Level Datum:

OS Orthometric hts

## Control & Datum Information

Co-ordinates and levels are based upon OSGB 1936 National Grid (OSGB36) and Ordnance Survey Datum Newlyn (ODN).

They are derived using realtime on site GPS survey, that utilises the National Grid Transformation OSTN15GB and the National Geoid Model OSGM15GB.

The data obtained for use in this drawing involved the use of realtime GPS survey and total station survey.

Contours are shown at 0.5m intervals.

| Rev | Description | By | Date |
|---|---|---|---|
| | | | |

| Surv. | Drawn | Date | Chkd | Date |
|---|---|---|---|---|
| NH | NH | 14.07.20 | | |

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MARTIN WALSH ARCHITECTURAL

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Holden Surveys Ltd

Topographical Building & Site Surveys - CAD Services

T: 0773 4936469 E: holdensurveys@msn.com

Title. Site Plan

Site. Lubrizol
Leeds Rd
Huddersfield
West Yorkshire

COMPUTER GENERATED DRAWING - DO NOT ALTER

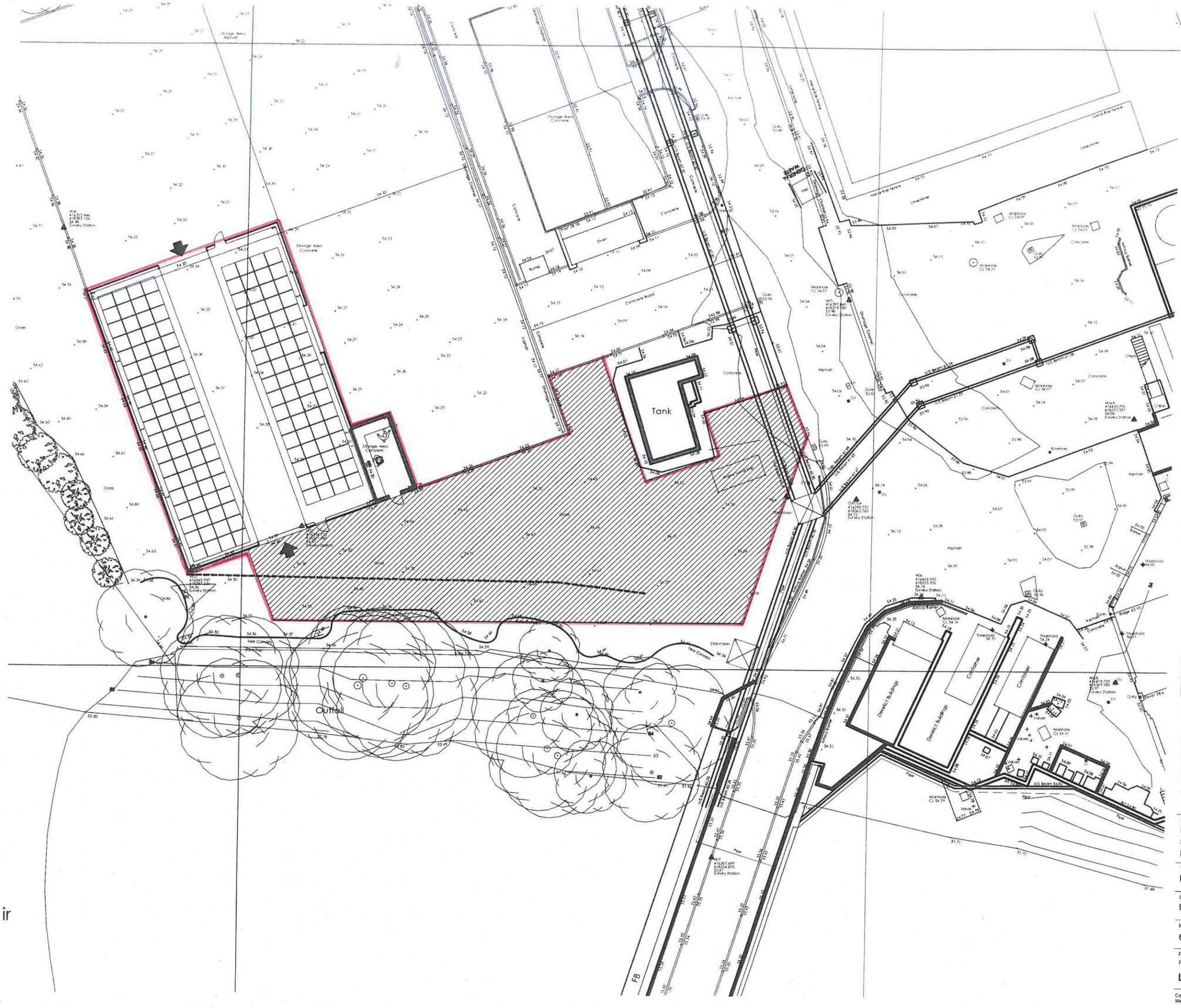
Dwg No. MWA_221_Lubrizol

Sheet No. 1

| SCALE | 1/200 | REV. | |
|---|---|---|---|

# Appendix C

## PROPOSED DEVELOPMENT PLAN


Tank
Outfall
Storage Area Concrete
Storage Area Asphalt
Concrete
Asphalt
Grass
Gully
Manhole
Drainage Channel
Tree Canopy
Stanchion
Pipe
Water (pond) Lvl
Container
Portakabin Buildings
Lime Hme
Asphalt Kerb
Threshold
Ridge
Valve
Water Main
Fence
Hedge
Brickwork
Steps
Slope
Kerb
Inlet
Chkr
Ramp
Bollard
Timber Fence
Metal Fence
Stone Wall
Concrete Base
Concrete Road
Asphalt Ramp
Asphalt Path
Asphalt Kerb
Concrete Kerb
Concrete Channel
Concrete Step
Concrete Slope
Concrete Wall
Concrete Pad
Concrete Plinth
Concrete Bollard
Concrete Ramp
Concrete Path

# Appendix D

## RELEVANT MAPS, DATA AND CORRESPONDENCE

# Flood map for planning

| Your reference | Location (easting/northing) |
| --- | --- |
| **Lubrizol** | **416356/418369** |

**Your selected location is in flood zone 3, an area with a high probability of flooding.**

## This means:

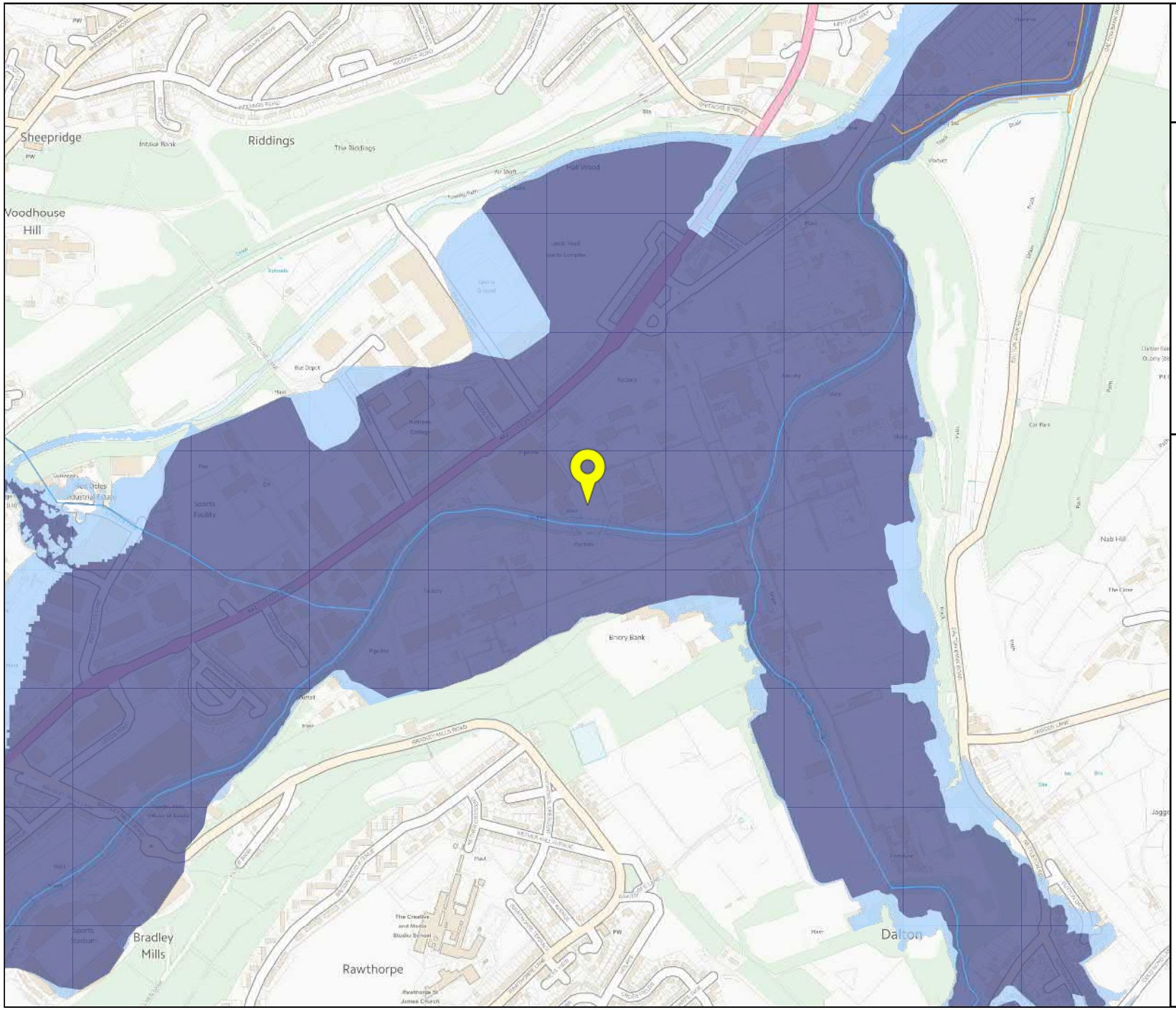
- you must complete a flood risk assessment for development in this area
- you should follow the Environment Agency's standing advice for carrying out a flood risk assessment (see www.gov.uk/guidance/flood-risk-assessment-standing-advice)

**Notes**

The flood map for planning shows river and sea flooding data only. It doesn’t include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

The Open Government Licence sets out the terms and conditions for using government data. https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/




Environment Agency

## Flood map for planning

Your reference
**Lubrizol**

Location (easting/northing)
**416356/418369**

Scale
**1:10000**

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

0 100 200 300m



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**RFI/2021/198301**

**The Flood Map for Planning**

**The Flood Map for Planning (Rivers and Sea) can be viewed and downloaded as a PDF file on GOV.UK by following this link:** https://flood-map-for-planning.service.gov.uk **or downloaded in GIS format under an open data licence from the following address**: https://data.gov.uk/publisher/environment-agency
Please type Flood Map for Planning in the search box.

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). The extent of flooding, and/or flood level information is only shown for those watercourses surveyed after the flood. Other flooding may have occurred which is not shown. This is the best information currently available.

| Name | Start Date | End Date | Flood Source | Flood Cause | Source of data |
|---|---|---|---|---|---|
| 2020 February Flood Incident - Storm Dennis | 15/02/2020 | 19/03/2020 | main river | channel capacity exceeded (no raised defences) | Visual |
| December 2015 Flood Event | 25/12/2015 | 29/12/2015 | main river | channel capacity exceeded (no raised defences) | Survey |
| 123 April1970 | 13/04/1970 | 13/04/1970 | main river | channel capacity exceeded (no raised defences) | Survey |
| 123 April1970 | 13/04/1970 | 13/04/1970 | main river | channel capacity exceeded (no raised defences) | Survey |

***Please note that this record doesn't include all of the flooding that may have occurred during and since February 2020. Given the process of recording, verifying and updating our record from major floods is extensive and may take a considerable amount of time.***

## 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 Colne & Holme - Flood Modelling**
The River Colne & Holme Flood Mapping Study, Flood Estimation, Modelling and Floodplain Mapping report was produced by Jeremy Ben Associates in March 2006. It was updated in 2010 to incorporate bank level data surveyed in 2009.

See enclosed:

- Model Nodes Location Map.

- Table showing modelled water levels and flows for the 1% (1 in 100), 1.3% ( 1 in 75), 2% (1 in 50), 4% (1 in 25) and 10% (1 in 10) Annual Exceedance Probabilities (AEP).
- Model Summary Sheets showing the results for the 0.1% Annual Exceedance Probabilities (AEP), as calculated in 2006. These were not updated in 2010.

Please note there are no depth grids currently available for this model.

Please note no breach scenarios were modelled for this study.

## Climate Change

Updated guidance on how climate change could affect flood risk to new development - 'Flood risk assessments: climate change allowances' was published on gov.uk on 19 February 2016. You should confirm the flood risk vulnerability classification and lifetime of your proposed development in line with NPPF and apply the appropriate climate change allowances.

## Bespoke Flood Risk Assessment (FRA) advice:

If the pre-application advice is required with regards the preparation of a site-specific Flood Risk Assessment, this can be requested via the Yorkshire Sustainable Places team (email: sp-yorkshire@environment-agency.gov.uk). Charges may apply for any advice that is provided, this currently stands at £100 per hour per person. The .gov.uk pages provide a good starting point on what to include within a site-specific Flood Risk Assessment and can be accessed via https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications. A site-specific Flood Risk Assessment will need to consider flood risks from all sources, including those associated with defence failure (e.g. breach) and accounting for the predicted impacts as a result of climate change. Please contact the Sustainable Places team if you require advice on how to include these within a Flood Risk Assessment.

## Other

## Surface Water Map

Lead Local Flood Authorities (LLFA) are responsible for managing local flood risk from surface water flooding and groundwater flooding.  You should check with the LLFA as they may have more up to date information regarding this type of flooding.

The Risk of Flooding from Surface Water Flood Map can be viewed and downloaded as a PDF file on GOV.UK by following this link: https://flood-warning-information.service.gov.uk/long-term-flood-risk

Please note:

It is not possible to say for certain what the flood risk is but we use the best information available to provide an indication so that people can make informed choices about living with or managing the risks. The information we supply does not provide an indicator of flood risk at an individual property / site level.

The flood risk information provided on the attached map does not cover other sources of flooding such as from rivers and sea.

## Surface Water Drainage

The Lead Local Flood Authority is the statutory consultee for planning matters relating to surface water drainage, therefore it is recommended they should be consulted separately regarding this.

Surface water discharge from new development should ideally 'mimic' the pre-development situation using a sustainable drainage system so that the flow and volume of water in watercourses is not increased.

A permit may be required, under the Environmental Permitting Regulations 2016 from the Environment Agency for any proposed works or structures in, under, over or within eight metres of a 'main river' (e.g. a new outfall). A permit is separate to and in addition to any planning permission granted. Further details and guidance are available on the GOV.UK website:
https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

## Risk of Flooding from Reservoirs Map

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

https://flood-warning-information.service.gov.uk/long-term-flood-risk/#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 covered by a Flood Warning. To register to receive this service, you can call Floodline 24 hours a day on 0845 988 1188.

## 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.

For more information on Rights and Responsibilities of a riverside owner, you can visit our website at:

https://www.gov.uk/guidance/owning-a-watercourse

**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.




# Planning advice for developers – FAQs

## Introduction

Local planning authorities (LPAs) across Yorkshire are required to consult us on certain planning applications which affect flood risk, groundwater, waste, or water quality.

If your development falls into one of these categories, we'll be invited to comment on your planning application. Your LPA, when considering your application, will take our comments into account.

We've produced this guidance to summarise the environmental issues we're responsible for. The guidance forms part of our free advice service; if you require site-specific or face-to-face advice, we'll need to recover our costs through our charged advice service. Engaging with us early can help you identify the big issues, reduce the chances of subsequent delays and help you design a more sustainable and attractive development.

## Development and flood risk

**Is my development proposal at risk of flooding?**

The flood map for planning shows where flooding from rivers and the sea may occur. Whilst this map isn't suitable for a detailed flood risk assessment, it'll show which flood zone your development is located within and therefore will indicate whether further assessment is needed. You should also refer to your LPA's strategic flood risk assessment which will provide additional local information on flood risk, including the location of functional floodplain and areas which are susceptible to other sources of flooding such as from surface water or reservoirs.

**Will my application need to pass the sequential and exception tests?**

Local planning authorities apply the sequential test to steer development towards areas at the lowest risk of flooding. If your proposal is located within flood zones 2 or 3, you should contact your LPA to discuss the sequential test **before** submitting your application. The LPA may require you to submit information with your application in support of the sequential test.

If the LPA confirm that the sequential test has ruled out steering the development to lower risk sites, the development may also need to pass the exception test by demonstrating that its sustainability benefits outweigh flood risk and that it can be made safe for its lifetime, through the production of a site-specific flood risk assessment. Planning practice guidance advises when an exception test will be required, which will depend on the vulnerability of the development and the flood zone it lies within.

**Do I need to submit a flood risk assessment with my planning application?**

You'll need to submit a flood risk assessment if your application lies within flood zones 2 or 3 or is over 1 hectare within flood zone 1. You'll also need to submit an assessment if your proposal could be affected by sources of flooding other than from rivers or the sea. For certain lower risk applications, we've provided 'flood risk standing advice' which enables local planning authorities to assess flood risk assessments without the need to consult us.

**What information should I include in my flood risk assessment?**

We recommend that you refer to the checklist for a site-specific flood risk assessment for detailed advice on what to include in your flood risk assessment. Alongside referring to your LPA's strategic flood risk assessment, you should contact your LPA to find out whether there are any development guidelines which are specific to your locality.

**Can I undertake my own flood risk assessment?**

Your FRA must be appropriate to the scale, nature and location of the development whilst being credible and fit-for-purpose. Whilst it's possible to undertake your own assessment, most applicants employ suitably experienced professionals. We're not able to recommend specific consultants, but a simple web search should help you source a competent individual or company.

**Do I need to consider how climate change will affect my proposal's flood risk?**

Yes, you should demonstrate how flood risk will be managed now and over the development's lifetime, taking climate change into account. Please refer to the following guidance when undertaking your flood risk assessment. In some cases we'll hold the climate change flood data you need. In others you'll need to undertake your own analysis to understand the impacts.

**Where can I get modelled or historic flood levels from?**

Email our Customers and Engagement team (neyorkshire@environment-agency.gov.uk) to find out whether we have any modelled or historic flood levels available for your development site. A list of the packages of information we're able to provide can be found under the 'get information to complete an assessment' section of the planning practice guidance. They'll aim to provide this information within 20 days. We no longer charge for providing this information.

**The risk portrayed by your flood map doesn't seem to reflect the site's actual risk. How do I 'challenge' your flood map?**

If you have evidence suggesting that our flood map is inaccurate, please contact our Customers and Engagement team (neyorkshire@environment-agency.gov.uk) who will provide you with any existing data we hold. To formally contest our flood zones, you'll need to submit supporting evidence, such as digital copies of a topographic survey or modelling for quality assurance purposes. Digital files of the proposed new flood zones in ArcMap or MapInfo format should also be supplied. Any new outline data you submit must conform to our flood zones policy, copies of which are available on request.

Whilst we'll usually be happy to review any topographical survey or model prior to the application being submitted, we would have to recover our costs for this work. In some cases where work to review and update our existing models is already underway, we may decline to consider a challenge.

As we have to be certain that the data which informs our flood map is fit-for-purpose, any revisions will need to meet stringent quality checks.

## SURFACE WATER AND DRAINAGE

**Who's responsible for managing surface water?**

Lead local flood authorities are responsible for providing advice on the management of surface water resulting from new major development. Internal drainage boards, where established, have permissive powers to manage water levels within their drainage districts, so also play a key role in managing surface water.

**Will I need to provide surface water storage and limit the discharge rate?**

You should contact your lead local flood authority to discuss surface water discharge rates and storage requirements. Typically, they'll ask that your development does not increase run-off and limits the discharge to the existing greenfield run-off rate (usually 1.4l/s/ha if not calculated).

**Do I need to install sustainable drainage systems?**

Sustainable Drainage Systems (SuDS) should always be carefully considered in discussion with your lead local flood authority. A SuDS scheme can reduce flood risk, improve water quality, create better habitats for wildlife, and produce pleasant, more amenable places for people.

Infiltration drainage must not, however, pose a risk to groundwater quality. All infiltration SuDS must:

- Meet the groundwater protection criteria set out on GOV.UK
- Not be constructed in ground affected by contamination

**Who should I contact about connecting my development to the mains sewer?**

Talk to your water company about connecting to their sewerage system. Here are some contact details for water companies operating in the Yorkshire Environment Agency area:

| | |
|---|---|
| Yorkshire Water | planningconsultation@yorkshirewater.co.uk |
| Northumbrian Water | developmentenquiries@nwl.co.uk |
| Severn Trent Water | new.connections@severntrent.co.uk |

**My development is a long way from the mains sewer. Can I install a 'non-mains' drainage system, such as a package treatment plant?**

New development should connect to the public mains sewer wherever possible. Individual treatment plants can deteriorate local water quality and are more challenging to monitor and regulate. If you can't connect to the mains sewer, your planning submission should outline how you will deal with foul drainage discharge. You should include evidence as to why it is not possible to connect to the mains system, including details of any prohibitive costs. Please note that some 'non-mains' foul water drainage systems will require an environmental permit, irrespective of any planning approval.

## OTHER ENVIRONMENTAL CONSIDERATIONS

**What other environmental issues will you consider with my planning application?**

Your planning application will need to demonstrate that any environmental risks can be managed, through design and construction, for the development's lifetime. Alongside flood risk, the key environmental risks we'll consider are:

- **Land Contamination**
  We're mainly interested in those sites where there is a risk of pollution to controlled waters. You should investigate any contamination to see whether the environmental risk or cost of clean-up (remediation) would hinder your proposal. If contamination is known or suspected, a desktop study, investigation, remediation and other works may be required to enable safe development. Our model procedures for the management of land contamination provide further information.

- **Pollution prevention**
  Your application should demonstrate how you'll minimise the risk of pollution from all aspects of your development, including construction and

operation phases. Groundwater can be vulnerable to pollution, as well as rivers and streams. Some areas (source protection zones and aquifers) are especially sensitive to pollutants as they typically supply public drinking water. To find out whether your development is located in an area sensitive to groundwater pollution, visit our interactive maps. Advice on groundwater protection can be found on GOV.UK

- **Fisheries, biodiversity, geomorphology and protected species**
  If your proposal is likely to affect the ecology of a main river, you'll need to carry out a risk assessment. This assessment should show that your development can proceed without demonstrable harm, and should propose mitigation, compensation or enhancements where required. A survey should be carried out if any protected species are thought to be nearby. If this survey confirms the presence of protected species or their habitat, measures should be taken to manage the development's risks. Natural England are the statutory consultee for other biodiversity-related matters. Further information on their remit can be found on GOV.UK

- **Water framework directive**
  If your proposal affects ground or surface waterbodies, you'll need to consider the Water Framework Directive (WFD) and the actions set out in the Humber River Basin Management Plan. You'll also need to submit a WFD Assessment demonstrating how the development will prevent deterioration and improve the waterbody's ecological status.

- **River buffer zone**
  Your development should ensure that an 8m strip of land (planted with locally appropriate, native species) is left undisturbed next to the bank of any main river. This 'river corridor' will improve habitat connectivity and will ensure we're able to access the bank for any future flood defence construction and maintenance.

- **Culverting**
  We're opposed to culverting. Culverts degrade watercourses' ecology and prevent the movement of wildlife and fish. As culverts can easily become blocked, they increase flood risk. They're also difficult to inspect and maintain. We may object to any planning applications involving culverting on a main river and may refuse to grant an environmental permit. Existing culverts should be removed and the river channel and bankside habitat reinstated to restore the ecological continuity of the river channel and its corridor.

**Will I need any other Environment Agency permits for my development?**

You might need an environmental permit if your development manages or produces waste or emissions that pollute the air, water or land or is work that affects a main river or a sea defence. The lead local flood authority is responsible for any consents relating to ordinary watercourses.

The Environmental Permitting Regulations (England and Wales) 2015 cover water discharges, groundwater activities, flood risk activities, radioactive substances, waste, mining waste and installations. They also include provision for a number of directives including batteries. Further information, including contact details for further permitting related enquiries, can be found here.

As planning and permitting decisions are often closely linked, we have issued detailed guidance for developments requiring planning permission and environmental permits. This guidance explains how, when responding to planning consultations that require environmental permits, we will advise of three possible positions:

- No major permitting concerns
- More detailed consideration is required and parallel tracking is recommended
- Don't proceed – unlikely to grant a permit.

## PRE-APPLICATION ADVICE

**Can you provide site-specific advice, review a submission document, or attend a site meeting before I submit my planning application?**

We encourage you to seek pre-application advice as it can help you solve key environmental issues early, reduce the chance of an objection and help you design a more sustainable development. If you'd like to take advantage of this service, please email our Sustainable Places team so that we can provide further details and estimated costs.

Please note that any pre-application guidance we provide doesn't represent our final view in relation to any future planning application. We recommend that you seek your own expert advice prior to submitting your application.

**Who should I contact for further information?**

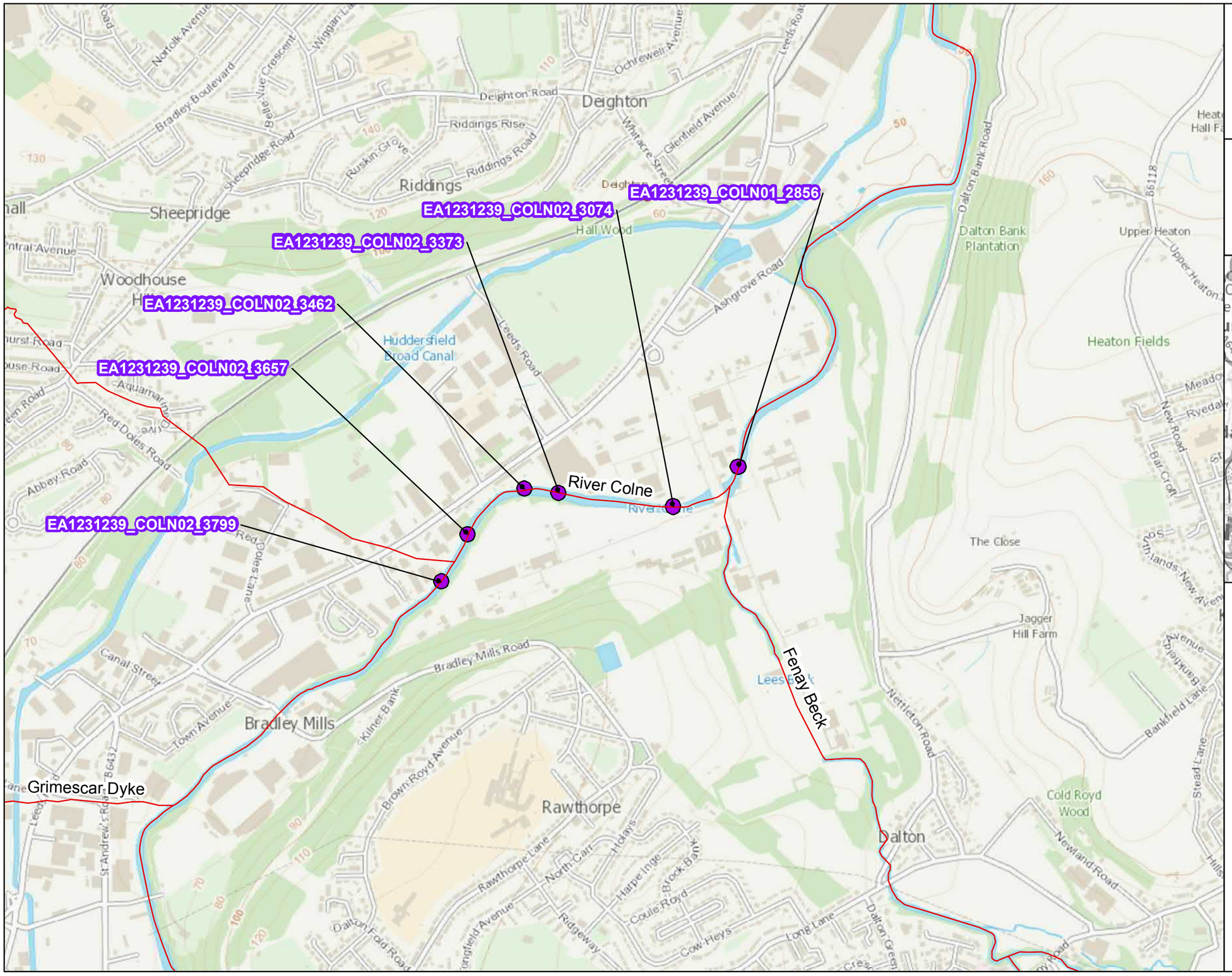
Yorkshire planning enquiries: sp-yorkshire@environment-agency.gov.uk

General enquiries: 03708 506 506

Environment Agency, Lateral, 8 City Walk, Leeds LS11 9AT
https://www.gov.uk/government/organisations/environment-agency

# RFI/2021/198301 Node Point Map Centred on Leeds Rd, Huddersfield HD2 1YU

**Date created: 01/03/2021**

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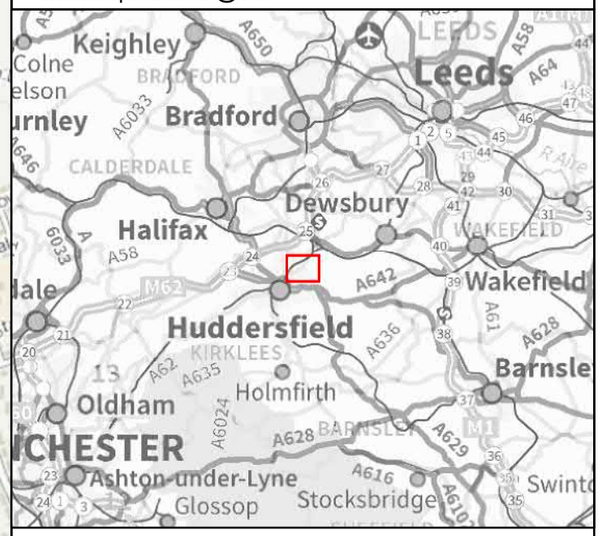
N W E S




## LEGEND

- Main River
- 2010 ASM Colne and Holme Node Points

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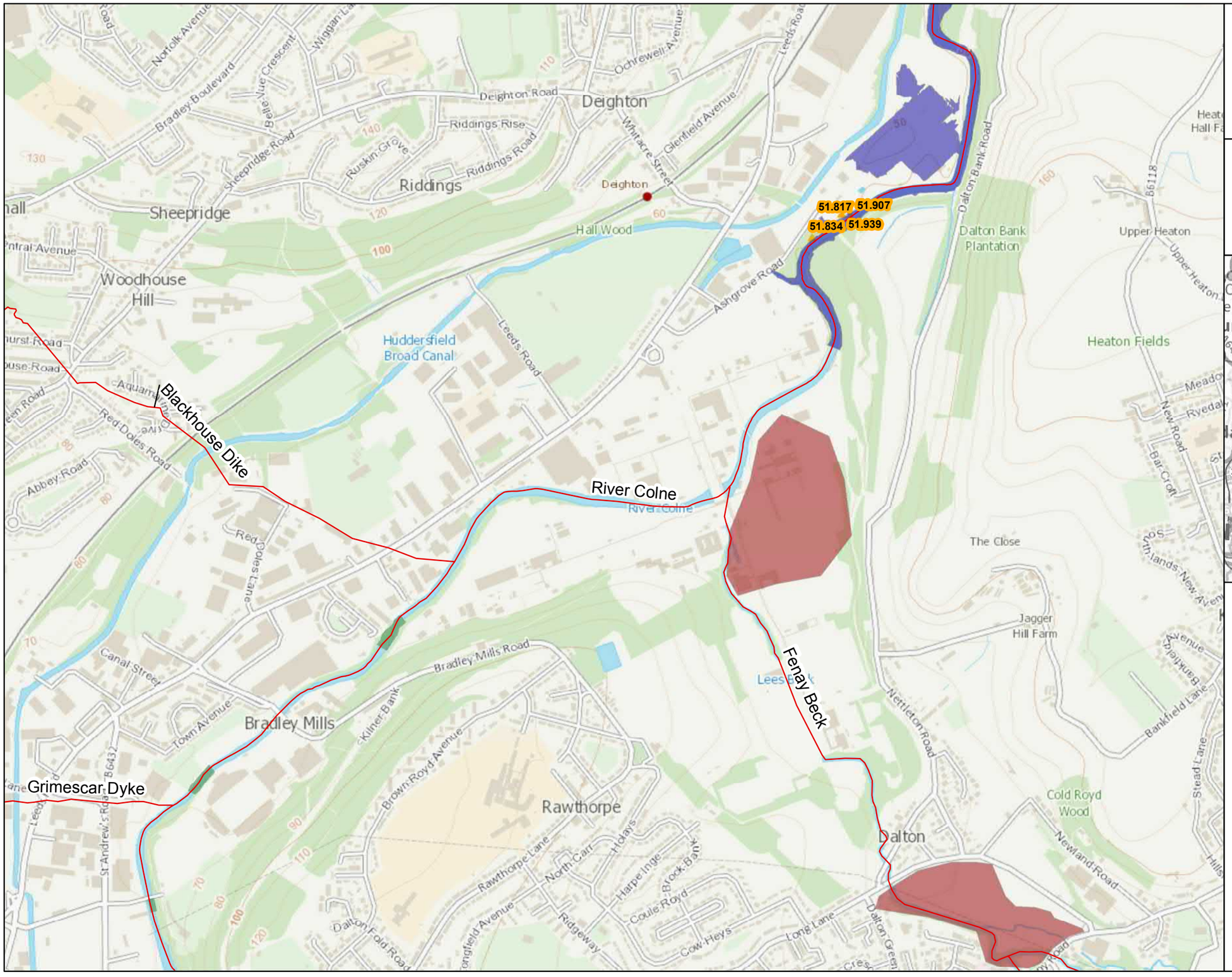
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506(Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

| 2010 ASM Colne and Holme Undefended Model Results – RFI/2021/198301 (Level - mAOD, Flow - m³s) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Node Point | Annual Exceedance Probability (AEP) | | | | | | | | | |
| | 10% AEP ( 1 in 10) | | 4% AEP (1 in 25) | | 2% AEP (1 in 50) | | 1.33% AEP (1 in 75) | | 1% AEP (1 in 100) | |
| | Max Stage | Max Flow | Max Stage | Max Flow | Max Stage | Max Flow | Max Stage | Max Flow | Max Stage | Max Flow |
| COLN01_2856 | 54.20 | 140.46 | 54.61 | 171.06 | 54.86 | 204.65 | 54.96 | 218.95 | 55.05 | 230.74 |
| COLN02_3074 | 54.43 | 124.27 | 54.83 | 153.46 | 55.06 | 179.27 | 55.15 | 192.82 | 55.21 | 202.51 |
| COLN02_3373 | 55.33 | 124.78 | 55.67 | 155.43 | 55.83 | 181.01 | 55.89 | 194.24 | 55.94 | 204.13 |
| COLN02_3462 | 55.58 | 124.84 | 55.82 | 155.58 | 55.92 | 181.24 | 55.96 | 194.42 | 56.00 | 204.33 |
| COLN02_3657 | 56.01 | 123.75 | 56.17 | 154.51 | 56.21 | 179.75 | 56.24 | 192.99 | 56.26 | 202.45 |
| COLN02_3799 | 56.14 | 123.87 | 56.32 | 154.56 | 56.40 | 179.76 | 56.44 | 193.02 | 56.61 | 202.46 |

# RFI/2021/198301 Flood History Map Centred on Leeds Rd, Huddersfield HD2 1YU

**Date created: 01/03/2021**

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## LEGEND

Main River

**RECORDED FLOOD OUTLINES**

- 2020 February Flood Incident - Storm Dennis
- December 2015 Flood Event
- 123 April1970
- Dec 2015 Flood Levels (mAOD)

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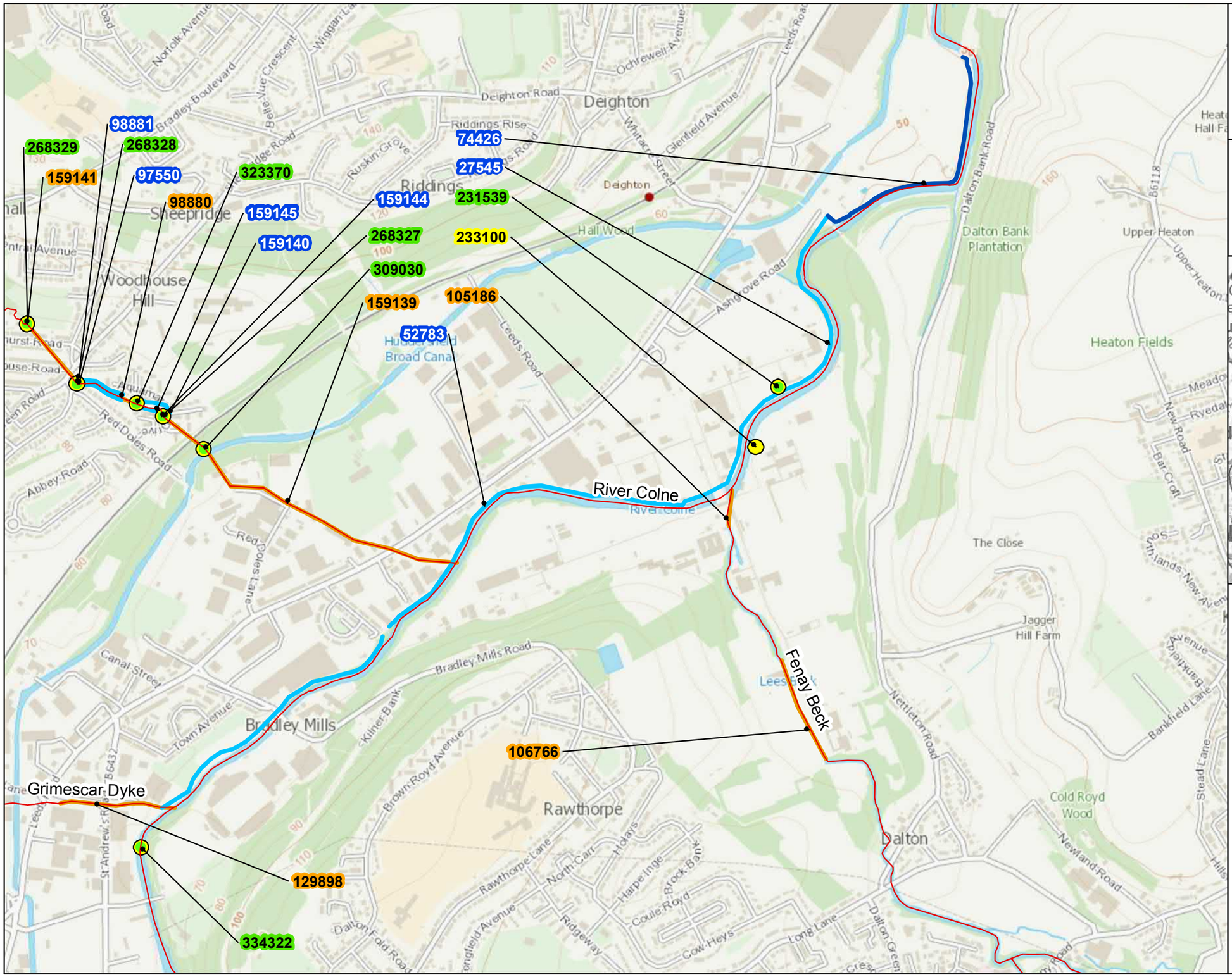
# RFI/2021/198301 Assets Map Centred on Leeds Rd, Huddersfield HD2 1YU

**Date created: 01/03/2021**

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## LEGEND

- Main River
- Structures (EA maintained)
- Structures (3rd party maintained)

**Defences (3rd party maintained)**

**SUB_TYPE**

- high_ground
- wall

**Channels (3rd party maintained)**

**SUB_TYPE**

- simple_culvert

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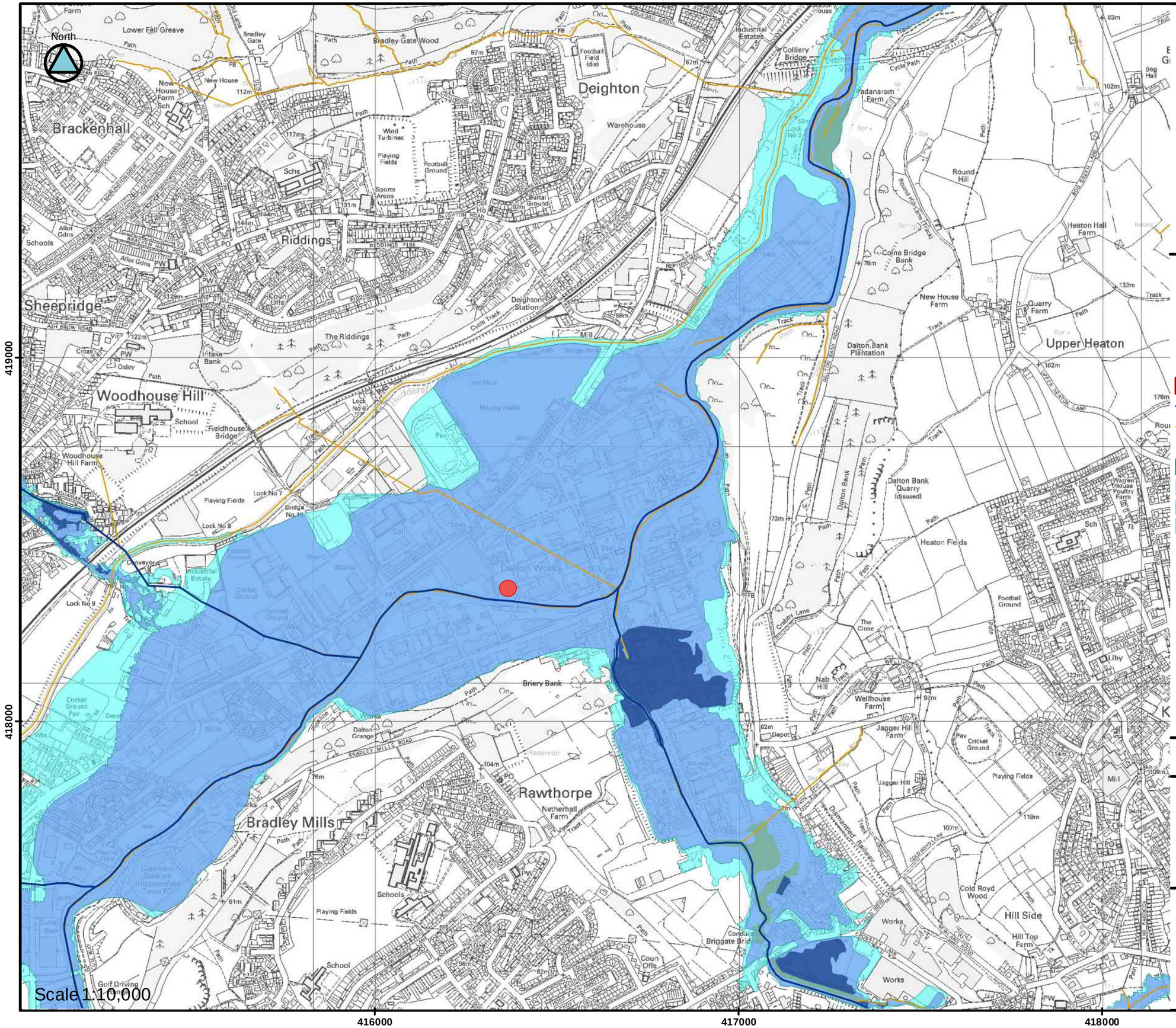
| Structures (EA Maintained) - RFI/2021/198301 | | | | | | | |
|---|---|---|---|---|---|---|---|
| ASSET ID | ASSETS TYPE | DESCRIPTION | DESIGN STANDARD OF PROTECTION (SOP) | ASSET MAINTAINER | PROTECTION | TARGET CONDITION | OVERALL CONDITION |
| 233100 | control_gate | | | environment_agency | fluvial | 9 | 2 |




LEGEND

Choose Option Flood Zones

- Council boundary
- Main River
- Detailed River Network

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3ai
- Flood Zone 3a
- Flood Zone 2

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JBA consulting

Kirklees COUNCIL

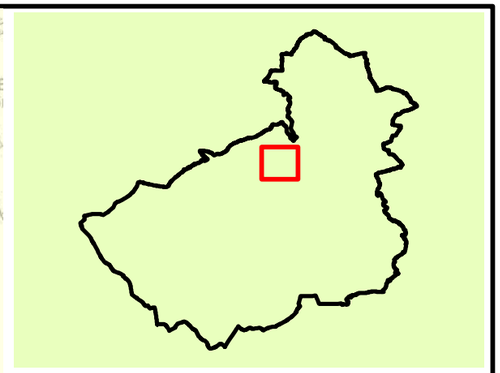
STRATEGIC FLOOD RISK ASSESSMENT

For

KIRKLEES COUNCIL

MAP_J

North



LEGEND

Choose Option

Areas Susceptible to Ground water Flooding

Council boundary

Main River

Detailed River Network

**Areas Susceptible to Ground Water Flooding**

**Risk of Groundwater Emergence**

>= 75%

>= 50% <75%

>= 25% <50%

< 25%

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Kirklees COUNCIL

STRATEGIC FLOOD RISK ASSESSMENT

For

KIRKLEES COUNCIL

MAP_J

Scale 1:10,000

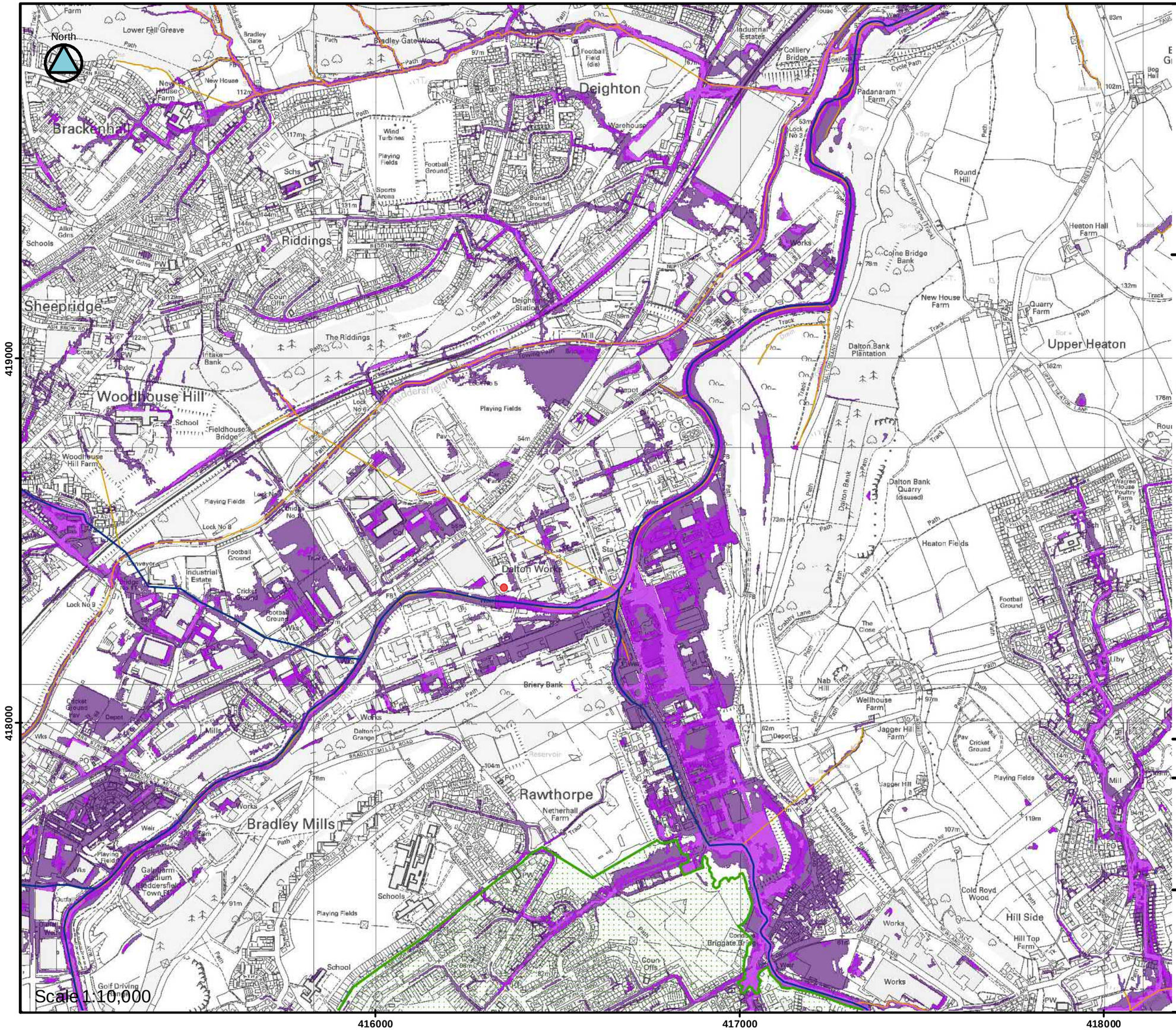
419000

418000

416000

417000

418000




LEGEND

Choose Option

Updated Flood Map for Surface Water

- Council boundary
- Main River
- Detailed River Network

**uFMfSW**

- 30 year event
- 100 year event
- 1000 year event
- CDA indicative

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JBA consulting

Kirklees COUNCIL

# STRATEGIC FLOOD RISK ASSESSMENT

For

KIRKLEES COUNCIL

MAP_J

# Appendix E

## IMPERMEABLE AREA PLAN AND DRAINAGE STRATEGY CALCULATIONS

File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70081XXX\70081327 - LUBRIZOL HUDDERSFIELD\03 WIP\EI EIA AND FLOOD RISK\02 CAD-BIM MODELS\LBZ-WSP-XX-XX-M2-C-001.DWG, printed on 23 February 2021, by Valla, Deepika

EXISTING CHANNEL DRAIN

EXISTING STORAGE AREA ASPHALT

HIGH

LOW

ADDITIVES SUMP

Tank

RIVER COLNE

Weir

River Colne

# DO NOT SCALE

## NOTES

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES AND ALL LEVELS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING IS IN THE DEVELOPMENT STAGE AND IS SUBJECT TO CHANGE.
3. THIS DRAWING IS BASED ON THE FOLLOWING INFORMATION:
   - TOPOGRAPHICAL SURVEY REF MWA_221_LUBRIZOL DATED JULY 2020 BY HOLDEN SURVEYS LTD.
   - PROPOSED BLOCK PLAN OPTION D REF LLLR-MWA-XX-XX-DR-A-0004 REV B BY MARTIN WALSH ARCHITECTURAL.
4. APPROXIMATE PERMEABLE AND IMPERMEABLE AREAS MEASURED FROM THE SITE LAYOUT SUPERIMPOSED ON THE TOPO SURVEY.

## KEY

- TOTAL SITE AREA (PROPOSED AREA) 943m²
- EXISTING IMPERMEABLE AREA 406m²
- EXISTING GREENFIELD AREA 537m²
- EXISTING SURFACE WATER DRAINAGE
- EXISTING WASTEWATER DRAINAGE

## CALCULATIONS

ALLOWABLE DISCHARGE RATE
EXISTING IMPERMEABLE AREA 406m²
EXISTING DISCHARGE RATE Q = 2.78ciA
WITH i = 50mm/h, Q = 5.6 l/s
LESS 30% BROWNFIELD SITE Q = 4.0 l/s

ATTENUATION STORAGE
ALLOWABLE DISCHARGE RATE Q = 4.0 l/s
PROPOSED IMPERMEABLE AREA = 943m²
STORAGE REQUIRED FOR 100 YEAR + 30% CLIMATE CHANGE = 33m³

| REV | DATE | BY | DESCRIPTION | CHK | APP |
|---|---|---|---|---|---|
| P01 | 22/02/2021 | DV | ISSUED WITH FRA | XXX | CC |

DRAWING STATUS: S2 - FOR INFORMATION

wsp
Three White Rose Office Park, Millshaw Park Lane, Leeds, LS11 0DL, UK
T+ 44 (0) 113 395 6200, F+ 44 (0) 113 395 6201
wsp.com

CLIENT:

ARCHITECT: MARTIN WALSH ARCHITECTURAL

PROJECT: LUBRIZOL LTD, HUDDERSFIELD

TITLE: DRAINAGE CATCHMENT AREA PLAN

| SCALE @ A2: | CHECKED: | APPROVED: |
|---|---|---|
| 1:250 | | CC |

| PROJECT No: | DESIGNED: | DRAWN: | DATE: |
|---|---|---|---|
| 70081327 | DV | | February 21 |

DRAWING No: LBZ-WSP-XX-XX-DR-C-002 REV: P01

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# Valla, Deepika

From: Paul Farndale <Paul.Farndale@kirklees.gov.uk>
Sent: 12 February 2021 16:36
To: Valla, Deepika <Deepika.Valla@wsp.com>
Subject: RE: Leeds Rd, Huddersfield - Flood Risk and Drainage Enquiry

Hello Deepika,

If the original hardstanding was positively drained then 4l/s is fine to the same system. If the original hardstand just drained to landscaped areas then 3l/s needs to be imposed.

Make sure the original drainage is shown on any application if the former is applicable.

Kind regards,

Paul Farndale
Kirklees LLFA

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Date 29/01/2021 18:11 | Designed by UKDXV006
File 210128 Lubrizol v1.0.SRCX | Checked by
XP Solutions | Source Control 2019.1

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 97.515 | 0.515 | 2.9 | 18.0 | O K |
| 30 min Summer | 97.664 | 0.664 | 3.2 | 23.2 | O K |
| 60 min Summer | 97.775 | 0.775 | 3.5 | 27.1 | O K |
| 120 min Summer | 97.828 | 0.828 | 3.6 | 29.0 | O K |
| 180 min Summer | 97.826 | 0.826 | 3.6 | 28.9 | O K |
| 240 min Summer | 97.804 | 0.804 | 3.6 | 28.1 | O K |
| 360 min Summer | 97.748 | 0.748 | 3.4 | 26.2 | O K |
| 480 min Summer | 97.693 | 0.693 | 3.3 | 24.2 | O K |
| 600 min Summer | 97.641 | 0.641 | 3.2 | 22.4 | O K |
| 720 min Summer | 97.594 | 0.594 | 3.1 | 20.8 | O K |
| 960 min Summer | 97.512 | 0.512 | 2.8 | 17.9 | O K |
| 1440 min Summer | 97.391 | 0.391 | 2.5 | 13.7 | O K |
| 2160 min Summer | 97.273 | 0.273 | 2.1 | 9.5 | O K |
| 2880 min Summer | 97.187 | 0.187 | 1.8 | 6.5 | O K |
| 4320 min Summer | 97.122 | 0.122 | 1.5 | 4.3 | O K |
| 5760 min Summer | 97.099 | 0.099 | 1.3 | 3.4 | O K |
| 7200 min Summer | 97.085 | 0.085 | 1.1 | 3.0 | O K |
| 8640 min Summer | 97.076 | 0.076 | 0.9 | 2.7 | O K |
| 10080 min Summer | 97.069 | 0.069 | 0.8 | 2.4 | O K |
| 15 min Winter | 97.580 | 0.580 | 3.0 | 20.3 | O K |
| 30 min Winter | 97.751 | 0.751 | 3.4 | 26.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 114.207 | 0.0 | 20.1 | 20 |
| 30 min Summer | 77.276 | 0.0 | 27.2 | 33 |
| 60 min Summer | 49.937 | 0.0 | 35.2 | 60 |
| 120 min Summer | 31.152 | 0.0 | 43.9 | 90 |
| 180 min Summer | 23.275 | 0.0 | 49.2 | 126 |
| 240 min Summer | 18.782 | 0.0 | 52.9 | 160 |
| 360 min Summer | 13.860 | 0.0 | 58.6 | 228 |
| 480 min Summer | 11.162 | 0.0 | 62.9 | 294 |
| 600 min Summer | 9.429 | 0.0 | 66.5 | 360 |
| 720 min Summer | 8.209 | 0.0 | 69.4 | 424 |
| 960 min Summer | 6.591 | 0.0 | 74.3 | 550 |
| 1440 min Summer | 4.828 | 0.0 | 81.7 | 796 |
| 2160 min Summer | 3.528 | 0.0 | 89.5 | 1156 |
| 2880 min Summer | 2.820 | 0.0 | 95.4 | 1508 |
| 4320 min Summer | 2.052 | 0.0 | 104.2 | 2204 |
| 5760 min Summer | 1.636 | 0.0 | 110.7 | 2936 |
| 7200 min Summer | 1.373 | 0.0 | 116.1 | 3664 |
| 8640 min Summer | 1.190 | 0.0 | 120.8 | 4400 |
| 10080 min Summer | 1.055 | 0.0 | 124.9 | 5120 |
| 15 min Winter | 114.207 | 0.0 | 22.5 | 20 |
| 30 min Winter | 77.276 | 0.0 | 30.5 | 33 |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 97.884 | 0.884 | 3.7 | 30.9 | O K |
| 120 min Winter | 97.938 | 0.938 | 3.9 | 32.8 | O K |
| 180 min Winter | 97.926 | 0.926 | 3.8 | 32.4 | O K |
| 240 min Winter | 97.888 | 0.888 | 3.7 | 31.1 | O K |
| 360 min Winter | 97.801 | 0.801 | 3.6 | 28.0 | O K |
| 480 min Winter | 97.717 | 0.717 | 3.4 | 25.1 | O K |
| 600 min Winter | 97.642 | 0.642 | 3.2 | 22.5 | O K |
| 720 min Winter | 97.577 | 0.577 | 3.0 | 20.2 | O K |
| 960 min Winter | 97.469 | 0.469 | 2.7 | 16.4 | O K |
| 1440 min Winter | 97.321 | 0.321 | 2.3 | 11.2 | O K |
| 2160 min Winter | 97.169 | 0.169 | 1.8 | 5.9 | O K |
| 2880 min Winter | 97.122 | 0.122 | 1.5 | 4.3 | O K |
| 4320 min Winter | 97.091 | 0.091 | 1.1 | 3.2 | O K |
| 5760 min Winter | 97.076 | 0.076 | 0.9 | 2.6 | O K |
| 7200 min Winter | 97.066 | 0.066 | 0.8 | 2.3 | O K |
| 8640 min Winter | 97.060 | 0.060 | 0.7 | 2.1 | O K |
| 10080 min Winter | 97.055 | 0.055 | 0.6 | 1.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 49.937 | 0.0 | 39.4 | 60 |
| 120 min Winter | 31.152 | 0.0 | 49.2 | 96 |
| 180 min Winter | 23.275 | 0.0 | 55.1 | 134 |
| 240 min Winter | 18.782 | 0.0 | 59.3 | 172 |
| 360 min Winter | 13.860 | 0.0 | 65.6 | 244 |
| 480 min Winter | 11.162 | 0.0 | 70.5 | 314 |
| 600 min Winter | 9.429 | 0.0 | 74.4 | 382 |
| 720 min Winter | 8.209 | 0.0 | 77.8 | 446 |
| 960 min Winter | 6.591 | 0.0 | 83.3 | 574 |
| 1440 min Winter | 4.828 | 0.0 | 91.5 | 824 |
| 2160 min Winter | 3.528 | 0.0 | 100.3 | 1168 |
| 2880 min Winter | 2.820 | 0.0 | 106.9 | 1476 |
| 4320 min Winter | 2.052 | 0.0 | 116.7 | 2204 |
| 5760 min Winter | 1.636 | 0.0 | 124.0 | 2936 |
| 7200 min Winter | 1.373 | 0.0 | 130.1 | 3624 |
| 8640 min Winter | 1.190 | 0.0 | 135.3 | 4392 |
| 10080 min Winter | 1.055 | 0.0 | 139.9 | 5088 |

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Date 29/01/2021 18:11 | Designed by UKDXV006
File 210128 Lubrizol v1.0.SRCX | Checked by
XP Solutions | Source Control 2019.1

## 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 | 0.337 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +30 |

## Time Area Diagram

Total Area (ha) 0.094

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|
| 0 | 4 | 0.050 | 4 | 8 | 0.044 |

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## Model Details

Storage is Online Cover Level (m) 100.000

## Tank or Pond Structure

Invert Level (m) 97.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 35.0 | 1.000 | 35.0 | 1.001 | 0.0 |

## Crown Vortex Valve® Outflow Control

Design Head (m) 1.000 Vortex Valve® Type R1 SW Only Invert Level (m) 97.000
Design Flow (l/s) 4.0 Diameter (mm) 82

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 1.3 | 1.200 | 4.4 | 3.000 | 6.9 | 7.000 | 10.5 |
| 0.200 | 1.8 | 1.400 | 4.7 | 3.500 | 7.4 | 7.500 | 10.9 |
| 0.300 | 2.2 | 1.600 | 5.0 | 4.000 | 8.0 | 8.000 | 11.2 |
| 0.400 | 2.5 | 1.800 | 5.3 | 4.500 | 8.4 | 8.500 | 11.6 |
| 0.500 | 2.8 | 2.000 | 5.6 | 5.000 | 8.9 | 9.000 | 11.9 |
| 0.600 | 3.1 | 2.200 | 5.9 | 5.500 | 9.3 | 9.500 | 12.3 |
| 0.800 | 3.6 | 2.400 | 6.2 | 6.000 | 9.7 | | |
| 1.000 | 4.0 | 2.600 | 6.4 | 6.500 | 10.1 | | |

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