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FLOOD RISK ASSESSMENT

ON

Land at
Cellars Clough,
Nr Marsden,
Huddersfield,
West Yorkshire
HD7 6NB

FOR

David Storrie Planning

E15/6518/FRA001A

April 2016
REVISED September 2017

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

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1.0 INTRODUCTION

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

2.0 THE SITE

2.1 The site is located of an access road off the A62 between Slaithwaite and Marsden approx. miles west of Huddersfield town centre. It is situated around Ordnance Survey grid reference SE 405834 412511. A site location plan is shown on Figure 1 in Appendix A.

2.2 The site is roughly trapezoidal in nature and situated on the site of a former water mill. There are a few residential properties to the north and south of the site. The site was originally 90% covered with industrial properties except for land to the east of the site which is open pasture land. Only the main mill buildings now remain on site. The surrounding area in generally open pasture land. The site area is approximately 1ha.

2.3 To the west of the site is the former mill pond which now acts as a fishing pond. This is spilt into two distinct areas: the main pond sits to the west before passing through a former sluice gate to form a smaller pond immediately adjacent to the site. This part of the pond is to be infilled as part of the proposed development. To the south of the pond and adjacent to the site runs the River Colne; to the north runs the Huddersfield Narrow Canal. To the north of the canal is Sparth reservoir which is owned by the canal Trust and acts as a

feeder reservoir for the canal. The access to the site is from the A62 and down a steep access road before crossing a steel bridge over the River Colne which provides access to the site and to the fishing pond. The River Colne forms the southern boundary to the site and normal water levels are 3-4m below the bank levels. The river is further contained by an existing stone wall 350mm wide by 900mm high on the bank top. The northern boundary is formed by the towpath to the Canal and whilst the canal water levels are some 2.5 metres above the general site levels there is a former buildings external wall on the boundary that stands 2.5m above the towpath level and is 600mm thick. Beyond the main buildings this reduces to a 1.2m high stone wall 450mm thick. The area of land to the north of the canal is generally level or slightly lower than the canal towpath.

There is a second bridge from the site that originally served the land on the south side of the river which has been partially utilised for residential use. The bridge is closed off for access and should be removed as part of the redevelopment.

2.4 The site is generally flat with a high point of 160.8m AOD in the north west corner of the site and a lower point of 159.9 m on the middle of the eastern boundary to the development site. The site to the east falls away from the site at a slight gradient. The millpond has a 2m thick stone retaining wall to its perimeter which thickens out to 4m thick at the mill end of the pond. The mill pond is approx. 2.4m deep at the mill end which has now been partially drained. and the top of this stands at a level of 165.3m AOD. Water level was maintained at 164.50m AOD. On the northern boundary the towpath level is around 162.7m whilst the site side of this wall currently stands at 2m below this at 160.70m AOD. The top of the boundary wall between the site and the towpath is over 2.5m above the towpath level.

2.5 The mill pond is supplied by a simple goit adjacent to a weir on the River Colne some 400m upstream of the site. This is controlled by a simple penstock to adjust in flows into the pond. The top of this some 1.5m above the weir level. The mill pond itself has a number of flow control and over flows. The first control is adjacent to the mill building and was a sluice controlled inlet to the water turbine that provided power to the site. The outlet from this runs through the site and into the River Colne.

2.6 The section of mill pond adjacent to the mill also has a drawdown shaft on its southern edge 10m away from the building which also discharges directly to the River Colne to the south. This has been used to drain the mill pond immediately adjacent to the old mill buildings. The upper section of the mill pond has been separated from the main pond by a narrow bank and a sluice gate that crossed the remaining opening and allowed the flows into the upper pond to be controlled. The sluice gate has been removed in the past but now has a temporary coffer dam to allow the upper mill pond to be drained.

2.7 The water levels in the main pond are controlled by two overflow systems. The first one is a simple side weir that over flows directly to the River Colne around the separating bank between the two ponds and is a simple pipe and cascading weir structure built into the pond walls. The second and main overflow structure is some 150m away to the west of the site. It is built on the southern edge of the pond. This has a 8m wide, stone built, broad crested weir that acts as the overflow from the large pond. Any water leaving at this point flows via a simple cascade, directly under the towpath and down to the river some 4m below the path level. Adjacent to the main weir there is a steel penstock, or sluice, that controls the final will allow a further reduction in top water levels of 1m by adjusting the opening of this penstock.

2.8 The walls to the upper pond vary in height between 300mm at the western end of the pond to 2400mm in height at the north east corner. The depth of retained

water in the larger pond is approximately 1.8m. The northern edge of the pond abuts the towpath to the canal. The towpath at the western end of the pond is 2-3m above the pond level and as the canal passes through the locks the tow path dips below the level of the pond. The canal has two locks along its length adjacent to the pond which form this change in level. This boundary between the pond and the tow path is formed by earth banks up to the towpath in the western section. At the eastern end of the large pond, the boundary is formed by dry stone-faced walls with possible rubble filling to give a minimum thickness of 2m thick above the towpath level. The internal face of these walls would appear to be graded back below the water level and this can be seen in the walls in the smaller eastern mill pond now the water has been drawn down in the eastern section.

2.9 A copy of a condition report by Kirklees MDC in October 2014 has been supplied by Kirklees MDC. A copy of that report is attached to this report in the appendices. The report shows the some of the walls has minor issues with localised bulging and seepage through the walls. The walls where not considered as unstable and the seepage is of a low volume and discharge rate. The walls have all been re-inspected as part of a walkover survey for this repoint. There are still areas of slight seepage through the walls on both the north and south pond boundary walls. These areas and very localised and the seepage is of a minor nature. The development proposals will include some cementitious grouting of the walls in these areas to prevent the seepage re-occurring. The walls would benefit from repointing works as a preventative measure to maintain their structural integrity but they have been generally found to be in reasonable condition. The bulging seen is minor in nature and symptomatic of dry stone walls construction. The thickness of the walls means that their structural stability is still adequate.

2.10 At the time of inspection the eastern mill pond had been drained down and temporary dam between the eastern and western section of the ponds had

been constructed. These allow a clearer understanding of the water flows through the ponds and the mills and its effect on the proposed scheme.

3.0 PROPOSED DEVELOPMENT

3.1 The proposed development is for a series of terraced, detached and semi-detached residential units with associated roads and car parking areas. It is envisaged that the impermeable areas for the whole development would be close to that occupied by the former mill buildings and paved areas. The eastern mill pond is also to be infilled and three residential units formed at a higher level. The total impermeable area of the upper pond and the mills equates to 8510sq. m, of this the impermeable area of the mills equates to 6855sq. m. The impermeable areas on the new development would be 7330sq.m. There is a proposed site plan in the appendices of this report.

3.2 The northern boundary of the site will stay as existing with a 2m high wall 340 - 450mm thick running along the site boundary. The rear garden areas will be some 3m above existing site levels at a similar level to the towpath. The existing boundary wall is to remain at a height of 2m above the tow path level. The lower levels buildings will be built at a level of 900mm above the existing ground levels with the road ways running from west to east. The proposals will include attenuation of flows from the site to 70% of original flows thereby giving a substantial reduction in flows off the site.

4.0 PROPOSED SURFACE WATER DRAINAGE

4.1 In the first instance the use of soakaways and infiltration systems should be investigated and if these appear to be unsuitable based on the infiltration tests then alternative systems can be investigated. Whilst the site has previously been developed, the un-attenuated surface water run off from this site would slightly decrease due to the development. However this is not fully in line with current re-development policies and normal practise for brown-field sites would

be to reduce the run off by 30% rather than the 16% achieved by redevelopment. Therefore discharges should be managed by the use of surface water attenuation and storm water storage systems. The site currently does have a significant existing impermeable areas relating to roofs or hard paved areas. The current point of discharge of the surface water drainage systems on site would appear to be the River Colne on the southern boundary of the site. As the site has been previously developed any drainage system would have to be designed to reduce flows down to 70% of the original discharge rates. Further discussions with Yorkshire Water, and Kirklees MBC - Land Drainage Department, and the Environment Agency will be necessary to formerly agree discharge rates but the estimated run off from the site for a 1 in 1 year storm would be 95lit/s. So the design flows from the site should be reduced to around 66lit/s. This assumes that the eastern section of the ponds acts as an impermeable surface which it would effectively be. Once it is infilled it can be considered to be a permeable surface thus there is a nett reduction in run off from the site. Checking this against the 6 hour volume test the discharge rate reduces to 33lit/s so this has been utilised for an estimate of the storage requirements for the site.

4.2 The flows would be controlled by a hydraulic flow device such as a Hydrobrake or similar. This would mean that storm-water storage would have to be provided on site. The existing mills and ponds previously discharged to the River Colne via a culvert that runs beneath the main mill buildings. It would be proposed to reconnect to this system which will give a point of discharge to a surface water sewer or watercourse but this would have to be agreed and approved by the Environment Agency, but it does provide the site with a right to discharge in perpetuity granted. The EA would /may also need to approve any such discharge rate and water quality.

4.3 Due to the small nature of the site and the land uptake required it is proposed to provide storage in above ground storage systems in the open fields to the east of the site. This will be designed to cater for storms up to and including the

100year storm with due allowances for climate change. In accordance with NPPG this would mean an extra 30% based on the site usage and possible duration of development.

4.4 The sizes of the storm water storage facilities would need to determine accurately in the final designs. This is all in accordance with the PP**G-FRCC** and previously in NPPF. The volumes of storage for the 100 year and 100 year plus climate change can include flooding to roads and designated areas but must ensure that no buildings are flooded.

4.5 If infiltration systems or on-site balancing is utilised then the risk to downstream properties would be slightly reduced due to the development of the site.

5.0 FLOOD RISK

5.1 The site currently falls partially within flood zone 1 and partially in Zones 2 and 3 with the area to the east of the site, as shown on the Environment Agency Websites. It does not fall within an area shown to benefit from flood defences up to the 1 in 100 year flood event. The development is classified as More Vulnerable in Table 2 of the PP**G-FRCC**. The proposed area of development falls within Zone 2 and as such table 3 of that document also states that the proposed residential development is appropriate.

5.2 Due to the size of the development over 1Ha it will not be necessary to prepare a site Specific Flood risk Assessment for the site.

5.3 There are a number of potential flooding mechanisms that NPPF now requires are evaluated for each proposed development site. Each method of flooding requires an assessment to be made on its probability relative to the site development. The normal requirement of the document is for no flooding of properties for storms up to a 1% probability or a once in a 100 years storm. The

risk assessment also includes for flooding both on site and off site, and the effects of the development on the downstream catchment or the flow regime of the watercourse. NPPF also requires that the effects of severe storms above the normal 1% probability are reviewed together with the effects of climatic change relating to the design life of the development.

5.4 It also requires that the effects of climate change are taken into account together with the impacts of extreme events and flood defence failures.

5.5 Based on the published Environment Agency Flood Risk Maps the proposed development on site does fall within the 0.1% Flood Risk (i.e. Zone 2) and part of the site adjacent to the River Colne falls within the 1% Flood Risk (zone 3). The proposed residential development falls within the More Vulnerable Classification in Table 02 Technical Guidance to PP**G-FRCC**. The development is considered appropriate in accordance with Table 3. However it would be appropriate to consider the residual flood risks on this site because it stands within Zone 2 and what flood risk mitigation can be provided as part of this development.

5.6 PP**G-FRCC** requires that each flooding mechanism is addressed and levels of risk evaluated. We consider there are three main risks of flooding to the site the alternative mechanisms are not applicable to this site.

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

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

5.6.3 Risk of flooding from reservoirs coupled with flows from adjacent of sewerage systems or other watercourses.

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

5.7 Discussion of Flood risks

5.7.1 Flood Risk from Watercourses, River & Tidal

5.7.2 The nearest watercourse shown on the O.S Survey is the River Colne that runs adjacent to the southern boundary of the site. River Colne is classed as main river and runs from west to east past the site. There are watercourses to the east that flow from north to south and outfall into the River Colne. There is an existing watercourse that is culverted beneath the larger western pond. The area of site immediately adjacent to the main river appears to fall within the 1% probability Flood Risk Maps as published by the Environment Agency. Flood modelling levels previously obtains for previous reports show the 1 in 100 year flood levels to be slightly above the existing bank levels adjacent to the beck for a short way. The flood zones shown on the plans ignore any flood protection so do not take into account the small 350mm thick 1m high solid wall on the edge of the site. The wall would prevent the 1 in 100 year flood water flows from actually entering the site. Whilst this is not a EA maintained flood defence its effect needs to be taken into account. The flood water levels for the 1000 year flood do exceed the top levels of the wall for short sections but there would be no reason why the wall could not be reinforced or raised in height to prevent flood water entering the site. New house floor levels could be sited above these floodwater levels and the ground raised accordingly without affecting any flood water displacement. The site is therefore considered to be at risk from fluvial flooding, but not for the 1 in 100year flood.

5.7.3 The site is generally flat with very slight falls towards the eastern area of the site. The bank height of the river adjacent to the could be raised slightly to protect the site from the 1 in 1000year flood levels and a measure of compensatory flood water provided off site in the attenuation basin to the west.. There are no reports of this site flooding in the past nor during the major flooding storms at Christmas 2015.

5.7.4 The River Colne has been modelled and flood water levels for the 100 year and 1000 year flood have been obtained and previously submitted as part of the previous Flood \Risk assessments for this site. The results of this show that the access road into the site which has a level of 162.363m AOD would remain above the 1 in 100 year flood levels for the beck (160.630 m AOD) and also above the 1 in 1000year flood level of 161.323. Thus the road would remain accessible at all times even for extreme events.

5.7.5 The modelled levels suggest that the floodwaters from the river stays within the banks upstream of the bridge but slight alterations in the access track levels could be made to ensure no flows travel down the access track towards the site even in exceedance events.

5.7.6 Immediately below the bridge the floodwater levels appear to be much closer to the site levels and it is proposed to ensure that flooding for the 100 year storm cannot enter the site by raising ground levels slightly so that house and garden levels are a minimum of 600mm above the 100 year flood levels or even above the 1 in 1000 year flood levels.

5.7.7 The existing perimeter wall to the site would actually prevent waters leaving the river but these are not considered in production of the E A Maps. If the wall retains the flood waters for the 100 year flows this would suggests that the site will not be flooded and that compensatory flood volumes would not be needed. However, if the modelled levels are considered and the boundary wall was assumed to have failed, then a small area between the river and the former

building would be below the flood levels and may have flooded during the 100 year storm if the wall had collapsed or not been maintained. This would equate to an area of 700sq. m which would have been flooded to an average depth of 120mm for the 100 year flood. It is considered that a flood water compensation of 84cu.m would adequately compensate for that.

5.7.8 For the development to proceed on this site we would recommend floor levels are set a minimum of 600mm above the modelled 100 year flood water levels or even above the 1 in 1000 year flood level of the site.

5.7.9 If development were to be approved then the residual flood risk would need to be considered. The layout of the site with a flood route through it would allow any overland flows from exceedance events, would simply flow along the roads from west to east and thence back into the river downstream. If building levels are raised above the 1 in 100 year flood levels then the residual risk of flooding to the buildings would be low and therefore be acceptable. An area at the eastern end of the site could be lowered as compensatory flood water volumes. If the area of buildings is considered this volume would be around 80cu.m. as stated earlier.

5.7.10 The road level to the front of the site will be passable during the 100 year and the 1000 year flood event. The lower bridge may not be and as it is now disused, and not functional, we would suggest that it is removed as part of the site development. The site can therefore be accessed even during the 1 in 100 year flood event.

5.7.11 The site falls within the flood warning area designated by the E.A. The residents will need to subscribe to the flood warning system already operated by the EA to ensure they are aware of any risks to personnel and property due to flooding from the watercourse. Whilst it would not be necessary to evacuate the site up to the 100 year flood event, the risk of being isolated, which only

occurs for exceedance events, remains and refuge areas should be provided within the buildings.

5.8 Risk of Flooding from overland flows from adjacent land.

5.8.1 The site lies at the bottom of a valley with steep slopes down to open fields to three sides. To the south and west of the site the land is substantially higher than the site. To the north the adjacent land is higher than the site whilst the land to the east is lower than the site and falls away from the site. The risk of any overland flow is principally from the north and west.

5.8.2 The land to the west is higher but any flows will be intercepted by the existing pond and the river or canal to the south and north of the site respectively. The risk of overland flows is considered low, apart from reservoir breech events, which is discussed later in this section.

5.8.3 The risk of overland flows following reservoir breech scenarios needs to be considered. The site is shown to be within a zone subject to flooding from reservoirs should a breech occur. The plans do not show what the source would be for this site as there are a significant number of upstream reservoirs.

5.8.4 In close proximity to the site is Sparth Reservoir to the north west of the site. This is owns by the Canal Trust and acts as a top up reservoir for the Huddersfield Narrow canal which runs west to east between the site and the reservoir. The reservoir is fed by watercourses from the north that discharge into the reservoir. At its western end the water levels are only 1m above the canal and the canal water levels are approx. 1m above the western mill pond water levels. At its eastern end the reservoir has both its over-spillway and a drawdown channel to allow it to be emptied. At this point the water level is some 3m above the level of the canal. The dam is of earth construction with a concrete and stone spillway some 8m wide. The length of dam is limited to

approx. 40m long due to the topography and the adjacent locks to the canal. It is assumed that this reservoir is maintained and inspected on a regular basis under the Reservoirs Act by the Canal Trust.

5.8.4 If a breech in the holding dam occurred, the flows would firstly enter the canal system and would flow away to the east. The flows could not enter the mill pond due to the 2.4m high stone faced retaining walls to the pond at this point. Thus any flows would be channelled along the canal route. The flows would therefore spill out to the northern side of the canal as this is a lower area than the site. Some flows may enter the existing watercourse that runs in a culvert beneath the western mill pond and would discharge to the River Colne to the south of the site. At some 50m from the dam, the water from any breech would overflow to land to the north rather than into the site due to the existing 600mm thick perimeter wall to the site. The height of retained water in Sparth Reservoir is not particularly high so any flows from a breech would probably not exceed 1m in depth along this route and would dissipate to a depth of flow significantly less than that before meeting the lower boundary wall (approx. 1200mm high) some 280m away from the dam. The water would also dissipate into the land to the north further reducing the depth of flow.

5.8.5 The risk of flooding on the site from this source is further reduced by the proposal to infill the eastern mill pond which would provide a further strengthening of the wall at this point. The waters would not be able to enter the proposed development site due to the existing perimeter wall. Some 280m downstream the boundary wall reduces in height to 1200mm but the breech flow depth would be low by this point and again would not be able to enter the site. As such the level of risk of flooding from Sparth reservoir is considered to be very low. Any flows in the canal channel would remain there due to the site perimeter walls and the topography until it is some way downstream of ten development.

5.8.6 The risk of flooding from other reservoirs would still remain and the reservoirs that may influence this site are not detailed in the EA plans. These are however, all major reservoirs that have annual inspections and are covered by the requirements of the Reservoirs Act to be regularly maintained. The risk of flooding from this source is considered to be less than the 1% flood risk from rivers. It would however be prudent to ensure there is an overland flood route through the site to cater for extreme events and that the residents are subscribing to the EA Flood warnings system. We would suggest that external levels and the road levels are designed to provide such a route, and this will effectively reduce this risk to an acceptable level.

5.8.7 The risk of flooding from the mill ponds has been raised by the report carried out by Kirklees MDC on the ponds in October 2014. If the existing mill ponds were to be left then the site would be at risk of flooding if there was a breech scenario at the eastern end of the mill ponds where the culvert beneath the mills begins. The dam which formerly held back a head of water approaching 3m, does appear to be in good condition at the present time, but would need regular inspection and maintenance to ensure its long term stability. Whilst the proposals would include a system to route flood waters, from such a scenario, along the highways, the risk of flooding to the dwellings could not be discounted.

5.8.8 The proposals therefore include the infilling of the eastern mill pond with inert fill materials to remove the risk of a breech occurring at this point. This would also reinforce the existing walls to the canal to prevent breech waters from Sparth Reservoir entering the site from this point. The nearest point to the ponds would then be some 70m away from the new buildings.

5.8.9 The report also noted that there may be a significant risk of flood water entering the site from a breech in the western ponds perimeter walls. On the northern side of the pond there is only a short section of wall that would retain approx. 1.2m depth of water once the eastern section is infilled. Once the wall

construction has been consolidated by grouting works the risk of failure of this wall would be significantly reduced. In a similar way any flood water s from this breech would be channelled along the canal system as defined in the discussion regarding Sparth Reservoir earlier in this report.

5.8.10 The possible risk of flooding from a breech on the southern side of the western pond is also considered remote once the eastern section of the mill pond is infilled. In such a scenario the flood waters would flow directly into the River Colne adjacent to the wall. There is slight risk that some flood waters may reach the site entrance road crossing the River Colne but would then be channelled through the site via the highways flood water route.

5.8.11 The risk of flooding from this source is therefore considered to be acceptable for this development once the proposals are implemented fully.

5.9 Risk of Flooding from Rainwater Falling on Site

5.9.1 The risk of flooding from water falling on site and not being able to leave is considered to be medium partly due to the topography of the site and its previous development. At present there are 6855sq.m of buildings and hard paved and positively drained areas on site. The new development would amount to 7330sq.m of hard paved areas. Although this suggests an increase in impermeable areas, the area of the infilled millpond would transform this into a net reduction in flows off site by approx. 15%. This is not sufficient to comply with current criteria and planning policies so these flows would however need to be attenuated to ensure no surcharging of systems downstream.

5.9.2 Storms up to the once in 100 year risk, and allowances to be made for climatic change, can be managed by the use of storm water storage systems. The design of these systems would be dependent on the agreed discharge for the site which is normally 70% of existing annual storm run off. The design can be detailed to cater for storms up to the 100 year return period with an allowance

made for climatic change. This would currently suggest a 30% increase in storm intensities and additional flood water storage volume requirements. With this system in place the flows from the site into the surface water systems would be considered acceptable.

5.9.3 If the underlying ground is not suitable for infiltration then the system should be made to connect to the existing drainage system which discharges to the River Colne. The discharge from this system would be limited to agreed discharge rates. The storage system should be designed to cater for a 100 year storm and additional storage to cater for climatic change. This storage could be catered for above ground in designated flood areas such as car parks or shallow swales or public open spaces. The space for these is available in land to the east of the development site.

5.9.4 The storage volumes required are calculated as shown in the appendices and are defined as 110cum for the 30 year storm; 157cu.m for the hundred year storm and rising to 235cu.m when 30% climate change is taken into consideration. This can be provided in a shallow pond or swale to the east of the site. The flows would have to be controlled by a “Hydrobrake” or similar low maintenance flow control device. If these are provided the risk of onsite flooding from rainfall would be effectively controlled to acceptable levels.

6.0 CONCLUSIONS

6.1 In our opinion the site, is shown to be at risk of flooding, partially, from river or tidal water for a 1% return period and predominantly for storms in excess of the 0.1% risk level. The site is however defended by flood defences not maintained by the Environment agency and as such the residual flood risk should be evaluated. The development of the site would require the raising of floor levels but because the site was previously developed with building covering large areas of the site behind the flood defences mentioned earlier it does not form part of the flood plain. The provision of compensatory flood water storage for

the site should be discounted but a notional volume can be provided to the east of the site. We would recommend that floor levels are raised 450m above the 1 in 100 year flood event levels or even above the 1 in 100 year flood level.

6.2 The development of the site with the use of soakaways or other infiltration methods is to be investigated but is thought to be unlikely due to the lack of infiltration capacity of the underlying strata.

6.3 It would be necessary to provide storm water attenuation systems on site to limit flows from the completed development to 70% of the existing flows from the site. Discharges would have to be limited to agreed rates of discharge to ensure flood risks downstream are not increased.

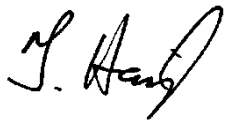
6.4 The site is considered to be accessible even during the 1 in 1000 year event.

6.5 The residual flood risk to the properties from fluvial sources can be reduced to acceptable levels by raising garden levels on the southern side of the development to prevent flood waters leaving the river channel which is currently performed by the site perimeter wall. Public open space areas to the east could be left low or reduced to accommodate any flood waters displaced by the development.

6.6 The risk of flooding from Sparth reservoir is considered to be low due to the site features and the local topography as is discussed in this report. It is important that the eastern section of the mill ponds is infilled and that the wall to the northern boundary is maintained at its existing height and width for the lifetime of the development. It is noted that there are minor problems with the existing pond retaining walls and these should be remedied as part of the development to reduce the risk of flooding from reservoir breech scenarios.

6.7 The provision of a flood route through the site will ensure that any residual flood risk and exceedance events are catered for the effect flood water displacement for extreme events beyond the 1 in 100 year event. This can be achieved by simply ensuring that floor levels are a minimum of 450mm above the road levels.

6.8 The site is in an area covered by the EA flood waning scheme and residents should be made aware that they should subscribe to this system and respond to any warning given. It is our opinion however that the site will not be at risk when developed due to the items outlined above.



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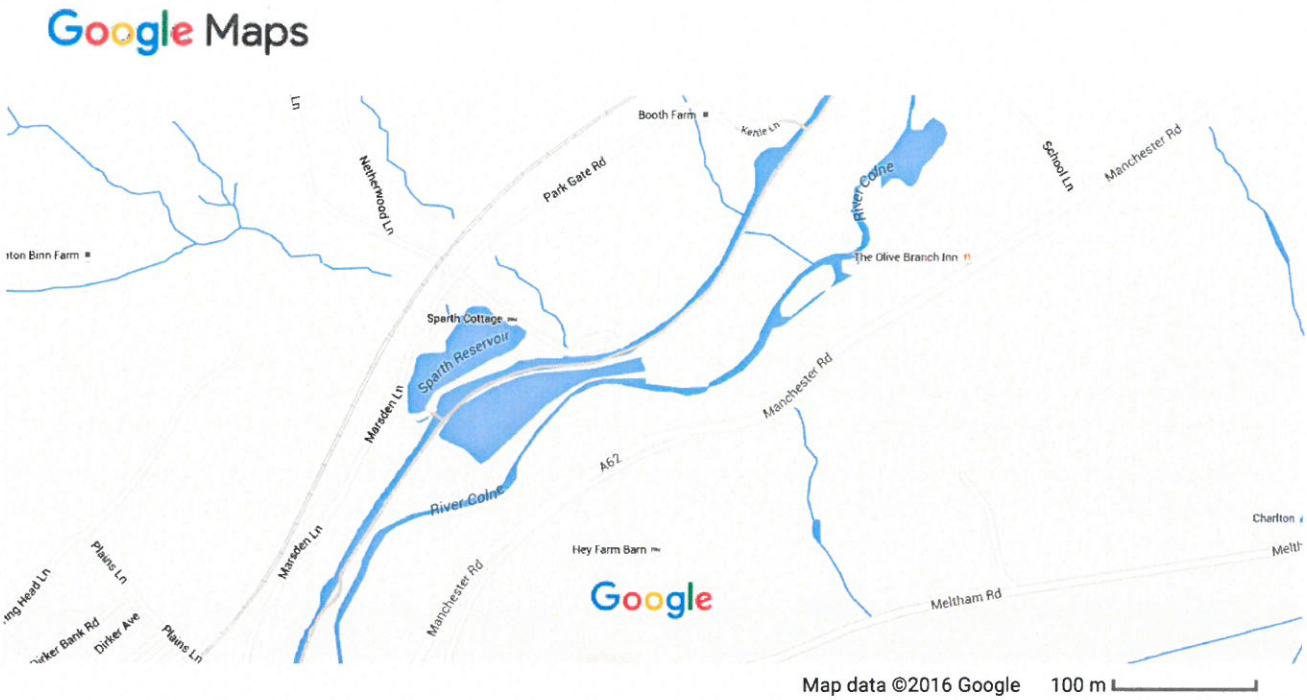
APPENDIX A

LOCATION PLAN & AERIAL VIEW


Google Maps
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Kente Ln
Netherwood Ln
Park Gate Rd
River Colne
School Ln
Manchester Rd
The Olive Branch Inn
Sparth Cottage
Sparth Reservoir
Marsden Ln
Manchester Rd
A62
River Colne
Hey Farm Barn
Google
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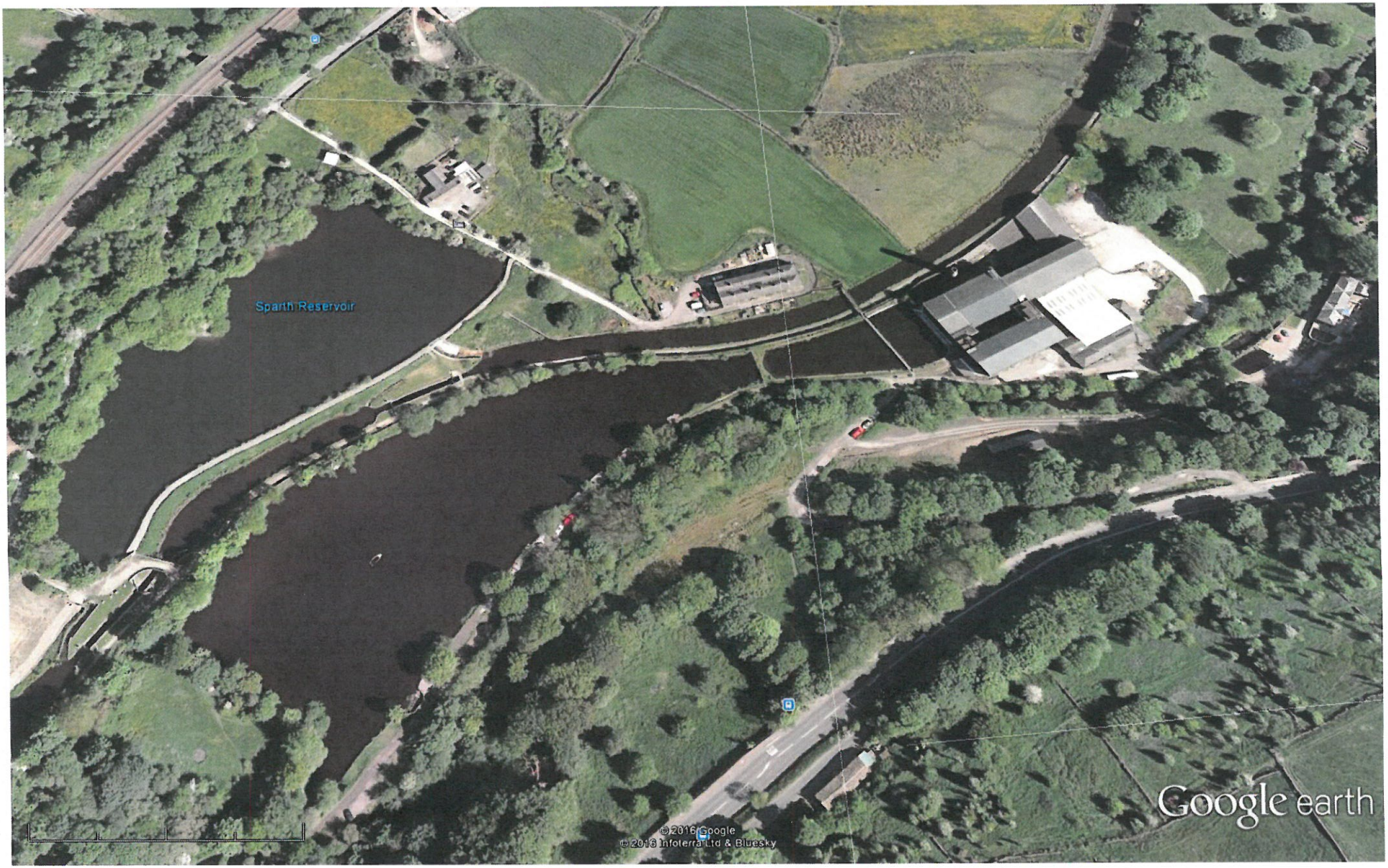
Plains Ln
Dirker Ave
Map data ©2016 Google
100 m

Google Maps



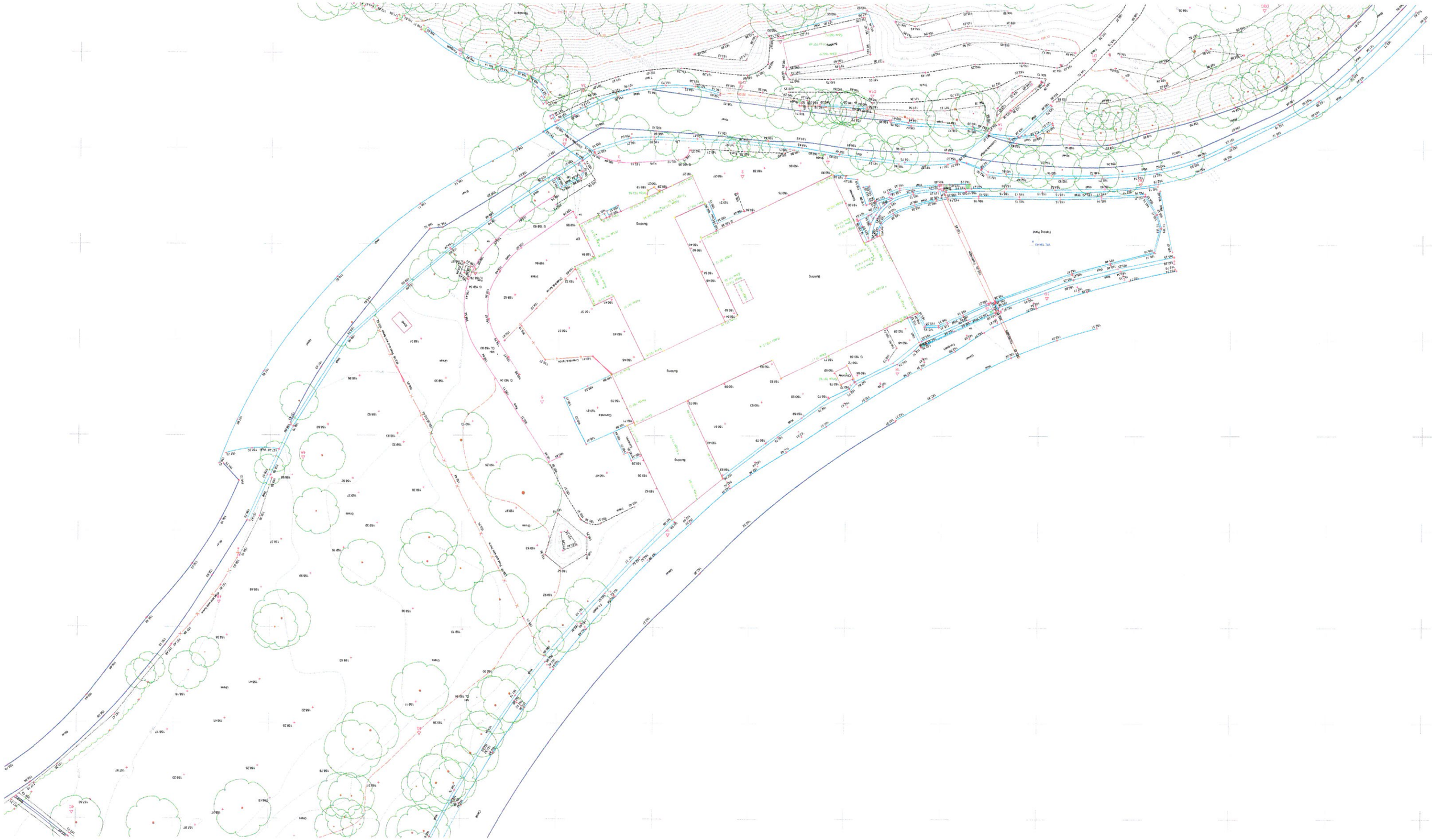
Google earth

feet 800

meters 200

APPENDIX B

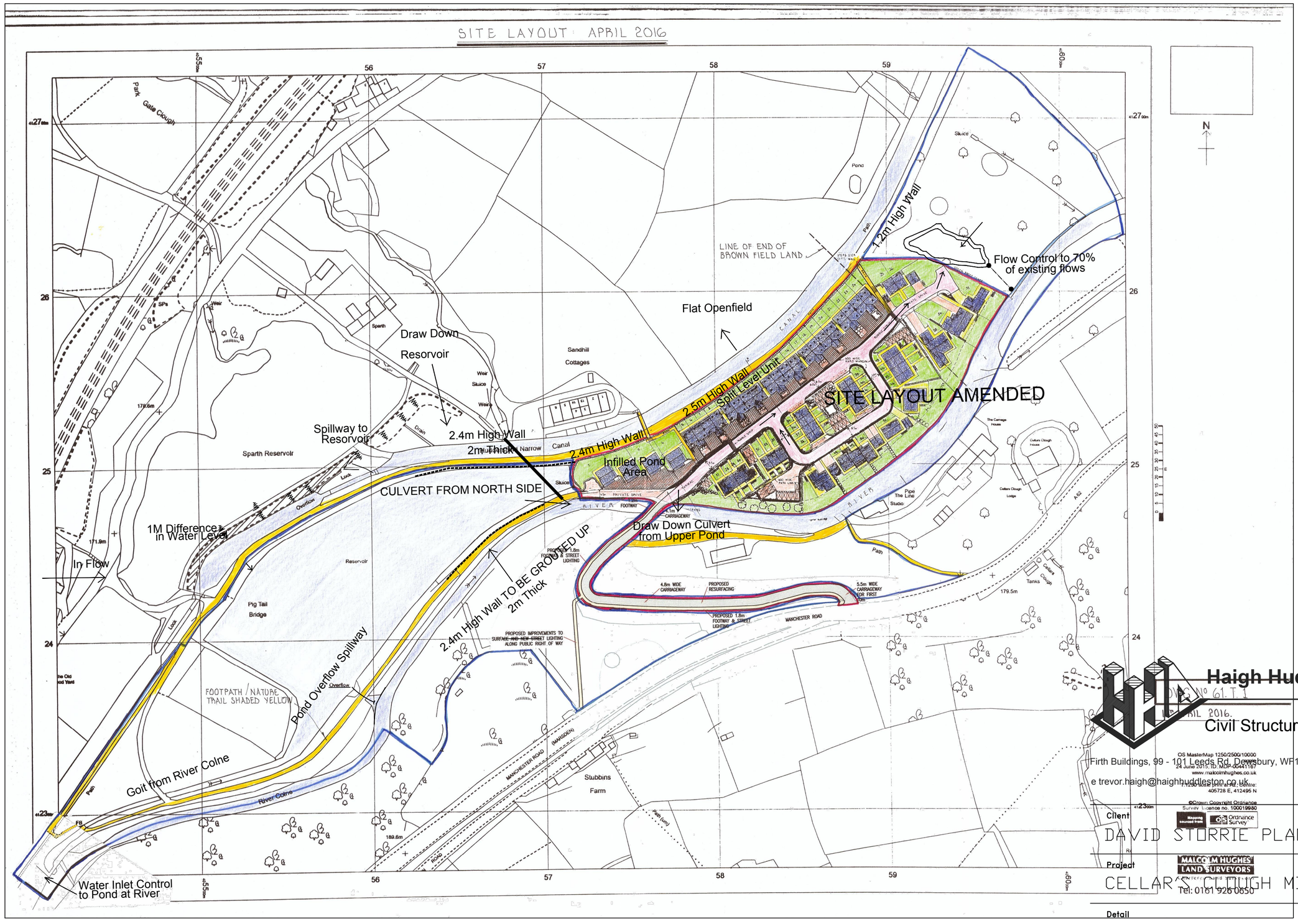
SITE SURVEY



APPENDIX C

PROPOSED SITE PLAN WITH FEATURES NOTED

SITE LAYOUT APRIL 2016



Haigh Huddleston & Associates

Civil Structural Engineering Consultants

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

e trevor.haigh@haighhuddleston.co.uk

Client

DAVID STORRIE PLANNING

Project

CELLARS CLOUGH MILL

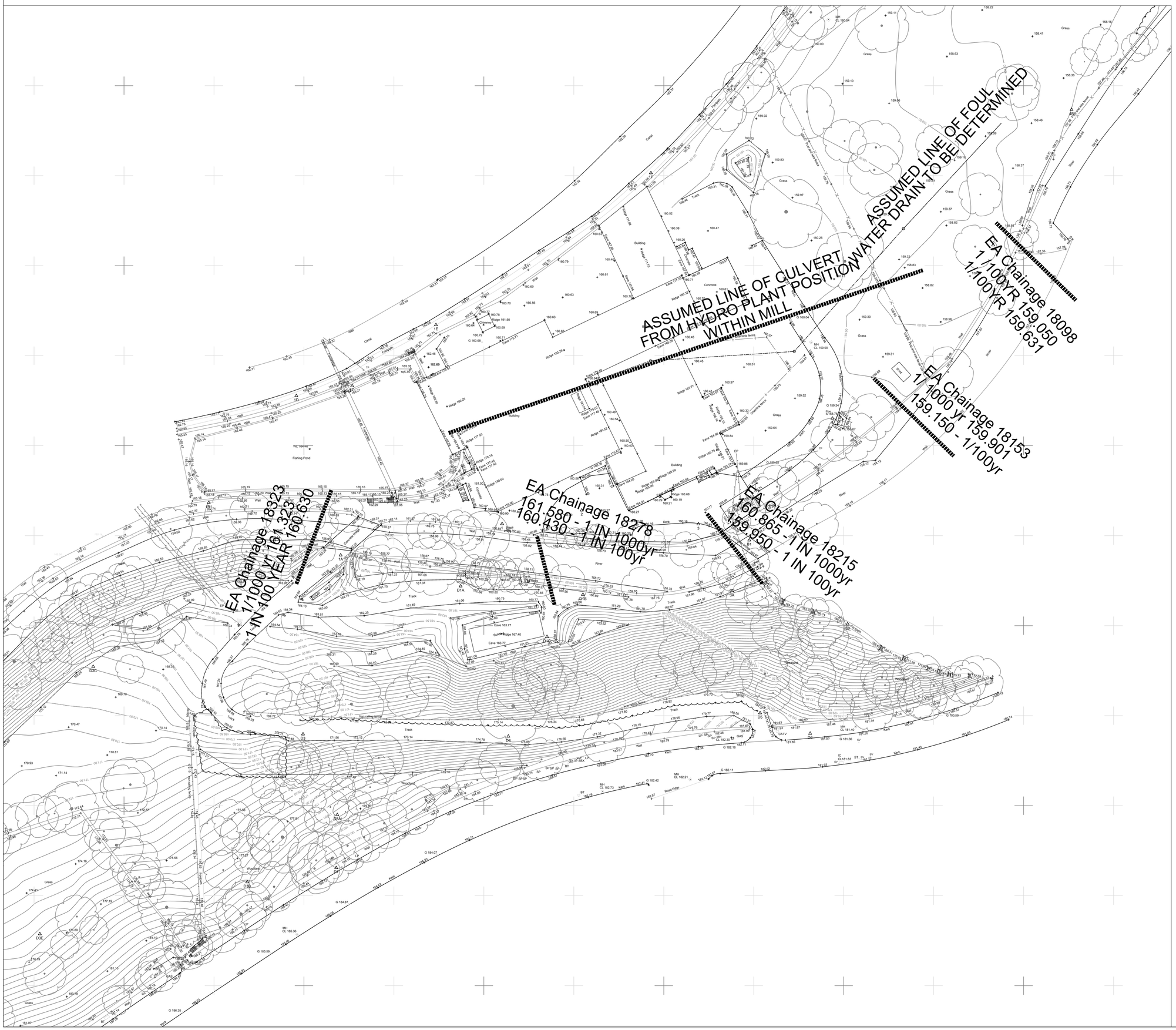
Detail

FRA NOTES AND LAYOUT OF OFF SITE FEATURES

Dwn	Chkd	Date	Scale	Dwg No.
DG	TH	Apr'2016	1:2000	6518 02

APPENDIX D

RIVER COLNE FLOOD LEVELS PLAN & SITE DRAINAGE



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Civil Structural Engineering Consultants

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e trevor.haigh@haighhuddleston.co.uk

Client
DAVID STORRIE PLANNING

Project
CELLAR'S CLOUGH MILL

Detail
Plan

Dwn	Chkd	Date	Scale	Dwg No.
DG	TH	Apr'2016	1:2000 @A1	6518_01

APPENDIX E

FLOOD RISK MAPS

Environment Agency

Enter a postcode or place name: WF1 1AD Go

Other topics for this area... Flood Map for Planning (Rivers and Sea)

Flood Map for Planning (Rivers and Sea)

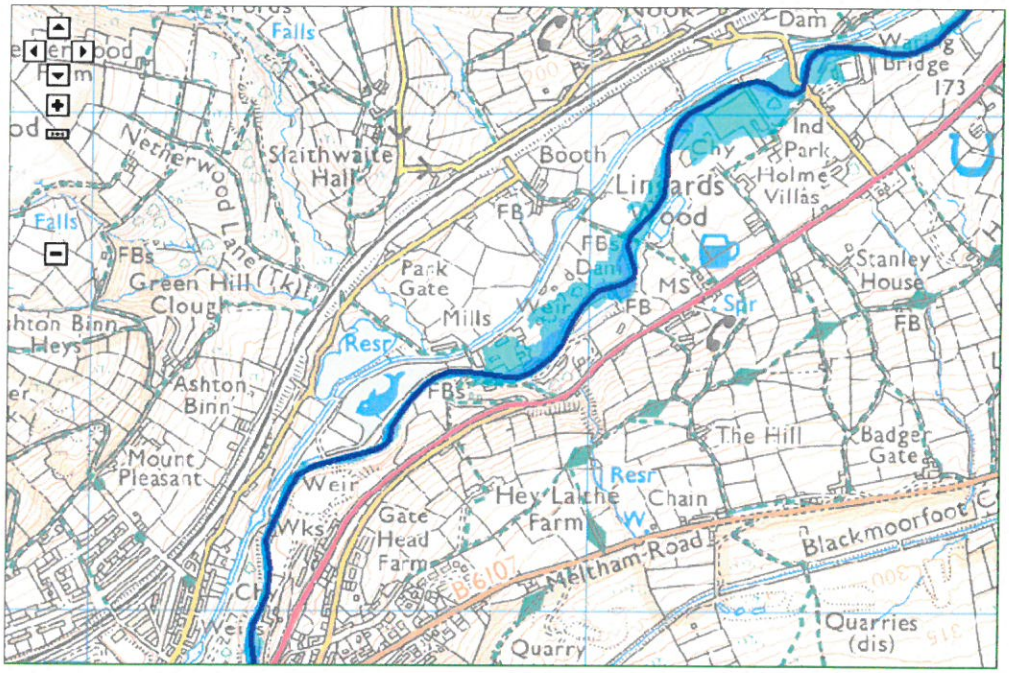
Map legend

Click on the map to see what Flood Zone (National Planning Policy Guidance definitions) the proposed development is in.

- Flood Map for Planning (Rivers and Sea)
  - Flood Zone 3
  - Flood Zone 2
  - Flood defences (Not all may be shown*)
  - Areas benefiting from flood defences (Not all may be shown*)
- Main River Line
  - Main River Line
- Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility

X: 405,832;Y: 412,552 at scale 1:10,000

Other maps **Data search** **Text only version**



More about flooding:

Understanding the Flood Map for Planning (Rivers and Sea)

A more detailed explanation to help you understand the flood map shown above.

Current flood warnings

We provide flood warnings online 24 hours a day. Find out the current flood warning status in your local area.

*** Legend Information:** Flood defences and the areas benefiting from them are gradually being added through updates. Please contact your **local environment agency office** for further details.

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Follow us: YouTube Twitter Flickr Facebook

Author: Environment Agency | wiybysupport@environment-agency.gov.uk
Last updated: 21st January 2016

Environment Agency

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

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

Risk of Flooding from Surface Water

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

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

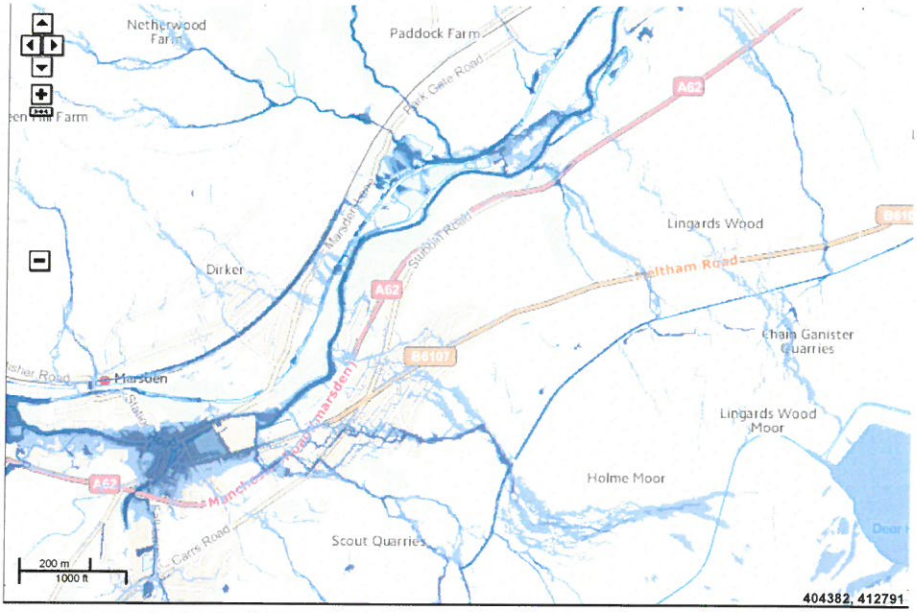
Click on the map for a more detailed explanation.

Map of X: 405,705; Y: 412,081 at scale 1:10,000

Data search

Map legend

- ☑ Risk of Flooding from Surface Water
  - High
  - Medium
  - Low
  - Very Low
- ☑ Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility



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Author: The Environment Agency | enquiries@environment-agency.gov.uk
Last updated: 01 March 2016

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

Go | Risk of Flooding from Reservoirs | View other Interactive Maps

Risk of Flooding from Reservoirs

Reservoir flooding is extremely unlikely to happen.

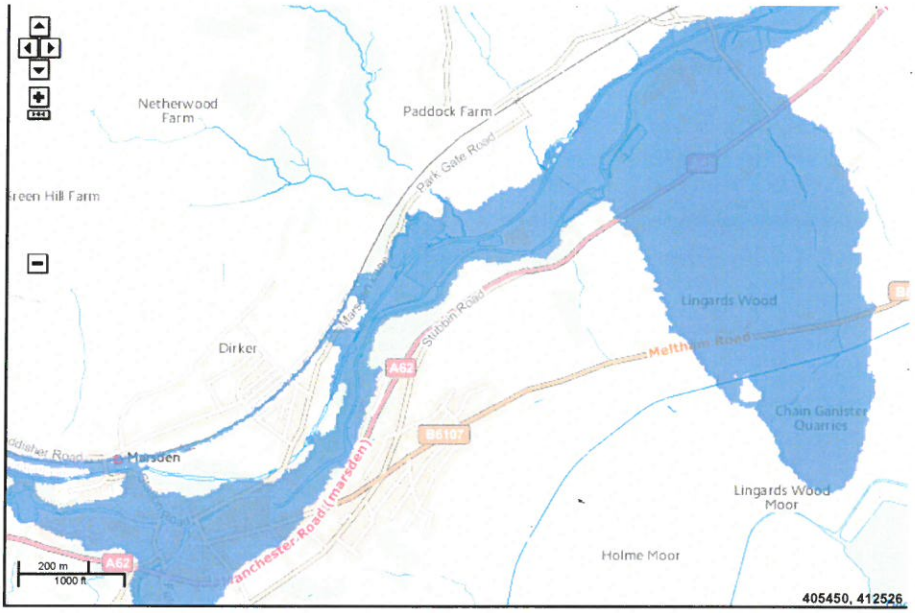
The shading on the map shows the area that could be flooded if a large reservoir were to fail and release the water it holds. A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools. Since this is a worst case scenario, it's unlikely that any actual flood would be this large.

Click on the shading to see details of reservoirs that could cause flooding in this area.

Map legend

- [x] Risk of Flooding from Reservoirs
- Maximum extent of flooding
- [x] Other national environmental organisations
- Natural Resources Wales Area of responsibility
- Scottish Environment Protection Agency Area of responsibility

Map of X: 405,659; Y: 412,308 at scale 1:10,000 **Data search**



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Environment Agency

Enter a postcode or place name: Go

Other topics for this area... Flood Warning Areas

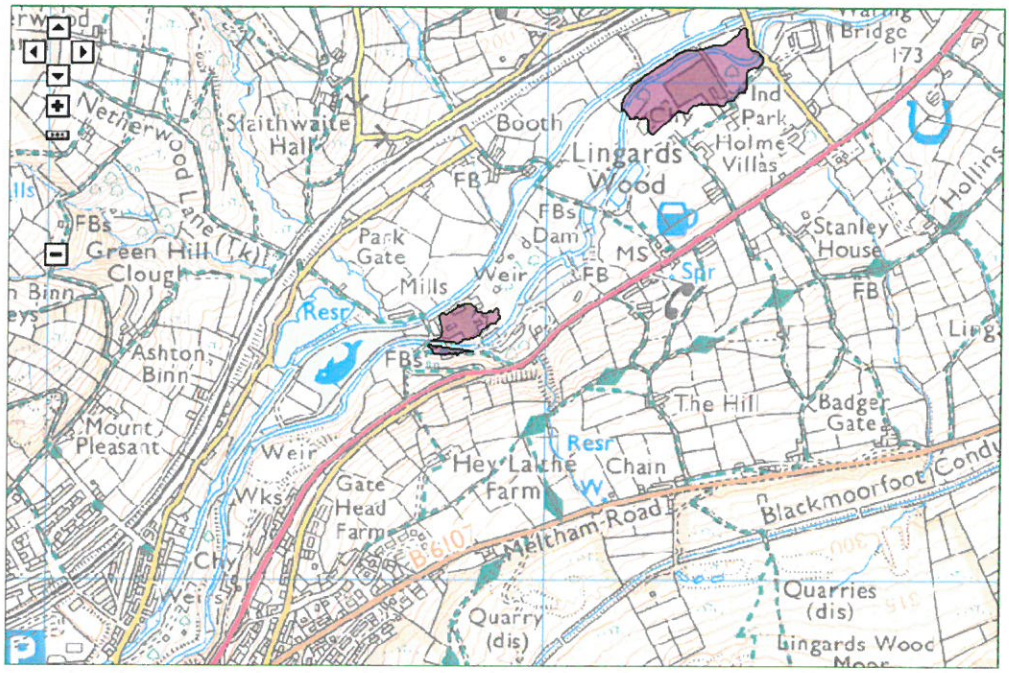
Flood Warning

Map legend

Click on an area for details.

- Flood Warning Areas
  - Areas where we issue flood warnings
- Flood Alert Areas
  - Areas where we issue flood alerts
- River and Sea levels
  - River and Sea levels

Map of X: 405,919; Y: 412,488 at scale 1:10,000 **Other maps** **Data search** **Text only version**



More about Flood Warnings:

Flood Warning Areas

If your home or business is within a purple shaded area on the map then you can receive free flood warnings. We issue flood warnings to specific areas when flooding is expected. **If you receive a flood warning you should take immediate action**.

For further information visit our Flood warning pages.

Flood Alert Areas

If your home or business is within a pink shaded area on the map then you can receive free flood alerts. We issue flood alerts when flooding is possible. In many areas we issue flood alerts for flooding from rivers, the sea and groundwater. **If you receive a flood alert you should be prepared for flooding and to take action**.

It is very difficult to predict the exact location of flooding from groundwater as it is often related to local geology. We can't say for definite which properties are at risk from groundwater flooding. To help people we provide flood alerts for large areas that could be affected if groundwater levels were high.

For further information visit our Flood warning pages.

River Levels

River level monitoring sensors are placed in the waters at key points and measure changes in water level. This data is recorded at 15 minute intervals; it's then sent back to our offices to be published online at least once a day. The information may be updated more frequently to meet operational needs, for example when water levels are high. This is the most up to date information available about river and sea levels.

For further information visit our River and Sea Levels pages.

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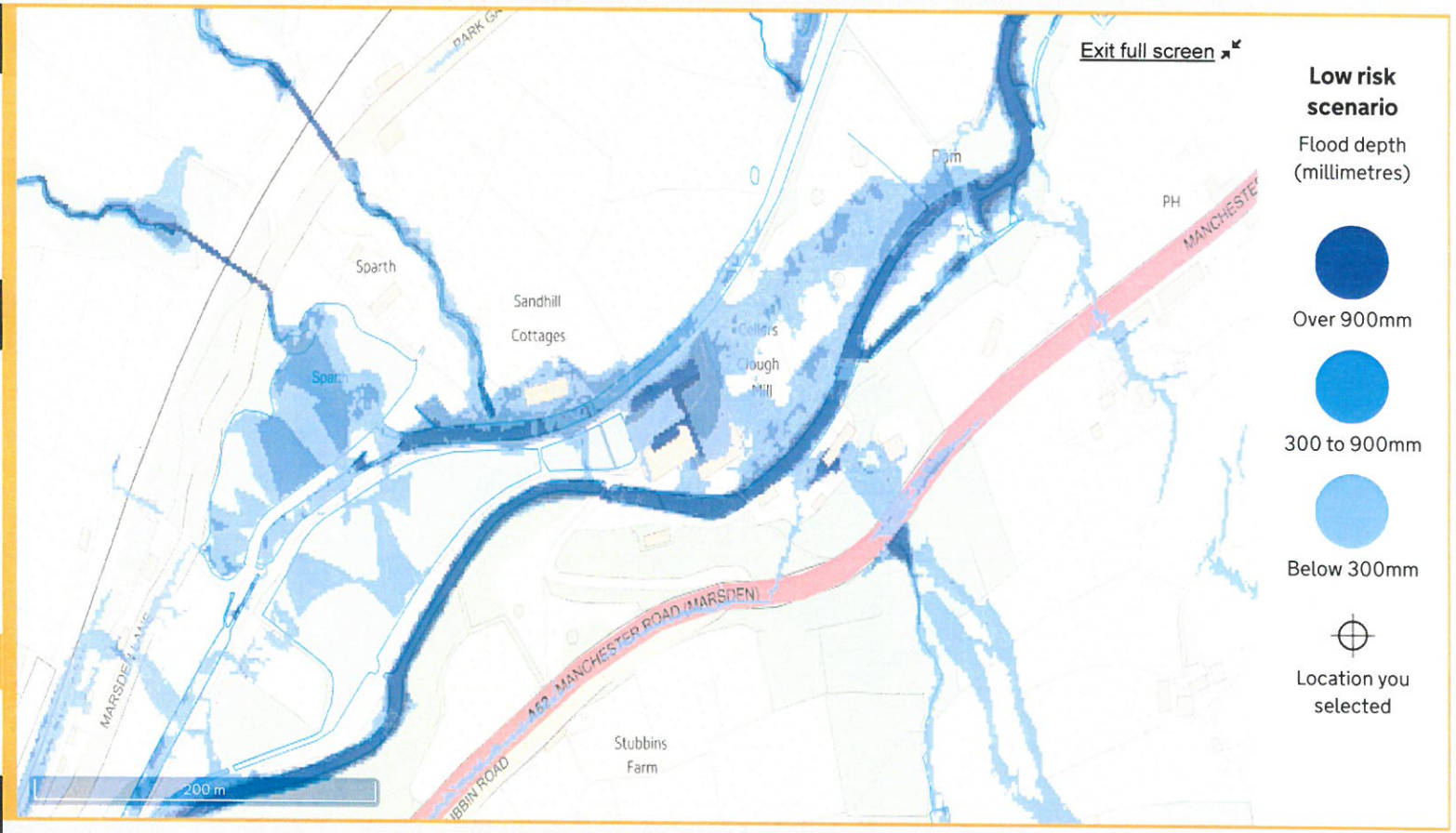
Basic view Detailed view

Location Enter a place or postcode in England

- Extent of flooding
- Depth and flow estimates at monitoring stations

- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth
- Medium risk: velocity
- Low risk: depth
- Low risk: velocity

- Extent of flooding
- Flood depth
- Flood speed



Basic view Detailed view

Location Enter a place or postcode in England

Extent of flooding

Depth and flow estimates at monitoring stations

Extent of flooding

High risk: depth

High risk: velocity

Medium risk: depth

Medium risk: velocity

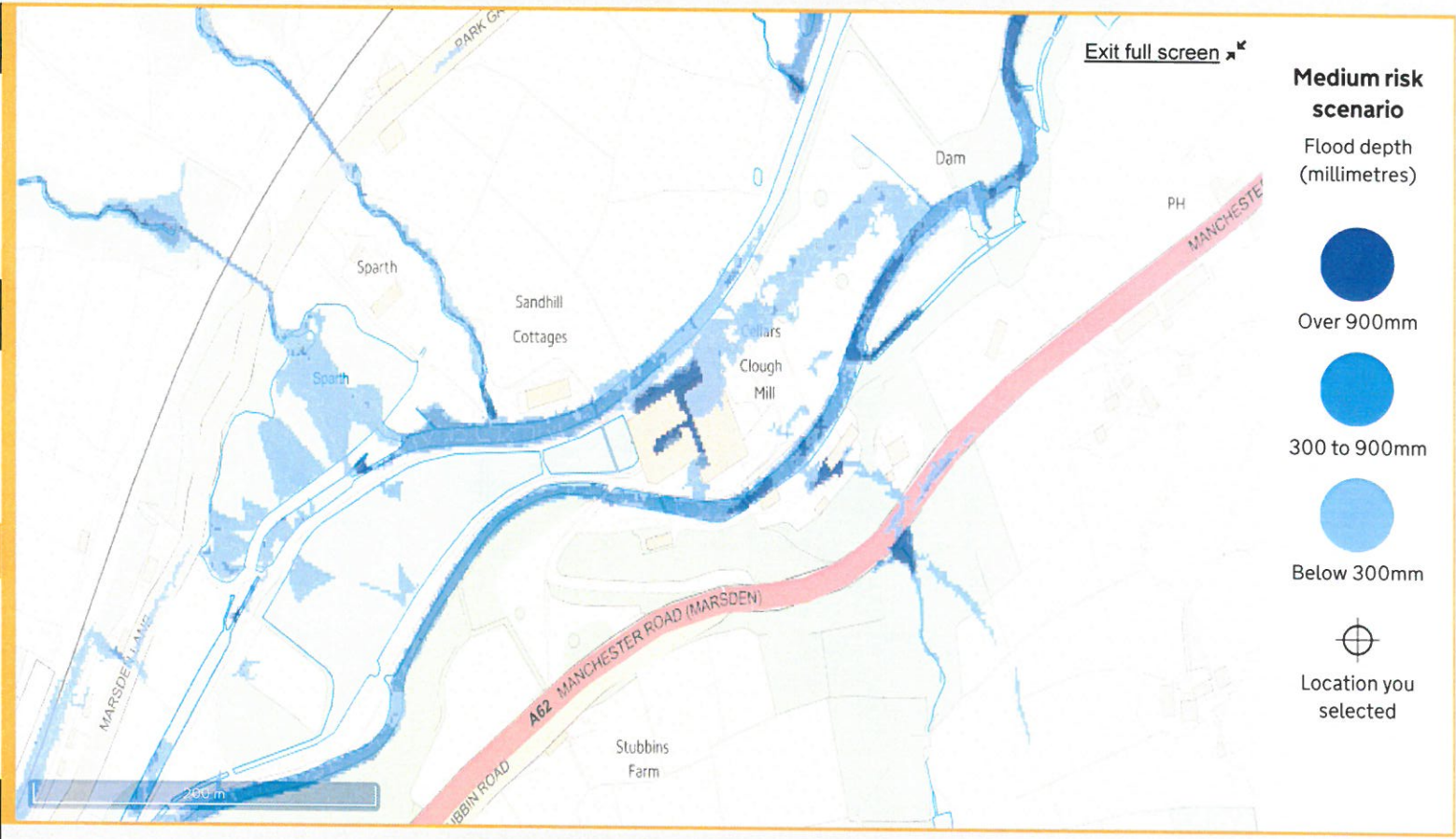
Low risk: depth

Low risk: velocity

Extent of flooding

Flood depth

Flood speed



Basic view Detailed view

Location Enter a place or postcode in England

Extent of flooding

Depth and flow estimates at monitoring stations

Extent of flooding

High risk: depth

High risk: velocity

Medium risk: depth

Medium risk: velocity

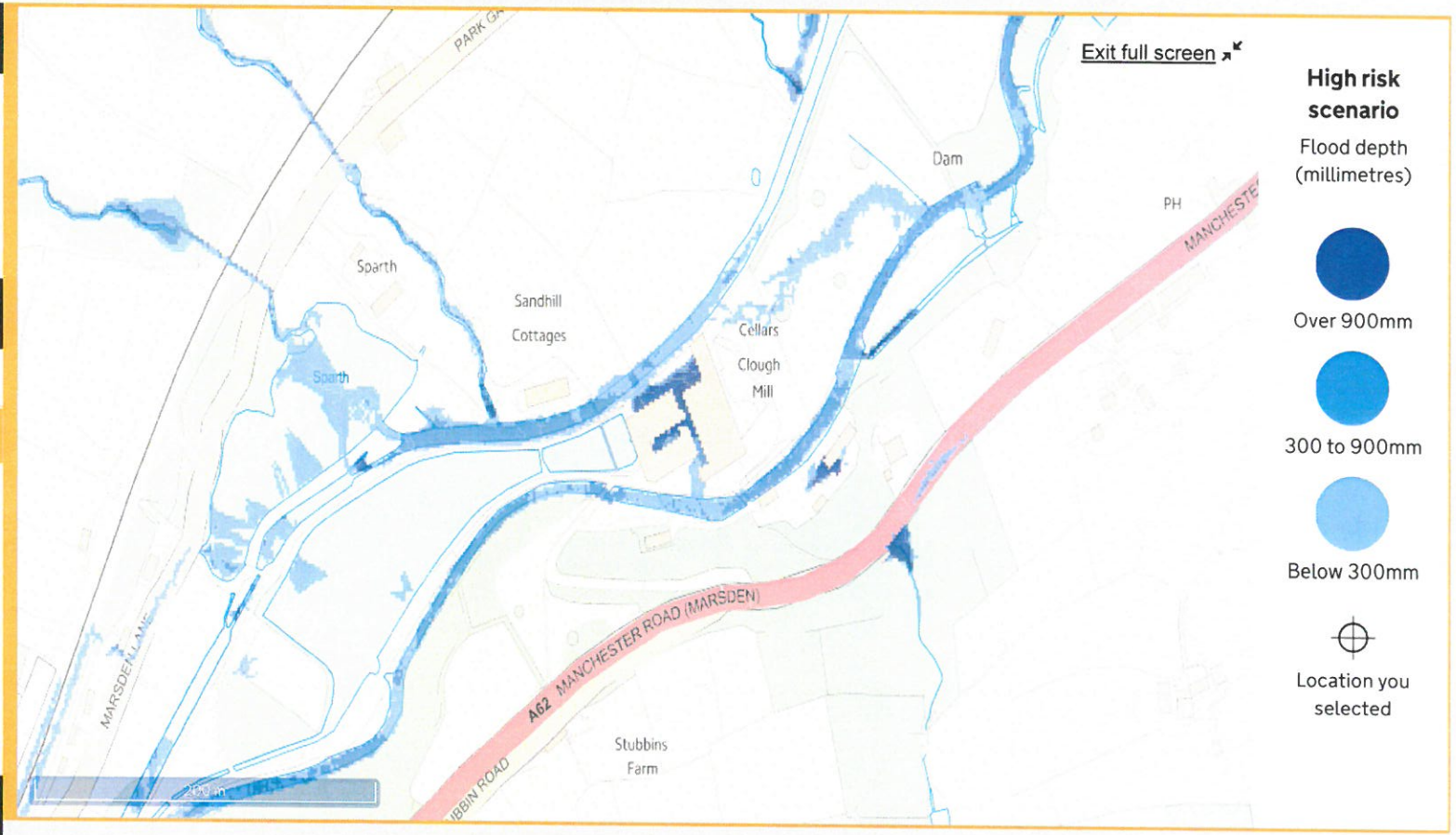
Low risk: depth

Low risk: velocity

Extent of flooding

Flood depth

Flood speed



Basic view Detailed view

Location Enter a place or postcode in England

Extent of flooding

Depth and flow estimates at monitoring stations

Extent of flooding

High risk: depth

High risk: velocity

Medium risk: depth

Medium risk: velocity

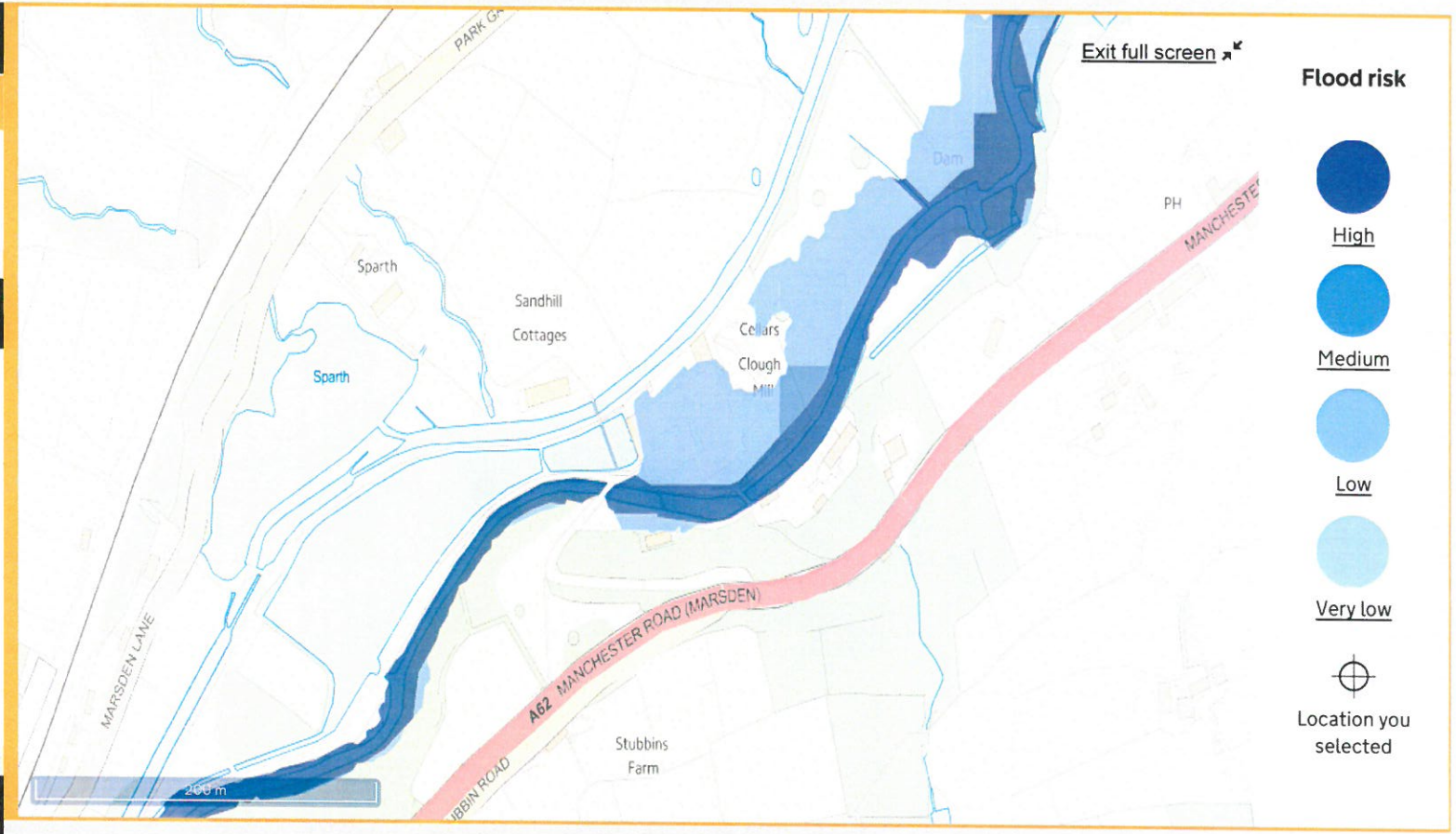
Low risk: depth

Low risk: velocity

Extent of flooding

Flood depth

Flood speed



APPENDIX F

STORMWATER STORAGE CALCULATIONS

HAIGH HUDDLESTON ASSOCIATES **Stormwater Storage Calculations**

Client **David Storrie Planning**

Site **Cellars Clough Huddersfield**

Design storm 30 M5-60 19 mm
r 0.4
Site area sq m. 15260
Imp Area sq m. 7336
T of Conc min 4 Time to Flow

Allow Discharge 33 Lit / sec Imp Ratio 0.48

30 YEAR STORM | 100 year storm | 100year plus 30% climate | 2 year storm

Storm Duration Mins	Intensity mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.	Q	t	Intensity mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.	Intensity mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.	mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.
10	81.8	13.63	100.01	26.15	73.86	166.82	0.8	101.27	16.88	123.82	26.15	97.66	131.65	21.94	160.96	26.15	134.81	35.17	5.86	43.01	26.15	16.85
20	59.8	19.93	146.23	45.38	100.85	121.96	1.1	74.03	24.68	181.03	45.38	135.66	96.24	32.08	235.34	45.38	189.97	25.71	8.57	62.88	45.38	17.50
30	47.6	23.80	174.60	64.63	109.97	97.08	1.4	58.93	29.46	216.15	64.63	151.52	76.61	38.30	281.00	64.63	216.37	20.47	10.23	75.08	64.63	10.45
50	34.4	28.67	210.30	103.19	107.10	70.16	1.9	42.59	35.49	260.35	103.19	157.16	55.36	46.14	338.45	103.19	235.26	14.79	12.33	90.43	103.19	-12.77
60	30.3	30.30	222.28	122.49	99.79	61.79	2.1	37.51	37.51	275.18	122.49	152.69	48.76	48.76	357.74	122.49	235.25	13.03	13.03	95.58	122.49	-26.91
120	18.7	37.40	274.37	238.67	35.70	38.14	3.5	23.15	46.30	339.67	238.67	101.00	30.10	60.19	441.57	238.67	202.90	8.04	16.08	117.98	238.67	-120.69
180	14.1	42.30	310.31	355.23	-44.92	28.76	4.6	17.46	52.37	384.17	355.23	28.94	22.69	68.08	499.42	355.23	144.19	6.06	18.19	133.43	355.23	-221.80
240	11.5	46.00	337.46	471.98	-134.52	23.45	5.6	14.24	56.95	417.77	471.98	-54.21	18.51	74.03	543.10	471.98	71.13	4.95	19.78	145.11	471.98	-326.87
300	9.8	49.00	359.46	588.84	-229.38	19.99	6.6	12.13	60.66	445.02	588.84	-143.83	15.77	78.86	578.52	588.84	-10.32	4.21	21.07	154.57	588.84	-434.27
360	8.7	52.20	382.94	705.99	-323.05	17.74	7.4	10.77	64.62	474.08	705.99	-231.91	14.00	84.01	616.30	705.99	-89.69	3.74	22.45	164.66	705.99	-541.33
420	7.9	55.30	405.68	823.30	-417.62	16.11	8.2	9.78	68.46	502.23	823.30	-321.07	12.71	89.00	652.90	823.30	-170.40	3.40	23.78	174.44	823.30	-648.86
480	7.5	60.00	440.16	941.23	-501.07	15.30	8.6	9.29	74.28	544.92	941.23	-396.31	12.07	96.56	708.39	941.23	-232.84	3.23	25.80	189.27	941.23	-751.96
540	6.9	62.10	455.57	1058.55	-602.98	14.07	9.4	8.54	76.88	563.99	1058.55	-494.56	11.10	99.94	733.19	1058.55	-325.36	2.97	26.70	195.89	1058.55	-862.65
600	5.38	53.80	394.68	1172.10	-777.42	10.97	12.0	6.66	66.60	488.61	1172.10	-683.49	8.66	86.59	635.19	1172.10	-536.91	2.31	23.13	169.71	1172.10	-1002.39
900	4.00	60.00	440.16	1757.88	-1317.72	8.16	16.2	4.95	74.28	544.92	1757.88	-1212.96	6.44	96.56	708.39	1757.88	-1049.49	1.72	25.80	189.27	1757.88	-1568.61
1200	3.16	63.20	463.64	2343.36	-1879.73	6.44	20.5	3.91	78.24	573.98	2343.36	-1769.38	5.09	101.71	746.17	2343.36	-1597.19	1.36	27.18	199.36	2343.36	-2144.00
1440	2.74	65.76	482.42	2812.35	-2329.93	5.59	23.6	3.39	81.41	597.23	2812.35	-2215.12	4.41	105.83	776.40	2812.35	-2035.95	1.18	28.28	207.44	2812.35	-2604.91
2880	1.63	78.24	573.97	5631.70	-5057.73	3.32	39.7	2.02	96.86	710.57	5631.70	-4921.12	2.62	125.92	923.75	5631.70	-4707.95	0.70	33.64	246.81	5631.70	-5384.89
				Storage	109.97						Storage	157.16				Storage	235.26				Storage	17.50
Length of 1800		43.21						Length of 1800	61.75784				Length of 1800	92.451				Length of 1800	6.87797			
Length of 1500		62.23	Culvert	2.4*1.5m	30.55			Length of 1500	88.93898				Length of 1500	133.141				Length of 1500	9.90513			
Length of 1200		97.23	culvert	3.6*1.8m	16.97			Length of 1200	138.9524				Length of 1200	208.011				Length of 1200	15.4751			
Length of 1050		126.99						Length of 1050	181.47				Length of 1050	271.663				Length of 1050	20.2106			
Length of 900		172.91						Length of 900	247.10				Length of 900	369.906				Length of 900	27.5194			
Length of 750		248.80						Length of 750	355.55				Length of 750	532.263				Length of 750	39.5981			
Length of 600		388.58						Length of 600	555.32				Length of 600	831.308				Length of 600	61.8458			

	Footprint Area (m)				
Aquacell Storage Crates	289.392	30 year	Pond 900mm deep	122.2	30 year
(400mm deep)	413.566	100 year		174.6	100 year
	619.106	100 year plus climatic		261.4	100 year plus climatic

APPENDIX G

RESERVOIR CONDITION REPORT

Investment and Regeneration Service
PO Box B93, Civic Centre 3,
Off Market Street, Huddersfield, HD1 2EY

Flood Management

Tel: 01484 225377
Email: Gemma.snell@kirklees.gov.uk

Date: 28th October 2014

Smith Developments Ltd
Burn Farm
Grains Bar
Oldham
OL1 4ST

Dear Sir/ Madam

Re: Cellars Clough Mill Pond (our Ref 11)

We are writing to you as it appears you are the owner of Cellars Clough Mill Pond, Marsden, Huddersfield.

Kirklees Council has a duty under the Flood and Water Management Act 2010, to investigate and understand local sources of flood risk.

The Council has recently undertaken a study of around 70 small raised reservoirs, looking at their condition, use and ownership. The condition of these is not regulated through legislation (as is the case with larger reservoirs) and the study was commissioned in order to gain an understanding of the risk these small reservoirs could pose to surrounding properties and infrastructure if they were to fall into disrepair and fail.

Ultimately the responsibility for the management and maintenance of such reservoirs rests with the owners.

The purpose of this study was to understand the condition of raised mill ponds and to offer advice and support to owners. We are not insisting that you take any action, however we do feel the need to share our findings, to allow you to consider what actions you may wish to take yourselves.

The findings of all the surveys have now been reviewed and given a priority rating based on the current condition of the reservoir and the impact to the surrounding area should failure occur.

Cellars Clough Pond is considered to be a high priority due to the residential properties in the surrounding area and the recorded condition of the pond. Of particular concern is the evidence of leakage and movement in the masonry walls alongside the adjacent canal, which is causing erosion of the canal towpath. For this reason we are also sharing our findings with the Canal & Rivers Trust.

Please find attached the Surveyor Record Sheet which details the observations recorded during the site visit to your reservoir, including pictures.

The observations have been summarised below, highlighting areas you may want to consider if you decide to take any remedial action. They have been divided into two categories – works which would be considered routine maintenance and areas for further investigation

Routine Maintenance

- Removal of the upturned boat on the overflow spillway.(picture 8)

- Remedial works to stop the leakage from the northern dam along with repairs undertaken to Canal towpath (picture 28)
- Removal of the submerged boat within the reservoir.
- Maintenance of overflow spillway to reinstate missing masonry.
- Management and maintenance of trees within the inlet channel, on the upstream face and dam crest. (picture 5)
- Consideration given to the removal of the fencing panel on the overflow arrangement to reduce blockage risk. (picture 18)

Further Investigation

- Structural assessment of all dams showing signs of leakage and movement to gain better understanding of their current condition.
- Investigation into the condition of the outlet arrangement from the eastern reservoir which may enter mill building on eastern boundary. (picture 26)
- Investigation of the scour within the inlet channel and possible undermining of the retaining walls.
- Investigation into condition and operability of the possible drawdown facility identified in picture 27.

These observations result from a brief visual inspection of the reservoir's condition on the date of the inspection and a general opinion on the overall condition of the reservoir has been formed. The surveyor's note is not an assurance or guarantee of reservoir safety in the future. I appreciate that the information in this letter is technical in nature and you may wish to seek the advice of a civil engineer experienced in reservoirs to confirm the initial observations noted above before any work is undertaken.

If you have any questions or would like to arrange a site visit to discuss this letter further please don't hesitate to contact me.

Yours sincerely,

Gemma Snell
Principal Engineer
Flood Management & Drainage

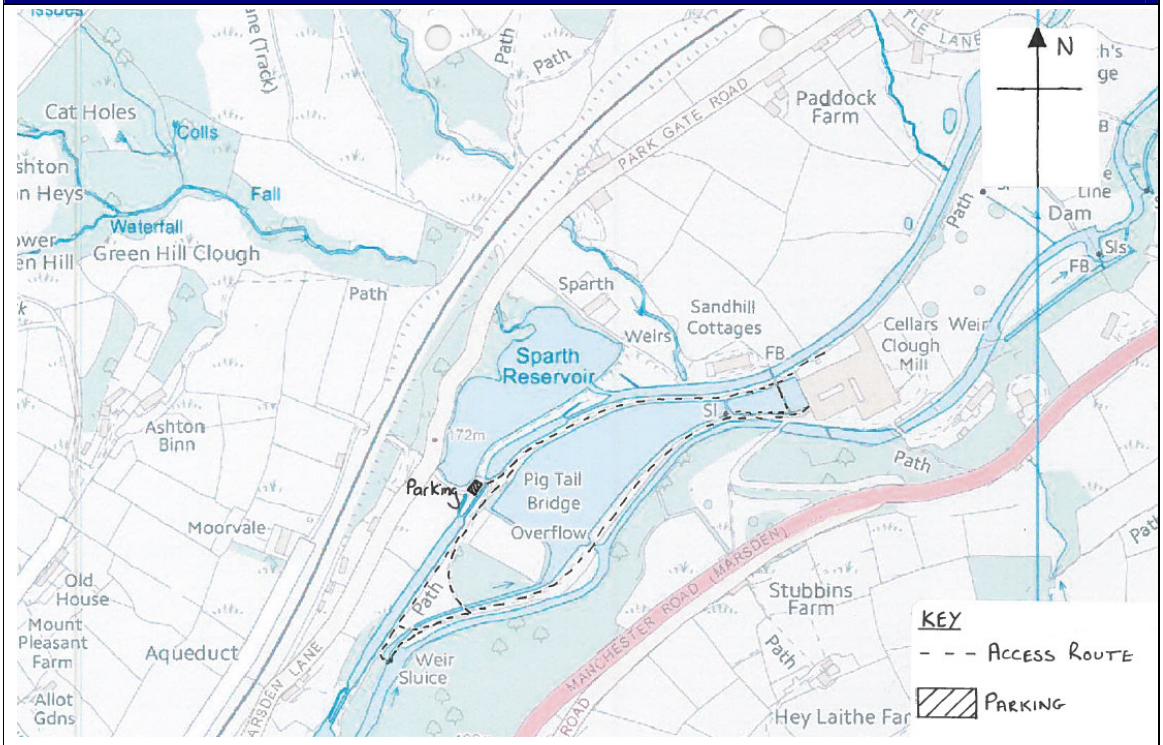
Surveyor Record Sheet

Project	**Kirklees Mill Pond Surveys**
Site Ref	**11. Cellars Clough Mill Pond (main)**

Coordinates

405590, 412430

Parking and Access Routes



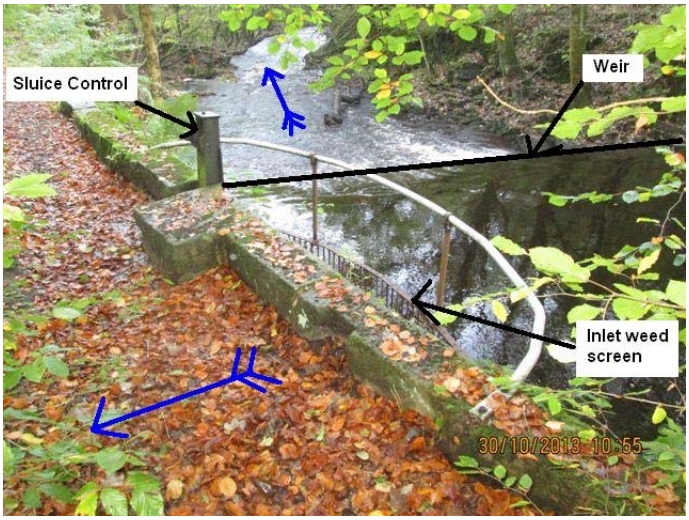
No.	Component	Findings	
1.	**Current Use**	Private fishing pond.	
	Current Ownership	Smith Developments LTD (Co. Regn. No 04856733) of 19 Queen Street, Oldham, Greater Manchester.	
2.	**Reservoir**	Area (A) from OS, (m^2)	14,000 m^2
		Estimated Dam Height (h_{max}), (m)	3m
		Estimated Capacity (1/3 X A X h_{max}), (m^3)	14,000 m^3
		The estimated capacity of the reservoir has been calculated to allow comparison between all of the millponds that have been inspected. This calculation has not been undertaken in accordance with the Reservoirs Act 1975 and should not be used for any other purpose.	

		Condition	Good	Average	Poor (circled)
		Notes. ▪ An upturned boat was identified on the overflow arrangement. ▪ Significant leakage and movement was identified in the northern dam which was causing erosion of the canal towpath. ▪ A heras panel was present on the overflow arrangement and may increase the blockage risk.			
3.	**Inlet**	Description	Masonry channel (Photo 3).		
		Control	Sluice gate (Photo 1).		
		Notes. ▪ Sluice and weed screen adjacent to weir on the river (Photo 1). ▪ Sluice discharges into a rectangular masonry culvert which then changes to a masonry arch culvert (Photo 2). ▪ Loose masonry observed on the right bank wall adjacent to arch on downstream face. ▪ Due to vegetation growth, the condition of channel walls was not determined during the inspection. ▪ A number of mature trees were observed growing in the wall (Photo 5). ▪ Scour of channel bed was observed downstream of 2nr stone weirs (Photo 4).			
4.	**Retaining Structure (Southern Bank)**	Construction	Earth embankment (upstream) and masonry dam (downstream).		
		Freeboard	▪ Freeboard estimated to be 500mm.		
		Upstream Face	▪ Masonry retaining wall, condition not assessed as the inspection was obscured for much of its length by vegetation (Photo 17). ▪ Several mature trees were observed growing from upstream face.		
		Crest	▪ Earth crest with a width of 2-3m (Photo 13, 14, 15, 16 & 18). ▪ Patchy grass/moss coverage with areas of hard standing for anglers. ▪ Several mature trees were observed growing on the crest.		
		Downstream Face	▪ Masonry retaining wall in average condition, minor leakage and bulging identified on eastern end (Photo 21 & 23). ▪ Possible overtopping erosion identified at the eastern end, with ponding on the footpath (Photo 21).		
	Retaining Structure (Northern Bank)	Construction	Masonry dam and earth crest.		
		Freeboard	▪ Freeboard estimated to be 500mm.		
		Upstream Face	Not visible during site inspection.		
		Crest	Not visible during site inspection.		
		Downstream Face	▪ Masonry retaining wall with leakage identified in 3nr locations resulting in ponding and erosion of canal towpath (Photo 28 & 29). ▪ Bulging identified in a number of locations along its length (Photo 28). ▪ Possible overtopping flow path identified opposite Sparth reservoir discharge point (Photo 30).		

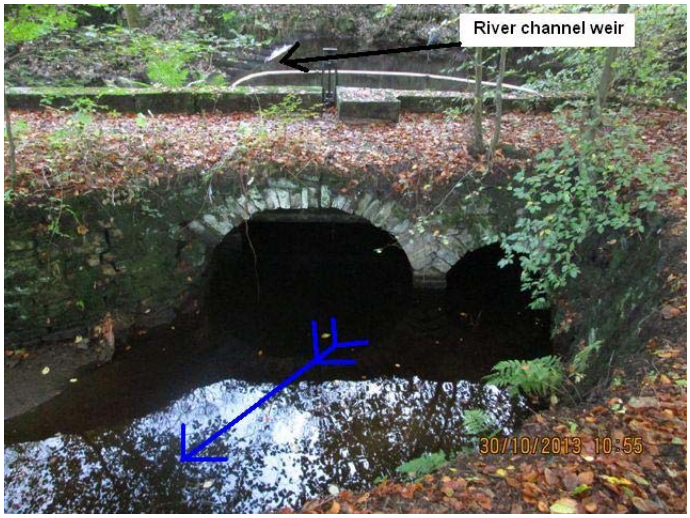
5.	**Overflow**	Description	Masonry weir (Photo 8, 9, 10 & 12).
		Width(m)	6m.
		Inlet	▪ Broad crested masonry weir. ▪ Masonry spillway with loose blocks. ▪ Masonry headwall in average condition.
		Control	▪ Weir height/width. ▪ 3nr masonry rectangular culverts 500(h) x 700(w). ▪ Sluice gate on left side of spillway 900(h) x 900(w).
		Conveyor	3 masonry rectangular culverts 500(h) x 700(w).
		Energy Dissipation	Masonry spillway, average condition, moss coverage and some loose masonry observed.
		Notes. ▪ Heras panel upstream of culverts possibly installed to act as a weed screen. ▪ Small upturned dingy laid on spillway. ▪ Himalayan Balsam present.	
6.	**Outlet 1**	Description	Chamber identified within downstream face of southern dam at eastern end.
		Upstream Control	Not identified during site inspection.
		Downstream Control	Not identified during site inspection.
		Notes. ▪ Inlet not identified during inspection. ▪ Operation and condition of structure unknown. ▪ Some water flow was observed during the inspection (Photo 22).	
	Outlet 2	Description	Sluice in intermediate dam between upstream (west) and downstream (east) reservoirs (Photo 20).
		Upstream Control	Sluice size, condition and operability not determined during inspection.
		Downstream Control	Not identified during site inspection.
	Outlet 3	Description	Outlet into mill building via weed screen (Photo 26).
		Upstream Control	Not identified during site inspection.
		Downstream Control	Not identified during site inspection.
		Notes. ▪ Access to confirm outlet arrangement not available during inspection.	
7.	**Environmental Condition**	Good	(Average) Poor
		Notes. ▪ Reservoir currently used as a fishing Pond. ▪ Himalayan Balsam identified adjacent to overflow.	
8.	**Potential Flood Risk Receptors**	Consequence	(High) Medium Low
		Failure of the dam may result in flooding of the mill building located immediately downstream. At the time of inspection the mill building was derelict. Floodwater may discharge to the canal (north) and river (south). This will increase flood risk to properties known as 'Sandhill Cottages'. Failure may also pose a health and safety risk to canal users and the general public who may be present on the canal towpath. Flood risk may also be increased to properties and infrastructure located downstream. Refer to figure B1959000/11/02 for details of potential flood routes during failure.	

9.	**Other Issues**	▪ Reservoir is divided by an intermediate dam with a sluice gate control. ▪ Upstream reservoir (west), currently used as a private fishing pond which is possibly managed by 'Slaithwaite and district angling club'. ▪ Reservoir dam formed by a masonry dam on the northern and southern boundaries with the former (derelict) mill building forming the eastern edge. ▪ Overhead electricity cables identified across the reservoir on the eastern edge. ▪ Weed/fish screen identified across the reservoir on eastern edge, upstream on the intermediate dam (Photo 19). ▪ No public access to southern embankment. ▪ Northern dam accessed via canal towpath with no access to the crest.

Site Photographs 30/10/13



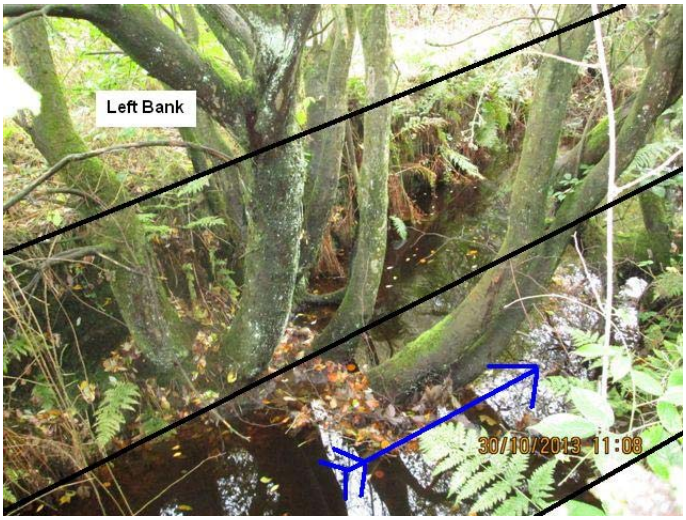
1. Weir and sluice inlet



2. Masonry arch inlet culvert

3. Masonry lined inlet channel

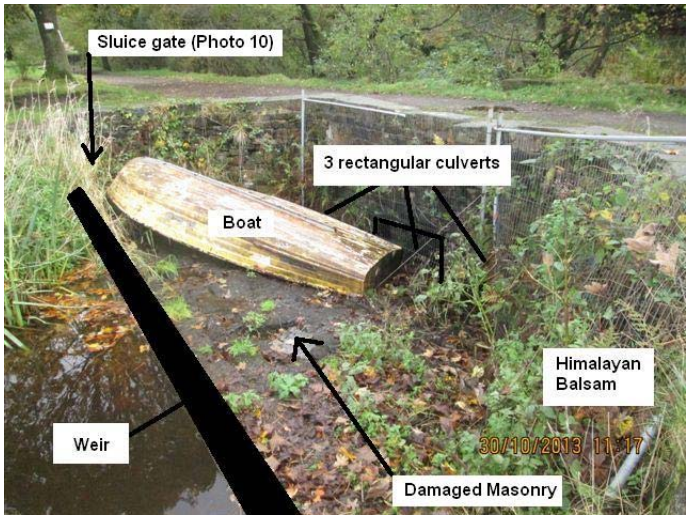
4. Stone weir in inlet channel



5. Tree in inlet channel reducing capacity

6. Bridge over inlet channel

7. Scaffold access bridge over inlet channel



8. Overflow

9. Rectangular culvert from overflow

10. Sluice control on left side of overflow

11. Possible overtopping flow path

12. Culverts from overflow into watercourse

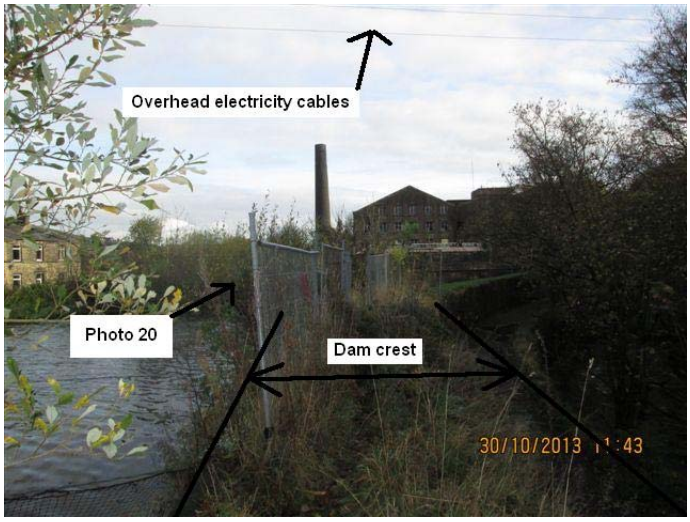
13. View looking north east across crest

14. View looking north east across crest

15. View looking south west across crest

16. View looking north east across crest

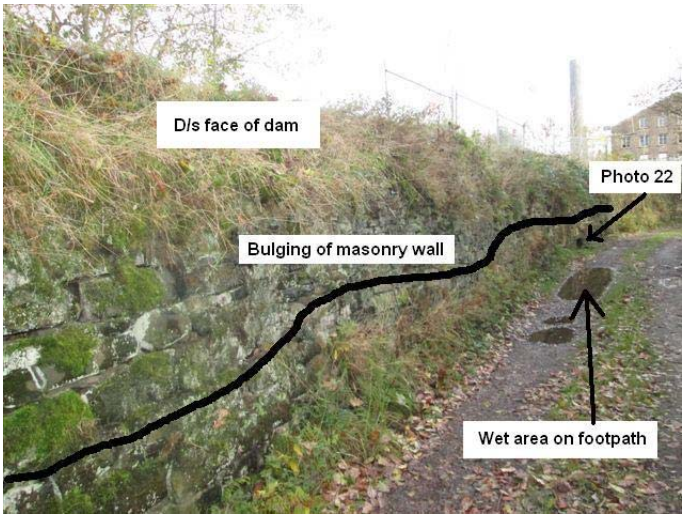
17. View looking east across upstream face



18. View looking east across crest

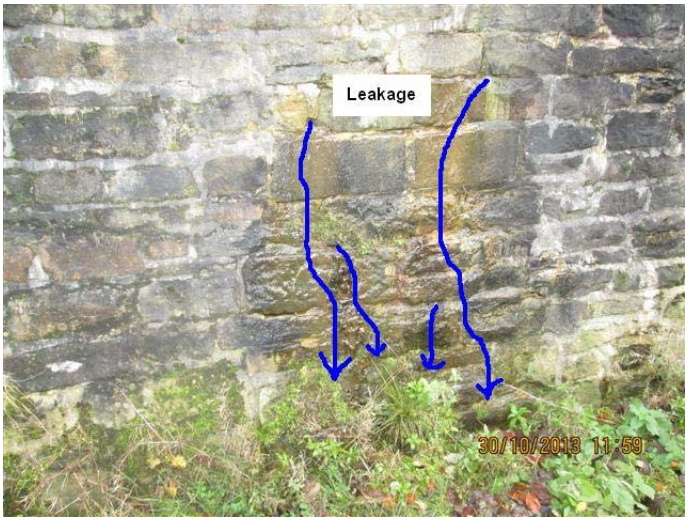
19. Weed/fish screen across pond

20. Sluice control in intermediate dam.

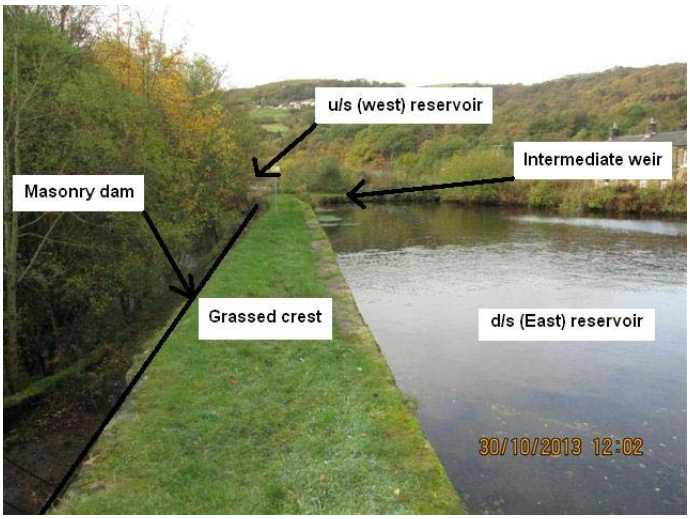


21. Bulging of masonry wall

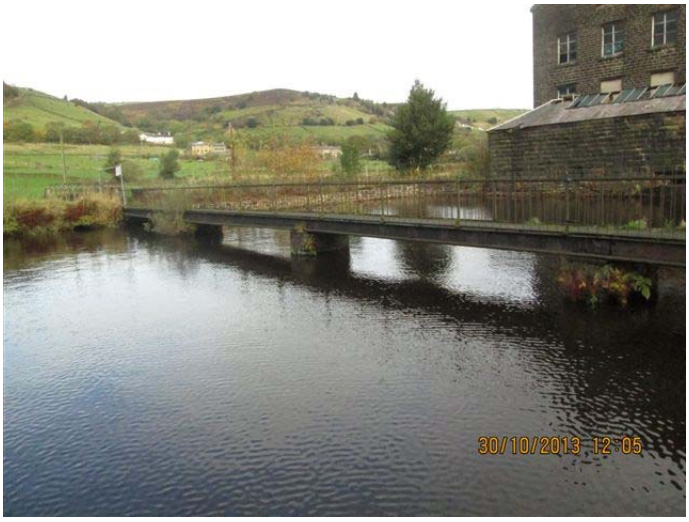
22. Chamber in masonry retaining wall



23. Leakage through masonry wall



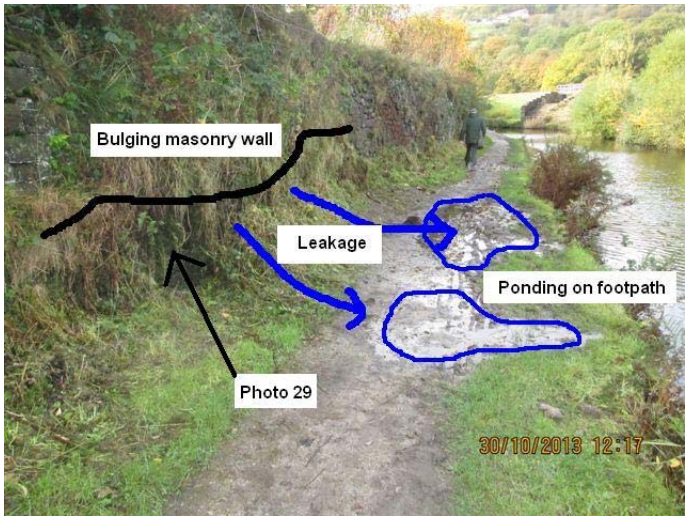
24. View looking west across crest



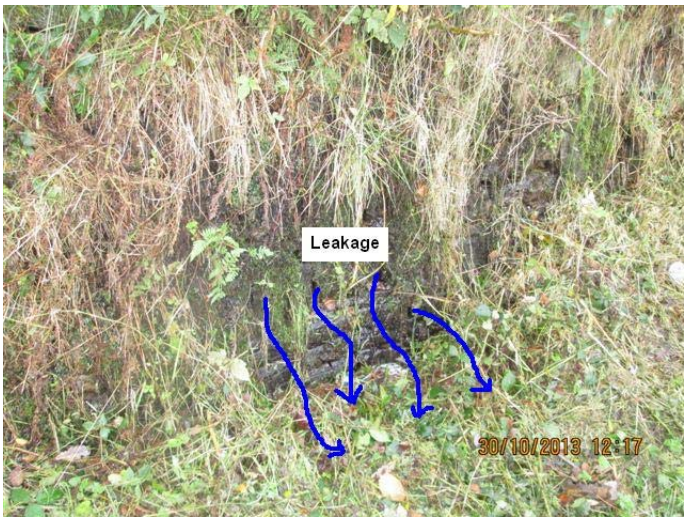
25. Footbridge over d/s (east reservoir)

26. Outlet into mill building

27. Possible draw-off point



28. Leakage and bulging masonry



29. Leakage flow

30. Possible Overtopping

APPENDIX H

PHOTOGRAPHS


PRIVATE
PROPERTY
NO ACCESS