

Brandhall Flood Investigation Report

Sandwell Metropolitan Borough Council

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NK Graduate Engineer	NB Senior Engineer	MI Regional Director	LW Project Manager

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Prepared for:

Sandwell Metropolitan Borough Council

Prepared by:

AECOM Limited
AECOM House
63-77 Victoria Street
St Albans
Hertfordshire AL1 3ER
United Kingdom

T: +44(0)1727 535000
aecom.com

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1. Introduction

AECOM Ltd has been appointed by Sandwell Metropolitan Borough Council (SMBC) to undertake a flood investigation in and around the former Brandhall Golf Course site in Sandwell near Birmingham, hereafter referred to as 'the Site'.

The Brandhall Golf Course Site is allocated for development in the draft Black Country Plan¹. SMBC presented four emerging development options for the Site at public consultation in Autumn 2021 where concerns were raised around flooding issues, specifically the following key areas:

- Former Brandhall Golf Course Site
- Brook Road Area
- Wolverhampton Road Area

The findings from this flood investigation report will inform development of mitigation measures to reduce the existing flood risk.

The potential flood alleviation scheme (to be developed at the next stage of work) would go beyond the planning policy requirement of demonstrating that any proposed development on the Brandhall Site would not increase flood risk. The planning requirement of demonstrating no increase in flood risk can be achieved by locating proposed development parcels outside of existing flood risk areas and by developing a drainage strategy which restricts surface water runoff to the greenfield runoff rate using Sustainable Drainage Systems (SuDS). The SuDS strategy is being prepared separately.

1.1 Scope of Work

The impacts and mechanisms of reported flooding in the key areas detailed above were assessed to understand the likely cause and source of flooding. The scope of the flood investigation (reflected within the following chapters of the report) comprised the following:

- 1) **Desktop Flood Risk Assessment:** a desktop assessment of the flood risk in the study area, including a review of publicly available information around the existing Flood Storage Area (FSA) within the Site constructed as part of the Sandwell College development;
- 2) **Third Party Data Review:** obtain flood risk information and data from relevant third parties including SMBC Highways, SMBC Lead Local Flood Authority (LLFA); Environment Agency (EA), Severn Trent Water, and West Midlands Fire Service.
- 3) **Site Visit:** undertake a site visit to assess flood mechanisms in the area including topography, overland flow paths, watercourses, and associated flow control structures.
- 4) **Flood Investigation Summary:** determine the likely cause and source of flooding based on the data collected.
- 5) **Recommendations:** provide recommendations for next steps (including hydraulic modelling) to inform the development of a potential scheme to alleviate or reduce the identified flooding.

¹ <https://consultation.wolverhampton.gov.uk/regeneration/draft-black-country-plan-2039/>.

1.2 Site Description

The Site (Figure 1) is located in Sandwell approximately 7.5km to the west of Birmingham at National Grid Reference SO 99382 86572. The Site is bounded by the M5 to the west, Wolverhampton Road to the east, and residential roads and properties to the north and south. Areas known to have reported flooding issues along Brook Road and Wolverhampton Road are also shown for context. The Site currently comprises a disused golf course made up of fields, trees, and several existing flood alleviation basins and ponds.

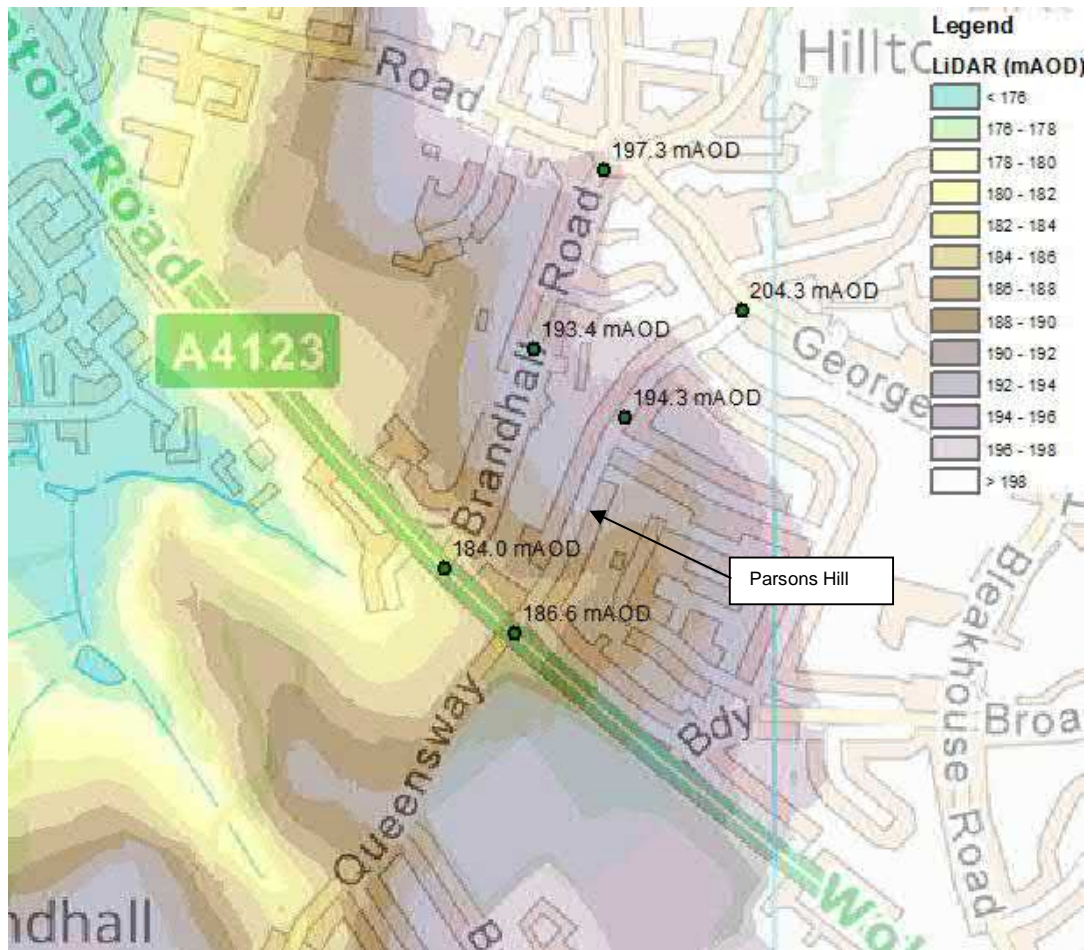
Figure 1: Site Boundary



Source: <https://www.google.co.uk/maps>, [accessed April 2022]

The topography of the Golf Course Site (included in Appendix A) falls significantly towards the Brandhall Brook. LiDAR data provided in Figure 2 overleaf shows that levels of Brandhall Road and Parsons Hill fall towards Wolverhampton Road, from approximately 200m Above Ordnance Datum (AOD) to approximately 184m AOD.

Figure 2: LiDAR data focused on Wolverhampton Road

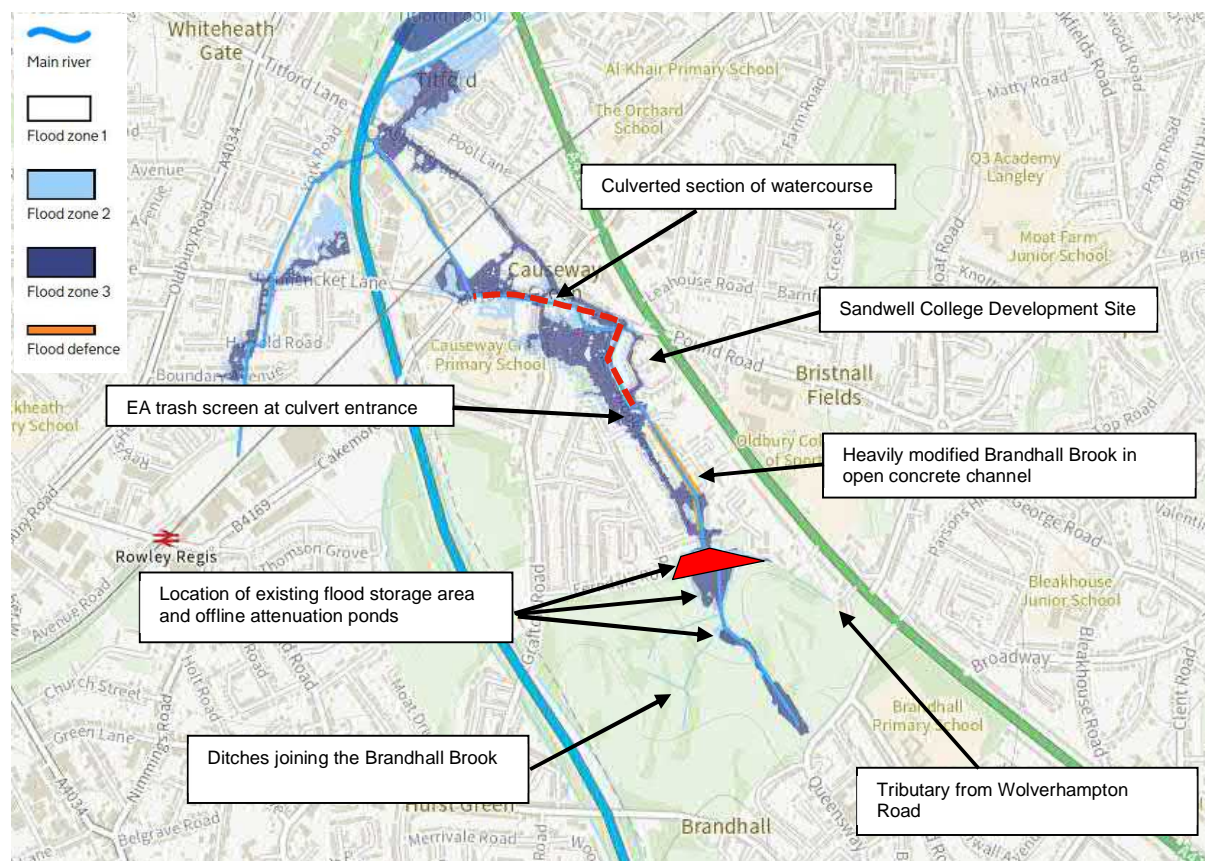


Source: Defra Data Download, LiDAR, [accessed April 2022]

2. Desktop Flood Risk Assessment

A desktop assessment of the flood risk in the study area was undertaken using EA and British Geological Survey (BGS) mapping as well as information from the SMBC planning portal. Figure 3 shows the various existing features relevant to flood risk within and surrounding the Site, which are discussed in more detail in the following sections.

Figure 3: Existing Flood Risk Features



Source: <https://flood-map-for-planning.service.gov.uk/>, [accessed April 2022]

2.1 Fluvial

The Brandhall Brook (denoted as Main River on the EA Flood Map for Planning, see Figure 3) runs from south to north through the Golf Course Site. There are several smaller informal tributaries and ditches within the Site which discharge into the Brandhall Brook, as well as two offline attenuation ponds. A larger tributary joins the Brandhall Brook at the northern end of the Golf Course Site from Wolverhampton Road in the east (for ease of reference referred to as the Wolverhampton Road tributary).

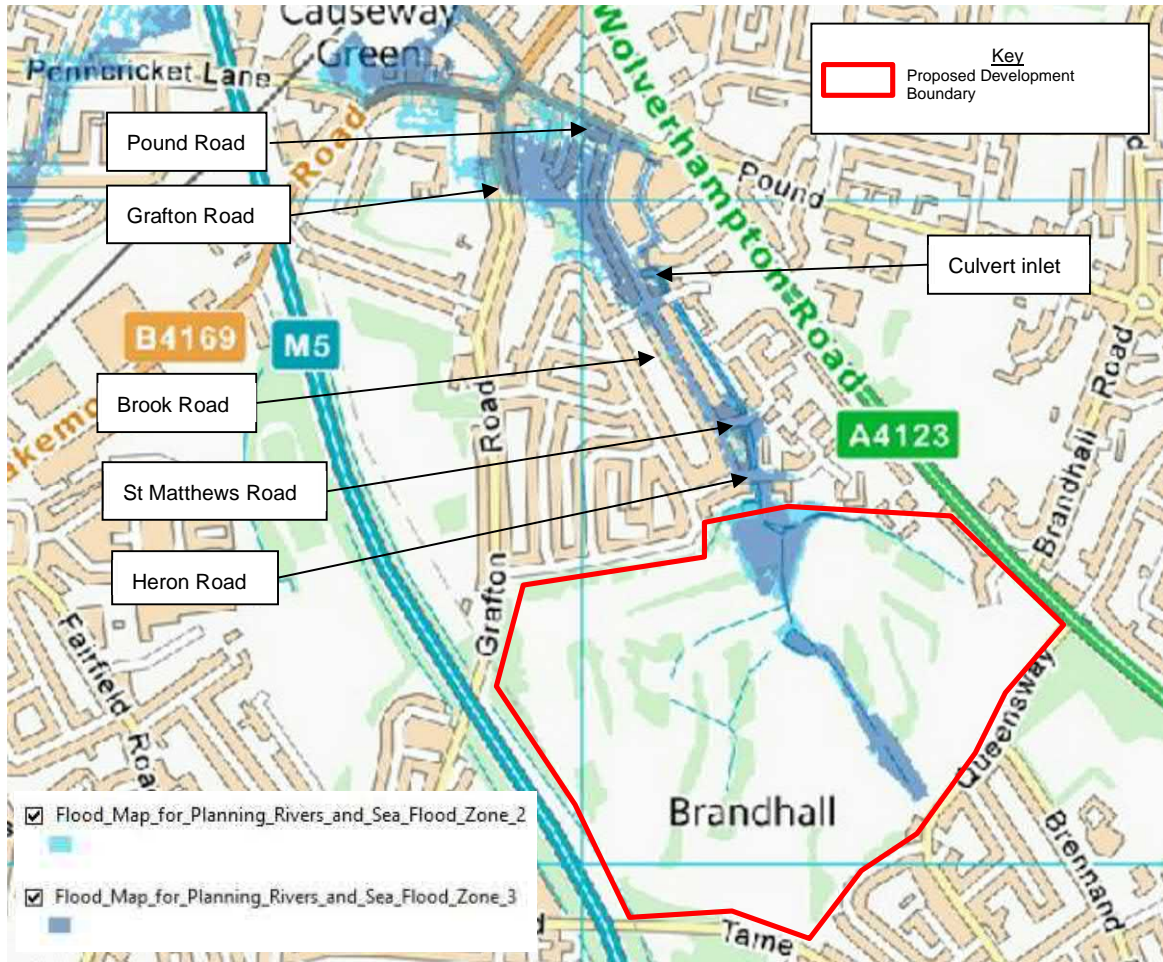
At the northern extent of the Golf Course Site, the Brandhall Brook discharges into an existing Flood Storage Area (FSA) which was completed as part of the Sandwell College Development Site located approximately 450m to the north. The existing FSA (discussed in more detail later in this section) was constructed to attenuate flows within the Golf Course Site to reduce flooding downstream at the Sandwell College Site.

To the north of the FSA the Brandhall Brook becomes a large, heavily modified, concrete channel, which includes a series of weirs and is denoted as formal flood defence. The Brandhall Brook then discharges into a culvert via a double trash screen just south of the Sandwell College Development site. The Brandhall Brook is culverted beneath Brook Road and Pound Road before discharging back into open channel at Pencricket Lane. The watercourse continues northwards beneath the railway line and the M5 before discharging into the Tifford Canal and River Tame.

The EA Flood Zone mapping (Figure 4) shows that the majority of the Site is located in Flood Zone 1 (<0.1% Annual Exceedance Probability (AEP)). There are areas of Flood Zone 2 (0.1% AEP) and Flood Zone 3 associated with the Brandhall Brook in the centre of the Site.

The EA mapping suggests that water overtops Brandhall Brook at Heron Road and St Matthew Road forming a flood flow route down Brook Road. Further overtopping is predicted at Brook Road near Old College Avenue where the Brandhall Brook enters a culvert beneath Brook Road. The associated Flood Zone 3 extends wide in this location, affecting the area between Brook Road, Pound Road, and Grafton Road. There are several properties shown within Flood Zone 3, denoting a high risk of fluvial flooding.

Figure 4: Environment Agency Flood Zone 2 and 3



Source: Defra Data Download, Flood Map for Planning, [accessed April 2022]

2.2 Surface Water

The EA surface water flood extents within the Golf Course Site and Brook Road Area to the north follow a similar pattern as the fluvial flood extents. Flood water is predicted to be conveyed along local roadways including Brook Road.

The EA mapping (Figure 5) shows surface water flow routes along Brandhall Road and Parsons Hill Road towards Wolverhampton Road. Ponding is also predicted on Wolverhampton Road. The flood flow routes are predominantly present in the 'medium risk' scenario, but there is also some flooding predicted in these locations in the 'high risk' scenario.

Figure 5: Environment Agency surface water flood map

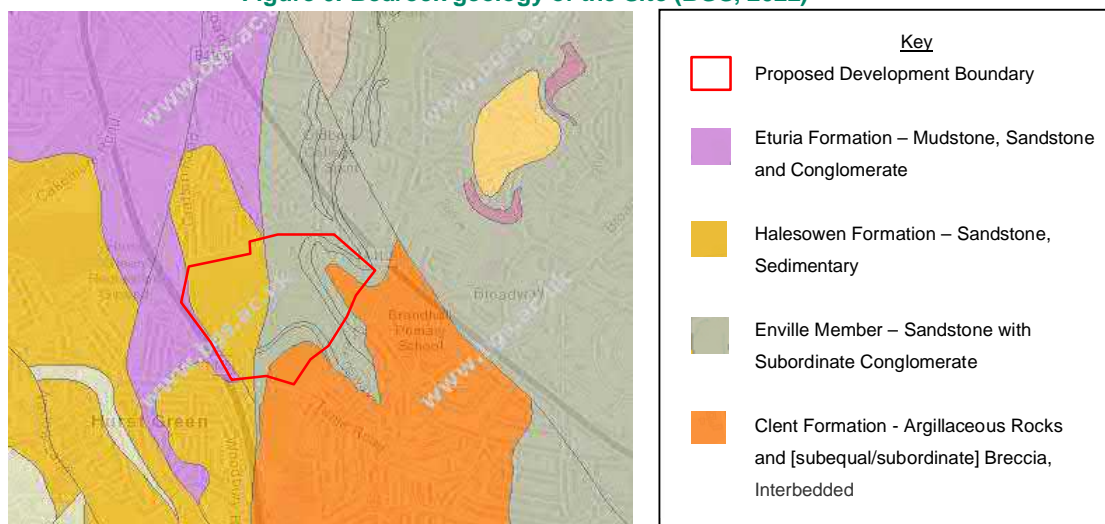


Source: Source: Defra Data Download, Risk of Flooding from Surface Water (RoFSW), [accessed April 2022]

2.3 Groundwater

The Black Country Strategic Flood Risk Assessment (SFRA)² states that the risk of groundwater flooding is generally low throughout the Black Country. The 1:50,000 scale BGS Geology of Britain online mapping (Figure 6 overleaf) shows that the Bedrock beneath the area is varied, comprising a range of formations based on Sandstone. BGS data indicates that Superficial Deposits in the area are only present beneath the Brandhall Brook and to the north of the Site between Brook Road and the M5. The Bedrock beneath the Site is a designated Secondary A aquifer, which means there is the potential for elevated groundwater.

² Jacobs, 2009. Black Country Strategic Flood Risk Assessment.

Figure 6: Bedrock geology of the Site (BGS, 2022)

Source: <https://mapapps.bgs.ac.uk/geologyofbritain/home.html>, [accessed April 2022]

2.4 Sewer

The Severn Trent Water asset plans (Appendix B) indicate the presence of a foul sewer crossing the Brandhall golf course Site generally following the alignment of the Brandhall Brook. The surface water sewer network from the residential area to the south of the Site is shown to discharge into the Brandhall Brook. Surface water sewers from the sports fields to the south are shown to discharge into the Wolverhampton Road tributary which feeds into the Brandhall Brook. The sewer records to the east of the Site along Wolverhampton Road suggest there is potential for a surface water connection from Wolverhampton Road into the tributary. It is recommended that this is confirmed with a CCTV survey.

The Severn Trent Water sewer flooding records show that there were four incidences of sewer flooding in vicinity of the Site. External flooding was reported along Wolverhampton Road in December 2017, August 2020, and July 2021, and along Heron Road in June 2019 and September 2021.

2.5 Reservoir

According to EA mapping the Site and surrounding area is not at risk of reservoir flooding. In addition, the Black Country SFRA does not reference any reservoirs or significant artificial bodies of water within the area.

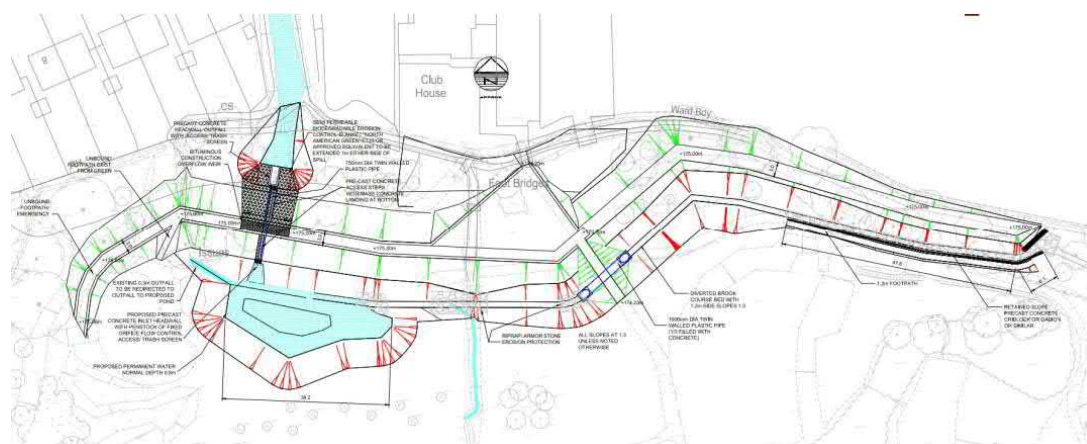
2.6 Existing Flood Storage Area

There is an existing FSA in the northern corner of the Golf Course Site (Figure 7). The FSA was constructed as part of the completed Sandwell College development site (planning references DC/12/55410³ and DC/09/51660⁴), which is located to the north of the golf course Site off Brook Road. The existing FSA is a key feature impacting the flood mechanisms on the Golf Course Site and further downstream.

The Flood Risk Assessment⁵ (FRA) accompanying the planning application for the FSA was obtained from the SMBC online planning portal and reviewed to understand the function of the FSA. The FRA states that the FSA was designed to:

- Remove the Sandwell College Site from the 100 year plus 20% climate change flood extents, to reduce flood levels and extents within the surrounding residential areas around Brook Road, and to reduce the magnitude and extent of the 1,000 year floodplain.
- Throttle outflow from the Brandhall Brook further downstream by creating embankments to impound flow above surrounding ground levels.
- Utilise a partially open penstock to control the outflow. This is to allow the penstock to be opened and allow any blockages to be cleared during normal flow condition.
- Provide a short diversion of Brandhall Brook and the tributary from Wolverhampton Road to allow both sub-catchments to be attenuated by the scheme.
- Include an over deepened online pond upstream of the embankment to settle sediments and mitigate risk of deposition within the FSA control structure.
- Include a row of wooden posts within the pond to create a debris screen offset from the control structure.
- Lower the embankment crest along a 10m length to create a spillway which will help direct overtopping flows generated during events which exceed its design standard into downstream channel.

Figure 7: General Arrangement of Sandwell College Site Flood Storage Area



Source: BWB, 2012. Sandwell College Site Flood Storage Area Flood Risk Assessment.

To support the FSA design, the EA Brandhall Brook hydraulic model⁶ was updated in 2012 to incorporate minor changes to the open channel ISIS 1D model domain to improve stability and correct geometry through the Brandhall Golf Course. The floodplain (represented in 2D using TUFLOW) was re-digitised so that the level of detail could be increased and to allow the incorporation of the golf course and Sandwell College topographic survey. The hydraulic model resulted in slightly different extents when compared with the EA model.

³ <https://webcaps.sandwell.gov.uk/publicaccess/simpleSearchResults.do?action=firstPage>

⁴ <https://webcaps.sandwell.gov.uk/publicaccess/simpleSearchResults.do?action=firstPage>

⁵ BWB, Nov 2012. Brandhall Brook Flood Storage Area Flood Risk Assessment.

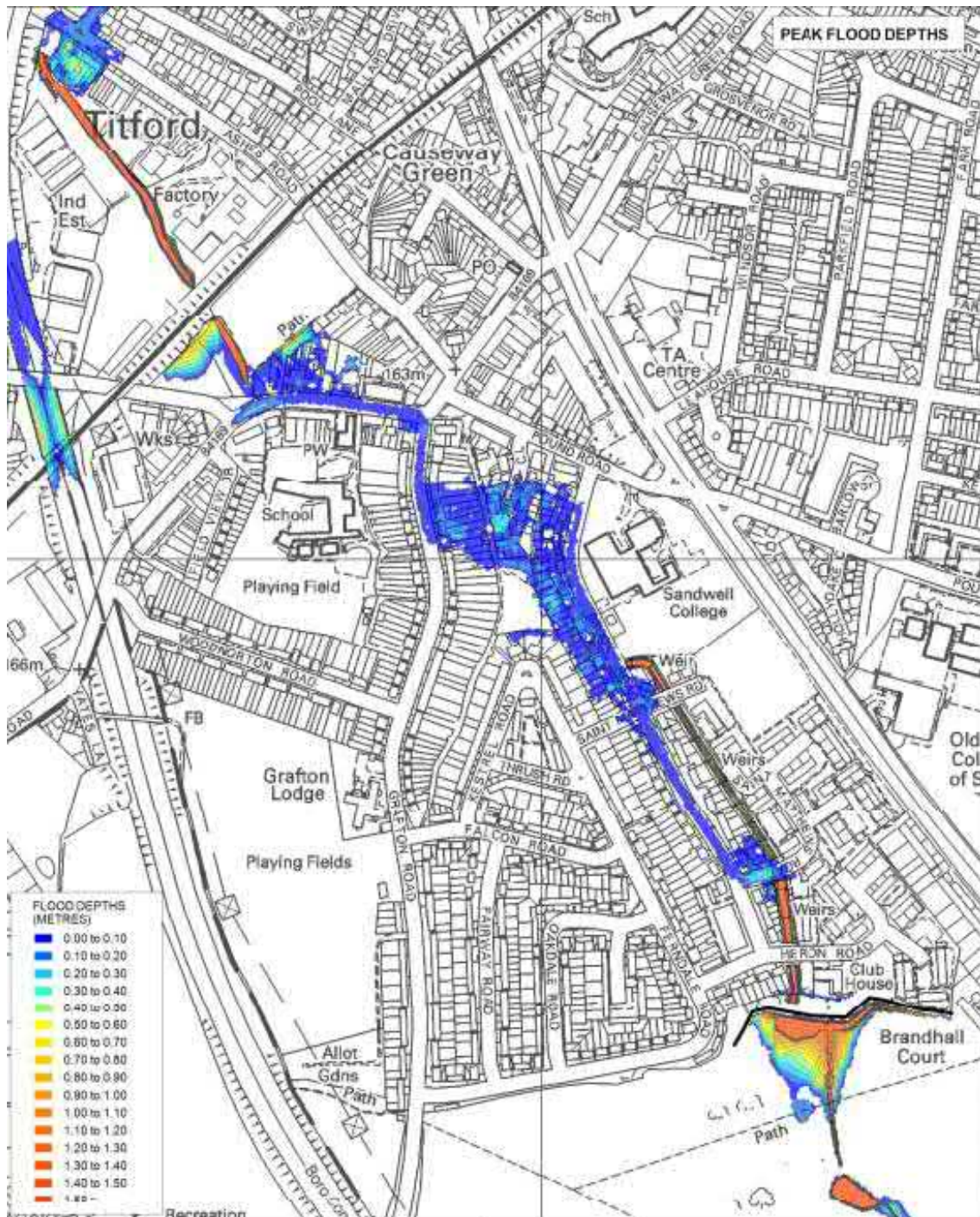
⁶ EA, 2011. Brandhall Brook Strategic Flood Risk Mapping.

Figure 8 and Figure 9 overleaf show the post-FSA modelling (taken from the FSA FRA). It should be noted that the post-FSA model results still show Brook Road and properties between Brook Road and Grafton Road within Flood Zone 3.

The key differences between the post-FSA modelling and the EA Flood Zones for the 1% AEP event (Flood Zone 3) are that the post-FSA model predicts:

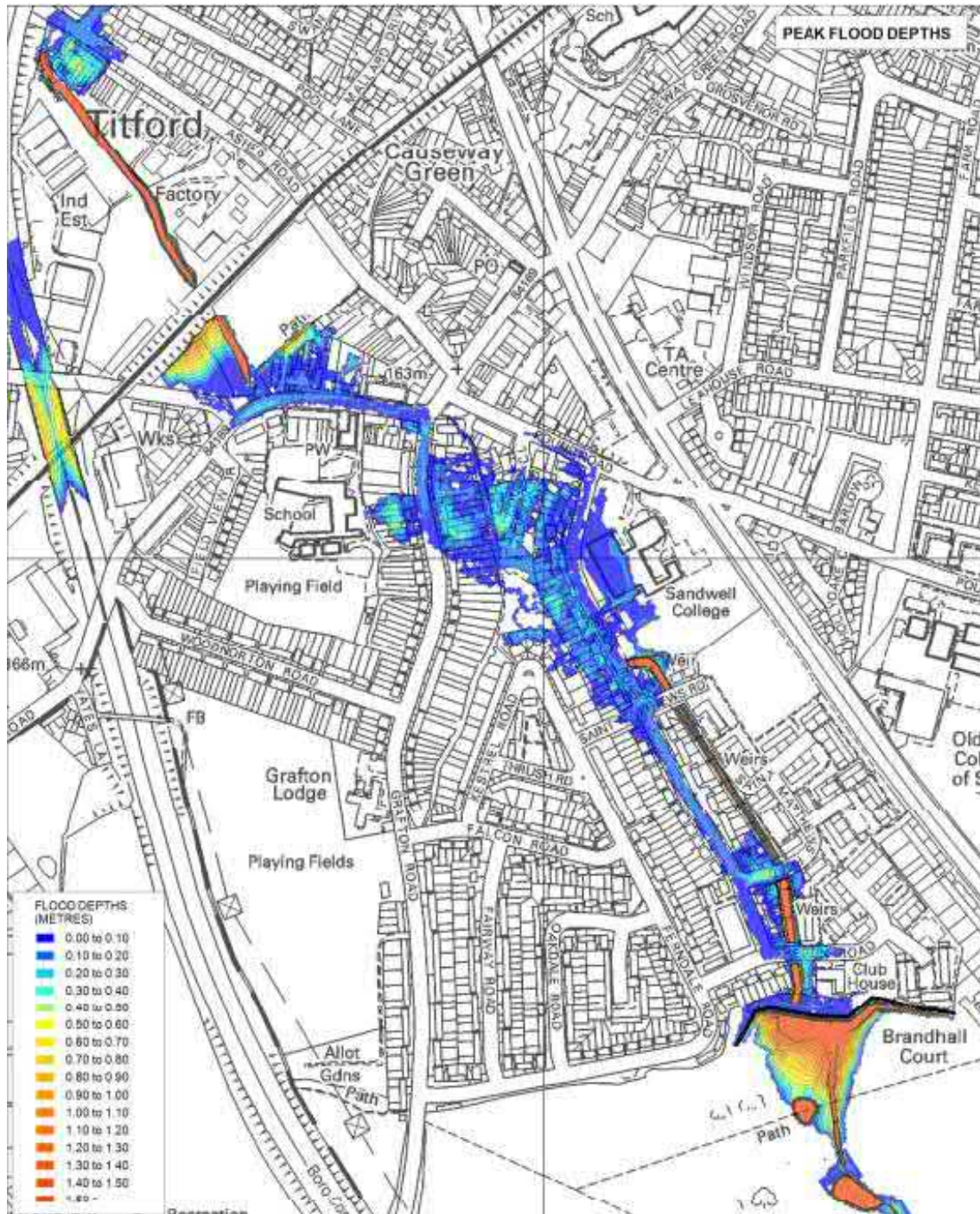
- No overtopping from Brandhall Brook onto Heron Road.
- No flood flow route through the Sandwell College Development Site.
- No flow route onto Pound Road and Ashes Road to the north.
- A reduction in flood depths to the north of the FSA.

Figure 8: Post-FSA Floodplain Extents (1% AEP, Flood Zone 3)



Source: BWB, 2012. Sandwell College Site Flood Storage Area Flood Risk Assessment.

Figure 9: Post-FSA Floodplain Extents (0.1% AEP, Flood Zone 2)



Source: BWB, 2012. Sandwell College Site Flood Storage Area Flood Risk Assessment.

3. Third Party Data Review

3.1 Data Requests

In February 2022, data requests were sent to third-party organisations (including the EA, West Midlands Fire Service, Severn Trent Water, SMBC Highways, and SMBC LLFA) to collate all available information around the flooding in the area. Table 1 overleaf summarises the key data received.

Table 1: Summary of Key Data Received from Third Parties

Organisation	Information	Comment
Environment Agency	Hydraulic model (fluvial) – Brandhall Brook SFRM 2011	<ul style="list-style-type: none"> • Linked 1D/2D Flood Modeller (formerly ISSI) – TUFLOW model including Brandhall Brook floodplain. • Hydrology: includes flow data from Severn Trent Water drainage models. • Catchment: Flood Estimation Handbook (FEH) version 3 and adjusted to account for surface water sewers that feed into Brandhall Brook & York Road brook.
	Modelled Flood Extents	Product 4 info received as PDF, Node Point Location Plan. AEPs received: 5%, 2%, 1.33%, 1%, 1% + CC, 0.5% and 0.1%.
	Rainfall data and River flow data at nearest gauge	Frankley (within 7km) Stourbridge (within 10km) and Halesowen (within 4km)
	Historic flooding records.	No records of flooding
SMBC Planning	Public Consultation responses around flooding	Anecdotal evidence of flooding problems predominantly around Brook Road, as well as Wolverhampton Road and some localised areas outside of the study area.
SMBC Highways & LLFA	Historic Flood Records	No historic flooding database available. Some anecdotal and email evidence of reported flooding in and around the golf course Site.
	Ordinary watercourse plan	
	Ordinary watercourse consent application report	Watercourse consent application for the Brandhall Brook: application form, feasibility report, preliminary ecological appraisal, embankment and brook course report
	Sandwell Surface Water Management Plan	Feasibility report on the preparation of a repairs scheme to deal with the problems of scour and embankment instability of the brook at the boundary of the Brandhall Golf Course and the rear of Bungalow at Brandhall Lane.
West Midlands Fire Service	Brandhall Flooding Incidents Map	No flooding incidents in vicinity of the Site.
Severn Trent Water	Sewer flooding records	Several flood incidents in vicinity of the Site, predominantly on Heron Road and Wolverhampton Road.
	Sewer network plans	

3.2 Data Review Summary

The proceeding sections discuss the high-level review of the EA hydraulic model and the limited information on historic flooding records been assessed in relation to the three key areas of interest.

Environment Agency Hydraulic Model

The EA's 2011 hydraulic model of the Brandhall Brook was obtained and a high-level review was undertaken to understand the likely requirements for model updates and improvements. A detailed model review would be undertaken as part of the next stage of works.

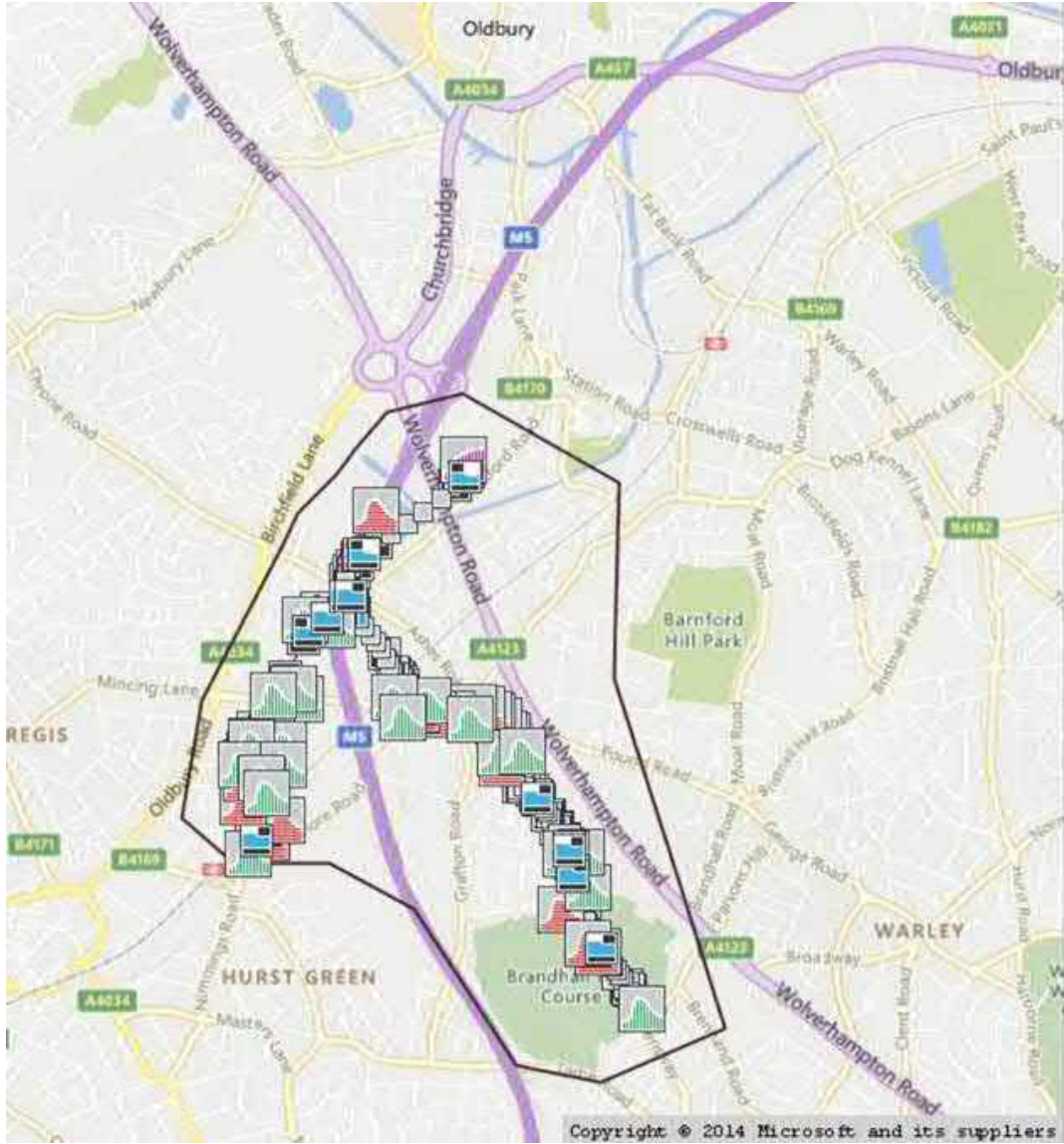
The findings from the high-level review of the 2011 EA model are summarised below:

- Objective: to map the flood extent outlines, the spatial variation of depth, velocity, and hazard rating across the floodplain.
- Software: ISIS (ISIS version 6.3.0.45, source: .zsd file)-TUFLOW (2009-07-AF-iDP, source: .tif file). All files in TUFLOW are in MI format (.MIF files).
- Model extent (see **Error! Reference source not found.**): A 1D model was constructed for the Brandhall Brook and York Road Brook channels. The Brandhall reach extends from the golf course to the confluence with the River Tame. The York Road reach extends from the Cakemore Road Trading Estate to the confluence with the Brandhall Brook. The 2D TUFLOW model includes the Brandhall Brook floodplain from Worcester Road upstream of the Golf Course to Langley.
- Hydrology: Includes inflows from Severn Trent Water drainage models into the Brandhall Brook and York Road Brook. These results were provided for 0.5, one and two hour durations and for the following AEPs: 50% (QMED); 5%; 2%; 1.33%; 1%; 1% + Climate Change; 0.5%; and 0.1%.
- Catchment: The catchment boundaries for the Brandhall Brook catchment were initially extracted from the FEH version 3. The catchment was then adjusted based on the information provided by STW drainage plans to account for the surface water sewers that feed into the Brandhall Brook and York Road Brooks. The catchment was then sub divided into sub catchments that represent the inflows to both the Brandhall and York Road Brooks.

Due to the age of the EA model, it is likely that the hydrology will need to be revisited, as well as improvements to the 2D floodplain and watercourse channel using new topographical survey covering the area to the north of the Golf Course Site. This would be confirmed following completion of a detailed model review.

The hydraulic model developed in support of the Sandwell College development has been requested, with a response currently outstanding.

Figure 10: Environment Agency Hydraulic Model Domain



Source: Brandhall Brook SFRM_Final Report, Environment Agency

The following tables summarise the limited information on historic flooding available in relation to the three key areas of interest.

Golf Course Site

Table 2: Reported Flooding Summary – Golf Course Site

Location	Source	Date	Description
Along northern Site boundary adjacent to the Wolverhampton Road tributary	SMBC (anecdotal)	Prior to 2015 (exact date(s) unknown)	Reported flood events at properties along the northern Site boundary adjacent to the Wolverhampton Road tributary. Works to improve stability and provide scour protection along the tributary was undertaken (the consent application is dated August 2015). SMBC are not aware of flooding issues since.
Within golf course Site and around existing Flood Storage Area	SMBC (email from Sandwell Leisure Trust who formerly managed the golf course Site prior to its closure)	Late 2014 (exact date(s) unknown)	<p>Areas of ponding within the golf course.</p> <p>Concerns that the existing FSA is nearing capacity (Figure 11), although there have been no reports of the FSA overtopping.</p> <p>Maintenance difficulties with the headwall of the FSA causing water to back up into the storage area.</p> <p>Works were undertaken to the trash screen of the outlet of the existing FSA to improve maintenance accessibility, and to the drainage system within the golf course.</p>

Figure 11: Existing Flood Storage Area nearing Capacity (November 2014)



Source: SMBC

Brook Road

Table 3: Reported Flooding Summary – Brook Road

Location	Source	Date	Description
Brook Road residential gardens and driveways.	Public consultation responses	Around 2016 (exact date(s) unknown)	<p>A photograph provided by a resident (Figure 12) indicates that water overtopped where Brandhall Brook flows into the culvert beneath Brook Road.</p> <p>The photograph suggests relatively fast moving water on Brook Road and a depth of flooding of approximately 50mm.</p> <p>Sandbags were deployed by SMBC to a property on Brook Road in this location.</p>

Figure 12: Photograph of Flooding on Brook Road



Source: Public consultation responses, 2021

Wolverhampton Road

Table 4: Reported Flooding Summary – Wolverhampton Road Area

Location	Source	Date	Description
Wolverhampton Road junction with Brandhall Road and junction with Parsons Hill	Public consultation responses	Unknown	Reports of water ponding on Wolverhampton Road. The desktop assessment using EA mapping suggests this could be due to overland surface water/highway flows ponding in this location due to topography. AECOM and SMBC visited the locations during the site visit to further understand the mechanisms in this area.

4. Site Visit Findings

A site visit was undertaken on the 29th March 2022 to understand the flooding mechanisms in the study area including local topography, overland flow paths, and condition of the existing features including watercourses, ditches, channels, culverts, and attenuation features. AECOM staff were accompanied by the SMBC highway/LLFA engineer and SMBC highway clerk. A site visit summary note was prepared (see Appendix C), which includes site photographs.

The site visit covered the Golf Course Site, the Brandhall Brook to the north of the Site, Brook Road, Wolverhampton Road junctions with Brandhall Road and Parsons Hill, as well as two key constriction points of the watercourse further north at the railway and at the M5 at Titford. Where possible, measurements were taken of key watercourse structures to enable comparison with the existing hydraulic model during a detailed model review which will be undertaken at the next stage of works.

The key findings are summarised below for the three key areas of interest.

4.1 Golf Course Site

Site visit observations:

- In addition to the existing FSA in the north of the Golf Course Site, there are two existing offline attenuation ponds within the Site to the west of the Brandhall Brook.
- Further upstream along the Brandhall Brook, it is culverted beneath a raised path. The pipe appeared blocked with water accumulating upstream.
- The Brandhall Brook within the golf course Site is generally poorly maintained with areas containing significant siltation and vegetation overgrowth. In one location (Figure 13 overleaf) this has caused flows from the Brandhall Brook being preferentially diverted into the offline attenuation pond rather than continuing along the culverted reach of the Brandhall Brook
- Prior to the site visit it had not rained for over a week, and the flow in the watercourse within the golf course Site was consistent and approximately 50mm in depth (Figure 14 overleaf).
- Scour protection has recently been installed on the Wolverhampton Road tributary to promote in-channel stability (Figure 15 overleaf). Prior to the repair scheme, the channel banks had partially collapsed, obstructing flow. During the site visit the channel appeared well maintained.
- The maintenance responsibilities of the existing attenuation basins in the golf course were historically undertaken by the golf course when it was still in operation. The maintenance responsibility now lies partly with SMBC as riparian owner and partly with the EA due to the Main River status of the Brandhall Brook.
- Manholes were observed to the south east of the Site on Queensway suggesting that the highway and surface water drainage from this area discharges into the Brandhall Brook. This is further supported by Severn Trent asset plans and the general topography of the area falling towards the Site.

Figure 13: Site Visit Photograph - Vegetation overgrowth



Figure 14: Site Visit Photograph - Brandhall Brook



Figure 15: Site Visit Photograph - Wolverhampton Road tributary



4.2 Brook Road Area

Site visit observations:

- The Brandhall Brook to the north of the golf course is a wide, heavily modified concrete channel (Figure 16). It contains several structures which appear to maintain upstream water levels.
- The inlet to the culvert beneath Brook Road is protected by a double trash screen which is fenced off from public access (Figure 17). The trash screen is an EA asset.
- In general, there appears to be a significant amount of storage volume available both within the golf course Site and in the Brandhall Brook channel downstream.

Figure 16: Site Visit Photograph - Brandhall Brook parallel to Brook Road



Figure 17: Site Visit Photograph - Double EA trash screen at the inlet to the culvert beneath Brook Road



4.3 Wolverhampton Road Area

Site visit observations:

- The levels of Brandhall Road and Parsons Hill fall relatively steeply towards Wolverhampton Road. Wolverhampton Road appear to level off near the junction with Brandhall Road, which would encourage surface water runoff from the surrounding highways to pond in this location. This is supported by the LiDAR level data shown in Figure 2.
- The SMBC highways clerk noted that there appeared to be insufficient highway drainage gullies on Wolverhampton Road, which would make it difficult for water to drain away quickly during a rainfall event.
- The SMBC highways clerk was not sure whether the highway drainage from Wolverhampton Road discharges into the Wolverhampton Road tributary within the golf course Site; however the Severn Trent asset plans suggest that there could a surface water connection into the tributary. A CCTV survey would be required to confirm the location of discharge for highway drainage in this area.

5. Flood Investigation Summary

Based upon the desktop assessment, third party data review, and site visit, the likely causes of flooding have been identified for the three key areas.

5.1 Golf Course Site

There is significant storage available surrounding the Brandhall Brook within the Golf Course Site in the form of existing FSAs as well as natural flood storage areas formed by the topography surrounding Brandhall Brook. The Brandhall Brook within the Golf Course Site is generally not well maintained with significant vegetation overgrowth and siltation. Reports of floodwater ponding within the Site is likely due to blockage of culverts, siltation and a lack of maintenance resulting in the attenuation basins not functioning as designed.

5.2 Brook Road

Following heavy rainfall, water appears to back up at the entrance to the culvert beneath Brook Road and overtop onto the road. The findings from the flood investigation suggest that overtopping at Heron Road or St Matthews Road (as shown on EA mapping) is unlikely as there is significant storage available within the Brandhall Brook channel in these locations. Once floodwater has overtopped onto Brook Road, it flows towards the north and north-west based on local topography, posing a risk to properties. This mechanism is generally in line with the EA fluvial flood extents and the flood mapping produced as part of the Sandwell College development.

There appears to be significant storage available upstream, both in the Brandhall Brook where it is heavily modified in a concrete channel and within the existing FSA in the golf course Site. Parts of the Brandhall Brook and existing attenuation basins within the golf course Site have been poorly maintained, which is likely to reduce the storage available and impact flooding downstream.

The entrance to the culvert at Brook Road has a double trash screen managed by the EA. The maintenance regime of this culvert and associated trash screen should be further investigated.

Based on this desktop assessment the cause of flooding at Brook Road is likely due to a combination of:

- Maintenance issues along the Brandhall Brook reducing available conveyance capacity and potential blockages of key structures and/or,
- The existing flood mitigation measures not functioning as intended.

At this stage it is considered unlikely that the volume of water arising from the Brandhall Brook catchment exceeds the volume of the existing watercourse channel and associated storage structures; however, this can only be confirmed using hydraulic modelling. In order to provide evidence to support the likely causes of flooding outlined above, the EA baseline model needs to be updated to represent current flood risk more accurately.

5.3 Wolverhampton Road

There are no watercourses or ditches to the east of Wolverhampton Road in the area of interest near Brandhall Road or Parsons Hill. The cause of flooding on Wolverhampton Road is likely to be a result of overland surface water flows arising from the surrounding highways. Levels at the Wolverhampton Road/Brandhall Road junction appear to be a localised low-lying area, encouraging water to pond in this location. Insufficient highway gullies are likely to exacerbate flood risk.

In order to provide evidence to support the likely cause of flooding outlined above, a CCTV survey should be undertaken to confirm where the highway drainage in this location discharges into and to understand the existing capacity of the highway drainage.

6. Recommendations

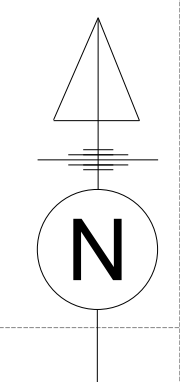
The purpose of this Flood Investigation Report was to understand the likely causes and sources of flooding reported within the Golf Course Site, in the Brook Road Area, and in the Wolverhampton Road area. The findings from this report will inform the development of potential flood alleviation measures to reduce the existing flood risk.

The potential future flood alleviation measures are separate to the proposed development options within the Golf Course Site and would go beyond the planning policy requirement of demonstrating that any proposed development on the Brandhall Site would not increase flood risk. A drainage strategy (prepared separately) for the Brandhall Village Development options would ensure that surface water runoff arising from the development would be restricted to the greenfield runoff rate so as not to increase the risk of flooding off-Site.

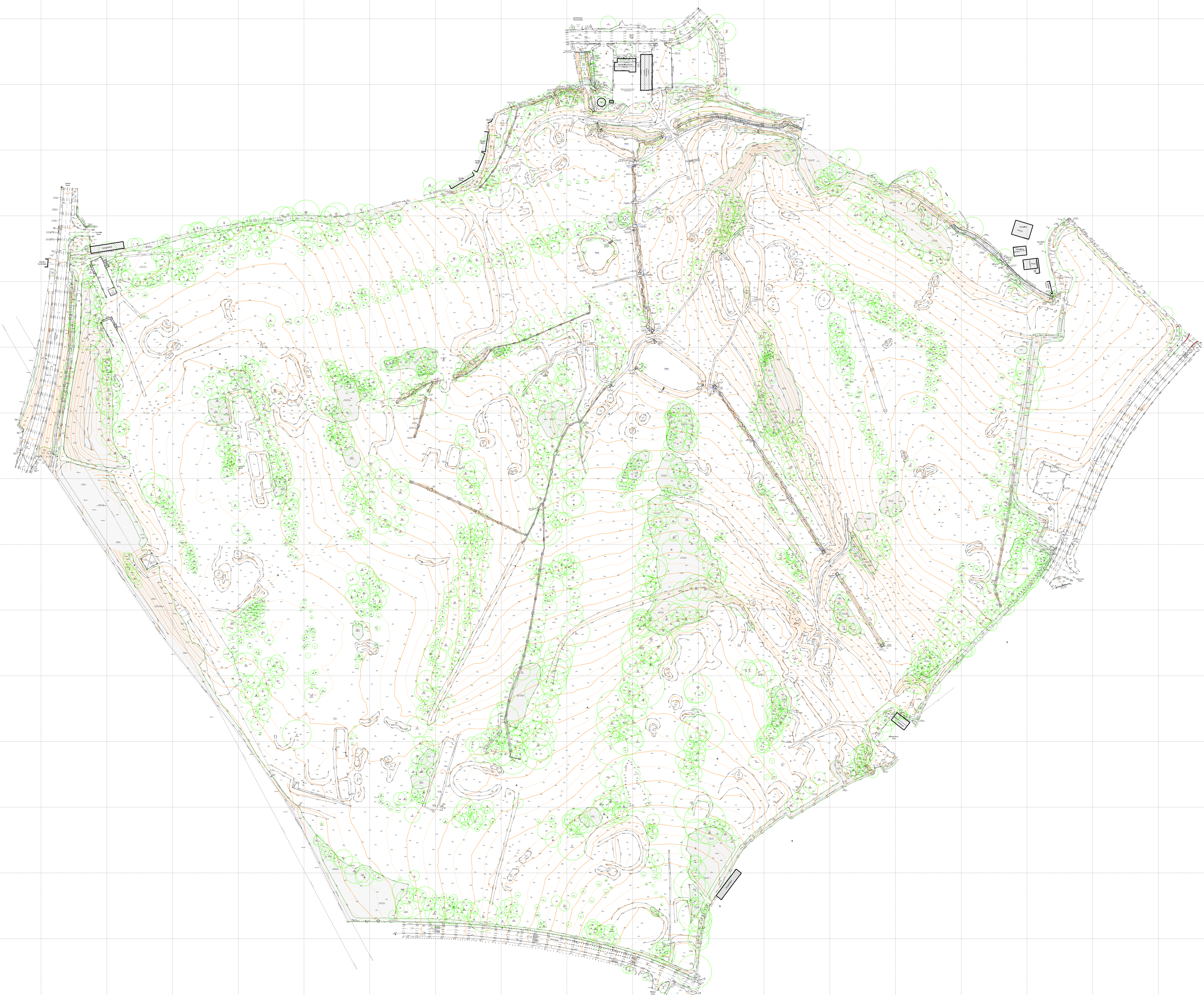
The following steps are recommended to progress the development of potential flood alleviation measures to reduce flood risk downstream:

- 1) Detailed review of the existing EA hydraulic model;
- 2) Updating the existing model (based on suitability) to accurately represent the existing/baseline flood risk. This item will likely require:
 - a. Commissioning of topographic/watercourse survey for the area to the north of the Golf Course Site;
 - b. Updating the hydrology; and
 - c. Other updates/improvements to be confirmed following the detailed model review.
- 3) Preparation of a Baseline Model Technical Note and submission to the EA for approval, if applicable;
- 4) Development of a range of mitigation options to reduce flood risk downstream (number to be confirmed) and testing them together with each of the emerging development scheme options. These measures could comprise amendments to the way the existing attenuation areas function to optimise their use or may require a re-design of flood storage areas. A more thorough maintenance plan is also likely to be recommended.
- 5) Liaison with the design team, client, and LLFA flood officer to determine the preferred mitigation option; and
- 6) Production of a Summary Report to summarise the modelled baseline flood risk, the preferred mitigation option, and the implications on the proposed development design.

Appendix A Topographic Survey



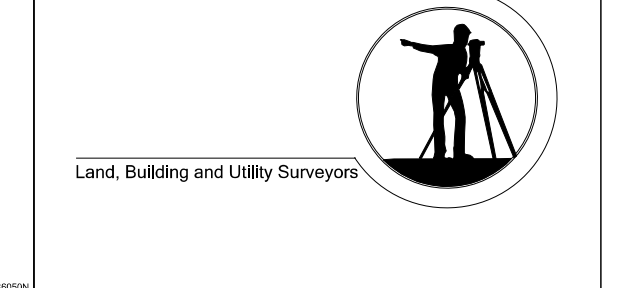
Grid and Levels to National Grid
Projection OSTN15 and OSGM15
Scale Factor = 0.999572



Survey Station	Number	Scale Factor = 0.999572	Height	Remarks
PC001	26809.443	26809.716	174.533	PC001
PC002	26810.862	26811.135	182.529	PC002
PC003	26812.281	26812.554	188.525	PC003
PC004	26813.700	26814.073	194.521	PC004
PC005	26815.119	26815.492	200.517	PC005
PC006	26816.538	26816.911	206.513	PC006
PC007	26817.957	26818.330	212.509	PC007
PC008	26819.376	26819.749	218.505	PC008
PC009	26820.795	26821.168	224.501	PC009
PC010	26822.214	26822.587	230.497	PC010
PC011	26823.633	26824.006	236.493	PC011
PC012	26825.052	26825.425	242.489	PC012
PC013	26826.471	26826.844	248.485	PC013
PC014	26827.890	26828.263	254.481	PC014
PC015	26829.309	26829.682	260.477	PC015
PC016	26830.728	26831.101	266.473	PC016
PC017	26832.147	26832.520	272.469	PC017
PC018	26833.566	26833.939	278.465	PC018
PC019	26834.985	26835.358	284.461	PC019
PC020	26836.404	26836.777	290.457	PC020
PC021	26837.823	26838.196	296.453	PC021
PC022	26839.242	26839.615	302.449	PC022
PC023	26840.661	26841.034	308.445	PC023
PC024	26842.080	26842.453	314.441	PC024
PC025	26843.499	26843.872	320.437	PC025
PC026	26844.918	26845.291	326.433	PC026
PC027	26846.337	26846.710	332.429	PC027
PC028	26847.756	26848.129	338.425	PC028
PC029	26849.175	26849.548	344.421	PC029
PC030	26850.594	26850.967	350.417	PC030
PC031	26852.013	26852.386	356.413	PC031
PC032	26853.432	26853.805	362.409	PC032
PC033	26854.851	26855.224	368.405	PC033
PC034	26856.270	26856.643	374.401	PC034
PC035	26857.689	26858.062	380.397	PC035
PC036	26859.108	26859.481	386.393	PC036
PC037	26860.527	26860.900	392.389	PC037
PC038	26861.946	26862.319	398.385	PC038
PC039	26863.365	26863.738	404.381	PC039
PC040	26864.784	26865.157	410.377	PC040
PC041	26866.203	26866.576	416.373	PC041
PC042	26867.622	26867.995	422.369	PC042
PC043	26869.041	26869.414	428.365	PC043
PC044	26870.460	26870.833	434.361	PC044
PC045	26871.879	26872.252	440.357	PC045
PC046	26873.298	26873.671	446.353	PC046
PC047	26874.717	26875.090	452.349	PC047
PC048	26876.136	26876.509	458.345	PC048
PC049	26877.555	26877.928	464.341	PC049
PC050	26878.974	26879.347	470.337	PC050
PC051	26880.393	26880.766	476.333	PC051
PC052	26881.812	26882.185	482.329	PC052
PC053	26883.231	26883.604	488.325	PC053
PC054	26884.650	26885.023	494.321	PC054
PC055	26886.069	26886.442	500.317	PC055
PC056	26887.488	26887.861	506.313	PC056
PC057	26888.907	26889.280	512.309	PC057
PC058	26890.326	26890.699	518.305	PC058
PC059	26891.745	26892.118	524.301	PC059
PC060	26893.164	26893.537	530.297	PC060
PC061	26894.583	26894.956	536.293	PC061
PC062	26896.002	26896.375	542.289	PC062
PC063	26897.421	26897.794	548.285	PC063
PC064	26898.840	26899.213	554.281	PC064
PC065	26900.259	26900.632	560.277	PC065
PC066	26901.678	26902.051	566.273	PC066
PC067	26903.097	26903.470	572.269	PC067
PC068	26904.516	26904.889	578.265	PC068
PC069	26905.935	26906.308	584.261	PC069
PC070	26907.354	26907.727	590.257	PC070
PC071	26908.773	26909.146	596.253	PC071
PC072	26910.192	26910.565	602.249	PC072
PC073	26911.611	26911.984	608.245	PC073
PC074	26913.030	26913.403	614.241	PC074
PC075	26914.449	26914.822	620.237	PC075
PC076	26915.868	26916.241	626.233	PC076
PC077	26917.287	26917.660	632.229	PC077
PC078	26918.706	26919.079	638.225	PC078
PC079	26920.125	26920.498	644.221	PC079
PC080	26921.544	26921.917	650.217	PC080
PC081	26922.963	26923.336	656.213	PC081
PC082	26924.382	26924.755	662.209	PC082
PC083	26925.801	26926.174	668.205	PC083
PC084	26927.220	26927.593	674.201	PC084
PC085	26928.639	26929.012	680.197	PC085
PC086	26930.058	26930.431	686.193	PC086
PC087	26931.477	26931.850	692.189	PC087
PC088	26932.896	26933.269	698.185	PC088
PC089	26934.315	26934.688	704.181	PC089
PC090	26935.734	26936.107	710.177	PC090
PC091	26937.153	26937.526	716.173	PC091
PC092	26938.572	26938.945	722.169	PC092
PC093	26940.000	26940.364	728.165	PC093
PC094	26941.419	26941.783	734.161	PC094
PC095	26942.838	26943.202	740.157	PC095
PC096	26944.257	26944.621	746.153	PC096
PC097	26945.676	26946.040	752.149	PC097
PC098	26947.095	26947.459	758.145	PC098
PC099	26948.514	26948.878	764.141	PC099
PC100	26949.933	26950.297	770.137	PC100

Symbol	Description
▲	Survey Station
○	Spot Height
□	Building
▭	Wall
▬	Boundary
▬	Contour
▬	Water
▬	Drainage
▬	Path
▬	Other

Brunel Surveys Ltd
UNIT 58, SHEPHERD HUNTER BUSINESS PARK
WATCHFIELD, SWINDON, WILTSHIRE, SN6 8TY
EMAIL: info@brunelsurveys.com
WEB: www.brunelsurveys.com
TEL: 01753 784700



CLIENT
AECOM
Aldgate Tower,
2 Leman Street,
London,
E1 8FA.

JOB TITLE
Topographical Survey
Branchall Golf Course,
Heron Rd.,
Oldbury,
B68 8AQ.

REVISIONS

No.	Description	By	Date
1	Issue for tender	JGE	15/04/2021

SCALE
A0 Sheet @ 1 to 1000

DATE
April 2021

DESIGNED BY
JGE

CHECKED BY
PJW

DRAWING NO.
22613-1000-01

Appendix B Severn Trent Asset Plans

Severn Trent Asset Plans
Received from Severn Trent Water 23 March 2022



Appendix C Site Visit Photos

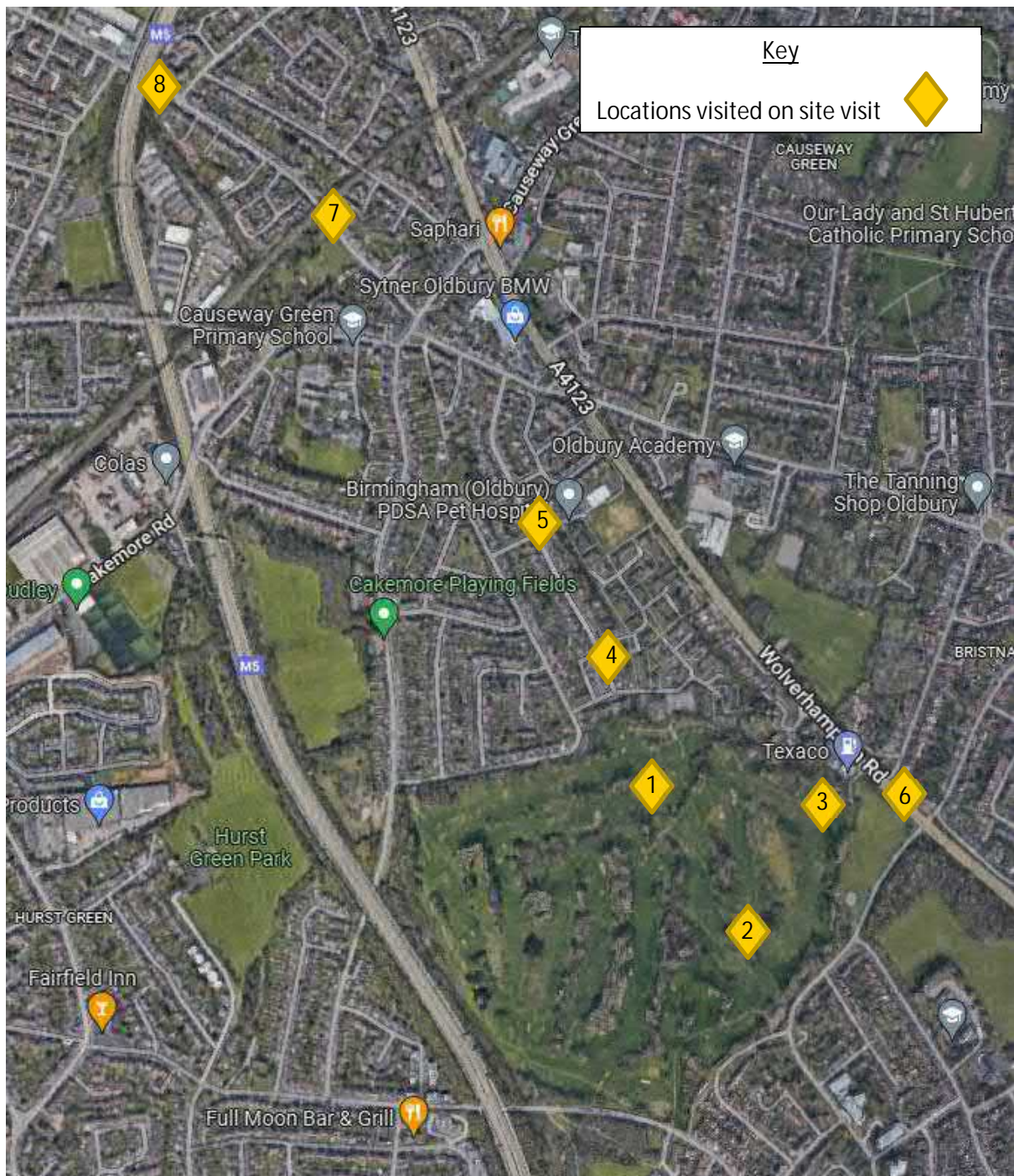
Brandhall Site Visit Summary – 29 March 2022

1. Site Visit Information

AECOM Ltd have been appointed by Sandwell Metropolitan Borough Council (SMBC) to undertake a flood investigation in and around the former Brandhall Golf Club in Sandwell near Birmingham.

A site visit was undertaken to assess flooding mechanisms in the area including topography, overland flow paths, watercourses, and associated structures. The site visit will inform the investigation to understand the cause of flooding on the site.

Item	Information
Date of visit	Tuesday 29 th March 2022
Time of visit	Arrival: 1030 hrs Departure: 1300 hrs
Location of visit	Approximate post code B68 8AQ National Grid Reference SO 99382 86572
Conditions (weather, precipitation, wind, temperature)	Overcast, had not rained in over a week
Names of attending engineer/s	N. Balboni – Senior Engineer, AECOM N. Kaur – Graduate Engineer, AECOM
SMBC contact/s on site	Mark Sifford – Highway/LLFA Engineer Kevin Bowden – Highways Clerk
Building/areas visited	Former Brandhall Golf Course Tributary into Brandhall Brook from Wolverhampton Road (at the boundary of Brandhall Golf Course and the Bungalow, Brandhall Lane) Brandhall Brook to north of golf course site near Brook Road Brandhall Road and Wolverhampton Road junction Parsons Hill and Wolverhampton Road junction Pencricket Lane - watercourse Ashes Road – watercourse






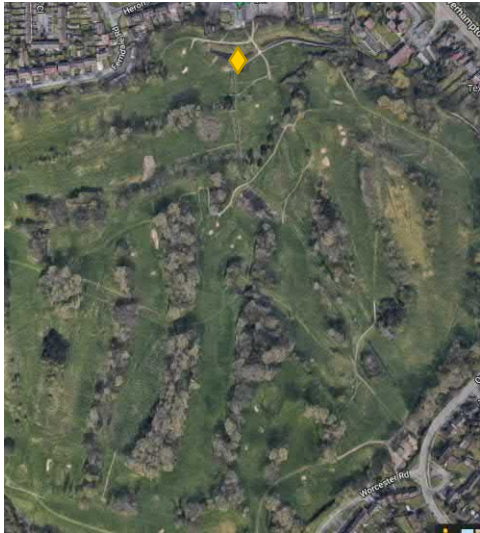
The figure above shows the indicative location of the site observations below.

2. Site Observations

The following table documents the a being done during the inspection:

Location & Description of Works	Photograph/s
---------------------------------	--------------

<p><u>North of Brandhall Golf Course, existing Flood Storage Area (FSA)</u></p> <p>Kevin mentioned that he has seen the pond approximately half-way full however, has not been on site following a significant storm. This is concurrent with approximately invert level of the outlet culvert ($\varnothing \sim 750\text{mm}$) into the main channel (highlighted by red circle).</p>	
	



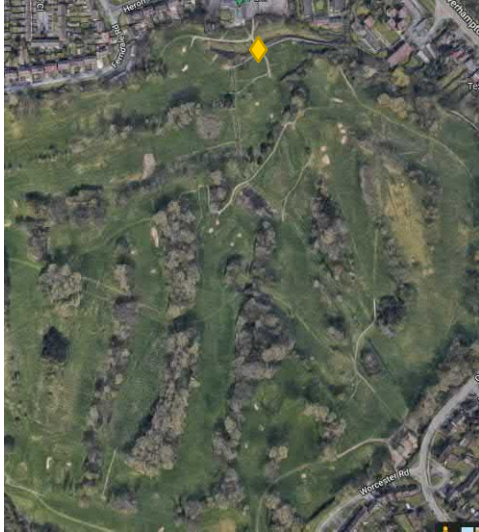
Location & Description of Works

Photograph/s

Tributary from Wolverhampton Road into FSA

Ø ~ 600mm

Base width ~ 1000mm

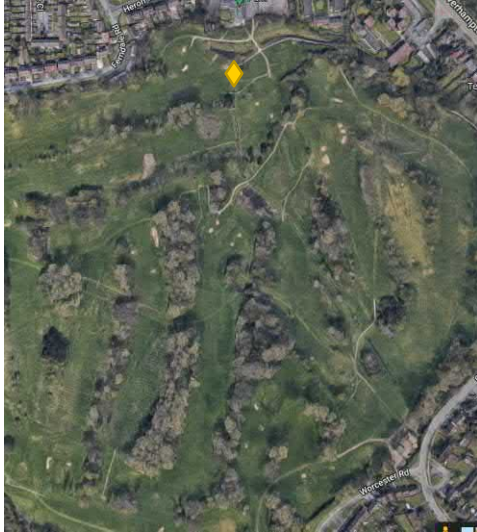


Culvert from Brandhall Brook (open channel) into FSA

Ø ~ 750mm

Brandhall Brook upstream of FSA

Base width ~ 500mm



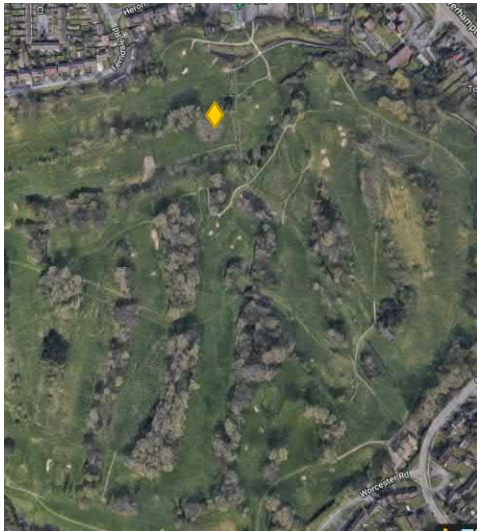
Location & Description of Works

Photograph/s

Vegetation which is directing flow into a side pipe towards an attenuation basin. There was no flow into the main culvert.

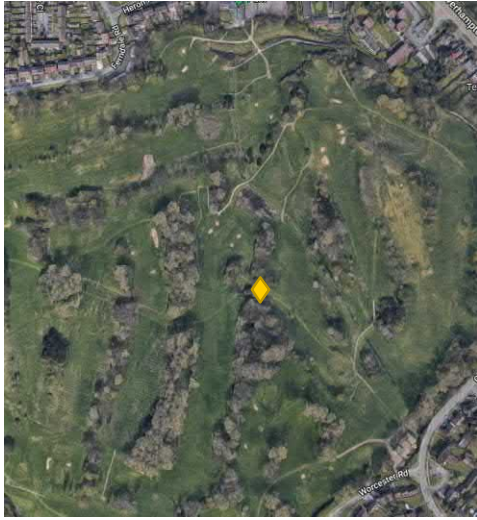
Culverted section of watercourse with what appears to be an offline attenuation pond. Entrance to culvert was partly silted up which meant that water was preferentially flowing into the attenuation pond in the first instance.

Offline attenuation pond to west



Culvert downstream of hill

Ø ~ 750mm (same diameter after stone)



Location & Description of Works

Photograph/s

Tributary from Wolverhampton Road towards Brandhall Brook (at the boundary of Brandhall Golf Course and the Bungalow, Brandhall Lane)

Main pipe \varnothing ~ 900mm

Potential old land drain from field \varnothing ~ 225mm (circled in green)

~1000mm

~1500 -1750mm depth



Location & Description of Works

Photograph/s

Brandhall Brook in wide, heavily modified channel

Heron Road

Ø~ 600mm (some silt at bottom)

Width of channel ~1450mm

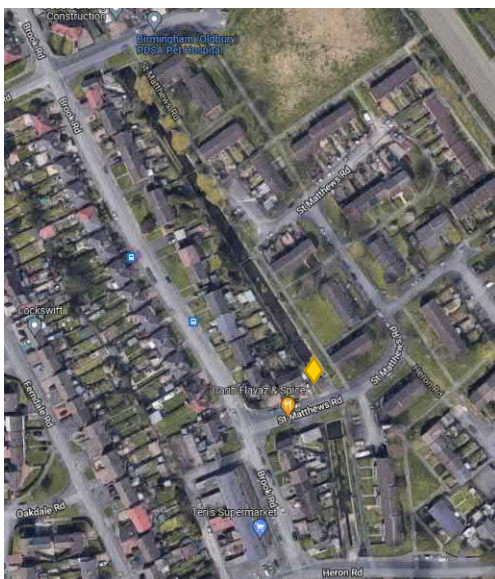


St Matthew's 1

Width of channel ~ 600mm (adjacent to main channel) +100mm slab above

Width of channel ~1450mm

Concrete/brick walls within channel.





Location & Description of Works

Photograph/s

Brook Road

NB: location of video evidence of flooding



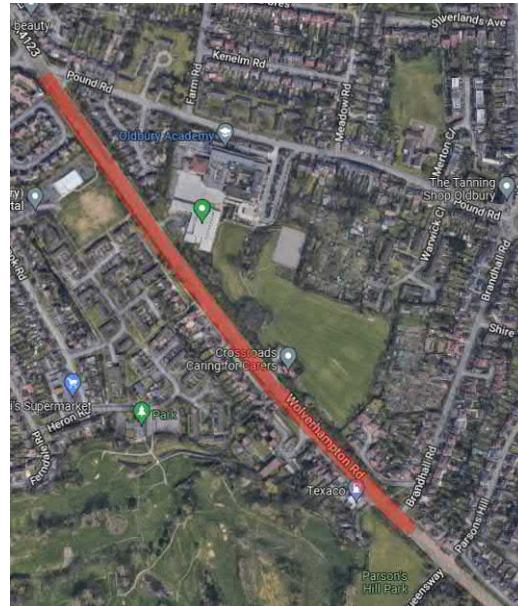
Location & Description of Works

Photograph/s

Brandhall Road and Wolverhampton Road junction

Only 7 road gullies from Pound Road to this junction (approximately 800m length, highlighted in red).

Junction is a low point in Wolverhampton Road. There's a lack of highway gullies. Uncertain of whether the drainage connects into the water course on the golf course site.



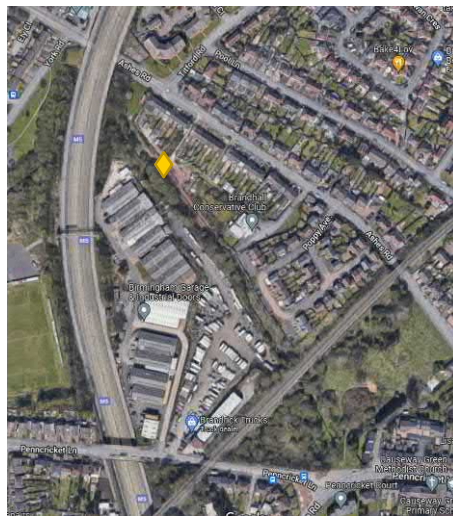
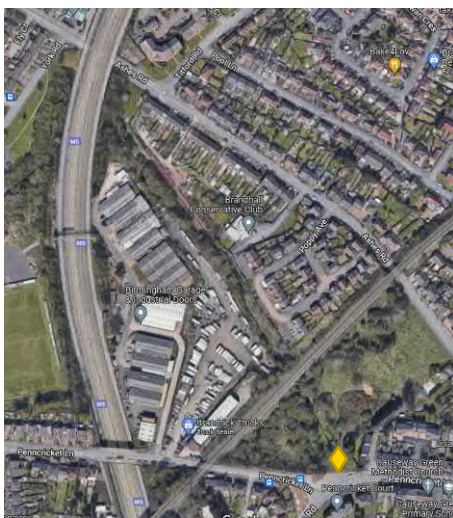
Location & Description of Works

Photograph/s

Railway location of water course

Pencrickett Road

Channel width ~2.5m



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