BANNERS GATE

CIVIL, STRUCTURAL AND
TRANSPORTATION ENGINEERS

Redrow Homes

Neddy Lane,
Billington

Flood Risk Assessment

October 2021

REDROW

Revision Schedule

Neddy Lane, Billington
Flood Risk Assessment

20023_ FRA

Rev	Date	Details	Prepared by	Reviewed by	Approved by
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1 INTRODUCTION

1.1 Background Information

1.1.1 Banners Gate were commissioned by Redrow Homes in August 2020 to undertake a Flood Risk Assessment for a proposed residential development on land off Neddy Lane in Billington, Lancashire, hereafter referred to as the Site.

1.1.2 Planning Permission[1] was granted on 30 November 2017, subject to conditions, for the erection of 41 dwellings and associated works. A Flood Risk Assessment[2] was submitted in support of the Planning Application.

1.1.3 Since Planning Permission was granted the Environment Agency has undertaken, and published the results of, additional flood modelling in the area.

1.1.4 This Revision 03 addresses comments made by the Environment Agency in their letter[3] dated 20 September 2021, included in Appendix I. Except for Sections 4.6 and 5.5 and Appendices I and III the content of this Assessment is as per the Revision 02 Report.

1.2 Summary of the 2017 Flood Risk Assessment

1.2.1 Scott Hughes Design undertook the Flood Risk Assessment on behalf of H&H Homes.

1.2.2 The Assessment concluded most of the development was located within Flood Zone 1, with only the very northern tip located within Food Zone 2.

1.2.3 The flood risk classification was based upon Environment Agency data received in June 2017, which is acknowledged was the most up-to-date available at the time. However, it was noted that the data was an Environment Agency approximation of the Boxing Day 2015 floods which affected Billington, along with many other areas across Lancashire and northern England.

1.2.4 It was proposed that surface water runoff would be discharged into an existing surface water sewer at a rate that mimicked greenfield rates with appropriate on-line attenuation storage incorporated.

1.3 Study Objectives and Methodology

1.3.1 The objectives of this Report are as follows:

- Determine likely sources of flooding,
- Assess the proposals in the context of the National Planning Policy Framework,
- Consider appropriate mitigation and / or protection measures.

1.3.2 The methodology followed in the preparation of this report included the following:

- Investigation of the flood risk within and external to the Site,

1.3.3 This Report deals with environmental issues as they are impacted by flooding, other impacts on the environment are not considered. Existing sources of flood risk have been assessed, including groundwater and urban drainage systems.

[1] Ribble Valley Borough Council Application Number: 3.2017/0133
[2] Scott Hughes Design Project Number: 3073 Issue: 5 dated 11 August 2017
[3] Environment Agency Reference: NO/2021/113355/03-L01

1.4 Policy Background

1.4.1 In accordance with the 'National Planning Policy Framework' (NPPF) a site-specific Flood Risk Assessment is required for:

- Proposals of 1 hectare or greater in Flood Zone 1,
- All proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the Local Planning Authority by the Environment Agency),
- Where proposed development, or a change of use to a more vulnerable class, may be subject to other sources of flooding.

1.4.2 The site-specific Flood Risk Assessment should demonstrate how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users.

1.4.3 The Department for Communities & Local Government publishes online Planning Practice Guidance to the NPPF, which is regularly updated, to provide additional guidance to ensure the effective implementation of the planning policy as set out in the NPPF.

1.5 Climate Change

1.5.1 The Environment Agency now uses climate change allowances from the Management Catchment as a benchmark.

1.5.2 The Site is within the Ribble Management Catchment of the North West River Basin District. The following Table shows the total potential current anticipated change in peak river flows.

Table 1.5.1: Peak river flow allowances for the Ribble Management Catchment

Allowance Category	Total potential change anticipated		
	2020s	2050s	2080s
Central	16%	23%	36%
Higher Central	19%	29%	46%
Upper End	27%	44%	71%

1.5.3 For residential developments, the central allowance is applicable in Flood Zones 2 or 3a.

1.5.4 The following Table shows current anticipated changes in extreme rainfall intensity in small and urban catchments.

Table 1.5.2: Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated		
	2015 to 2039	2040 to 2069	2070 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

1.5.5 For Flood Risk Assessments, and Strategic Flood Risk Assessments, both the Central and Upper end peak rainfall intensity allowances are to be considered so that the range of the impact can be assessed.

1.5.6 The drainage system serving the development is to be designed to ensure there is no increase in the rate of runoff discharged from the Site for the upper end allowance.

1.5.7 The design horizon of the proposed development is beyond 2070.

1.6 Background to Report

1.6.1 The Report has been prepared using the following documents for guidance:

- The NPPF and Planning Practice Guidance,
- Environment Agency/DEFRA Flood Risk Assessment Standing Advice,
- Environment Agency/DEFRA Rainfall runoff for management for developments - Report-SC030219,
- DEFRA non-statutory Technical Standards for Sustainable Drainage Systems,
- CIRIA Report C624 – Development and Flood Risk – Guidance for the Construction Industry,
- CIRIA Report C753 – The SuDS manual,
- Ribble Catchment Flood Management Plan, December 2009,
- Ribble Valley Borough Council, Strategic Flood Risk Assessment – Level 1 (revised), April 2017,

1.7 Strategic Flood Risk Assessment – Level 1 (2017)

1.7.1 Whilst the Site is not specifically mentioned within the Assessment the following extracts are considered relevant:

1.7.2 The main watercourses in the RVBC part of the catchment are the Ribble, Hodder and Calder along with their tributaries.

1.7.3 The catchment's headwater valleys are steep sided with numerous minor tributaries, giving way to less steep valley sides with wider floodplains in their middle courses.

1.7.4 Although the natural soils of the area are generally waterlogged and poorly drained, the historical practice of moorland "gripping", the excavation of narrow drainage channels over the last century to allow for more intensive sheep and grouse rearing, greatly improved the drainage of the upland peat areas of the upper Ribble, Calder and Hodder. This has allowed rainfall falling on hillsides to be rapidly channelled into the rivers, which can create large peaks in river flow during storm events.

1.7.5 Around 12% of the total River Ribble catchment is urban with the remainder being largely rural.

1.7.6 The December 2015 flooding affected communities in Billington, Whalley, Ribchester, Clitheroe and Longridge. Parts of the Ribble catchment received five times the normal December monthly rainfall. In Whalley the event approached a 1 in 1,000 chance of occurring. Most rivers in the catchment set new highest river level records over Christmas 2015.

1.7.7 Following consultation with the EA, no evidence of groundwater flooding in the area has been identified.

1.7.8 The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

1.8 Ribble Catchment Flood Management Plan

1.8.1 Catchment Flood Management Plans help us to understand the scale and extent of flooding now and in the future and set policies for managing flood risk within the catchment.

1.8.2 The Plan divides the Ribble catchment into ten 'sub-areas' with Billington located within 'Sub-Area 5 - Rural Calder and Darwen'.

1.8.3 This large, predominantly rural sub-area has a generally low flood risk which will not rise significantly due to climate change. There are a few isolated problems in villages such as Trawden, Whalley and Higher Walton.

1.8.4 *It is unlikely that flood risk management measures could be justified in this sub-area as other areas have much greater flood risk.*

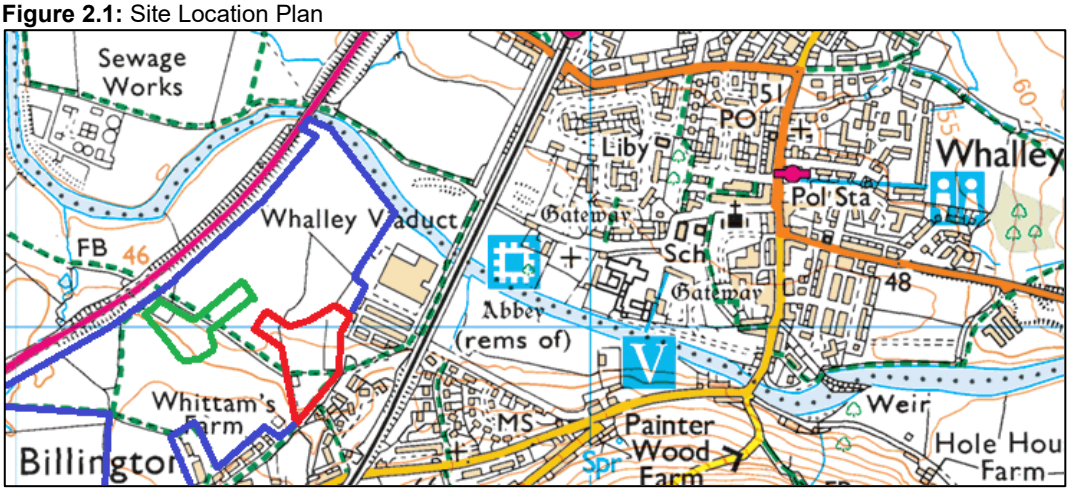
2 SITE DETAILS

2.1 Location

2.1.1 The Site is located to the north of Neddy Lane in Billington at approximate National Grid Reference SD725359 and post code BB7 9LL.

2.1.2 The approximate residential Site boundary is shown outlined red in Figure 2.1 below with an associated Floodplain Compensation boundary shown in green. The blue line illustrates the total extent of land within the same ownership.

Figure 2.1: Site Location Plan



2.2 Description

2.2.1 The residential Site has a total area of approximately 1.8 hectares and is Greenfield, save for a single United Utilities building, circled in the opposite figure, which contains a Sewage Pumping Station.

2.2.2 The residential Site is bounded by agricultural land to the north and west and dwellings to the south (Neddy Lane) and east (Dale View).

2.2.3 Ground levels within the residential Site fall from south to north from approximately 52mAOD to 43mAOD.

Figure 2.2: Aerial Image

2.3 Local Watercourses

2.3.1 The River Calder is approximately 200m to the north of the Site, flowing in a north-westerly direction towards its confluence with the River Ribble.

2.3.2 An unnamed tributary of the River Calder flows along the eastern boundary of the Site. It enters the Site adjacent to 15 Dale View as a 600mm diameter culvert, returning to open channel within the Site, before exiting at the northeast corner adjacent to Longworth Road in a culverted section.

2.4 Underlying Geology

2.4.1 The 1:50,000 British Geological Survey Maps shows Superficial Deposits of 'Till' and 'Alluvium' underlying the south and north of the Site, respectively.

2.4.2 Bedrock geology of the 'Bowland Shale Formation - Mudstone' is recorded below the entire Site.

2.4.3 The underlying soil types are considered to be loamy and clayey floodplain soils with naturally high groundwater.

2.4.4 Intrusive investigations undertaken between April and June 2021, the 'Phase 2 Site Investigation Report'[4] refers, confirms the geology to be generally consistent with that of the published geology although the bedrock geology was not encountered during the investigations.

2.5 Groundwater

2.5.1 The underlying soils are classified as Secondary (undifferentiated) Aquifers.

2.5.2 Groundwater is not considered to be vulnerable to pollution and the Site is not located within a Groundwater Source Protection Zone.

2.5.3 The depth to groundwater in the four monitoring wells installed during an earlier 2013 site investigation varied from 0.3m to 2.05m, although it is noted that prior to and during the monitoring period the weather conditions were relatively wet.

2.5.4 During two monitoring visits undertaken as part of the 2021 investigations the water depth was recorded at 1.2m below ground.

2.5.5 It is anticipated that groundwater levels will be close to ground level during the wettest periods of the year.

[4] TerraConsult Report No. 5334/01 dated 14 June 2021

3 ASSESSMENT OF FLOOD RISK

3.1 Fluvial Flooding

3.1.1 The Flood Risk Assessment that supported the Outline Planning application was based upon Environment Agency approximated data. Since then, the Environment Agency has undertaken a full review/update of the river modelling in the area and published a revised dataset.

3.1.2 The Environment Agency's current and previous (June 2017) Flood Maps are shown in the following Figures. The current map shows that whilst the Site remains predominantly within Flood Zone 1, Zones 2, and to a much smaller extent Zone 3, encroach into the northern boundary.

Figure 3.1.1: Current Environment Agency Flood Map for Planning

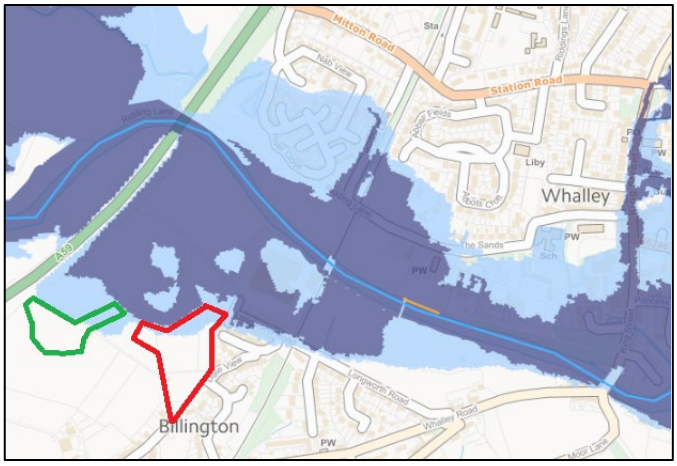


Figure 3.1.2: June 2017 Environment Agency Flood Map for Planning (Planning Boundary differs)

3.1.3 The definitions of each flood zone are as follows:

Table 3.1.1: Flood Zone Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. (Not separately distinguished from Zone 3a on the Flood Map.

3.1.4 The Environment Agency has provided detailed data[5] for the Site.

3.1.5 The following table summarises predicted flood levels and flows within the Site and for the modelled node locations immediately upstream and downstream of the Site.

Table 3.1.2: Environment Agency Data (Wider Calder 2017)

Node RCAL01	Annual Exceedance Probability Flood Level (mAOD) and Flow (m^3/s)							
	0.1%		1% + 15%		1%		4%	
	Level	Flow	Level	Flow	Level	Flow	Level	Flow
03915	44.65	413.11	43.80	333.08	43.60	307.09	43.26	273.92
Site	44.58	-	43.59	-	43.34	-	42.87	-
03810	44.57	414.81	43.62	339.93	43.40	316.35	43.04	279.30

3.1.6 By way of comparison, the estimated 0.1% Annual Exceedance Probability (1 in 1,000) flood level as stated within the Flood Risk Assessment that supported the Outline Planning application was 43.75mAOD; 0.83m lower than current predicted levels.

3.1.7 Based upon the current flood level data, the proportion of the Site at risk is as follows:

Proportion of Site at Risk			
Flood Zone 1	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
75%	21%	4%	0%

Table 3.1.3: Fluvial Flood Risk Summary

3.1.8 In the absence of suitable modelling data for the 1% (1 in 100) plus Climate Change Annual Exceedance Probability event, the present day 0.1% (1 in 1,000) levels have been used as a proxy.

3.2 Historical Flooding

3.2.1 The Strategic Flood Risk Assessment notes that flood records for the Ribble Catchment extend as far back as the 1600's.

3.2.2 Significant events, those causing widespread flooding to multiple communities, have been recorded in the following years:

1936	1995	2000
2002	2008	2012
2015	2018	2020

3.2.3 Recently, during February 2020, named Storms Ciara and Dennis brought heavy and persistent rain across much of the UK.

3.2.4 Regional News Broadcasters reported approximately 40 homes on Longworth Road in Billington were internally flooded when the River Calder burst its banks during Storm Ciara on 9th February 2020. Due to forecasts predicting primarily strong winds the Environment Agency were ill-prepared for the heavy rain and were unable to mobilise temporary flood defences to protect properties.

[5] Environment Agency Maps produced 27 January 2020, Ref: CL155482 (Appendix I)

3.2.5 Arriving one week after Storm Ciara, Storm Dennis preparations were more advanced with temporary defences erected to protect those properties previously flooded.

3.2.6 The December 2015 event followed a series of significant heavy rainfall events during November and December, saturating the catchment, culminating in the highest River Calder flow on record at Whalley on Boxing Day. Subsequently, this event was classified as approaching a 1 in 1,000 year return period event.

3.2.7 The following table summarises peak and daily mean flows recorded at the Whalley Weir Gauging Station[6] during recent flood events:

Date	Peak Flow (m^3/s)	Daily Mean Flow (m^3/s)	Quality
09/02/2020	-	177	Suspect
02/04/2018	-	68	Good
21/10/2017	170	65	Good
26/12/2015	501	248	Unchecked
22/06/2012	330	186	Unchecked
21/01/2008	269	126	Estimated
14/06/2002	261	77	Good

Table 3.2.1: Whalley Weir Gauging Station Flow Data

3.2.8 The unnamed tributary of the River Calder flowing along the eastern Site boundary serves a very small, approximately 0.1km^2, but steep catchment. Predicted flow rates, for a range of return periods are summarised in the following table.

Return Period (years)	Flow (m^2/s)
1	0.05
100	0.19
1,000	0.32

Table 3.2.2: Estimated Flow Rates for the unnamed tributary of the River Calder

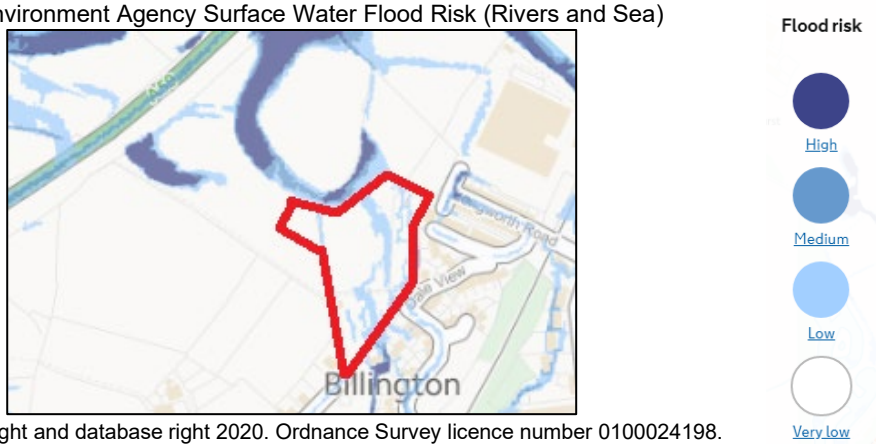
3.2.9 The 600mm diameter culvert upstream of the Site is understood to be laid at an average gradient of approximately 1 in 30 with an estimated un-surcharged capacity of 1.3m^3/s. Consequently, its capacity to convey catchment flows into the Site is deemed sufficient, assuming it remains in a serviceable condition and free from blockages.

3.3 Pluvial Flooding

3.3.1 The Flood Risk from Surface Water map, refer to Figure 3.3, shows the Site is crossed by several 'low risk' corridors, flowing from south to north. Due to the topography of the Site and surrounding area, this is unsurprising.

3.3.2 Overall, the surface water flood risk to the Site is low. Post-development the situation will be improved through the introduction of a positive surface water drainage system.

Figure 3.3: Environment Agency Surface Water Flood Risk (Rivers and Sea)



[6] National River Flow Archive Station Number 71004

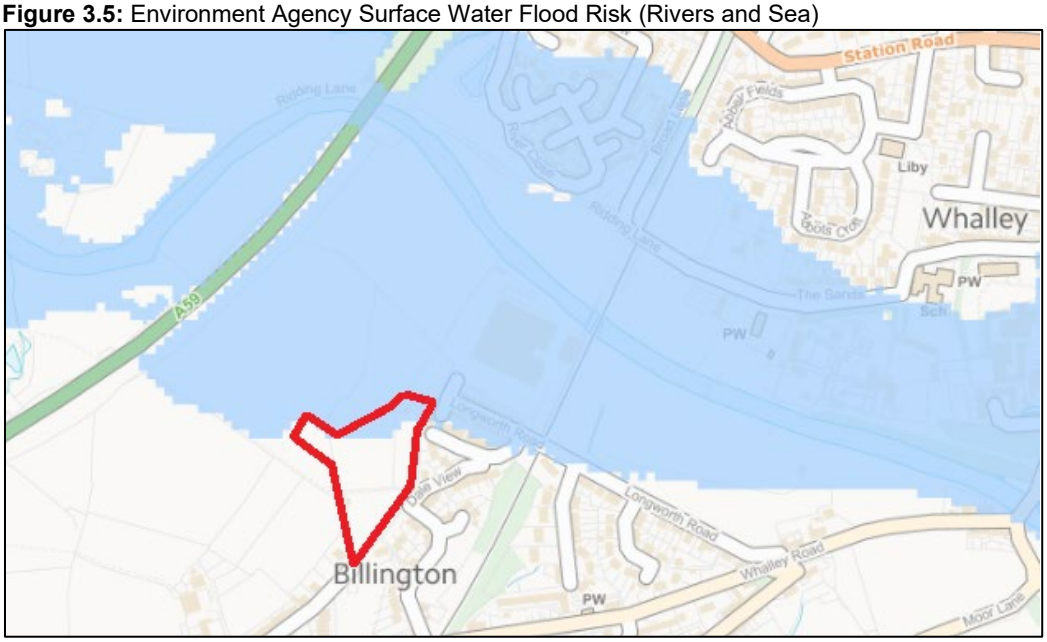
3.4 Groundwater Flooding

3.4.1 The Strategic Flood Risk Assessment states there is no evidence of groundwater flooding in the catchment.

3.5 Reservoir Flooding

3.5.1 The northern boundary of the Site is within an area at risk of flooding following a catastrophic failure of United Utilities Dean Clough Reservoir which is located approximately 2.8km to the southwest.

Figure 3.5: Environment Agency Surface Water Flood Risk (Rivers and Sea)



3.5.2 However, as the operation of reservoirs is strictly managed the likelihood of a catastrophic failure is low.

4 THE DEVELOPMENT PROPOSALS

4.1 Introduction

4.1.1 Planning Permission was granted in November 2017 for the erection of 41 dwellings and associated works as detailed on the approved Site Layout drawing[7] included within Appendix III.

4.1.2 However, since the granting of Planning Permission the Environment Agency has updated the River Calder Flood Modelling and redefined the fluvial Flood Zones.

4.1.3 A replan of the development is now proposed to ensure flood risk is appropriately managed.

4.2 Replan Layout

4.2.1 The Proposed Planning Layout[8] drawing, for a reduced 36 dwellings, is included within Appendix III.

4.3 Sewer & Culverted Watercourse Diversions

4.3.1 The Site is crossed by public foul/combined and surface water sewers and the diversion of some of these sewers will be necessary, subject to United Utilities approval. Initial discussions with United Utilities have established the sewers that can be diverted; these are depicted on the Drainage Strategy Plan included within Appendix III.

4.3.2 The unnamed tributary of the River Calder flowing along the eastern Site boundary should be redirected, below the proposed road, to the watercourse flowing along the western Site boundary; refer to the Drainage Strategy drawing included in Appendix III. This proposal will both facilitate the development and increase capacity within the existing downstream culverted section.

4.4 Area Take-off

4.4.1 The following table summarises the preliminary area take-off for the pre-and post-developed Sites based upon the Topographical Survey and Planning Layout drawings included in Appendix III; this is subject to change during detailed design.

Table 4.4: Preliminary Area Take-Off

Category	Area Take-off	
	Pre-Developed Site (ha)	Post-Developed Site (ha)
Impermeable Area	0.00	0.79
Permeable Area	1.83	1.04
Total Area	1.83	1.83

4.4.2 The approximate existing and proposed impermeable areas equate to 0% and 43% respectively of the developable area.

4.5 Proposed Levels

4.5.1 In accordance with Environment Agency's standing advice, it is expected that finished flood levels should be a minimum of whichever is higher of:

- 300mm above the general ground level of the Site,
- 600mm above the estimated river or sea level (1% AEP plus climate change allowance)

[7] Hattrell DS One Architects LLP Drawing Number: 2414.SK20-01
[8] Redrow Homes Drawing Number PPL-001

4.5.2 The minimum finished floor level should be 45.2mAOD; 600mm above the predicted 1 in 1,000 year flood level used as a proxy for the 1 in 100 year plus climate change level.

4.6 Floodplain Compensation

4.6.1 To facilitate development in the north of the Site, it will be necessary to raise ground levels resulting in a loss of floodplain.

4.6.2 Floodplain compensation is to be provided, on a level for level basis, to the west of the residential Site. Compensation is provided up to the 0.1% AEP (1 in 1,000) level as a proxy for the 1% AEP (1 in 100) plus climate change level.

4.6.3 Preliminary drawings showing the loss and compensatory floodplain areas are included within Appendix III.

4.6.4 The feasibility scheme demonstrates that compensatory storage can be provided. This has been acknowledged by the Environment Agency in their planning consultation response dated 20 September 2021, refer to Appendix I, which notes that marginal betterment is offered when compered to the existing situation.

4.6.5 However, the Environment Agency did not consider the proposed channel linking the natural floodplain to the compensatory area to be acceptable. Consequently, the channel has been widened to reduce the risk of progressive hydraulic detriment with suitable gradients applied throughout to minimise the likelihood of unintended pooling. Additionally, appropriate inspection and maintenance activities are to be included within the remit of the Management Company that will serve the development to ensure that the compensation area continues to operate in accordance with its design parameters in perpetuity.

4.7 Flood Resilience & Resistance

4.7.1 Ground levels within the residential Site will be raised so that the development platform is entirely within Flood Zone 1, both now and taking into account climate change for the lifetime of the development. Consequently, no specific flood resilience and resistance measures are considered necessary

4.8 Access & Egress

4.8.1 The Site and its access road, off Dale View, are located entirely within Flood Zone 1.

4.8.2 As ground levels rise significantly to the south access and egress via Dale View and Whalley Road, in a westerly direction away from the River Calder, would be appropriate in all circumstances.

4.9 Sequential Test

4.9.1 The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The aim is to steer new development to Flood Zone 1.

4.9.2 It is considered the principle of constructing dwelling houses, categorised as ‘More Vulnerable’ development at this location has already been established and a further application of the Sequential Test is therefore unnecessary.

4.9.3 Whilst it is accepted that following the redefinition of the fluvial Flood Zones the flood risk classification of the Site has changed, a pragmatic approach is being sought in this respect.

5 SURFACE WATER DRAINAGE

5.1 Introduction

5.1.1 This section relates to surface water run-off resulting from rainfall over the post-developed Site and the methods of disposing of that surface water. It is also concerned with the risk of flooding due to the capacity of the post-development drainage.

5.1.2 The drainage calculations attached to this Assessment including calculations of discharge rate, attenuation storage and the proposed methods of providing attenuation are for assessing the level of risk, and general feasibility, and are therefore indicative only.

5.2 Disposal Options

5.2.1 In accordance with Local Policy the disposal of surface water shall be to one of the following, listed in order of priority:

- Into the ground (infiltration),
- To a surface water body,
- To a surface water sewer, highway drain, or another drainage system,
- To a combined sewer,

5.2.2 Due to the nature of the underlying geology and the high groundwater table the use of infiltration techniques would be inappropriate.

5.2.3 The River Calder is a viable point of discharge and a gravity drainage solution feasible. However, to facilitate a connection it is proposed to discharge into the public surface water sewerage crossing the Site, subject to United Utilities approval.

5.3 Permissible Discharge Rates

5.3.1 In accordance with current guidelines Greenfield runoff rates have been calculated using the FEH methodology. The following tables summarise the Greenfield runoff rates for the Site, refer to Appendix II for calculations.

Table 5.3: ReFH2 Greenfield Runoff Rates

Return Period	Greenfield Runoff Rate	
	(l/s/ha)	Developable Area (l/s)
1 year	4.8	6.7
Qbar	5.9	8.3
100 year	19.4	27.1

5.3.2 it is recommended that post-development discharge rates are restricted to the Greenfield Qbar rate during all events up to and including the 1 in 100 year plus climate change return period.

5.4 Preliminary Attenuation Storage Estimate

5.4.1 The preliminary calculated volumes of storage required are summarised in the following Table, refer to Appendix II for calculations.

Table 5.4: Preliminary Attenuation Storage Estimate

Return Period (year)	Volume (m^3)
30	423
100 + 20%	710
100 + 40%	882

5.5 Sustainable Drainage Systems (SuDS)

5.5.1 In accordance with national and local guidance it is a requirement for any new development to include sustainable surface water drainage systems as a technique to manage surface water regimes sustainably.

5.5.2 The Environment Agency has published "A Practical Guide" to assist in the design of SuDS. The guide lists various SuDS techniques which are described as varying from the most to the least sustainable.

Table 5.5: SuDS Techniques

Most Sustainable ↑ / ↓ Least Sustainable	SuDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
	Living Roofs	✓	✓	✓
	Basins and Ponds - Constructed Wetlands - Balancing Ponds - Detention Basins - Retention Ponds	✓	✓	✓
	Filter strips and Swales	✓	✓	✓
	Infiltration Devices - Soakaways - Infiltration Trenches and Basins	✓	✓	✓
	Pervious surfaces and filter drains - Gravelled areas - Solid Paving Blocks - Porous Paviours	✓	✓	
	Tanked Systems - Over-sized pipes/tanks - Storm cells	✓		

5.5.3 Full consideration will be given, during the detailed design stage, to identify which sustainable drainage techniques are considered the most appropriate for the Site however a Detention Basin has been incorporated within the Planning Layout as the primary attenuation storage/treatment feature.

5.5.4 Any attenuation features are to be located on land within Flood Zone 1.

5.5.5 An Indicative Drainage Strategy Plan[9] is included in Appendix III for illustrative purposes and is subject to change during the detailed design stage.

5.6 Water Quality

5.6.1 In accordance with Table 26.2 of CIRIA Report C753 'The SuDS Manual' the pollution hazard level for the proposed development is 'Low' and therefore a simple index approach has been applied to ensure minimum water quality requirements are achieved.

5.6.2 The pollution hazard indices for the proposed development are summarised in Table 5.6.

Land Use	Total Suspended Solids	Metals	Hydrocarbons
Roofs	0.3	0.2	0.05
Driveways/road	0.5	0.4	0.4

Table 5.6: Pollution Hazard Indices (CIRIA Report C753 Table 26.2)

5.6.3 At the detailed design stage care must be taken when considering the proposed SuDS components to ensure the proposed mitigation indices exceed the land use pollution hazard to provide sufficient pollution risk mitigation.

[9] Banners Gate Drawing No: 20023-DS01

6 FOUL WATER DRAINAGE

6.1 The proposed development will produce a foul water effluent of a domestic nature only.

6.2 United Utilities has advised[10] that foul water flows will be allowed to drain to the public foul/combined sewer crossing the Site at an unrestricted rate.

6.3 A gravity drainage solution is achievable as depicted on the Drainage Strategy Plan included within Appendix III.

[10] United Utilities Pre-Development Enquiry email dated 24 November 2020

7 CONCLUSIONS

7.1 Based on the work carried out in the preparation of this Report the following conclusions are made:

7.2 A development of 36 dwellings is proposed on a 1.8-hectare Greenfield Site of Neddy Lane in Billington.

7.3 The River Calder is approximately 200m to the north of the Site and based upon modelled data provided by the Environment Agency its floodplain encroaches into the northern boundary of the Site. Approximately 75% of the Site is located within Flood Zone 1.

7.4 The Site has a 'low' to 'very low' risk of surface water flooding.

7.5 To facilitate development in the north of the Site, it will be necessary to raise ground levels resulting in a small loss of floodplain which is to be compensated for, on a level for level basis, to the west of the residential Site.

7.6 Based upon published data the use of infiltration techniques is unsuitable.

7.7 The River Calder is a viable point of surface water discharge and a gravity drainage solution is feasible. To facilitate a connection to the river, a discharge into the public surface water sewerage crossing the Site is proposed.

7.8 Post-development rates of surface water runoff should be restricted to the Greenfield Qbar rate of 8.3 litres per second for all events up to and including the 1 in 100 year plus climate change return period.

7.9 Foul water flows are to be directed to the public foul/combined sewerage crossing the Site.

7.10 The proposed development will not impede flood flows, will not result in a net loss of floodplain and will not adversely impact flood risk within or external to the Site.

7.11 It is considered that the proposed development, subject to detailed design, will not increase the risk of flooding and planning permission should not be withheld on the basis of flood risk.

8 RECOMMENDATIONS

8.1 Based on the work carried out in the preparation of this report it is recommended that:

8.2 Minimum finished floor levels should be 45.2mAOD, 600mm above the 0.1% AEP (1 in 1,000) level as a proxy for the 1% AEP (1 in 100) plus climate change level.

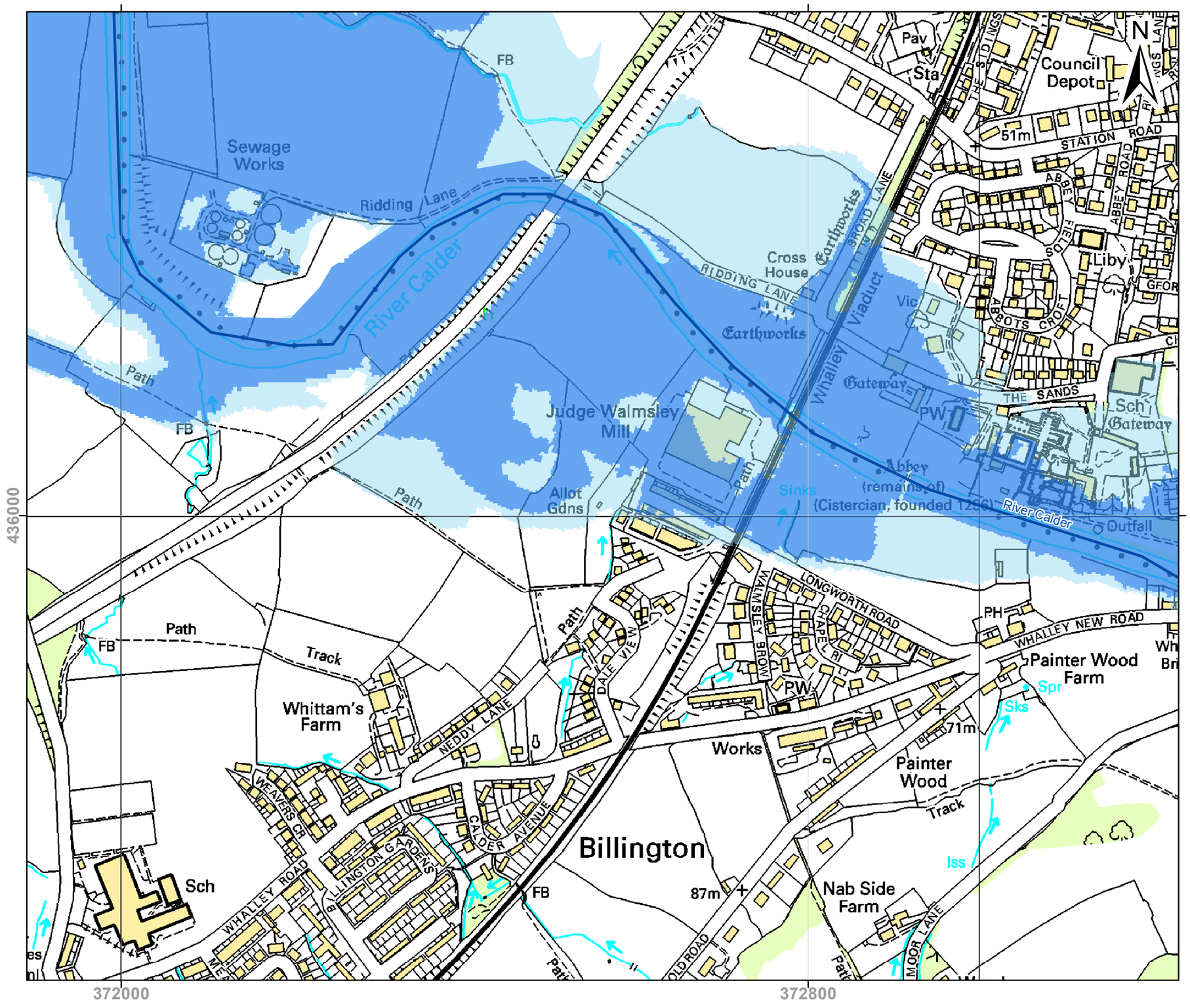
8.3 Floodplain compensation proposals should be agreed with the Environment Agency.

8.4 Flood resilient design and construction techniques should be adopted for the dwellings located in the northern half of the Site.

8.5 The detailed design stage should consider the most appropriate SuDS techniques available for use, in consultation with the Local Planning Authority.

8.6 During the detailed design stage careful consideration must be given to the risk of drainage settlement and appropriate mitigation measures adopted.

APPENDIX I – SUPPORTING INFORMATION



Flood Zones Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 27 January 2020
Our Ref: CL155482
NGR: 372538,435927

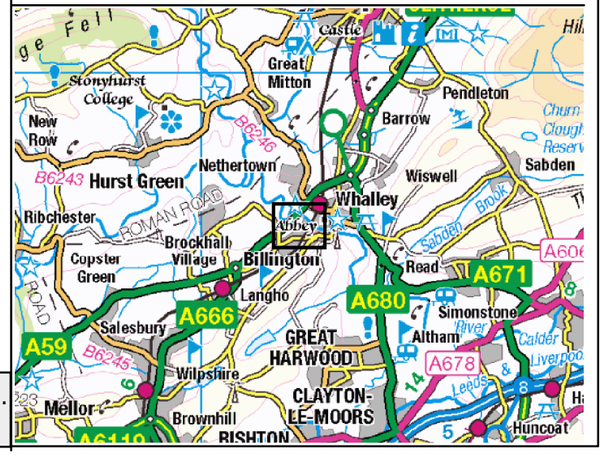
Key

- Main River
- Areas Benefitting from Defences
- Flood Zone 3
- Flood Zone 2

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



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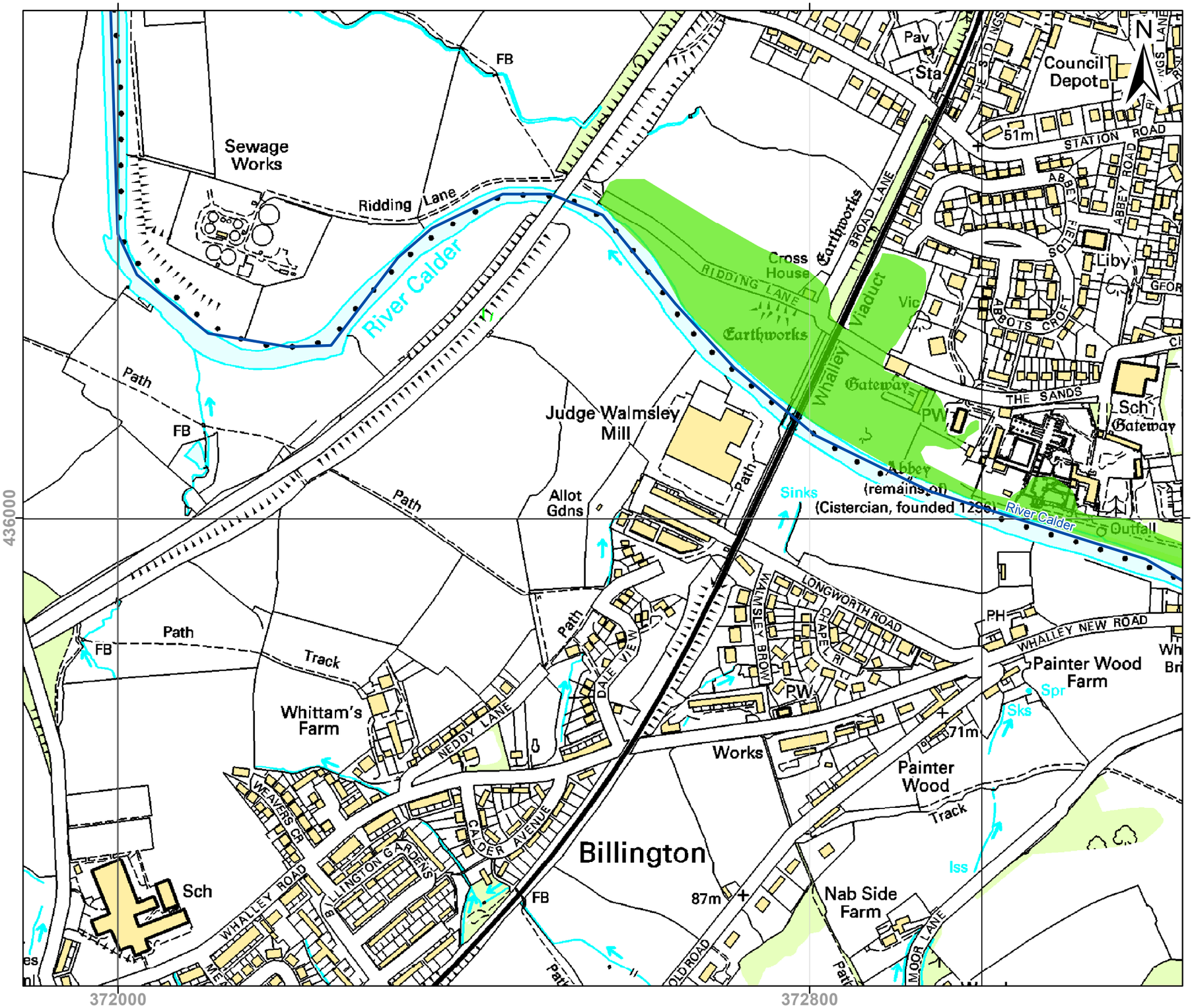

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Environment Agency

Historic Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 27 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

22 July 2012 Fluvial Flooding

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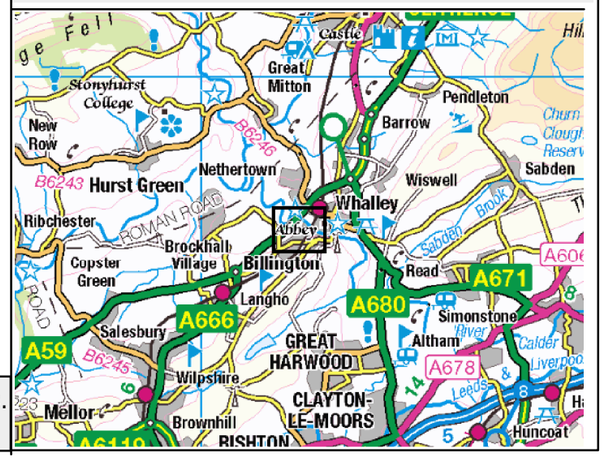

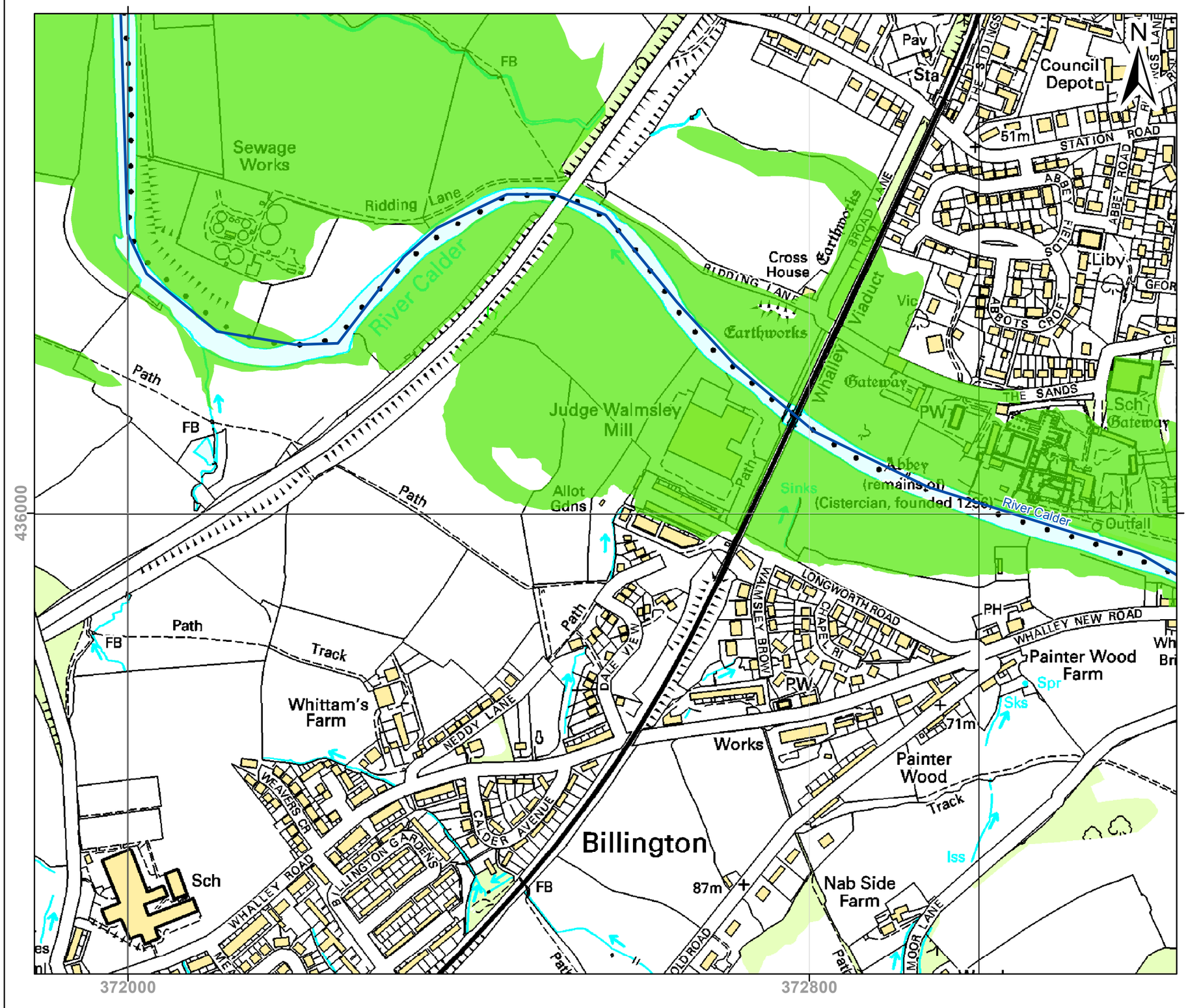

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Environment Agency

Historic Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 28 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

26 December 2015 Fluvial Flooding

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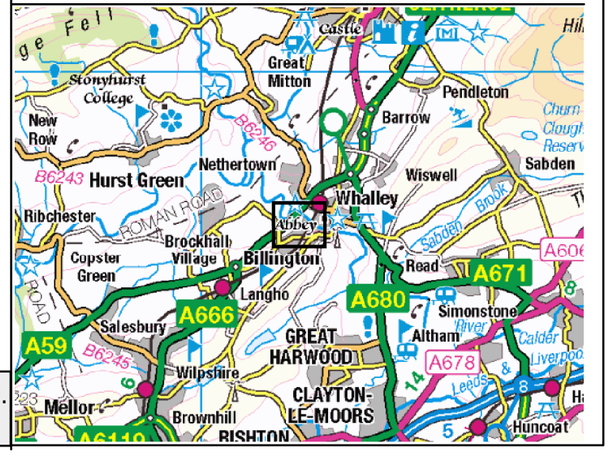
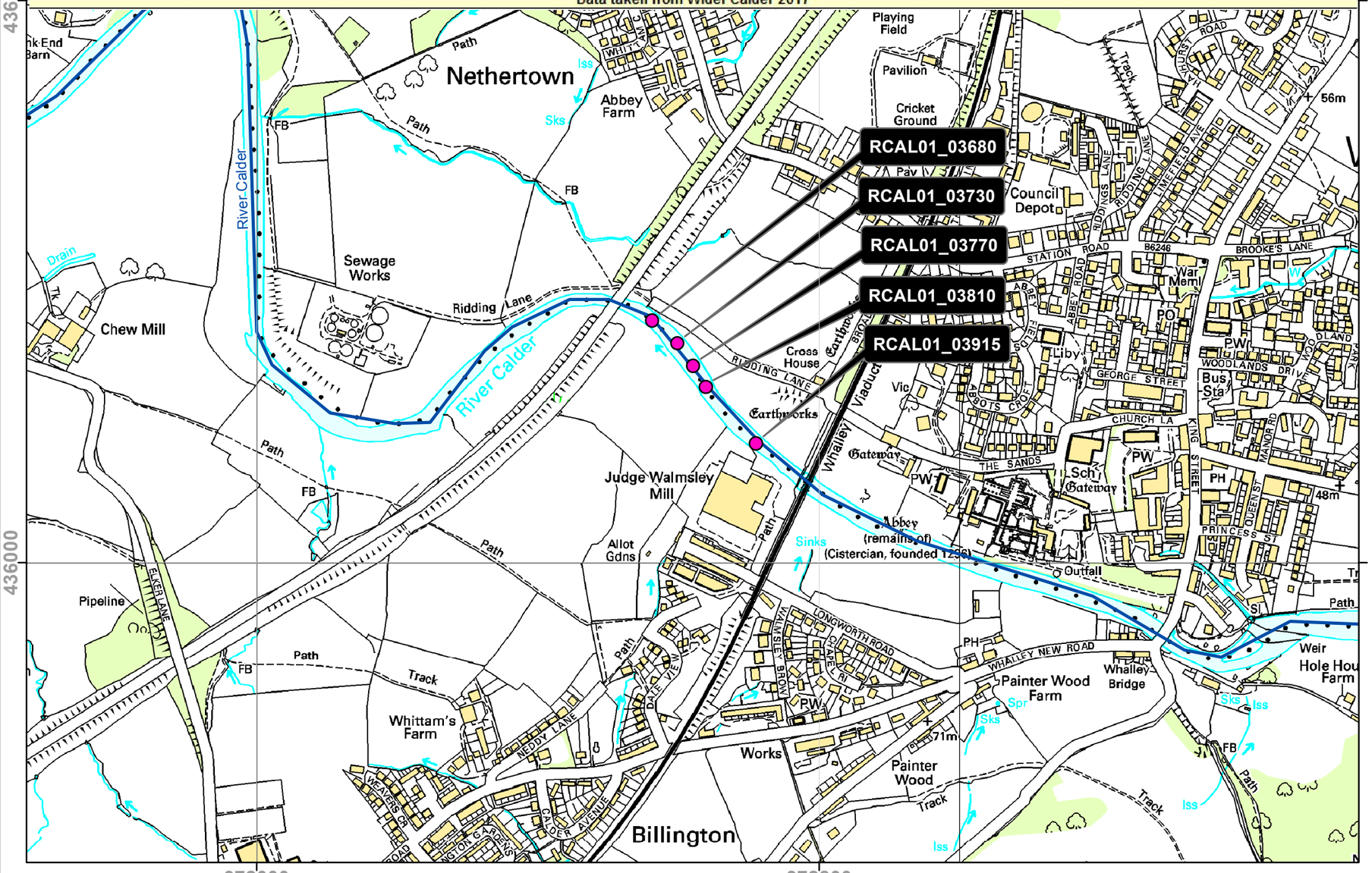


Node Point	Flood Flow (m^3s^{-1}) and Level (mAOD) data for a range of annual probability of flooding															
	0.1%				1%+Climate Change (+15%)				1.0%				4.0%			
	Defended		Undefended		Defended		Undefended		Defended		Undefended		Defended		Undefended	
Map ID	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
RCAL01_03915	44.65	413.01	44.65	413.11	43.80	332.88	43.80	333.08	43.60	307.02	43.60	307.09	43.26	273.90	43.26	273.92
RCAL01_03810	44.57	414.85	44.57	414.81	43.63	339.71	43.63	339.93	43.40	316.28	43.40	316.35	43.04	279.30	43.04	279.30
RCAL01_03770	44.55	416.94	44.55	416.83	43.59	338.90	43.59	339.09	43.35	315.00	43.35	315.07	42.96	280.28	42.96	280.29
RCAL01_03730	44.49	431.24	44.49	431.08	43.52	343.20	43.52	343.34	43.29	316.64	43.29	316.69	42.90	278.79	42.90	278.78
RCAL01_03680	44.27	494.19	44.27	494.38	43.33	372.88	43.33	372.93	43.13	336.42	43.13	336.44	42.78	283.52	42.78	283.52

Level data in mAOD (metres above ordnance datum). Flow data in m^3 per second

Data taken from Wider Calder 2017



Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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Environment Agency

Fluvial Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 28 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

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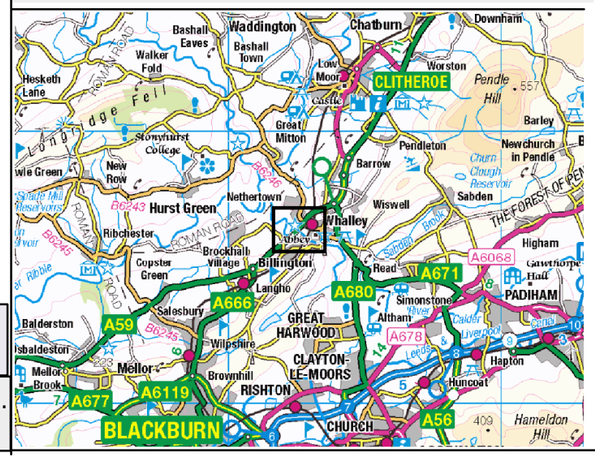

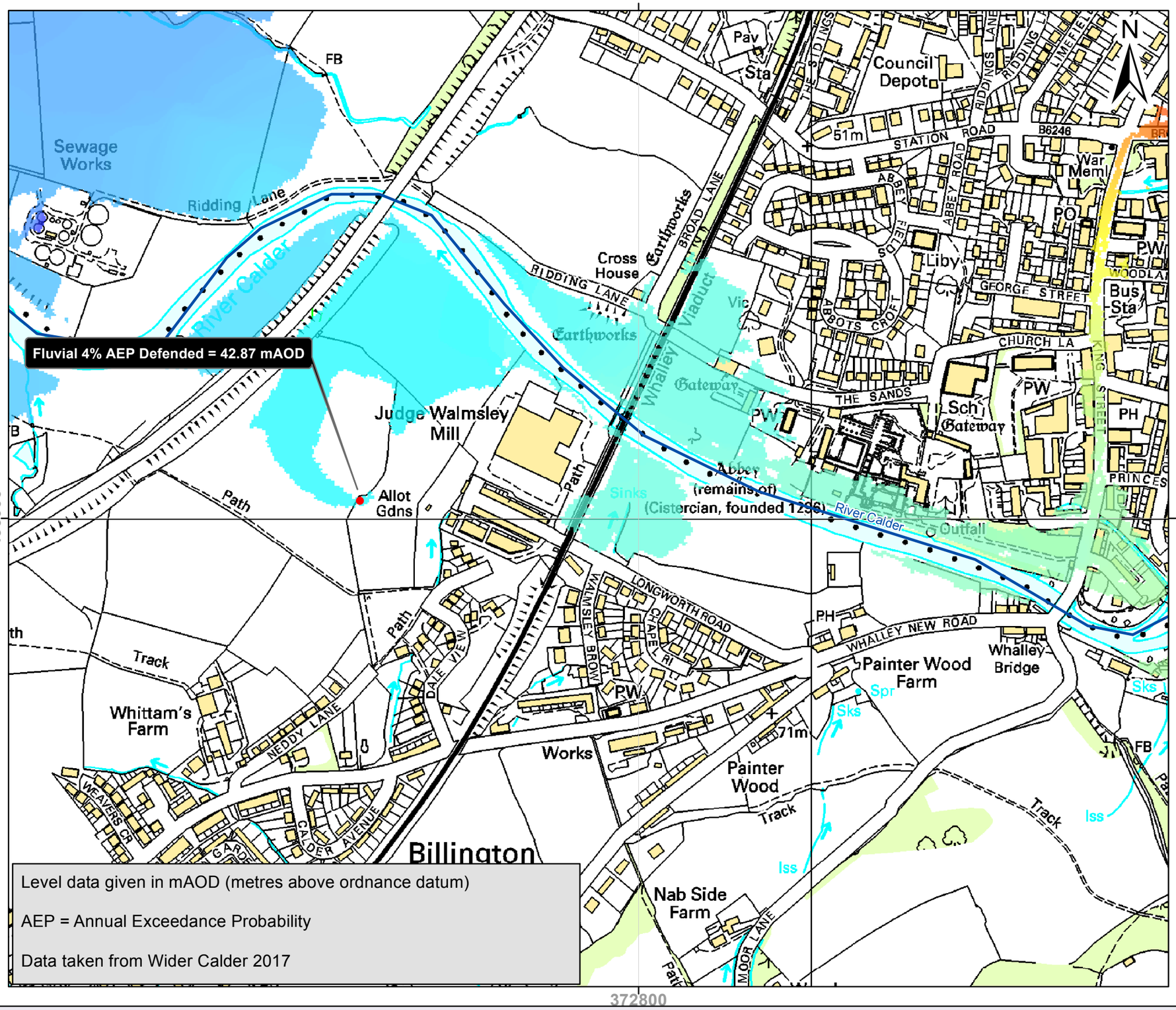

Level data given in mAOD (metres above ordnance datum)

AEP = Annual Exceedance Probability

Data taken from Wider Calder 2017

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Environment Agency

Fluvial Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 29 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

Fluvial Defended Scenario 4% AEP annual probability of flooding

mAOD

High : 53

Low : 38

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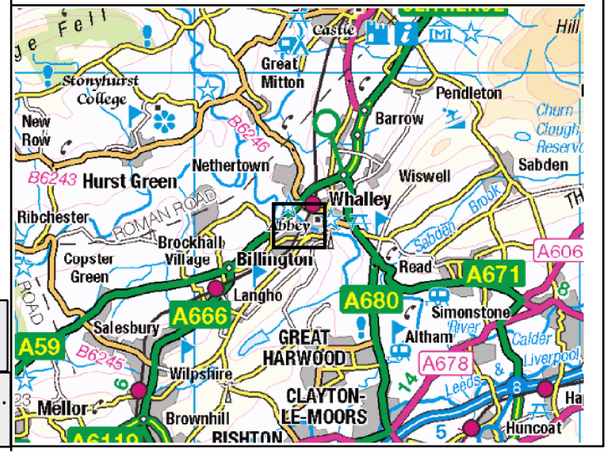

Fluvial Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 29 January 2020
Our Ref: CL155482
NGR: 372538,435927

Fluvial 1% AEP Defended = 43.34 mAOD

Fluvial 1% AEP Defended = 43.34 mAOD

436000

372800

Level data given in mAOD (metres above ordnance datum)

AEP = Annual Exceedance Probability

Data taken from Wider Calder 2017

Key

Main River

Fluvial Defended Scenario 1% AEP annual probability of flooding

mAOD

High : 53

Low : 38

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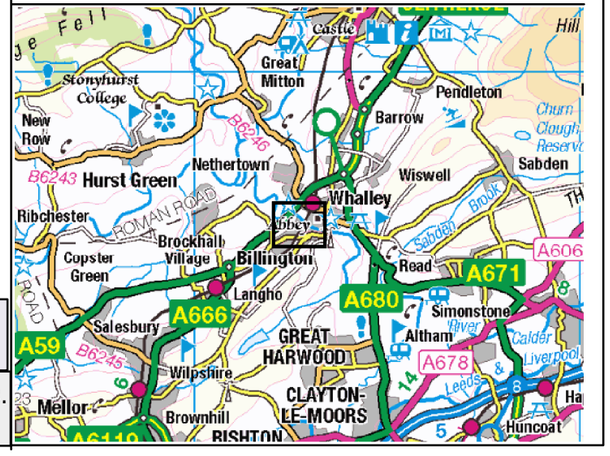

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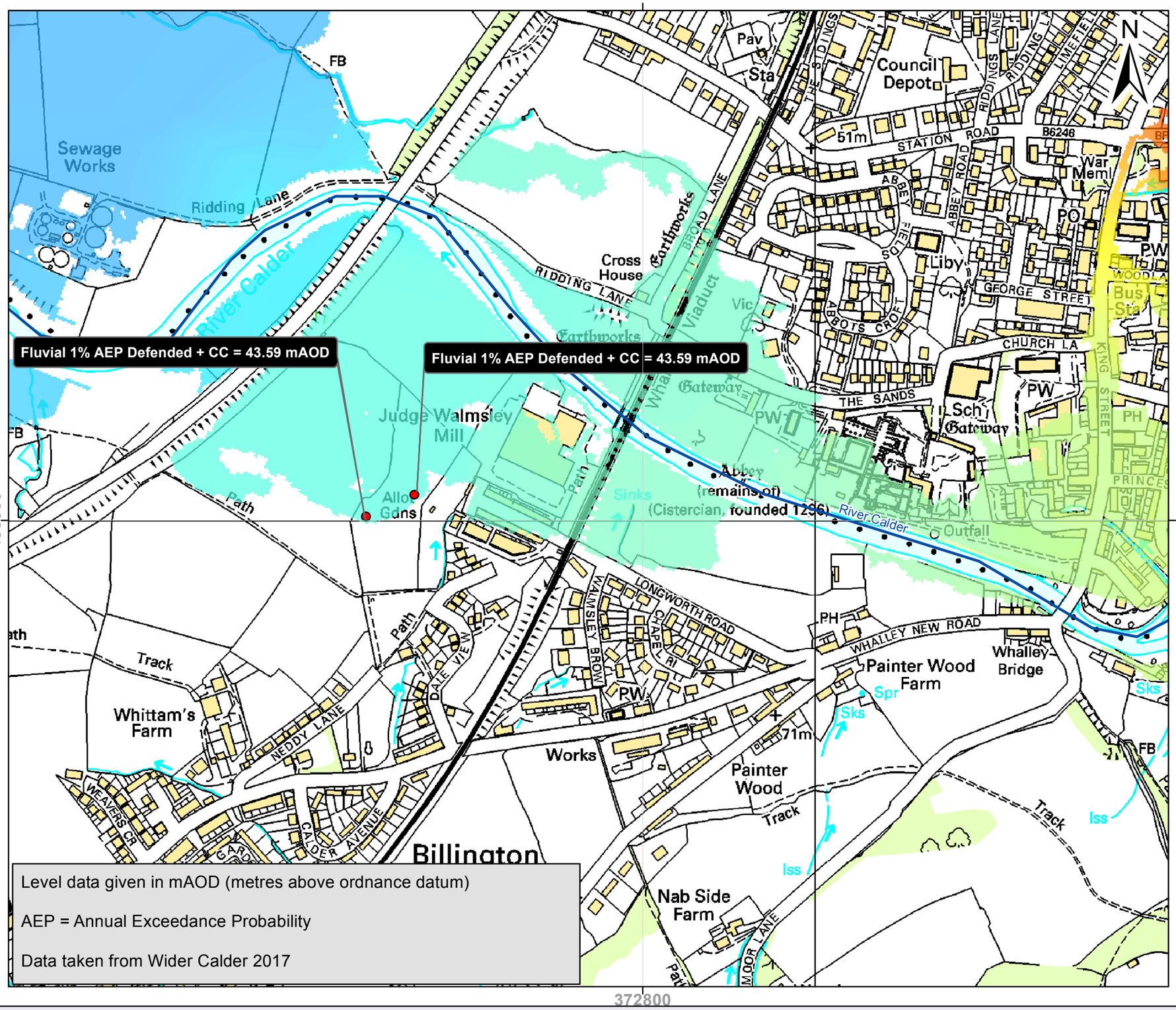

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Produced: 29 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

Fluvial Defended Scenario 1% AEP annual probability of flooding + Climate change (+15%) mAOD

High : 53

Low : 38

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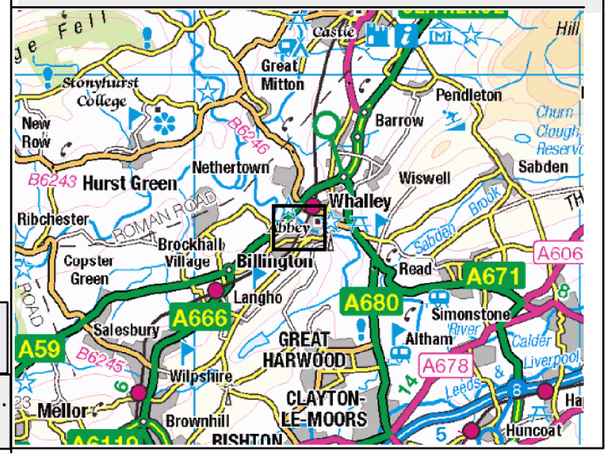

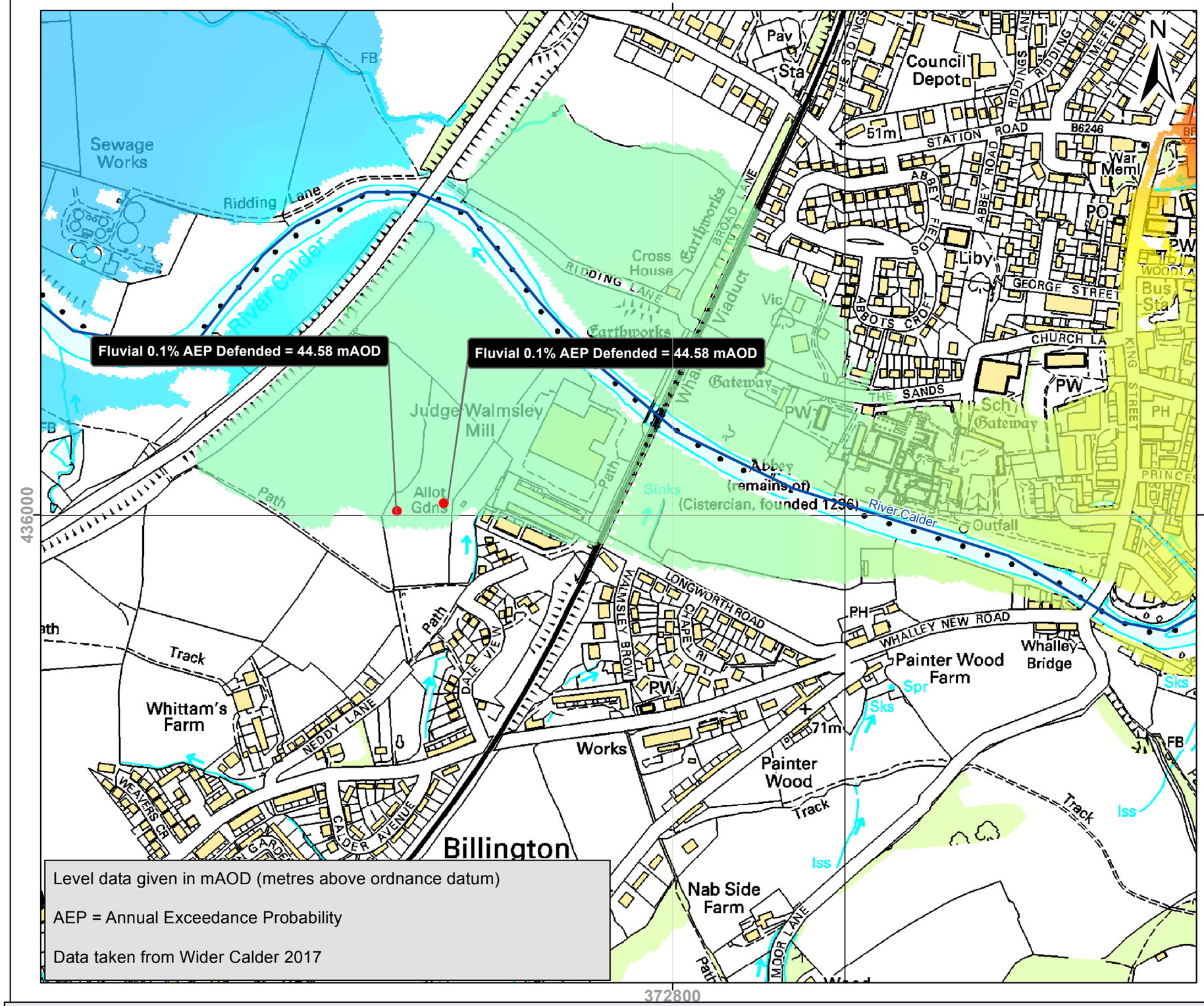

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Fluvial Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 28 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

Fluvial Defended Scenario 0.1% AEP annual probability of flooding

mAOD

High : 53

Low : 38

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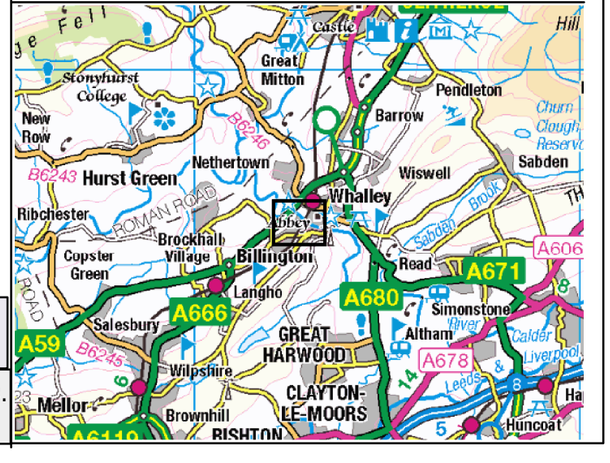

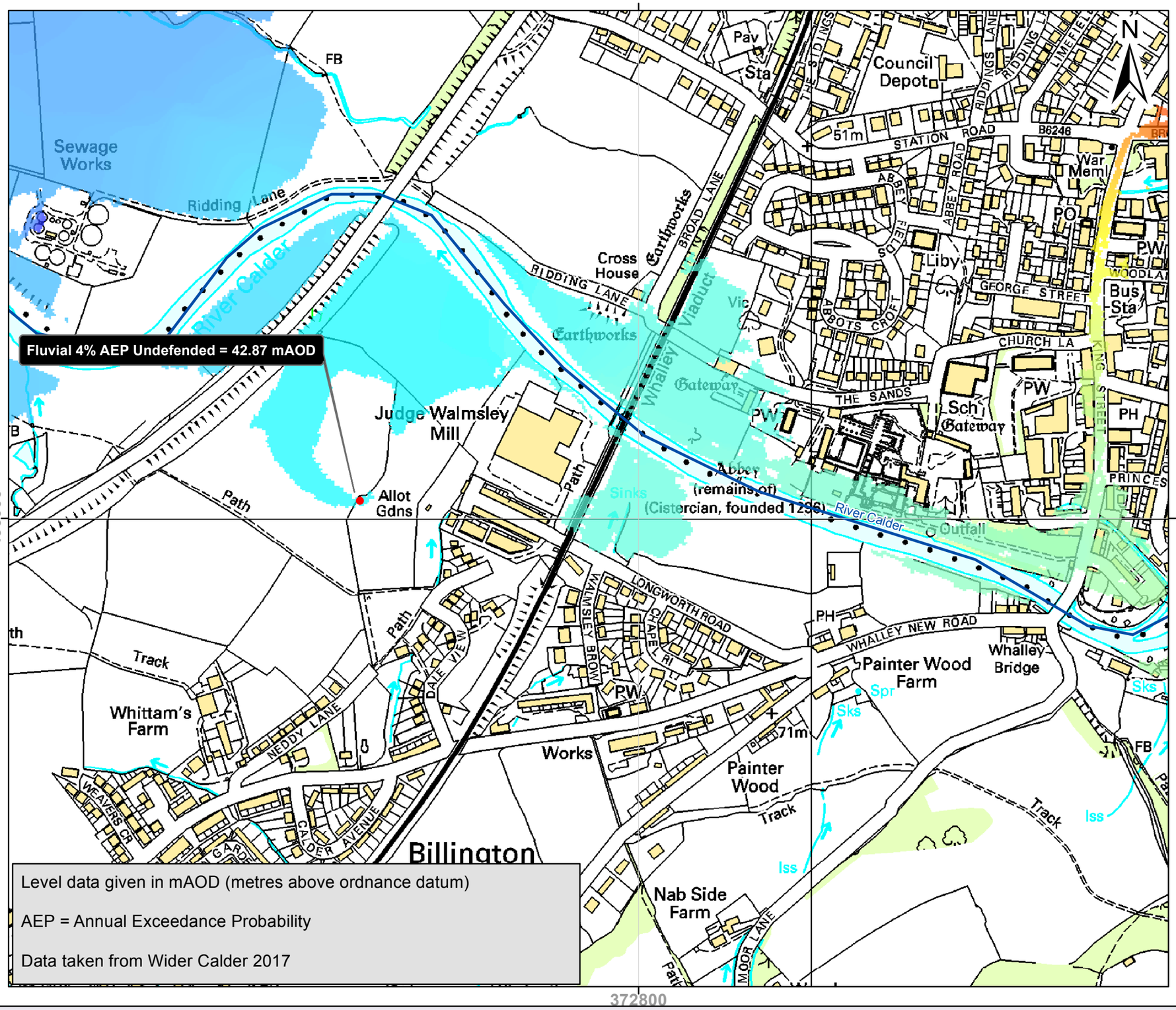

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Fluvial Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

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Our Ref: CL155482
NGR: 372538,435927

Key

Main River

Fluvial Undefended Scenario 4% AEP annual probability of flooding

mAOD

High : 53

Low : 38

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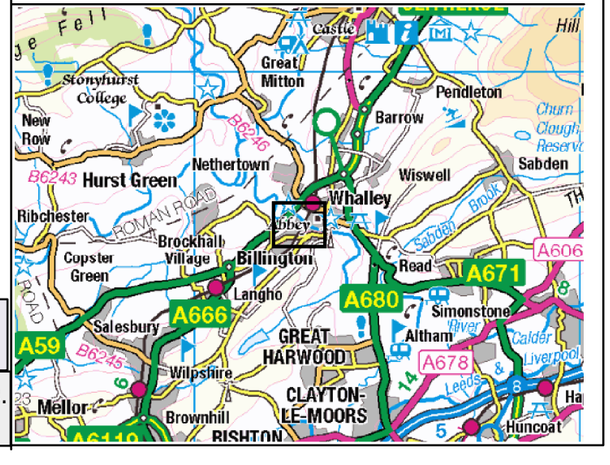

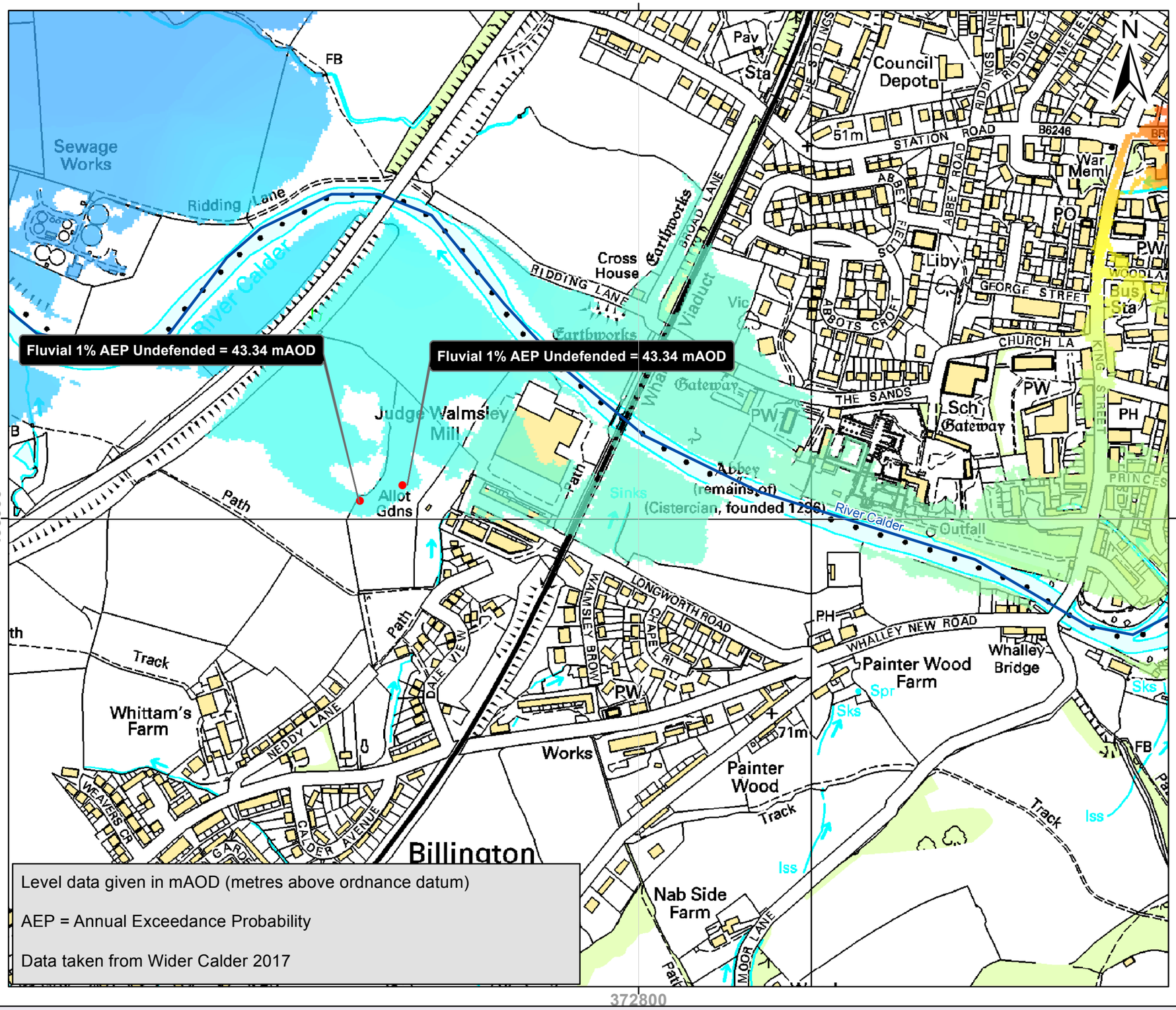

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Data taken from Wider Calder 2017

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Produced: 29 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

Fluvial Undefended Scenario 1% AEP annual probability of flooding

mAOD

High : 53

Low : 38

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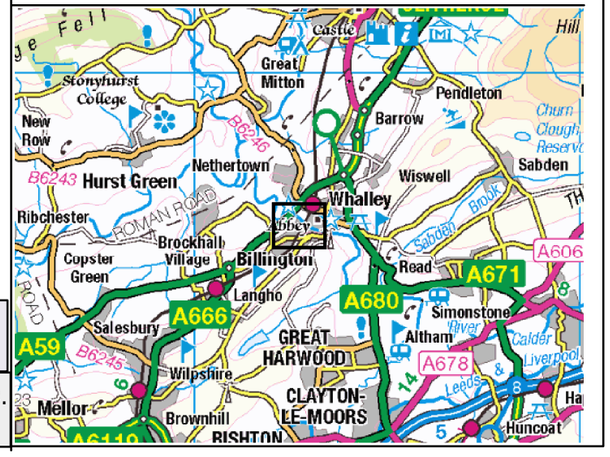

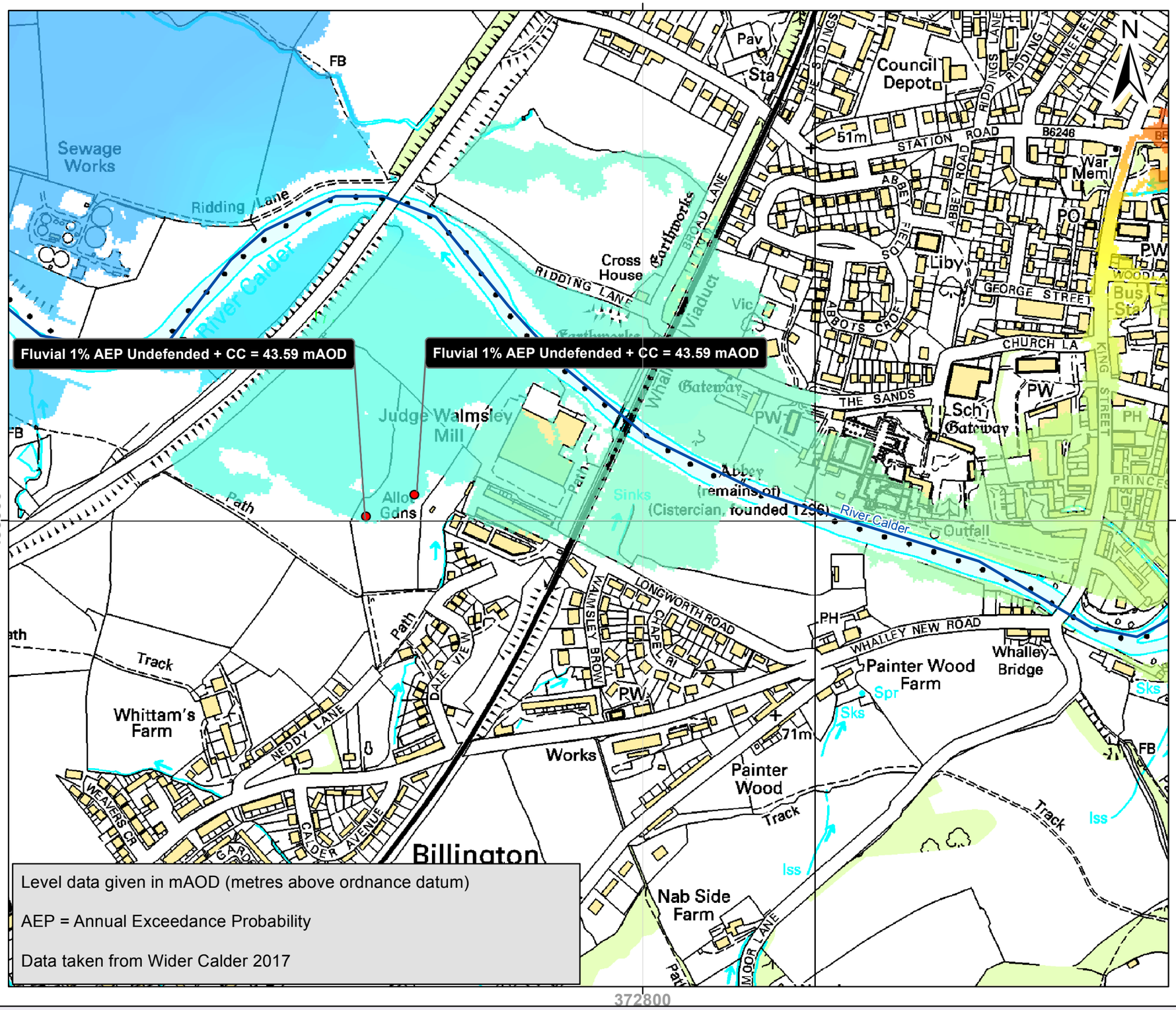

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Environment Agency

Fluvial Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 29 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

Fluvial Undefended Scenario 1% AEP annual probability of flooding + Climate change (+15%) mAOD

High : 53

Low : 38

Flood Zone 3 shows the area that could be affected by flooding:
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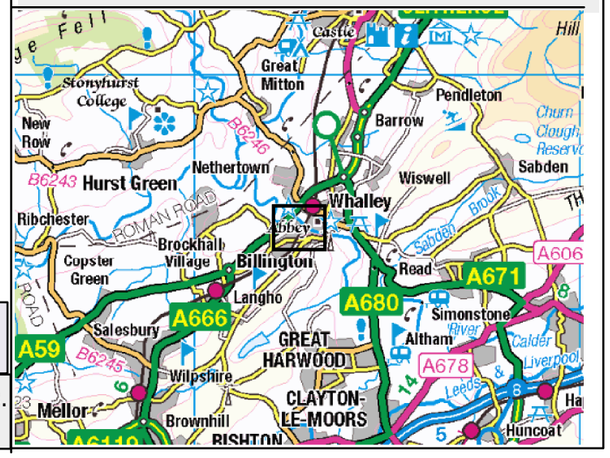

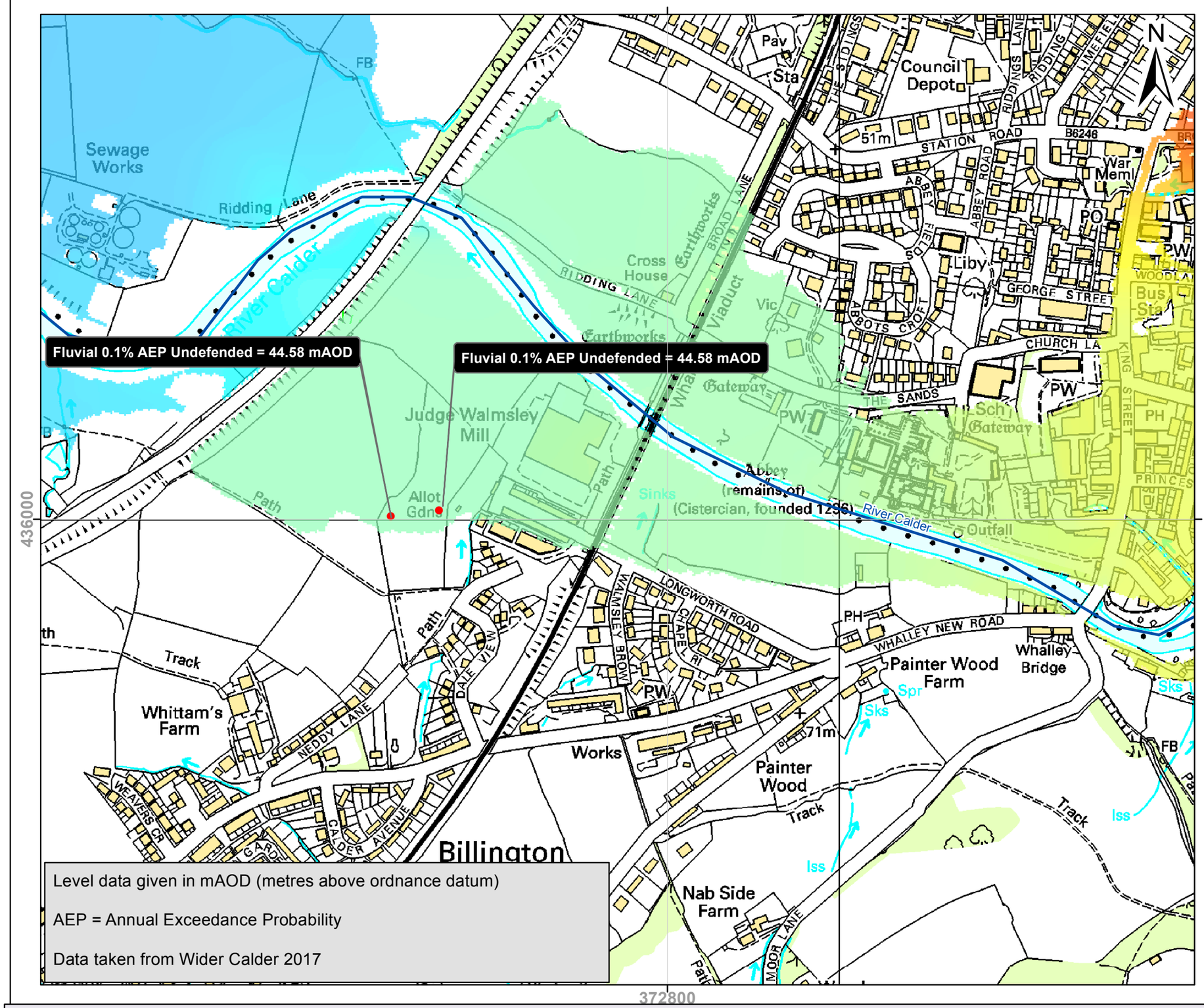

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Environment Agency

Fluvial Flood Map: Dale View, Billington, Clitheroe, BB7 9LL

Produced: 28 January 2020
Our Ref: CL155482
NGR: 372538,435927

Key

Main River

Fluvial Undefended Scenario 0.1% AEP annual probability of flooding

mAOD

High : 53

Low : 38

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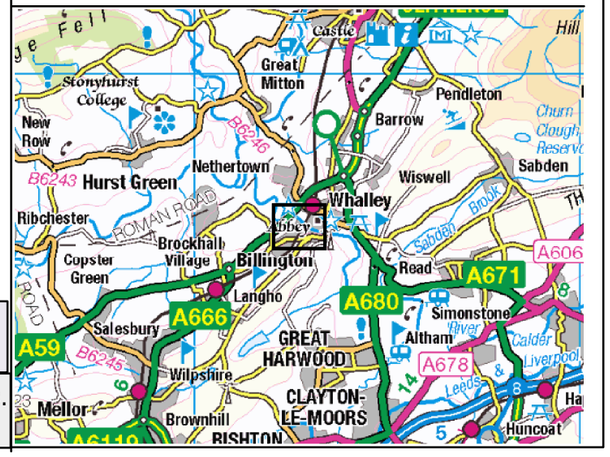


Scott Marshall

From: Perry, Graham <Graham.Perry@uuplc.co.uk>
Sent: 24 November 2020 16:32
To: Scott Marshall; mark.dawson@redrow.co.uk
Cc: Wastewater Developer Services
Subject: Pre Development Enquiry for : Land off Dale View, Billington, Lancashire BB7 9LL UU reference Number : 4200035244
Attachments: initial pre develpment

Dear Sirs,

Pre Development Enquiry for: Land off Dale View, Billington, Lancashire BB7 9LL UU reference Number : 4200035244

We have carried out an assessment of your application which is based on the information provided. This pre-development advice on your drainage strategy will be valid for 12 months. Your drainage strategy will need to be reviewed by other competent authorities as part of the planning process, and we advise that you carry out the necessary site investigations to confirm the viability of your proposals.

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 3723223 or refer to the link below:

https://www.unitedutilities.com/builders-developers/working-near-our-assets/

Foul Water

Foul flow from this site will be allowed to drain into the public foul water/combined sewer system.

Our preferred point of discharge would be to the 150mmmm diameter public combined sewer within the boundary of your proposed development at an unrestricted rate.

If you are able to identify an alternative, more suitable point of discharge, we request that you contact us at your earliest convenience so that we can assess suitability.

Surface Water

All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80, (Reference ID: 7-080-20150323), of the National Planning Practice Guidance. We also recommend you prioritise the use of multi-functional sustainable drainage systems for the management of surface water in accordance with national planning policy.

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable.
This is outlined as follows, in order of priority:

1. **into the ground (infiltration);**
2. **to a surface waterbody;**
3. **to a surface water sewer or highway drain;**
4. **to a combined sewer.**

For guidance, The North West SuDS Pro-Forma provides information on the appropriate evidence required at each stage of the hierarchy, to demonstrate how each level has been discounted.

The Lead Local Flood Authority has responsibility for all surface water drainage concerns and their input to your proposal is critical. You should also consider whether it is necessary to discuss your proposal with the Environment Agency, or Internal Drainage Board (if operating in your area).

The Local Planning Authority are the determining authority for any application for planning permission and the appropriate authority for determining cost viability of a proposed drainage scheme, such assessments are outside of the jurisdiction of United Utilities.

Infiltration

Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible.

A detailed evidence based feasibility assessment must be carried out in line with Chapter 25 of the CIRIA SuDS Manual 2015 to determine whether infiltration is a suitable method of surface water disposal.

Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website:
https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs

If your site is in a Groundwater Source Protection Zone, you should have regard to the Environment Agency's approach to Groundwater Protection. Information on this is available via the link below:

https://www.gov.uk/government/publications/groundwater-protection-position-statements

Please note that such a location could have implications for the principle of your development and the need for additional mitigating measures to protect the groundwater environment and public water supply in the detailed design of your site.

Waterbody

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you contact the Lead Local Flood Authority and/or Environment Agency to discuss a point of discharge to the open ordinary watercourse located to the north
We would encourage you to identify and engage with any third party landowner and riparian owner to agree access and discharge rights to the water body if this is not in your ownership.

Public Sewer

In accordance with the hierarchy of drainage options within the National Planning Practice Guidance, both discharge to ground via infiltration and discharge to a waterbody should be discounted prior to consideration of discharging surface water to the public sewer system. Evidence should be provided to demonstrate how these have been discounted, as outlined in the North West SuDS pro-forma.

Once evidence is provided as outlined above, United Utilities will consider a connection to the 300mm diameter public surface water sewer within the proposed site at a pass forward flow to be agreed by the Lead Local Flood Authority. United Utilities request that any agreed rate does not exceed 8 l/s.

As a Water Company, we have no obligation to accept highway drainage into our public sewer network. However, should your proposals include runoff from highways, we would request that consideration is given to SuDS components that deliver source control are incorporated within the design of the scheme to reduce the volume and frequency of discharges of these flows to the public sewer.

Levels

For low-lying sites, (where the ground level of the site or the level of a basement is below the ground level at the point where the drainage connects to the public sewer), care should be taken to ensure that the property is not at increased risk of flooding. If these circumstances exist, we recommend that you contact us to discuss further. It could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme.

Land drainage / Overland flows / track drainage

United Utilities have no obligation, and furthermore we do not accept land drainage, overland flows or track drainage into the pubic sewerage network under any circumstances

Sewer Adoptions

You have indicated on your application form that you intend to put the sewers forward for adoption (including any SuDS components that can come within the meaning of a sewer).

United Utilities assess adoption applications based on the current Design & Construction Guidance and local practices which have now replaced 'Sewers For Adoption 6th Edition'.

We recommend that you submit a pre design assessment to the sewer adoption mailbox (SewerAdoptions@uuplc.co.uk) stating pre design assessment in the title

Please refer to link**s** below to obtain further guidance:

https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-adoptions/

Site drainage must be designed in accordance with Building Regulations, National Planning Policy, and local flood authority guidelines, we would recommend that you speak and make suitable agreements with the relevant statutory bodies.

If you intend to put forward your wastewater assets for adoption by United Utilities, the proposed detail design will be subject to a technical appraisal by an Adoption Engineer as we need to be sure that the proposals meets the requirements set out in the Design & Construction Guidance. The proposed design should give consideration to long term operability and give United Utilities a safe and cost effective proposal for the lifetime of the assets. In these cases, we strongly recommend that no construction commences until the detailed drainage design, submitted as part of the Section 104 application, has been assessed and accepted in writing by United Utilities. Any work carried out prior to the technical assessment being approved is done entirely at the developer's own risk and could be subject to change.

Codes For Adoption

The new Codes for Adoption are outlined on the Water UK Website. The link below takes you to their webpage:

https://www.water.org.uk/technical-guidance/developers-services/codes-for-adoption/

A free copy of the new Design & Construction Guidance can be downloaded via the link below**:**

https://www.water.org.uk/wp-content/uploads/2020/03/SSG-App-C-Des-Con-Guide-v-2-100320-C.pdf

Existing Wastewater Assets Crossing the Site

According to our public sewer records there are public sewers located within your site boundary. We will require unrestricted access to the sewer for maintenance purposes, we would ask that you maintain a minimum clearance of 6m which is measured 3m from the centre line of the pipe unless there happens to be a formal easement

agreement in place, in which case the specified easement width would apply. If you cannot achieve this then you may wish to consider diverting and or abandoning the public sewer.

Following conversations with Mark Dawson, who I understand is involved in the scheme with you , I advised mark that the existing sewer is very slack and it is highly unlikely that we would simply allow the sewer to be diverted because this would cause an unacceptable deterioration in the performance of the existing sewer and could potentially cause flooding on the site. My recommendation would be to divert the pipe by installing a new pumping station as the head of the system as the sewer enters the site and then pump the diverted sewer either directly or indirectly to the existing downstream pumping station on the site. You could then potentially drain the development into the wet well of the new pumping station via gravity.

I must point out that there is also a 300mm dedicated surface water sewer that crosses this site and this sewer would also need to be diverted in a more traditional way.

Please refer to the link below to obtain full details of the processes involved with sewer diversions:

https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-diversions/

Existing Water Assets Crossing the Site

It is the developer responsibility to identify utilities on-site. Where clean water assets are shown on our records, we recommend that you contact our Water Pre-Development Team, via the following email address: DeveloperServicesWater@uuplc.co.uk. Further information for this service can be found on our website via the link below:
https://www.unitedutilities.com/builders-developers/larger-developments/pre-development/water-pre-dev/

Connection Application

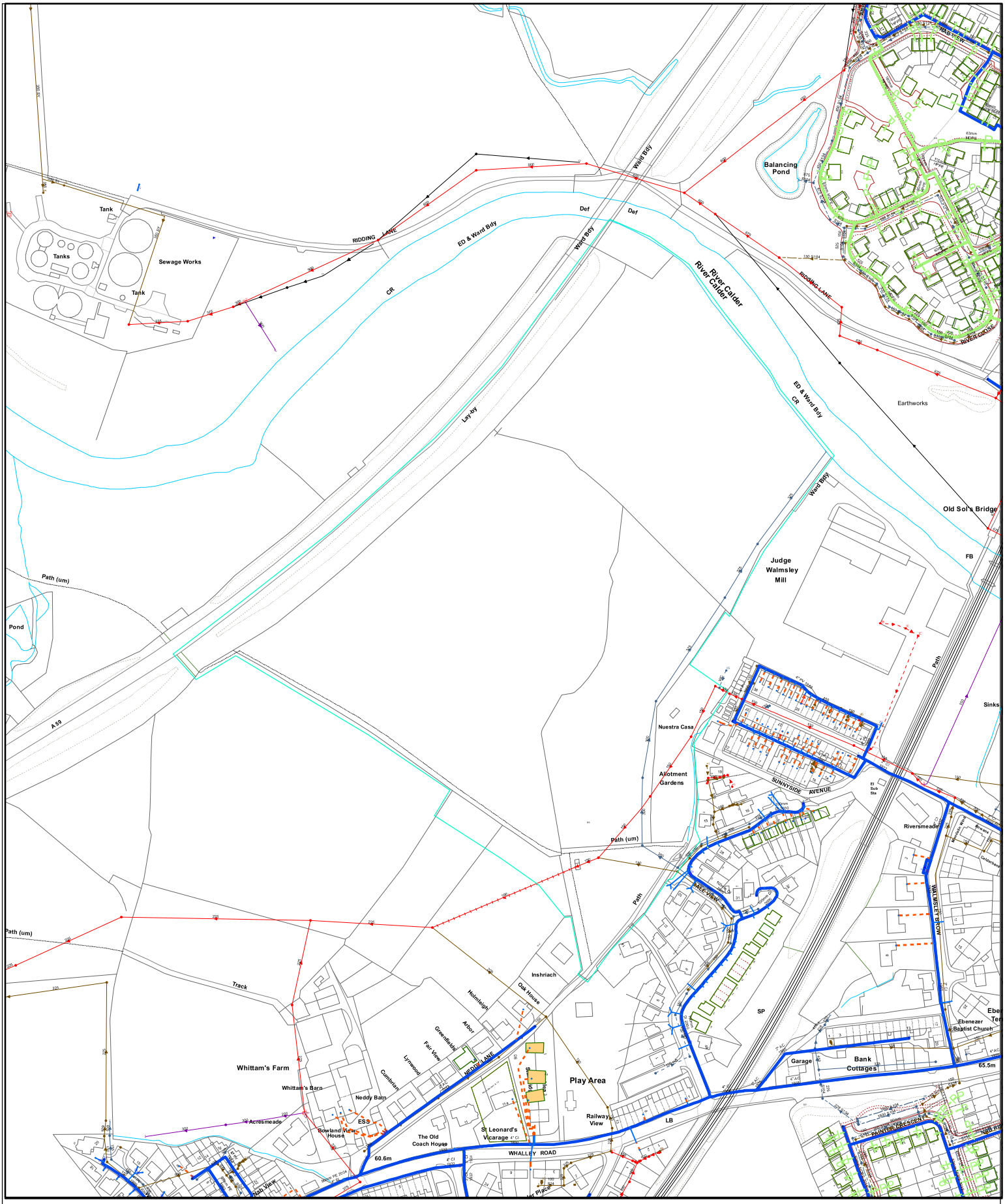
Although we may discuss and agree discharge points and rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-connections/

We recommend that the detailed design should confirm the locations of all utilities in the area and ensure that any proposed drainage solution considers routing and clash checks where required.

If we can be of any further assistance please don't hesitate to contact us further.

Kind regards,



Date: 05/12/2019

Extract from maps of public sewers and water mains

Printed By:
Property Searches

Land off Dale View Billington Clitheroe

United Utilities
helping life flow smoothly

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded. United Utilities Water PLC will not accept any liability for any damage caused by the actual positions being different from those shown.

Ribble Valley Borough Council
Development Control
Council Offices Church Walk
Clitheroe
Lancashire
BB7 2RA

Our ref: NO/2021/113355/03-L01
Your ref: 3/2021/0205

Date: 20 September 2021

Dear Sir/Madam

ERECTION OF 36 RESIDENTIAL DWELLINGS, ALONG WITH LANDSCAPING AND ASSOCIATED SITE INFRASTRUCTURE.
LAND AT NEDDY LANE, BILLINGTON, BB7 9LL

Thank you for consulting us on the above application which we received 31 August 2021.

Environment Agency position

In the absence of an acceptable flood risk assessment (FRA) we object to this application and recommend that planning permission is refused.

Reason(s)
The submitted FRA does not comply with the requirements for site-specific flood risk assessments, as set out in paragraphs 30 to 32 of the Flood Risk and Coastal Change section of the Planning Practice Guidance. The FRA does not therefore adequately assess the flood risks posed by the development. In particular, the FRA fails to:

- take the impacts of climate change into account
- address flood risk for the lifetime of the development, the measures included in the design are inadequate because they will not make the development resilient to the flood levels for a 1% AEP plus 36% allowance for climate change event (0.1% AEP levels are being used as proxy).

Consequently the development proposes:

- Inadequate flood storage compensation

Overcoming our objection

To overcome our objection, the applicant should submit a revised FRA which addresses the points highlighted above.

If this cannot be achieved, we are likely to maintain our objection. Please re-consult us on any revised FRA submitted and we'll respond within 21 days of receiving it.

Detailed comments.
The proposed development has used the 0.1% Annual Exceedance Probability (AEP) extent and levels as a proxy for the 1% AEP plus climate change allowance in this FRA. This is satisfactory in this location.

The development scheme proposes increasing ground levels within the 0.1% AEP event. Therefore a compensatory storage scheme has been proposed which results in a marginal betterment in flood storage as shown in drawing 20023-SK07 E, however the proposed design of the scheme is not considered to be acceptable.

The proposed storage area is connected by a restrictive channel design which cuts through an area of higher ground. This connection reduces the hydraulic and hydrological connection to the existing flood plain which the EA does not support.
In addition, as flood water drains from the flood plain, sediment often gets deposited. Over time, this deposition would increase ground levels and is likely to result in sediment build up in the narrow channel which would prevent water flowing into the storage area. There is also ground level lowering proposed within the existing floodplain as part of the storage scheme. For similar reasons as above, this is not supported as it is likely that there would be a continuous standing water level, or sediment build up that would reduce the flood plain storage volume.

We would generally encourage where possible, the re-contouring of the land adjoining a floodplain. This is to allow development without increasing, and ideally reducing, overall flood risk.

For schemes such as the one proposed, maintenance must be considered. However, maintenance and the continued regulation of such a scheme is considered to be onerous and the scheme would need to be supported by a maintenance regime, funding and would be likely to need legal agreements to protect the area from future development.

We also request that the applicant provide clarification of whether the proposed SUDs scheme is located within the 0.1% AEP extent and whether ground level raising in this area has been considered in the design of the proposed flood storage scheme. If so, this must also be considered when designing the compensatory storage scheme and the SUDs scheme should not be located within the fluvial flood plain**.**

Movement of culverted watercourses - Advice to applicant

The matter of culverting and rerouting the ordinary watercourses should be discussed with the Lead Local Flood Authority – Lancashire County Council.

Sequential test - advice to LPA

In accordance with the National Planning Policy Framework (paragraph 162), development should not be permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.
It is for the local planning authority to determine if the sequential test has to be applied and whether or not there are other sites available at lower flood risk. Our flood risk standing advice reminds you of this and provides advice on how to apply the test.

Cont/d..

Yours faithfully

Carole Woosey
Planning Advisor

E-mail clplanning@environment-agency.gov.uk

End

APPENDIX II – CALCULATIONS

ReFH2 Rural Runoff Peak Flows

Input

Return Period (Years)	2	Area (ha)	1.400
FEH Rainfall Version	2013	SAAR (mm)	1121
Site Location	GB 372520 435958 SD 72520 35958	BFIHOST	0.486
Data Type	Point	FARL	0.000
Season	Winter	SPRHOST	0.000
Country	England/Wales/Northern Ireland	URBEXT (2000)	0.0000

Results

Return Period (Years)	Rural (l/s)	Urban (l/s)
User	7.9	7.9
Q1	6.7	6.7
Q2	7.9	7.9
Q5	12.1	12.1
Q10	15.2	15.2
Q30	20.4	20.4
Q50	23.1	23.1
Q75	25.4	25.4
Q100	27.1	27.1
Q200	31.5	31.5
Q1000	44.5	44.5

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	30	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	6.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
02	0.124	6.00	45.255	1200	372555.040	435983.420	1.316
04	0.055	6.00	45.348	1200	372539.789	435973.962	1.372
06	0.030	6.00	45.435	1200	372545.802	435969.863	1.653
08	0.118	6.00	45.949	1200	372536.072	435956.042	2.221
10	0.053	6.00	47.585	450	372539.635	435912.383	1.635
12	0.028	6.00	47.244	1200	372517.918	435927.199	1.644
14	0.048	6.00	47.269	1500	372512.756	435925.087	3.815
16	0.042	6.00	47.499	1500	372505.093	435914.914	4.077
18	0.137	6.00	47.435	1500	372500.306	435915.039	4.025
20	0.000	6.00	46.870	1500	372479.042	435931.125	3.530
22	0.153	6.00	45.900	1500	372475.227	435955.884	2.623
HW1	0.000		45.000	20	372450.198	435973.212	1.800
HW2	0.093	6.00	45.000	20	372454.164	435978.516	1.820
CC01	0.000	6.00	45.250	2100	372461.659	435976.717	2.090
24	0.000		44.270	1200	372481.322	436003.342	1.316
26	0.000		45.000	1200	372503.756	436008.465	2.184
28	0.000		44.650	1200	372512.051	436019.432	1.917
30	0.000		44.500	1200	372528.215	436035.829	1.905
32	0.000		44.500	1200	372552.136	436044.598	2.058
D06			44.750	1200	372557.918	436040.708	2.350

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	02	06	16.405	0.600	43.939	43.857	0.082	200.1	300	6.25	117.6
2.000	04	06	7.277	0.600	43.976	43.932	0.044	165.4	225	6.12	118.4
1.001	06	08	16.902	0.600	43.782	43.728	0.054	313.0	375	6.52	115.7
1.002	08	14	38.754	0.600	43.728	43.604	0.124	312.5	375	7.16	111.4
3.000	10	12	26.290	0.600	45.950	45.600	0.350	75.1	225	6.29	117.3
3.001	12	14	5.577	0.600	45.600	43.754	1.846	3.0	225	6.30	117.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	1.108	78.3	52.7	1.016	1.278	0.124	0.0
2.000	1.014	40.3	23.5	1.147	1.278	0.055	0.0
1.001	1.019	112.5	87.4	1.278	1.846	0.209	0.0
1.002	1.019	112.6	131.6	1.846	3.290	0.327	0.0
3.000	1.510	60.0	22.5	1.410	1.419	0.053	0.0
3.001	7.582	301.5	34.3	1.419	3.290	0.081	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	14	16	12.736	0.600	43.454	43.422	0.032	398.0	525	7.35	110.2
1.004	16	18	4.789	0.600	43.422	43.410	0.012	399.1	525	7.42	109.8
1.005	18	20	26.663	0.600	43.410	43.340	0.070	380.9	525	7.81	107.4
1.006	20	22	25.051	0.600	43.340	43.277	0.063	397.6	525	8.18	105.3
1.007	22	HW1	30.442	0.600	43.277	43.200	0.077	395.3	525	8.63	102.9
4.000	HW2	CC01	7.708	0.600	43.180	43.160	0.020	385.4	525	6.11	118.5
4.001	CC01	24	33.099	0.600	43.160	42.954	0.206	160.7	225	6.65	114.8
4.002	24	26	23.012	0.600	42.954	42.816	0.138	166.8	225	7.03	112.2
4.003	26	28	13.751	0.600	42.816	42.733	0.083	165.7	225	7.26	110.8
4.004	28	30	23.025	0.600	42.733	42.595	0.138	166.8	225	7.64	108.5
4.005	30	32	25.478	0.600	42.595	42.442	0.153	166.5	225	8.06	106.0
4.006	32	D06	6.969	0.600	42.442	42.400	0.042	165.9	225	8.17	105.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.003	1.116	241.7	181.7	3.290	3.552	0.456	0.0
1.004	1.115	241.3	197.6	3.552	3.500	0.498	0.0
1.005	1.141	247.1	246.6	3.500	3.005	0.635	0.0
1.006	1.117	241.8	241.6	3.005	2.098	0.635	0.0
1.007	1.120	242.5	293.0	2.098	1.275	0.788	0.0
4.000	1.135	245.6	39.8	1.295	1.565	0.093	0.0
4.001	1.029	40.9	38.6	1.865	1.091	0.093	0.0
4.002	1.009	40.1	37.7	1.091	1.959	0.093	0.0
4.003	1.013	40.3	37.2	1.959	1.692	0.093	0.0
4.004	1.009	40.1	36.5	1.692	1.680	0.093	0.0
4.005	1.010	40.2	35.6	1.680	1.833	0.093	0.0
4.006	1.012	40.2	35.4	1.833	2.125	0.093	0.0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	16.405	200.1	300	Circular_Default Sewer Type	45.255	43.939	1.016	45.435	43.857	1.278
2.000	7.277	165.4	225	Circular_Default Sewer Type	45.348	43.976	1.147	45.435	43.932	1.278
1.001	16.902	313.0	375	Circular_Default Sewer Type	45.435	43.782	1.278	45.949	43.728	1.846
1.002	38.754	312.5	375	Circular_Default Sewer Type	45.949	43.728	1.846	47.269	43.604	3.290
3.000	26.290	75.1	225	Circular_Default Sewer Type	47.585	45.950	1.410	47.244	45.600	1.419
3.001	5.577	3.0	225	Circular_Default Sewer Type	47.244	45.600	1.419	47.269	43.754	3.290
1.003	12.736	398.0	525	Circular_Default Sewer Type	47.269	43.454	3.290	47.499	43.422	3.552
1.004	4.789	399.1	525	Circular_Default Sewer Type	47.499	43.422	3.552	47.435	43.410	3.500

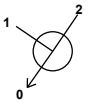
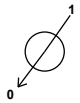
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	02	1200	Manhole	Adoptable	06	1200	Manhole	Adoptable
2.000	04	1200	Manhole	Adoptable	06	1200	Manhole	Adoptable
1.001	06	1200	Manhole	Adoptable	08	1200	Manhole	Adoptable
1.002	08	1200	Manhole	Adoptable	14	1500	Manhole	Adoptable
3.000	10	450	Manhole	Adoptable	12	1200	Manhole	Adoptable
3.001	12	1200	Manhole	Adoptable	14	1500	Manhole	Adoptable
1.003	14	1500	Manhole	Adoptable	16	1500	Manhole	Adoptable
1.004	16	1500	Manhole	Adoptable	18	1500	Manhole	Adoptable

Pipeline Schedule

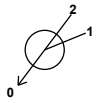
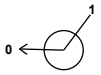
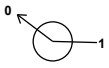
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.005	26.663	380.9	525	Circular_Default Sewer Type	47.435	43.410	3.500	46.870	43.340	3.005
1.006	25.051	397.6	525	Circular_Default Sewer Type	46.870	43.340	3.005	45.900	43.277	2.098
1.007	30.442	395.3	525	Circular_Default Sewer Type	45.900	43.277	2.098	45.000	43.200	1.275
4.000	7.708	385.4	525	Circular_Default Sewer Type	45.000	43.180	1.295	45.250	43.160	1.565
4.001	33.099	160.7	225	Circular_Default Sewer Type	45.250	43.160	1.865	44.270	42.954	1.091
4.002	23.012	166.8	225	Circular_Default Sewer Type	44.270	42.954	1.091	45.000	42.816	1.959
4.003	13.751	165.7	225	Circular_Default Sewer Type	45.000	42.816	1.959	44.650	42.733	1.692
4.004	23.025	166.8	225	Circular_Default Sewer Type	44.650	42.733	1.692	44.500	42.595	1.680
4.005	25.478	166.5	225	Circular_Default Sewer Type	44.500	42.595	1.680	44.500	42.442	1.833
4.006	6.969	165.9	225	Circular_Default Sewer Type	44.500	42.442	1.833	44.750	42.400	2.125

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.005	18	1500	Manhole	Adoptable	20	1500	Manhole	Adoptable
1.006	20	1500	Manhole	Adoptable	22	1500	Manhole	Adoptable
1.007	22	1500	Manhole	Adoptable	HW1	20	Junction	
4.000	HW2	20	Junction		CC01	2100	Manhole	Adoptable
4.001	CC01	2100	Manhole	Adoptable	24	1200	Manhole	Adoptable
4.002	24	1200	Manhole	Adoptable	26	1200	Manhole	Adoptable
4.003	26	1200	Manhole	Adoptable	28	1200	Manhole	Adoptable
4.004	28	1200	Manhole	Adoptable	30	1200	Manhole	Adoptable
4.005	30	1200	Manhole	Adoptable	32	1200	Manhole	Adoptable
4.006	32	1200	Manhole	Adoptable	D06	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
02	372555.040	435983.420	45.255	1.316	1200		0	1.000	43.939	300
04	372539.789	435973.962	45.348	1.372	1200		0	2.000	43.976	225
06	372545.802	435969.863	45.435	1.653	1200		1	2.000	43.932	225
							2	1.000	43.857	300
							0	1.001	43.782	375
08	372536.072	435956.042	45.949	2.221	1200		1	1.001	43.728	375
							0	1.002	43.728	375
10	372539.635	435912.383	47.585	1.635	450		0	3.000	45.950	225
12	372517.918	435927.199	47.244	1.644	1200		1	3.000	45.600	225
							0	3.001	45.600	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
14	372512.756	435925.087	47.269	3.815	1500		1	3.001	43.754	225
							2	1.002	43.604	375
							0	1.003	43.454	525
16	372505.093	435914.914	47.499	4.077	1500		1	1.003	43.422	525
							0	1.004	43.422	525
18	372500.306	435915.039	47.435	4.025	1500		1	1.004	43.410	525
							0	1.005	43.410	525
20	372479.042	435931.125	46.870	3.530	1500		1	1.005	43.340	525
							0	1.006	43.340	525
22	372475.227	435955.884	45.900	2.623	1500		1	1.006	43.277	525
							0	1.007	43.277	525
HW1	372450.198	435973.212	45.000	1.800	20		1	1.007	43.200	525
HW2	372454.164	435978.516	45.000	1.820	20		0	4.000	43.180	525
CC01	372461.659	435976.717	45.250	2.090	2100		1	4.000	43.160	525
							0	4.001	43.160	225
24	372481.322	436003.342	44.270	1.316	1200		1	4.001	42.954	225
							0	4.002	42.954	225
26	372503.756	436008.465	45.000	2.184	1200		1	4.002	42.816	225
							0	4.003	42.816	225
28	372512.051	436019.432	44.650	1.917	1200		1	4.003	42.733	225
							0	4.004	42.733	225
30	372528.215	436035.829	44.500	1.905	1200		1	4.004	42.595	225
							0	4.005	42.595	225
32	372552.136	436044.598	44.500	2.058	1200		1	4.005	42.442	225
							0	4.006	42.442	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
D06	372557.918	436040.708	44.750	2.350	1200	1	4.006	42.400	225

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	2160	Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 | 2160

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	0	0	0
100	20	0	0
100	40	0	0

Node D06 Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	1.225	420	1.225	840	1.225	1260	1.225	1680	1.225	2100	1.225
60	1.225	480	1.225	900	1.225	1320	1.225	1740	1.225	2160	1.225
120	1.225	540	1.225	960	1.225	1380	1.225	1800	1.225		
180	1.225	600	1.225	1020	1.225	1440	1.225	1860	1.225		
240	1.225	660	1.225	1080	1.225	1500	1.225	1920	1.225		
300	1.225	720	1.225	1140	1.225	1560	1.225	1980	1.225		
360	1.225	780	1.225	1200	1.225	1620	1.225	2040	1.225		

Node CC01 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.160	Product Number	CTL-SHE-0129-8300-1340-8300
Design Depth (m)	1.340	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	8.3	Min Node Diameter (mm)	1200

Node HW2 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	7.708
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	43.200	Main Channel Slope (1:X)	500.0
Safety Factor	2.0	Time to half empty (mins)	1110	Main Channel n	0.040

Inlets

HW1

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	369.7	0.0	1.800	941.9	0.0

Results for 30 year Critical Storm Duration. Lowest mass balance: 95.05%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	02	12	44.208	0.269	50.0	0.3045	0.0000	OK
15 minute summer	04	12	44.191	0.215	22.2	0.2435	0.0000	OK
15 minute summer	06	12	44.172	0.390	82.1	0.4415	0.0000	SURCHARGED
15 minute summer	08	12	44.131	0.403	126.0	0.4555	0.0000	SURCHARGED
15 minute summer	10	11	46.054	0.104	21.3	0.0166	0.0000	OK
15 minute summer	12	11	45.649	0.049	32.6	0.0556	0.0000	OK
1440 minute summer	14	930	44.047	0.593	15.2	1.0483	0.0000	SURCHARGED
1440 minute summer	16	930	44.047	0.625	16.2	1.1048	0.0000	SURCHARGED
1440 minute summer	18	930	44.047	0.637	20.5	1.1260	0.0000	SURCHARGED
1440 minute summer	20	930	44.047	0.707	20.2	1.2496	0.0000	SURCHARGED
1440 minute summer	22	930	44.047	0.770	25.0	1.3608	0.0000	SURCHARGED
1440 minute summer	HW1	930	44.047	0.847	24.9	0.0000	0.0000	OK
1440 minute summer	HW2	930	44.047	0.867	16.8	0.0000	0.0000	SURCHARGED
1440 minute summer	CC01	930	44.047	0.887	8.3	3.0726	0.0000	SURCHARGED
1440 minute summer	24	930	43.655	0.701	8.3	0.7930	0.0000	SURCHARGED
1440 minute summer	26	930	43.648	0.832	8.3	0.9409	0.0000	SURCHARGED
1440 minute summer	28	930	43.643	0.910	8.3	1.0293	0.0000	SURCHARGED
1440 minute summer	30	930	43.636	1.041	8.3	1.1772	0.0000	SURCHARGED
1440 minute summer	32	930	43.628	1.186	8.3	1.3413	0.0000	SURCHARGED
15 minute summer	D06	1	43.625	1.225	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	02	1.000	06	48.7	1.003	0.621	1.1243	
15 minute summer	04	2.000	06	21.3	0.899	0.529	0.2871	
15 minute summer	06	1.001	08	80.3	0.783	0.714	1.8642	
15 minute summer	08	1.002	14	125.6	1.207	1.115	4.2046	
15 minute summer	10	3.000	12	21.3	1.786	0.355	0.3203	
15 minute summer	12	3.001	14	32.6	4.287	0.108	0.1204	
1440 minute summer	14	1.003	16	14.8	0.375	0.061	2.7514	
1440 minute summer	16	1.004	18	15.9	0.369	0.066	1.0346	
1440 minute summer	18	1.005	20	20.2	0.411	0.082	5.7601	
1440 minute summer	20	1.006	22	19.8	0.351	0.082	5.4118	
1440 minute summer	22	1.007	HW1	24.9	0.553	0.103	6.5765	
1440 minute summer	HW1	Flow through pond	HW2	13.7	0.008	0.000	422.7865	
1440 minute summer	HW2	4.000	CC01	8.3	0.191	0.034	1.6652	
1440 minute summer	CC01	Hydro-Brake®	24	8.3				
1440 minute summer	24	4.002	26	8.3	0.461	0.207	0.9152	
1440 minute summer	26	4.003	28	8.3	0.462	0.206	0.5469	
1440 minute summer	28	4.004	30	8.3	0.262	0.207	0.9157	
1440 minute summer	30	4.005	32	8.3	0.209	0.206	1.0133	
1440 minute summer	32	4.006	D06	8.3	0.209	0.206	0.2772	479.1

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 95.05%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	02	19	45.240	1.301	78.2	1.4719	0.0000	FLOOD RISK
30 minute summer	04	19	45.182	1.206	34.7	1.3640	0.0000	FLOOD RISK
30 minute summer	06	19	45.135	1.353	125.1	1.5303	0.0000	FLOOD RISK
30 minute summer	08	19	45.035	1.307	195.9	1.4787	0.0000	SURCHARGED
15 minute summer	10	11	46.086	0.136	33.3	0.0217	0.0000	OK
15 minute summer	12	11	45.662	0.062	50.9	0.0696	0.0000	OK
30 minute summer	14	19	44.578	1.124	273.6	1.9862	0.0000	SURCHARGED
30 minute summer	16	19	44.497	1.075	297.7	1.8999	0.0000	SURCHARGED
1440 minute summer	18	1050	44.456	1.046	30.4	1.8484	0.0000	SURCHARGED
1440 minute summer	20	1050	44.456	1.116	30.3	1.9720	0.0000	SURCHARGED
1440 minute summer	22	1050	44.456	1.179	37.8	2.0833	0.0000	SURCHARGED
1440 minute summer	HW1	1050	44.456	1.256	37.7	0.0000	0.0000	OK
1440 minute summer	HW2	1050	44.456	1.276	22.6	0.0000	0.0000	SURCHARGED
1440 minute summer	CC01	1050	44.456	1.296	8.5	4.4891	0.0000	SURCHARGED
30 minute winter	24	28	43.674	0.720	8.3	0.8142	0.0000	SURCHARGED
30 minute winter	26	28	43.666	0.850	8.5	0.9615	0.0000	SURCHARGED
30 minute winter	28	28	43.658	0.925	9.1	1.0463	0.0000	SURCHARGED
30 minute summer	30	28	43.643	1.048	9.4	1.1851	0.0000	SURCHARGED
30 minute winter	32	28	43.632	1.190	9.7	1.3460	0.0000	SURCHARGED
15 minute summer	D06	1	43.625	1.225	5.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	02	1.000	06	74.5	1.058	0.951	1.1552	
30 minute summer	04	2.000	06	33.2	0.914	0.823	0.2894	
30 minute summer	06	1.001	08	124.2	1.126	1.104	1.8642	
30 minute summer	08	1.002	14	195.0	1.768	1.732	4.2745	
15 minute summer	10	3.000	12	33.3	1.985	0.555	0.4457	
15 minute summer	12	3.001	14	50.9	4.272	0.169	0.1354	
30 minute summer	14	1.003	16	272.2	1.260	1.126	2.7514	
30 minute summer	16	1.004	18	296.4	1.372	1.228	1.0346	
1440 minute summer	18	1.005	20	30.3	0.435	0.123	5.7601	
1440 minute summer	20	1.006	22	30.2	0.385	0.125	5.4118	
1440 minute summer	22	1.007	HW1	37.7	0.642	0.155	6.5765	
1440 minute summer	HW1	Flow through pond	HW2	18.0	0.007	0.000	709.6252	
1440 minute summer	HW2	4.000	CC01	8.5	0.195	0.035	1.6652	
1440 minute summer	CC01	Hydro-Brake®	24	8.3				
30 minute winter	24	4.002	26	8.5	0.787	0.211	0.9152	
30 minute winter	26	4.003	28	9.1	0.770	0.225	0.5469	
30 minute winter	28	4.004	30	9.3	0.756	0.233	0.9157	
30 minute summer	30	4.005	32	9.8	0.609	0.244	1.0133	
30 minute winter	32	4.006	D06	9.9	0.249	0.246	0.2772	163.2

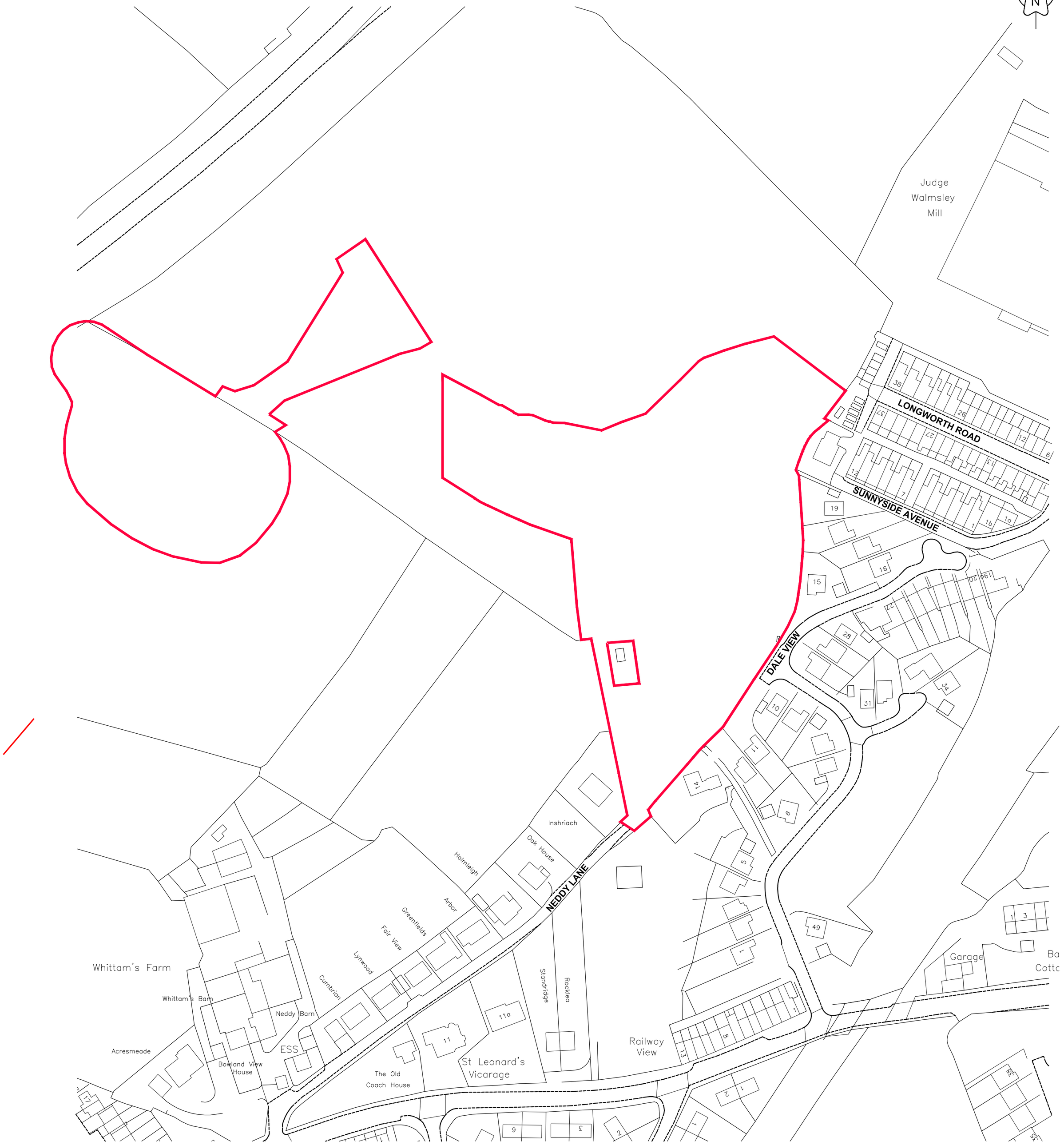
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 95.05%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	02	17	45.255	1.316	91.2	1.4884	7.8818	FLOOD
30 minute summer	04	18	45.299	1.323	40.5	1.4965	0.0000	FLOOD RISK
30 minute summer	06	18	45.228	1.446	129.7	1.6352	0.0000	FLOOD RISK
30 minute summer	08	18	45.162	1.434	205.3	1.6220	0.0000	SURCHARGED
15 minute summer	10	10	46.099	0.149	38.8	0.0237	0.0000	OK
30 minute summer	12	18	45.674	0.074	59.4	0.0833	0.0000	OK
30 minute summer	14	19	44.745	1.291	286.9	2.2816	0.0000	SURCHARGED
1440 minute summer	16	1080	44.671	1.249	28.2	2.2070	0.0000	SURCHARGED
1440 minute summer	18	1080	44.671	1.261	36.0	2.2282	0.0000	SURCHARGED
1440 minute summer	20	1080	44.671	1.331	35.9	2.3518	0.0000	SURCHARGED
1440 minute summer	22	1080	44.671	1.394	44.6	2.4630	0.0000	SURCHARGED
1440 minute summer	HW1	1080	44.671	1.471	44.4	0.0000	0.0000	OK
1440 minute summer	HW2	1080	44.671	1.491	25.4	0.0000	0.0000	SURCHARGED
1440 minute summer	CC01	1080	44.671	1.511	8.5	5.2334	0.0000	SURCHARGED
30 minute winter	24	28	43.678	0.724	8.3	0.8192	0.0000	SURCHARGED
30 minute winter	26	28	43.670	0.854	9.0	0.9656	0.0000	SURCHARGED
30 minute winter	28	28	43.662	0.929	9.2	1.0503	0.0000	SURCHARGED
30 minute winter	30	28	43.647	1.052	9.7	1.1900	0.0000	SURCHARGED
30 minute winter	32	28	43.633	1.191	9.5	1.3468	0.0000	SURCHARGED
15 minute summer	D06	1	43.625	1.225	8.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	02	1.000	06	78.2	1.110	0.998	1.1552	
30 minute summer	04	2.000	06	39.9	1.004	0.990	0.2894	
30 minute summer	06	1.001	08	121.7	1.103	1.082	1.8642	
30 minute summer	08	1.002	14	197.1	1.787	1.751	4.2745	
15 minute summer	10	3.000	12	38.8	2.006	0.646	0.5121	
30 minute summer	12	3.001	14	59.1	4.194	0.196	0.1424	
30 minute summer	14	1.003	16	281.9	1.305	1.167	2.7514	
1440 minute summer	16	1.004	18	28.1	0.366	0.116	1.0346	
1440 minute summer	18	1.005	20	35.9	0.438	0.145	5.7601	
1440 minute summer	20	1.006	22	35.8	0.395	0.148	5.4118	
1440 minute summer	22	1.007	HW1	44.4	0.678	0.183	6.5765	
1440 minute summer	HW1	Flow through pond	HW2	20.0	0.005	0.000	881.6284	
1440 minute summer	HW2	4.000	CC01	8.5	0.193	0.035	1.6652	
1440 minute summer	CC01	Hydro-Brake®	24	8.3				
30 minute winter	24	4.002	26	9.0	0.780	0.225	0.9152	
30 minute winter	26	4.003	28	9.2	0.775	0.229	0.5469	
30 minute winter	28	4.004	30	9.5	0.752	0.236	0.9157	
30 minute winter	30	4.005	32	9.5	0.622	0.236	1.0133	
30 minute winter	32	4.006	D06	9.7	0.243	0.240	0.2772	224.2

APPENDIX III – DRAWINGS

Neddy Lane, Billington



0m 125m

Scale: 1:1250

Revision	Date	Amendment	Initials
C	04.10.2021	Application red-edge amended	TW
B	26.08.2021	Application red-edge amended to include area of flood compensation.	GJF
A	25.05.2021	Red-edge altered to tally with updated red-edge illustrated on detailed site layout.	GJF

Development	**BILLINGTON**
Location	Neddy Lane
Marketing Name	Calder Grange
Drawing Title	Location Plan
Drawing Number	**4441-LP-001**
Revision	**C**
Scale @ A2	1:1250
Drawn By	RHL
Date Started	Jan 2020
Checked by	Date

REDROW HOMES

Redrow Homes Lancashire

Redrow House, 14 Eaton Avenue, Buckshaw Village, Chorley, PR7 7NA
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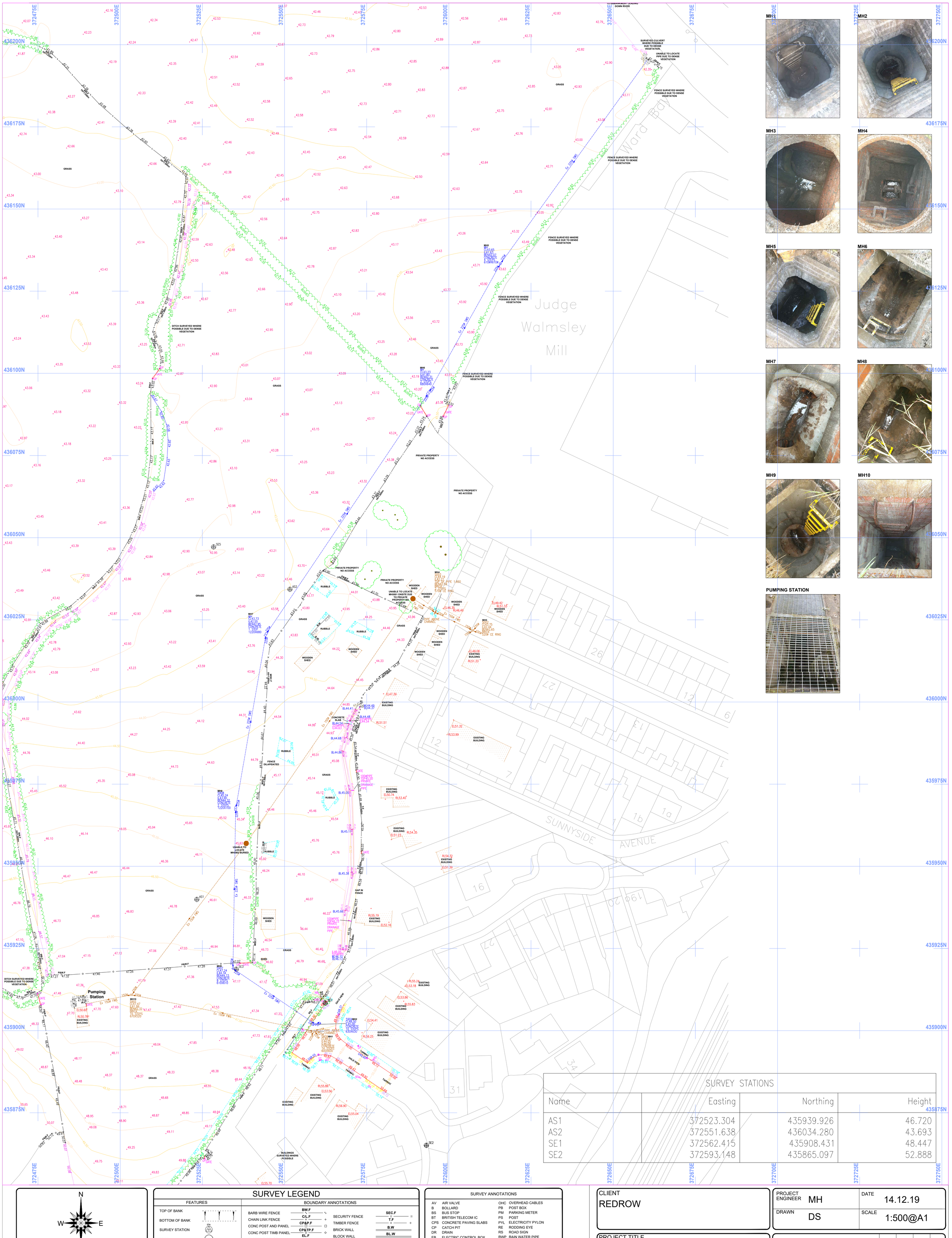


SURVEY STATIONS

Name	Easting	Northing	Height
AS1	372523.304	435939.926	46.720
AS2	372551.638	436034.280	43.693
SE1	372562.415	435908.431	48.447
SE2	372593.148	435865.097	52.888

N
W E
S

SURVEY ORIENTATED TO OS GRID (OSGB36-15)

SURVEY NOTES

ALL LEVELS ARE RELATED TO O.S DATUM (OSGB36-15)
ESTABLISHED AT SE1 USING THE LEICA SMARTNET GPS NETWORK

SURVEY LEGEND

FEATURES

TOP OF BANK
BOTTOM OF BANK
SURVEY STATION
TREE
HEDGE
TREE CANOPY
BUSHES
VEGETATION

BOUNDARY ANNOTATIONS

BARB WIRE FENCE — BW.F
CHAIN LINK FENCE — C/L.F
CONC POST AND PANEL — CP&P.F
CONC POST TIMB PANEL — CP&TP.F
ELECTRIC FENCE — EL.F
HERAS FENCE — HER.F
IRON RAIL FENCE — IR.F
KNEE RAIL FENCE — KR.F
MISCELLANEOUS FENCE — MISC.F
POST AND WIRE FENCE — P&W.F
RANCH STYLE FENCE — RS.F
SECURITY FENCE — SEC.F
TIMBER FENCE — T.F
BRICK WALL — B.W
BLOCK WALL — BL.W
CONCRETE WALL — C.W
GABIEN WALL — G.W
MISCELLANEOUS WALL — MISC.W
RETAINING WALL — R.W
RETAINING LOG WALL — RL.W
STONE WALL — S.W

LEVEL PREFIX ANNOTATIONS

ASL	ARCH SPRING LEVEL	IL	INVERT LEVEL		
BL	BED LEVEL	PL	PARAPET LEVEL	TRH	TREE HEIGHT
BD	BACK DROP	RL	ROOF/RIDGE LEVEL	THR	THRESHOLD LEVEL
CL	COVER LEVEL	SL	SOFFIT LEVEL	WL	WATER LEVEL
DH	TOP OF DOOR	TOF	TOP OF FENCE	WS	WINDOW SILL
DTC	DEPTH TO CROWN	TOP	TOP OF PIPE	WSF	WINDOW SOFFIT
FFL	FINISHED FLOOR LEVEL	TOW	TOP OF WALL		

GEOTECHNICAL INFORMATION

TRIAL HOLE / PIT — TH
BORE HOLE — BH
WINDOW SAMPLE — WS
MONITORING POINT — MP

SURVEY ANNOTATIONS

AV	AIR VALVE	OHC	OVERHEAD CABLES
B	BOLLARD	PB	POST BOX
BS	BUS STOP	PM	PARKING METER
BT	BRITISH TELECOM IC	PS	POST
CPS	CONCRETE PAVING SLABS	PYL	ELECTRICITY PYLON
CP	CATCH PIT	RE	RODDING EYE
DR	DRAIN	RS	ROAD SIGN
EB	ELECTRIC CONTROL BOX	RWP	RAIN WATER PIPE
EL	ELECTRICAL IC	ST	STOP TAP
EP	ELECTRICITY POLE	SM	SERVICE MARKER
ER	EARTH ROD	SP	SIGN POST
FH	FIRE HYDRANT	SV	STOP VALVE / SLUICE VALVE
FP	FLAG POLE	SVP	SOIL VENT PIPE
G	GULLY	TB	TELEPHONE BOX
GH	GREENHOUSE	TL	TRAFFIC LIGHTS
GP	GATE POST	TM	TELEPHONE MAST
GV	GAS VALVE	TP	TELEGRAPH POLE
IC	INSPECTION COVER	TPS	TACTILE PAVING SLABS
JB	JUNCTION BOX	VP	VENT PIPE
JKW	JAPANESE KNOT WEED	WM	WATER METER
KO	KERB OUTLET	WO	WASH OUT
LH	LAMP HOLE	UTL	UNABLE TO LIFT
LP	LAMP POST/LIGHT COLUMN	UTS	UNABLE TO SURVEY
MH	MANHOLE		
MP	MONITOR POINT		
NP	NAME PLATE		

CLIENT
REDROW

PROJECT ENGINEER: MH
DATE: 14.12.19
DRAWN: DS
SCALE: 1:500@A1

PROJECT TITLE
NEDDY LANE, BILLINGTON, CLITHEROE

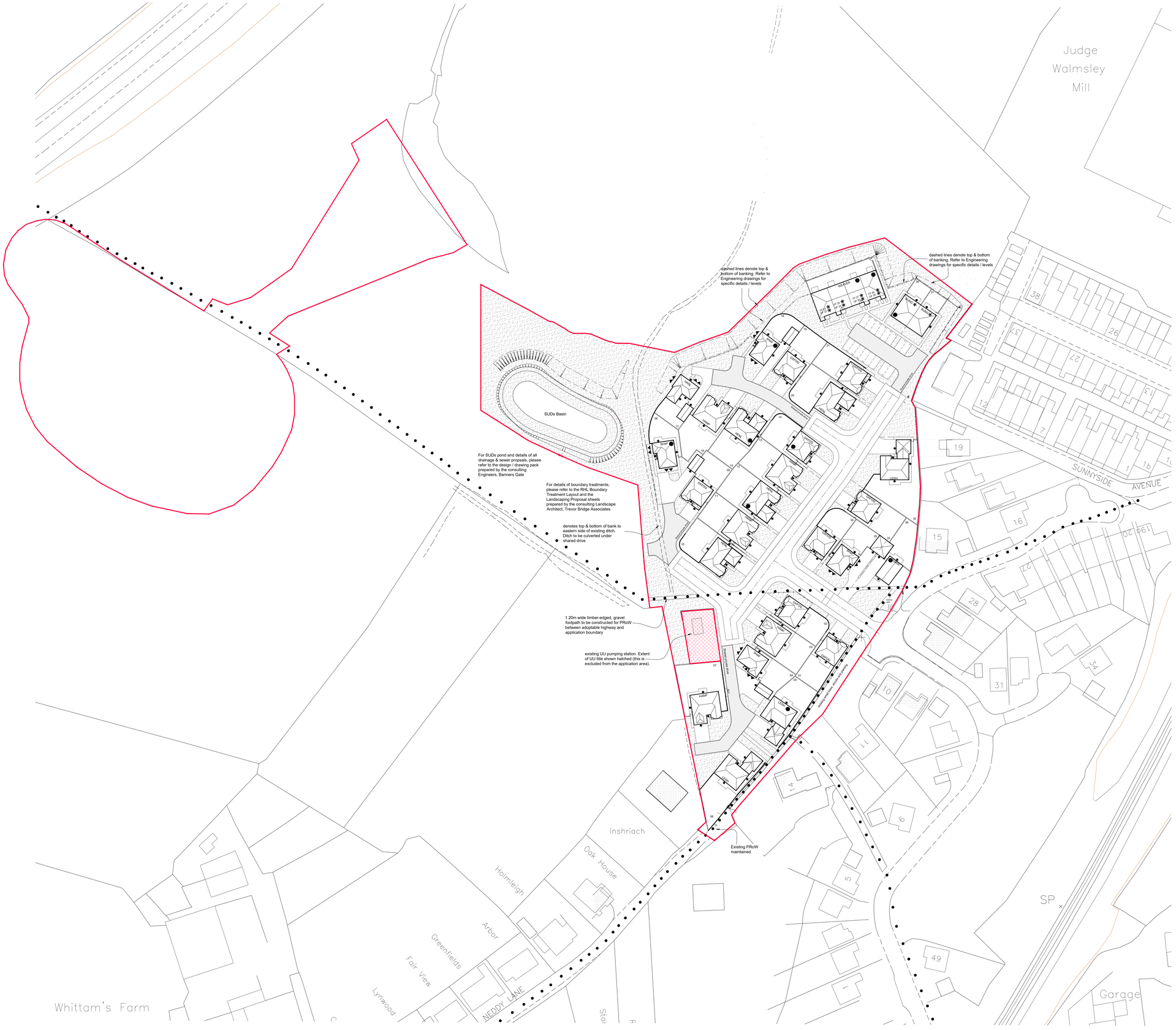
DESCRIPTION	REV	DATE	DRWN	APPR
TOPO SURVEY / MANHOLE SURVEY ADDED	A	19.10.20	DH	-

DRAWING DETAIL
TOPOGRAPHICAL LAND SURVEY

DRAWING NUMBER: RH.TS.15
REVISION: A

SurveyEng Ltd
Land Surveyors & Engineers
14 GREEN MILL
WESTHOUGHTON
BOLTON
LANCS
BL5 3GE
TEL/FAX: 0800 772 3040
MOB: 07850069993
info@surveyeng.co.uk

Calder Grange



0m 25m 50m

Scale: 1:500

Survey Information

Legend

- Line to delineate application Site Boundary
- Line to delineate extent of 1.8 metre high close boarded fencing. Refer to Redrow standard detail no. F-SD0906
- Line to delineate extent of 750mm high post and rail fencing. Refer to Redrow standard detail no. F-SD0900
- Indicates 1.2m bali-top railings. Refer to Redrow Standard Detail No. D-SD0922
- Indicates 0.6m Knee Rail. Refer to Redrow Standard Detail No. D-SD0902
- Indicates 1.8mm high brick, garden wall. Refer to Redrow standard detail no. F-SD0908
- Refer to Landscape Architect's layouts for landscaping proposals layout / planting schedules
- Indicates areas of turf surface finish
- Indicates position of timber gate for rear garden access. Refer to Commercial Department for specification
- Indicates tarmac shared drive surface. Refer to Engineer's External Works Plan for further details
- Indicates 'handed' house type
- Indicates affordable dwellings
- Indicates dual aspect property
- Indicates position of bollards
- Indicates line of existing Public Right of Way

Item	Description

Mix Schedule

House Type	Sqft	No Beds	Garage	Quantity
HOUSE TYPES				
Warwick	1081	3	SG	1
Harlech	1312	4	SG	1
Oxford Lifestyle	1318	3	ISG	8
Shaftesbury	1427	4	SG	4
Henley	1769	4	IDG	4
Ledsham	1842	4	IDG	3
Hampstead	1855	4	IDG	5
AFFORDABLE TYPES				
Weaver GF	597	1	-	4
Weaver FF	660	1	-	4
Bungalow	673	2	-	2
TOTAL				36

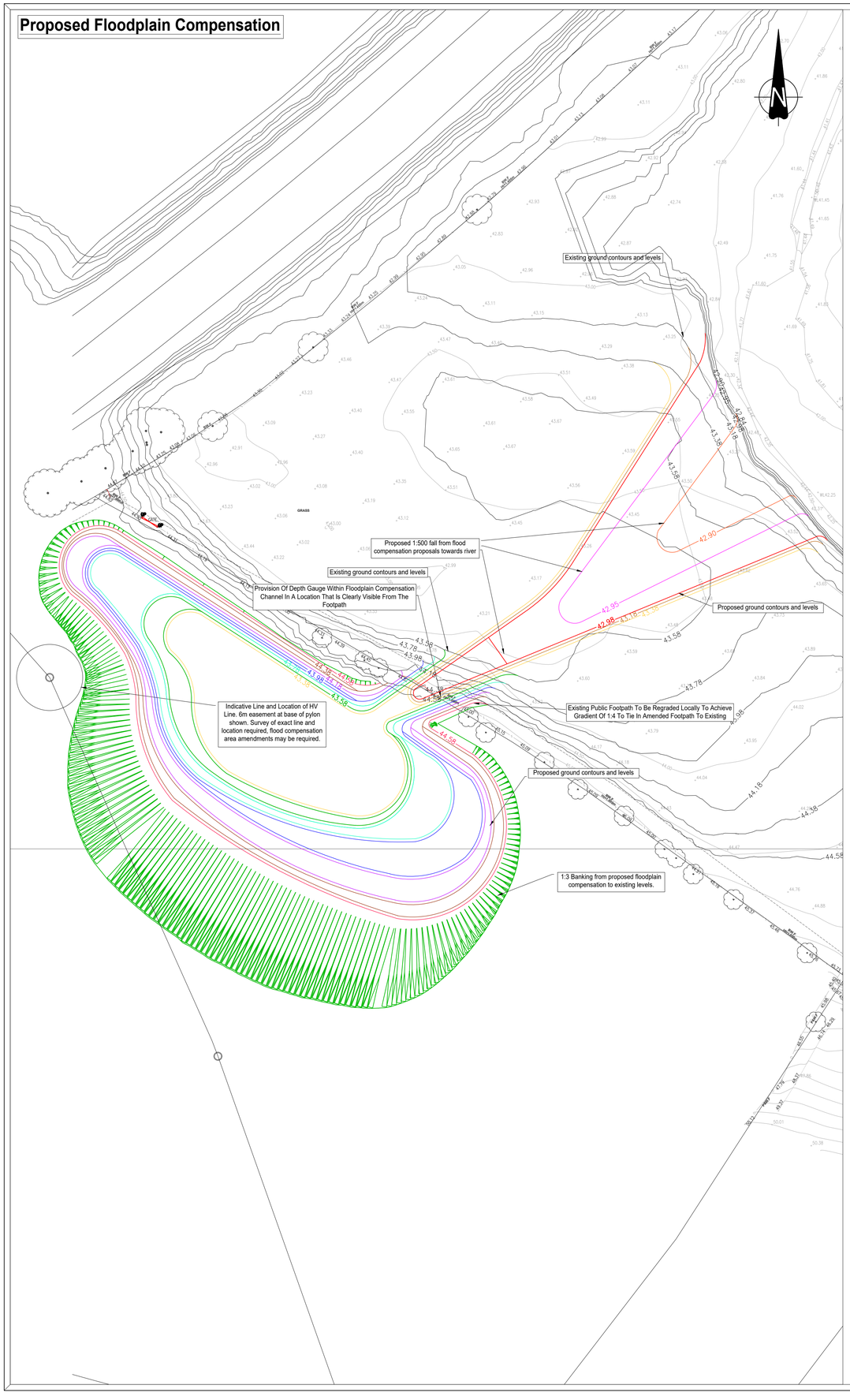
SG = Detached Single Garage
ISG = Integral Single Garage
IDG = Integral Double Garage

Revision	Date	Amendment	Initials
D	04.10.2021	Red line amended	AB
C	16.09.2021	Screen fences between plots changed from 750mm post and rail to 1.8m close boarded fences as per planner request.	HB
B	26.08.2021	Application boundary amended to include area of flood compensation. Highway amends adjacent to plot 02. FFLs to plots 16 & 17 raised 150mm.	GJF
A	07.04.2021	Minor amendments to the application red-edge. Rear boundary to plot 07 repositioned.	GJF

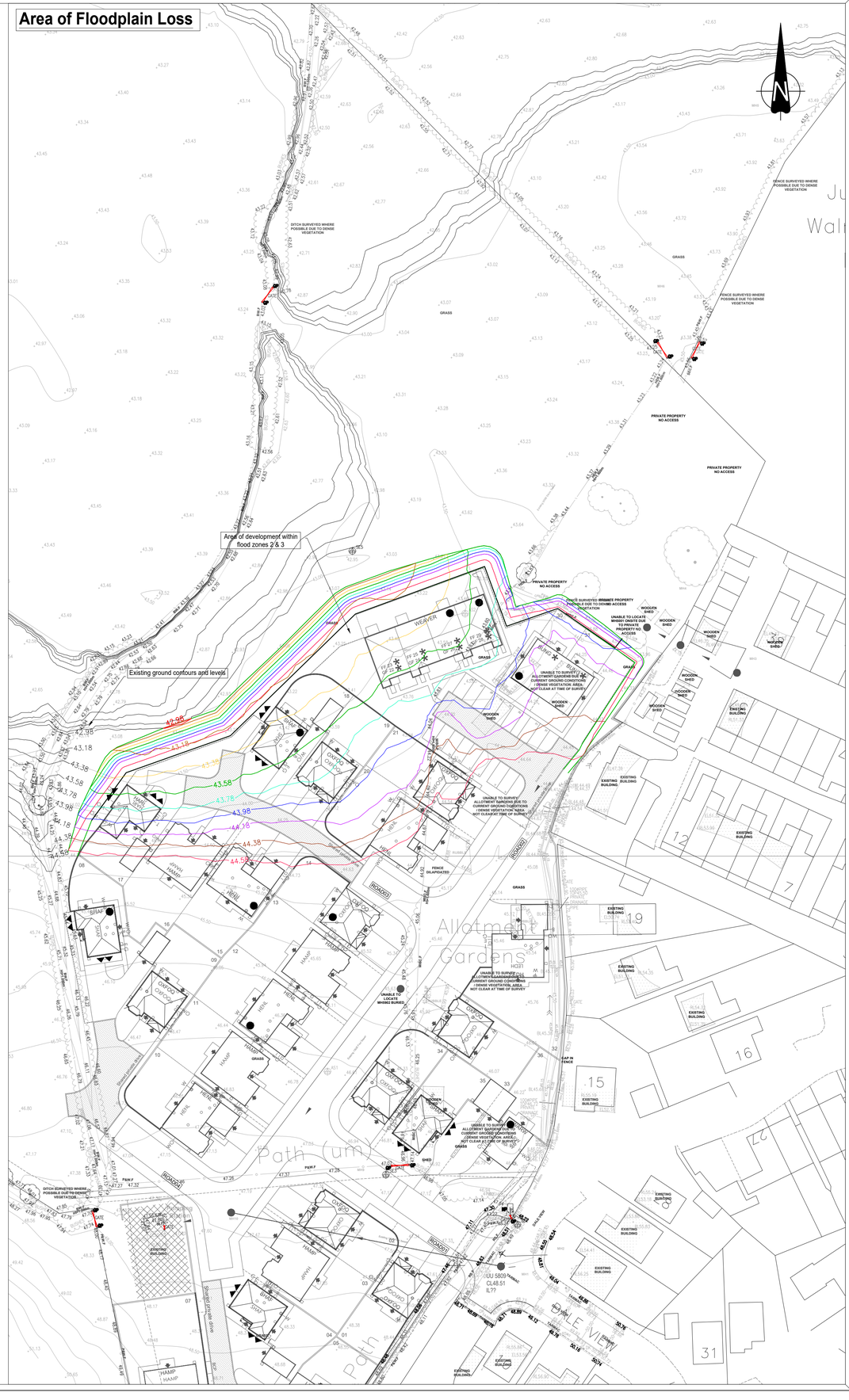
Development	**BILLINGTON**
Location	Neddy Lane
Marketing Name	Calder Grange
Drawing Title	Detailed Site Layout
Drawing Number	**4441-DSL-001**
Revision	**D**
Scale @ A0	1:500
Drawn By	RHL
Date Started	Jan 2021
Checked by	Date

REDROW HOMES
Redrow Homes Lancashire
Redrow House, 16 Eaton Avenue, Buckshaw Village, Chorley, PR7 7NA
Tel: 01772 643700 Fax: 01772 643701 Web: www.redrow.co.uk

Proposed Floodplain Compensation



Area of Floodplain Loss



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Notes:
1. Drawing based on : Topographical survey - RH.TS.15 Neddy Lane, Billington and Redrow planning layout PPL-001, Redrow Contract Pan CP-001 and supplemented with Lidar data.
2. Flood level data taken from "Wider Calder 2017" and provided by the Environment Agency on 27th January 2020.
3. Floodplain compensation assessed against the 0.1% AEP (1 in 1000) level as a proxy for the 1% + climate change level.
4. Volume of attenuation basin ignored for the purposes of floodplain compensation calculations.

Level (mAOD)	Depth (m)	Loss Of Floodplain Volume (m³)	Compensatory Floodplain Volume (m³)
42.98-43.18	0.200	20.6	324.5
43.18-43.38	0.200	92.6	323.9
43.38-43.58	0.200	234.9	243.6
43.58-43.78	0.200	314.1	320.9
43.78-43.98	0.200	417.6	421.7
43.98-44.18	0.200	521.1	526.8
44.18-44.38	0.200	626.8	631.9
44.38-44.58	0.200	712.6	717.0
Total		2940.3	3510.3

Environment Agency Modelled Flood Levels	
Return Period	**Level (mAOD)**
4% AEP (1 in 25)	42.87
1% AEP (1 in 100)	43.34
0.1% AEP (1 in 1000)	44.58

Rev.	Description	Date	By
F	Floodplain compensation proposals revised to suit comments from EA.	24.09.2021	RA
E	Note regarding footpath removed & note added about re-grading footpath to suit client comment.	27.08.2021	LJ
D	Floodplain compensation proposals revised to be within land requested by client.	19.08.2021	RA
C	Floodplain compensation proposals revised to be within land shown on Contract Plan CP-001.	03.06.2021	RA
B	Floodplain compensation proposals revised to suit Environment Agency comments.	16.05.2021	RA
A	Red line boundary updated.	01.02.2021	RA
-	First Issue	28.01.2021	RA

Drawing Status

SCHEMATIC

For initial discussions only and subject to detailed design

Client

REDROW

Project

Neddy Lane
Billington

Title

Schematic Flood Compensation
Floodplain Proposal

BANNERS GATE
CIVIL, STRUCTURAL & ARCHITECTURAL DESIGN SERVICES
10-11 Birmingham Street, Halesowen, West Midlands B63 3HN
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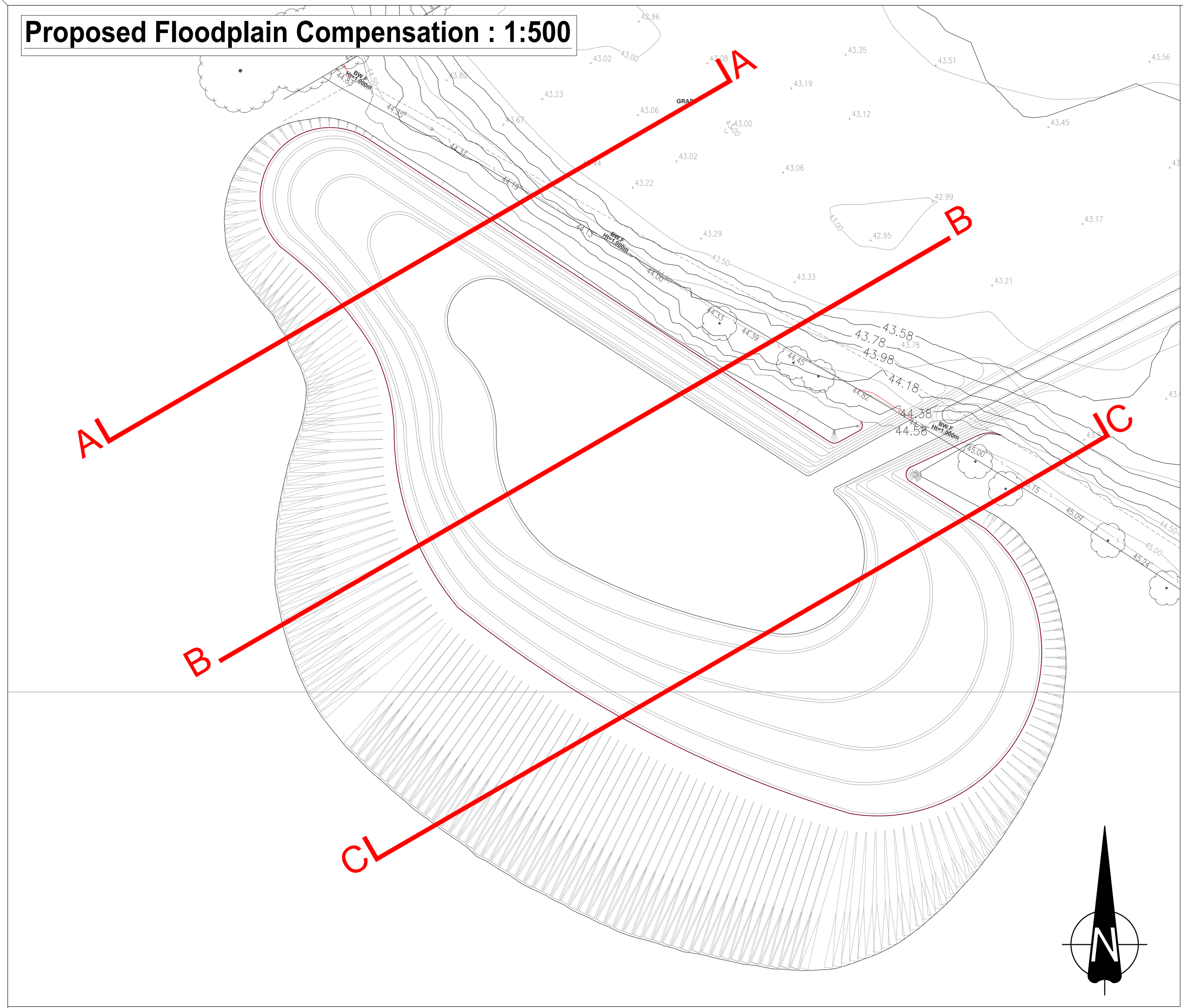
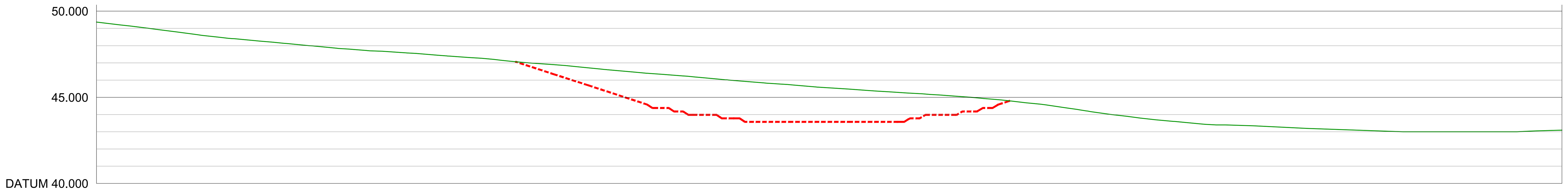
E-mail: mail@bannersgate.com

Scale	1:500 @ A1	Drawn	RA
Date	January 2021	Checked	SM
File	20023/dwgs/civils/current	Drawing	20023 - SK07 F

Proposed Floodplain Compensation : 1:500





CHAINAGE	0.000	5.000	10.000	15.000	20.000	24.303 25.000	30.000	35.000	40.000	45.000	50.000	52.983	55.000	60.000	65.000	70.000	75.000	80.000	85.000
PROPOSED FLOOD COMPENS						47.069 46.841	45.215	43.980	43.580	43.580	44.044	44.798							
EXISTING GROUND MODEL	49.366	48.749	48.221	47.769	47.427	47.008	46.570	46.157	45.748	45.383	45.055		44.572	43.869	43.400	43.211	43.030	43.000	43.096

SECTION A-A

CHAINAGE	0.000	5.000	8.608 10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000	55.000	60.000	65.000	69.066 70.000	75.000	80.000	85.000	90.000	95.000	100.000
PROPOSED FLOOD COMPENS			50.799 50.336	48.676	47.013	45.349	44.180	43.580	43.380	43.380	43.380	43.380	43.380	43.980	44.697						
EXISTING GROUND MODEL	51.156	50.959	50.725	50.431	50.017	49.515	48.901	48.134	47.371	46.722	46.082	45.569	45.117	44.874	44.641	44.000	43.835	43.398	43.246	43.200	43.200

SECTION B-B

Rev.	Description	Date	By
A	Cross sections redrawn to 1:1 natural scale.	27.08.2021	LJ
-	First Issue	19.08.2021	CS

Drawing Status

SCHEMATIC

For initial discussions only and subject to detailed design

Client

REDROW

Project

Neddy Lane
Billington

Title

Schematic Flood Compensation
Cross Sections - Sheet 1 of 2

BANNERS GATE
CIVIL, STRUCTURAL & ARCHITECTURAL DESIGN SERVICES
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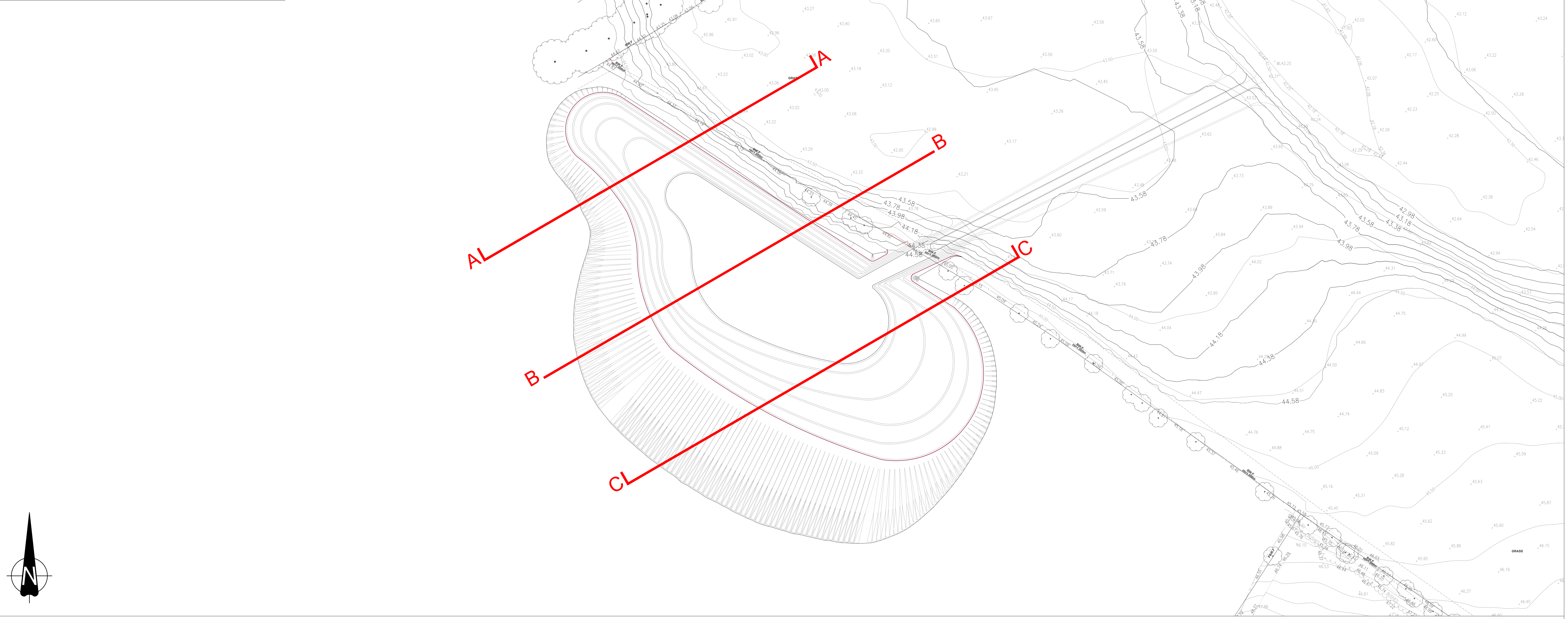
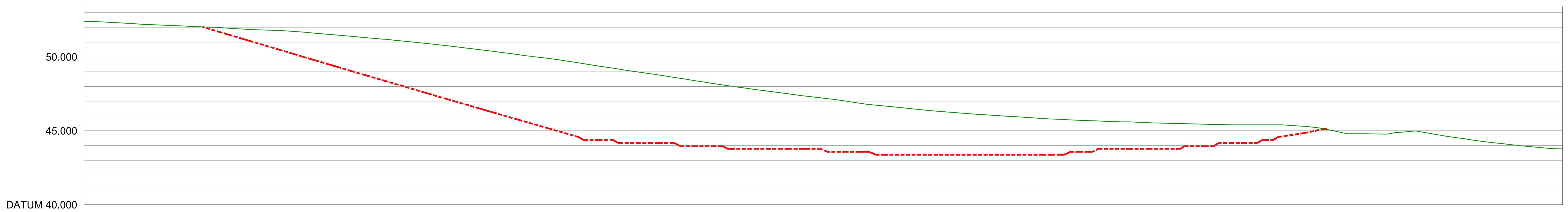
Scale	V = 1:200 / H = 1:200 @ A1	Drawn	CS
Date	August 2021	Checked	RA
File	20023/dwgs/civils/current	Drawing	20023 - SK10 - A

Proposed Floodplain Compensation: 1:500





CHAINAGE	0.000	5.000	8.010	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000	55.000	60.000	65.000	70.000	75.000	80.000	84.029	85.000	90.000	95.000	100.000
PROPOSED FLOOD COMPENS			52.036	51.441	49.951	48.480	47.015	45.567	44.380	44.133	43.780	43.694	43.380	43.380	43.380	43.780	43.980	44.380	45.123				
EXISTING GROUND MODEL	52.409	52.165		51.932	51.665	51.221	50.708	50.070	49.354	48.598	47.851	47.207	46.592	46.150	45.822	45.605	45.467	45.400		44.894	44.983	44.230	43.771

SECTION C-C

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Rev.	Description	Date	By
A	Cross sections redrawn to 1:1 natural scale.	27.08.2021	LJ
-	First Issue	19.08.2021	CS

Drawing Status

SCHEMATIC

For initial discussions only and subject to detailed design

Client

REDROW

Project

Neddy Lane
Billington

Title

Schematic Flood Compensation
Cross Sections - Sheet 2 of 2

BANNERS GATE

CIVIL, STRUCTURAL & ARCHITECTURAL DESIGN SERVICES
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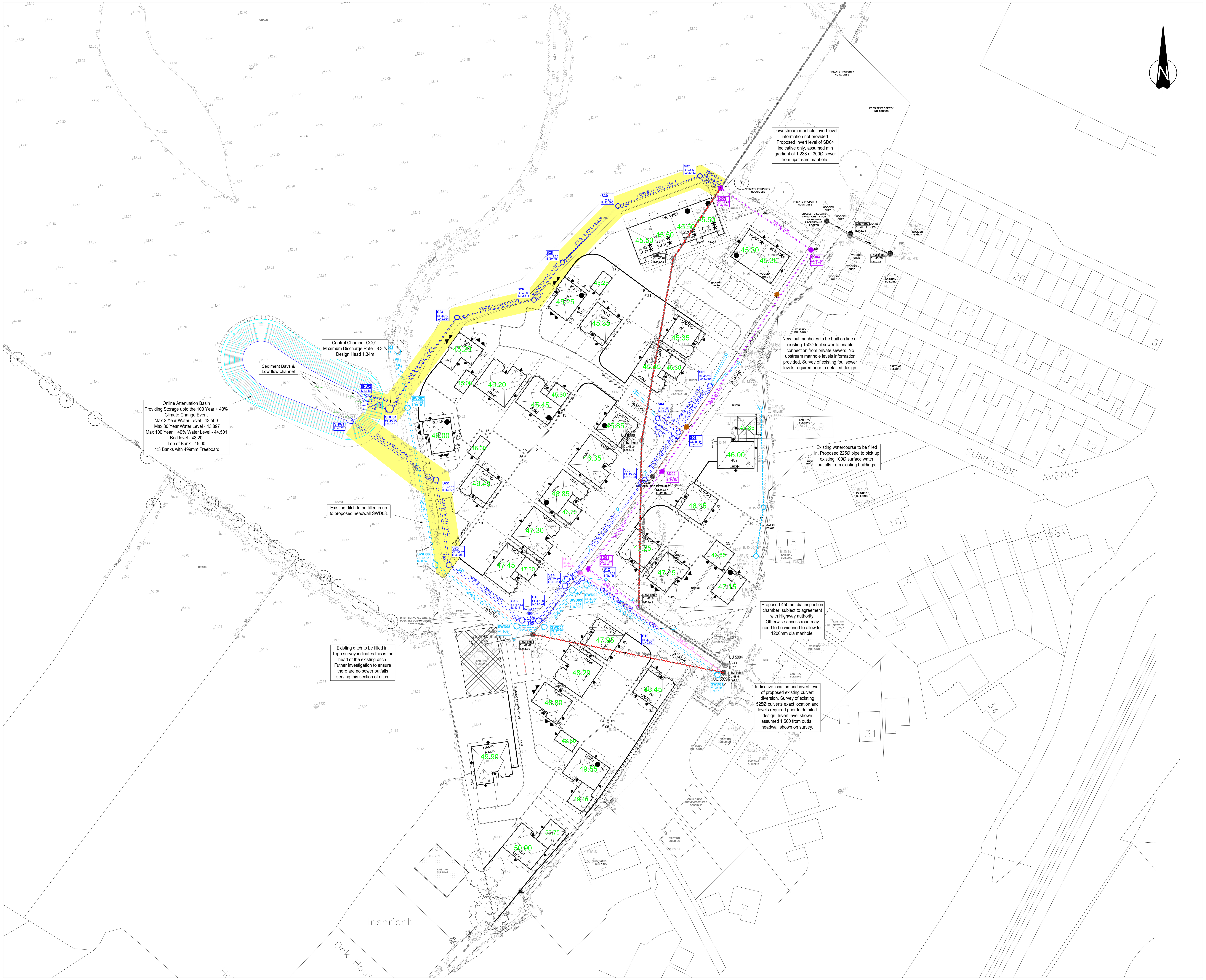
E-mail: mail@bannersgate.com

Scale	V = 1:200 / H = 1:200 @ A1	Drawn	CS
Date	August 2021	Checked	RA
File	20023/dwgs/civils/current	Drawing	20023 - SK11 - A



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GENERAL NOTES

- This drawing is to be read in conjunction with relevant architectural and engineering drawings.
- Levels indicated in blocks are Finished floor levels and are 150mm above adjacent finished ground levels unless otherwise shown.
- Levels of the existing road at the point of tie-in with proposed site road must be checked prior to commencement of works.
- Any discrepancies between the details shown and actual on site conditions to be reported immediately to the engineer prior to commencement of works.

ADOPTABLE ROADS AND SEWERS

- Roads, footways and parking bays which form part of the highway to be adopted under Section 38 of the Highways Act 1980 shall comply with the requirements of the Adopting Authority.
- Sewers to be adopted under Section 104 of the Water Industries Act 1991 shall comply with the Sewerage Sector Guidance (SSG) "Design & Construction Guidance" with any amendments specified by the Adopting Water Authority.
-
- All pipes to be used in adoptable sewerage shall be either clayware to BS EN 295 or concrete to BS EN 1916 and BS 5911: Part 1 with Class S bedding unless otherwise stated. With approval of the Adopting Authority solid wall concentric external rib reinforced uPVC pipes complying with the relevant provisions of BS EN 13476 may be used.
- Where cover to a pipe is more than 1200mm under adoptable carriageway the trench shall be filled to formation of the carriageway with well compacted DTp Type 1 material.
- Where cover to a pipe is less than 1200mm under adoptable carriageway it shall be provided with concrete protection in accordance with the specification of the adopting authority and back filled to formation of the carriageway with well compacted DTp Type 1 material. Where concrete bed and surround is specified flexibility of joints is to be maintained by using compressible bitumen impregnated fibreboard at each pipe joint.
- All existing drainage invert levels, diameters and locations are to be checked by the Contractor prior to the commencement of any proposed drainage work. Any difference between actual and drawn details is to be reported to the Engineer immediately.
- Positions of existing services/statutory undertakers apparatus adjacent to or crossing proposed sewers is to be checked by the Contractor prior to starting work.

Drainage Legend:

General

- 45.30 — Proposed Finished Floor Level
- 45.25 — Proposed Garage Slab Level
- Site Boundary

Adoptable Drainage

- S104 SW Sewer & MH
- S12 — S104 SW Manhole Ref. (Cover & Invert Levels)
- S104 FW MH
- Proposed S38 Gully & Connection (To be retained)
- S104 Sewer Easement

Existing Drainage

- Existing Foul Sewer
- Existing Storm Sewer
- Existing Storm Water MH
- Existing Foul Water MH
- EXMH5609 — Existing Manhole Ref. (Taken from Topo Survey)

Proposed Sewer Diversions

- Surface Water Sewer Diversion
- SD01 — Surface Water Diversion Manhole Ref. (Cover & Invert Levels)
- Foul Water Sewer Diversion
- FD01 — Foul Water Diversion Manhole Ref. (Cover & Invert Levels)
- Existing Sewer to be Abandoned
- Existing Watercourse Diversion
- SWD02 — Existing Watercourse Diversion Manhole Ref. (Cover & Invert Levels)

Rev.	Description	Date	By
F	Minor amendments to external levels near the attenuation basin.	24.09.21	RA
E	Drainage strategy amended to previous basin design & amended earthworks removed.	27.08.21	LJ
D	Drainage strategy updated to suit revised floodplain compensation proposals, attenuation basin levels and location updated.	03.06.21	RA
C	Flood compensation area added, site boundary updated.	01.02.21	RA
B	Updated to latest layout, sewer diversion route amended to suit, low flow channel and sediment forebays added.	25.01.21	RA
A	Watercourse diversion added.	25.01.21	RA
-	First Issue	24.01.21	RA

Drawing Status

SCHEMATIC

Drawings are subject to Detailed Design, United Utilities and Lancashire County Council approval as part of ongoing consultations and design checks. Amendments may therefore be requested.

Client

REDROW

Project

Neddy Lane
Billington

Title

Drainage Strategy Plan

BANNERS GATE
Civil, Structural & Architectural Design Services
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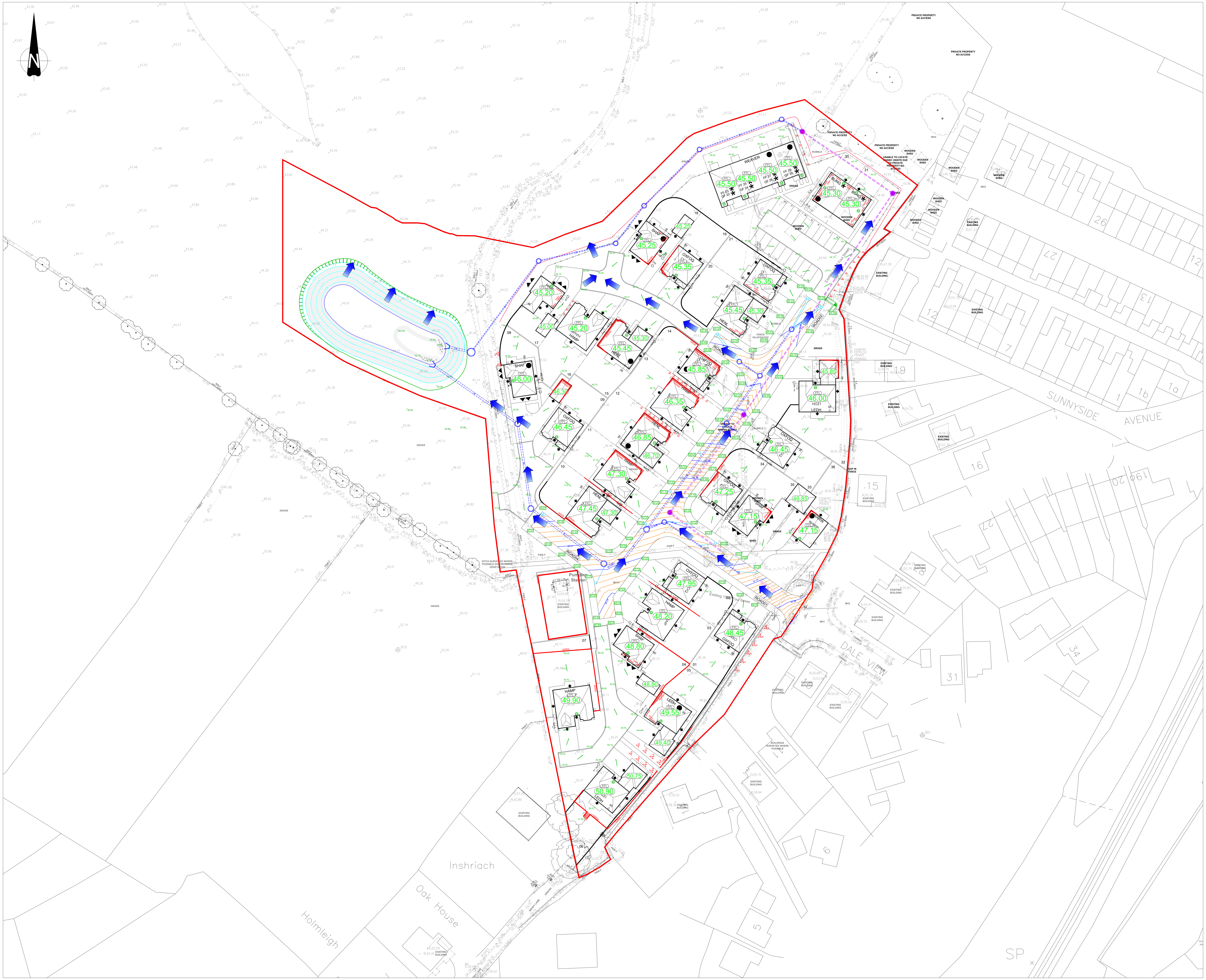
E-mail: mail@bannersgate.com

Scale	1:500 @ A1	Drawn	RA
Date	January 2021	Checked	
File	20023/dwgs/civils/current	Drawing	20023 - DS01 F



GENERAL NOTES

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FLOW ROUTE LEGEND

Flood Exceedance Flow Path

Rev.	Description	Date	By
C	Previous basin design included & drainage, FFL of plot 17 amended to suit.	27/08/21	LJ
B	Levels for shared driveway opposite plots 30/31 amended and flood routing updated to suit.	17/03/21	RA
A	Site boundary updated.	01/02/21	RA
-	First issue	26/01/21	RA

Drawing Status

SCHEMATIC

Subject to Lancashire County Council and United Utilities Water technical approval as part of ongoing consultations and design check, amendments may therefore be requested.

Client

Project

Neddy Lane
Billington

Title

Flood Exceedance Routing Plan

BANNERS GATE

CIVIL, STRUCTURAL & ARCHITECTURAL DESIGN SERVICES

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Scale	A1 @ 1:500	Drawn	RA
Date	January 2021	Checked	
File	20023 / dwgs / civils / current / drawings	Drawing	20023 / SK06 C