

DRAINAGE STRATEGY

PROPOSED DEVELOPMENT OF BRYMBO HERITAGE PROJECT



Prepared on Behalf of:

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1.0 Introduction

1.1 Project Background

- 1.1.1 Bingham Rawlings Partnership Ltd have been appointed by TACP Architects to provide a drainage strategy for surface water run-off generated for the proposed development of the Brymbo Heritage Site, Off Gwalia Road, Brymbo, Wrexham, LL11 5AX (National Grid Reference: **SJ 29454 53526**). Refer to the drawing enclosed in **Appendix A** for the proposed site location plan.
- 1.1.2 Bingham Rawlings Partnership Ltd reserve the right to undertake further investigation into the adequacy of the recommendations made within this report, if works on site have not commenced within twelve months of the issuing of this report.

1.2 Scope of Proposed Drainage Strategy

- 1.2.1 This report aims to provide a suitable drainage strategy for the discharge of surface water run-off and foul effluent generated by the proposed development.
- 1.2.2 The purpose of the calculations enclosed within this report and accompanying details are to produce a drainage layout that complies with the relevant legislation of the Tan 15, CIRIA C753 '*The SuDS Manual*', The Welsh ministers standards and Approved Document H of the Building Regulations 2010.

1.3 Proposed Development

- 1.3.1 The proposed scheme involves the development of the Brymbo Heritage Site. The proposed development involves improvements and repurposing of a number of existing buildings, construction of 2no additional extensions to an existing building and improving the existing hardstanding areas. The proposed layout is contained within **Appendix B**.
- 1.3.2 The previous site drainage strategy proposed by Wardell Armstrong proposed to control Surface water runoff on site to reduce the risk of flooding to areas downstream of the site. To help to achieve this, Sustainable Drainage Systems (SuDS) was be incorporated into the development to provide attenuation. The proposed was to discharge surface water runoff from the site into the culverted

watercourse via the existing drainage network. This drainage strategy formed part of a wider site design for the re-design of the former Brymbo Steelworks. The Flood Consequence Assessment can be found in **Appendix I**.

1.4 Existing Land Drainage Features / Watercourses.

- 1.4.1 There is an existing land drainage feature within the site boundary comprising of a stone culvert, located beneath the existing Machine shop. The culvert conveys land drainage from site, exiting site to the southeastern boundary. Existing land drainage features such as this culvert were formed as part of the original industrial development of the site and convey drainage from areas to the west in a southern direction to ultimately connect to a river at the lodge which in turn conveys flows to the river Gwenfro. The existing drainage layout is contained within **Appendix D**.

1.5 Site Hydrology

- 1.5.1 The site generally falls west to east away from the vegetated embankment, down towards the development site. The site is also affected by flows from beyond the site boundary to the west and north. All surface water which does not communicate into the industrial land drainage system is eventually directed towards the existing swales occupying the proposed car park location before being discharged into the existing surface water drainage under the highway to the east of site. The proposed layout is contained within **Appendix B**.

1.6 Existing Nearby Drainage

- 1.6.1 The Dwr Cymru / Welsh Water (DCWW) apparatus map contained within **Appendix D** indicates there is an existing 150mm Vitrified Clay (VC) combined drainage system to the southeast of site.
- 1.6.2 Although not highlighted in the The Dwr Cymru / Welsh Water (DCWW) apparatus map, there are separate foul and surface water drainage systems within the existing highway to the east of site. The existing site drainage arrangement has been illustrated on the attached layout contained within **Appendix C**.

2.0 Design Criteria

2.1.1 The following design criteria will apply to the surface water run-off and foul discharge design for the site:

- Approved Document H, Building Regulations.
- BRE Digest 365;
- BS EN 752:2017;
- CIRIA C753 'The SuDS Manual' 2015;
- DEFRA / Environment Agency 'Preliminary Rainfall Runoff Management for Developments' Technical Report;
- Discharge Units from BS EN 12056: Part 2;
- Flood & Water Management Act 2010;
- Highways Act 1991;
- Institute of Hydrology Report (IHR) 124;
- Land Drainage Act 1991;
- Modified Rational Method;
- Sewers for Adoption 7th Edition;
- Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems
- Technical Advice Note (TAN) 15: Development and Flood Risk;
- Wallingford Procedure;
- Water Industries Act 1991.

3.0 Surface Water Drainage Design

3.1 Guiding Principles

- 3.1.1 The disposal of surface water has been designed in strict accordance with the provision of TAN 15, the Flood and Water Management Act 2010 and other best practice documents, such as CIRIA C753 ‘SuDS Manual’ 2015.

3.2 Method of discharge

- 3.2.1 In accordance with the SuDS Manual 2015 and the Welsh ministers standards surface water should be managed and discharged from a new development in line with the following hierarchy:

- Priority level 1: Re-use of water;
- Priority level 2: Infiltration into ground;
- Priority level 3: Discharge to a water body;
- Priority level 4: Discharge to a surface water run-off drain;
- Priority level 5: Discharge to a combined surface water run-off and foul drain.

- 3.2.2 Re-use of surface water cannot be considered as the sole method of surface water disposal for this site due to its massing and potential for contamination or pollution transfer due to its former industrial processes., Paragraph G1.1 The Statutory SuDS Guidance for Wales states “As much of the runoff as possible (subject to technical or cost constraints) should be discharged to each destination before a lower priority destination (level) is considered.” Therefore, attempts must be made to reuse as much surface water as possible. As such, it is proposed to provide a 5000 litre above ground rainwater harvesting tank which captures roof water from one of the principal buildings on site. To service the proposed toilet block.

- 3.2.3 Due to the historical land use at the previous steelworks location and the significant volumes of made ground below the surface (comprising discarded iron and steel slags), the implementation of infiltration drainage within the site's area is deemed unviable. Allowing surface water to permeate the subsurface materials would potentially lead to undesirable ground subsidence and increase the likelihood of infiltration flows becoming a receptor for contamination transportation. As such all proposed drainage systems are to be wrapped in a non-permeable membrane to prevent surface water getting into the ground.
- 3.2.4 As noted in **Section 1.4**, the site contains an existing land drainage feature in the form of a stone culvert. It is proposed to continue to utilise the existing culvert to allow unquantified land drainage flows from beyond site to flow freely through site as they currently do.
- 3.2.5 As noted in **Section 1.6.2** there is an existing surface water drainage system contained in the Highway to the east of site. Therefore it is proposed to attenuate the surface water and communicate flows from the site to this system. To maintain the originally approved disposal strategy as referred to within the former drainage strategy contained in **Appendix I**.

3.3 Climate Change

- 3.3.1 TAN 15 states that an allowance for climate change should be provided within the on-site attenuation, without specifying what allowance should be made. The NPPF, which is the English equivalent of TAN 15, does however provide guidance derived from DEFRA FCDPAG3 'Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts' October 2006 (see **Table 1**). This document considers the effects of climate change for different design criteria.
- 3.3.2 The proposed development will have a design life of 100 years; based on the NPPF's guidance, the development therefore requires an allowance of 30% for climate change to be applied to the peak rainfall intensity.

Table 1. Climate Change Requirements.

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak Rainfall Intensity	+5%	+10%	+20%	+30%
Peak River Flow	+10%	+20%		
Offshore Wind Speed	+5%		+10%	
Extreme Wave Height	+5%		+10%	

3.4 Design Philosophy

3.4.1 The tables below summarise the existing effective areas with their corresponding run-off coefficients, as per the Wallingford procedure, IHR 124.

3.4.2 The existing areas for both systems area provided within **Tables 2 & 4** are provided on the existing area drawing contained within **Appendix F**, which are summarised as follows:

Table 2. Existing Brownfield Areas.

Surface	Total Area	Coefficient	Effective Area
Hardstanding Area	5,597.625 m ²	1.00	92.493 m ²
Blast Wall	92.493 m ²	1.00	92.493 m ²
Sub-Station	62.502 m ²	1.00	62.502 m ²
Furnace	123.057 m ²	1.00	123.057 m ²
Foundary Area	1,036.777 m ²	1.00	1,036.777 m ²
Agents House	101.037 m ²	1.00	101.037 m ²
Iron Line	194.684 m ²	0.75	146.013 m ²
Machine Shop	702.931 m ²	0.75	527.198 m ²
Pattern Store	244.478 m ²	0.75	183.358 m ²
Grassed Embankment	888.628 m ²	0.35	311.019 m ²
Total	9,044.212 m ²		8,181.080 m ²

3.4.3 Due to the site being a brownfield site, run-off has been calculated using the modified rational method, using the brownfield method. The results of this are confirmed within **Table 3** below.

Table 3. Brownfield Run-off rates for different return periods.

Reference	1 in 1 Year	1 in 30 Year	1 in 100 Year
Brownfield Rate	21.1 l/s	51.2 l/s	65.6 l/s

3.4.4 The Statutory SuDS guidance for Wales requests all development to be restricted to greenfield run-off rates or when analysing Brownfield sites, to impose a significant improvement, therefore a vortex flow control device is proposed restricting flow to the following discharge rates in order to meet the quoted figures in **Table 3**.

System One proposed discharge rate 12 l/s

System Two proposed discharge rate 36 l/s

Combined proposed discharge rate 48 l/s which represents 73% of the 1 in 100 year brownfield run off rate.

3.5 Method of Storage

3.5.1 Surface water run-off generated from all proposed hardstanding areas for the 1 in 100-year return period plus an allowance of 30% for climate change is to be attenuated onsite within a below ground storage structures and the below ground piped drainage network. This section of the report should be read in conjunction with the proposed on-site drainage arrangement enclosed in **Appendix** .

3.5.2 The site drainage system is split into two in order to collect surface water run-off effectively. System one collects surface water through a filter drain under the proposed Amphitheatre. This is to be collected and stored in an attenuation tank under the surface, and discharged at a controlled rate of 12 l/s to existing the existing surface water system to the east of site.

3.5.3 System two will accommodate the existing track and proposed extensions by collecting surface water into filter drains and directing it into existing surface water systems, where it will be collected in an attenuation tank, adjacent to the

existing machine shop, and is discharged at a controlled rate of 36l/s. The proposed drainage layout is contained within **Appendix G**.

3.5.4 The Statutory SuDS Guidance for Wales document requires green SuDS features to be used where possible to help provide treatment and improve biodiversity and ecology of the site though the management of surface water which lands on the site.

3.5.5 The proposed measured hardstanding areas accounted for within each attenuation structure summarised within **Table 6 & 7** and illustrated on the proposed area plan contained within **Appendix H**.

Table 4. Proposed Areas. (System One)

Surface	Total Area	Coefficient	Effective Area
Roofs	405.388 m ²	1.00	405.388 m ²
Hardstanding Gravel	3,519.623	0.75	2,639.717
Total	3,925.011 m ²		3,045.105 m ²

Table 5. Proposed Areas. (System Two)

Surface	Total Area	Coefficient	Effective Area
Roofs	746.835 m ²	1.00	746.835 m ²
Hardstanding Gravel	1,894.323 m ²	0.75	1,420.742 m ²
Grassed Embankment	888.628 m ²	0.35	311.019 m ²
Total	3,529.786 m ²		2,478.597 m ²

3.5.6 As the hydraulic model accounts for grassed areas that have the potential to enter the proposed system, no allowance has been made at this time for urban creep

3.6 Drainage System Maintenance

- 3.6.1 The SuDS Manual 2015 requires appropriate measures to be in place for the maintenance of surface water drainage systems and sustainable drainage features.
- 3.6.2 The maintenance schedule shown in **Tables 8 & 9** have been derived in strict accordance with the SuDS Manual 2015 and from a risk-assessed approach during the design stage. These schedules are not exhaustive and should be reassessed at regular intervals to determine if any additional maintenance is required to preserve the performance and condition of the site drainage system.
- 3.6.3 The surface water drainage system is to remain private within its entirety and the management and maintenance of the system will be under the responsibility of the site leaseholders. The maintenance schedule for each component of the proposed drainage network is contained within **Table 8 – 10**.
- 3.6.4 Provided preventive maintenance measures are undertaken in accordance with the frequencies recommended in **Tables 8 - 10**, the need for corrective maintenance should rarely arise.
- 3.6.5 Maintenance activities should be detailed in the Principal Contractor's Health and Safety Plan and Risk Assessments and should be updated on a regular basis to ensure the continued performance and long-term condition of the drainage system.

Table 6. Operation and maintenance requirements for filter drains in line with table 16.1 of the CIRIA C753 ‘The SuDS Manual 2015.

Maintenance Schedule	Required Action	Typical Frequency
Monitoring	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standard water, and structural damage.	Six Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies.	Six Monthly
	Inspect filter drain for tree roots encroaching sides.	
Regular Maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Six Monthly
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standard water, and structural damage.	Six Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies.	Six Monthly
	Remove Sediment from pre-treatment devices	Six Monthly or as required.
Occasional Maintenance	Remove or control tree roots where they are encroaching the side of the filter drain, using recommended methods (eg NJUG, 2007 or SB 3998:2010)	As required.
	In locations where high level of pollutants are anticipated, remove surface geotextile and replace or wash, and replace overlaying filter medium.	As required.
	Clear perforated pipework of blockages	As required.
Remedial Actions/ Corrective Maintenance	Reconstruct filter drain (replacing the all geotextile/membrane and granular medium) if not maintained in line with the above recommendations and is completely clogged up.	As required.

Table 7. Operation and maintenance requirements for pipework & chambers.

Maintenance Schedule	Required Action	Typical Frequency
Monitoring	Inspect using CCTV drain surveys to ensure they are in good condition and operating as designed.	Every 5 years (or as required)
	Inspect chambers to ensure they are in good condition and that accumulation of sediment, debris etc. is not preventing them from operating as designed.	Annually
Regular Maintenance	Remove any accumulation of silt, sediment, leaves, debris etc.	Bi-annually
Occasional Maintenance	High-pressure water jet for removal of silt builds up and avoid blockages, particularly at bends or changes in direction.	Every 5 years (or as required)
Remedial Actions/ Corrective Maintenance	High-pressure water jet to remove blockages.	As Required.

*Hydrobrake flow control device to be maintained in accordance with hydro international's recommendations.

3.7 Surface Water Treatment

3.7.1 In accordance with the SuDS Manual 2015, Table 26.2, Industrial sites are classified as having a 'high' pollution hazard level. **Table 10** shows the pollution hazard indices for the land use.

Table 8. Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Soils (PMI _{TSS})	Hydrocarbons (PMI _{HM})	Heavy Metals (PMI _{PAH})
Industrial Site	High	0.8	0.9	0.8

3.7.2 The SuDS Manual 2015 also provides pollution mitigation indices for different SuDS drainage features, as detailed in **Table 11**. The increase in surface water pollution resulting from the hardstanding areas during normal conditions is likely to be negligible. However, this risk increases during rainfall events of greater intensity.

Table 9. Pollution Mitigation Indices

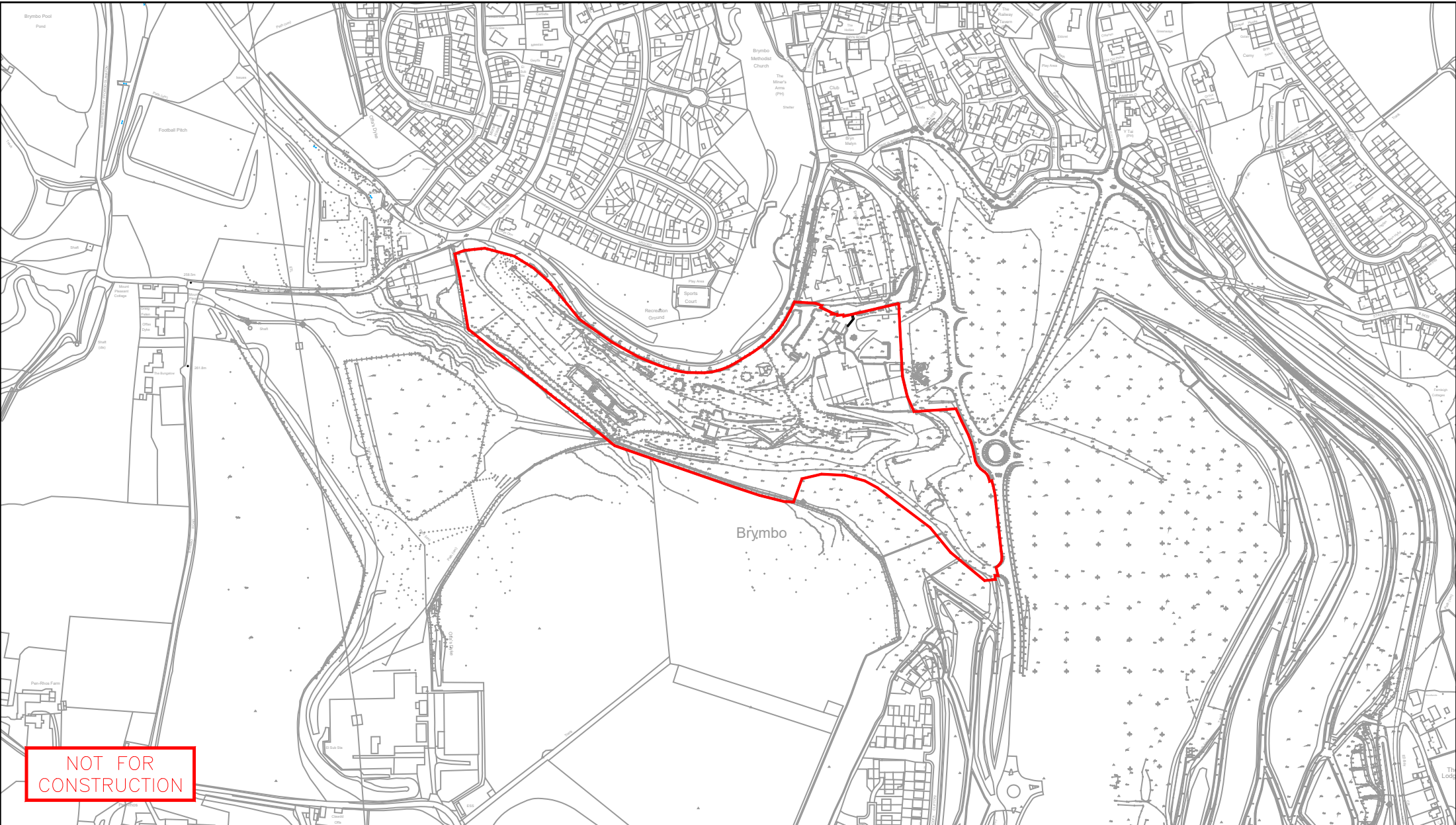
SuDS Component	Pollution Mitigation Indices		
	Total Suspended Soils (PMI _{TSS})	Hydrocarbons (PMI _{HM})	Heavy Metals (PMI _{PAH})
Filter Strip	0.9	0.8	0.7
Filter Drain	0.6	0.8	0.7
Swale	0.7	0.6	0.4
Bioretention System	0.8	0.8	0.8
Porous Paving	0.2	0.3	0.3
Infiltration Basin	0.05	0.05	0.05
Detention Basin	0.7	0.7	0.6
Pond	0.7	0.7	0.5
Wet Land	0.8	0.8	0.8
Proprietary Treatment Systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1-year return period event, for inflow concentrations relevant to the contributing drainage.		

3.7.3 The sum of the highlighted mitigation values (Bold) within each column of **Table 12** surpass the hazard values within **Table 12**, therefore suitable treatment of the surface water run-off from the site is provided.

APPENDICES

APPENDIX A

Proposed Site Location Plan



This drawing is to be read in conjunction with all relevant architects drawings and specifications.

Do not scale – use written dimensions only !

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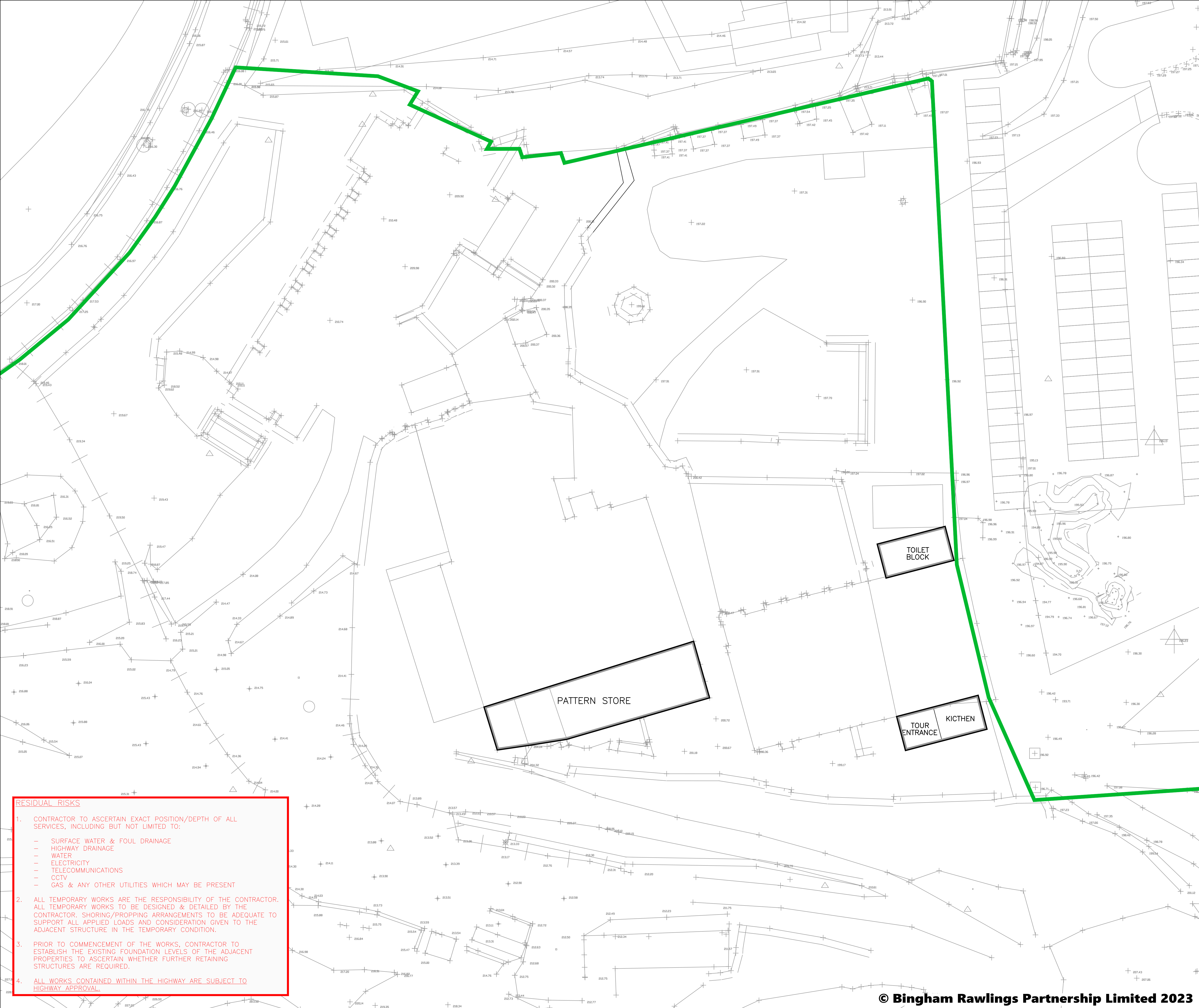
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Project: BRYMBO HERITAGE PROJECT				
Detail: LOCATION PLAN				
Project No.	Drawing No.	Scale	By	Rev.
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APPENDIX B

Proposed Site Layout



NOTES

- DO NOT SCALE FROM THIS DRAWING.
- ALL LEVELS IN METERS UNLESS NOTED OTHERWISE ON DRAWING.
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEER'S AND ARCHITECT'S DRAWINGS AND RELEVANT SPECIFICATION CLAUSES.
- PLEASE REFER TO ARCHITECTS DRAWINGS FOR FINAL BUILDING LOCATION.

KEY

DENOTES PROPOSED SITE BOUNDARY.

NOT FOR CONSTRUCTION

Revisions.

Revision	Made by	Date	Checked	Description

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Bingham Rawlings Partnership Limited

Project

BRYMBO HERITAGE PROJECT

Drawing Title

PROPOSED SITE LAYOUT

Architect

TACP ARCHITECTS

Client

BRYMBO HERITAGE TRUST

Scale 1/250 @ A1

Revision

Drawn M.Jones

4866 | 0002

Date 14.08.2023

Checked L.Rowlands

RESIDUAL RISKS

1. CONTRACTOR TO ASCERTAIN EXACT POSITION/DEPTH OF ALL SERVICES, INCLUDING BUT NOT LIMITED TO:

- SURFACE WATER & FOUL DRAINAGE
- HIGHWAY DRAINAGE
- WATER
- ELECTRICITY
- TELECOMMUNICATIONS
- CCTV
- GAS & ANY OTHER UTILITIES WHICH MAY BE PRESENT

2. ALL TEMPORARY WORKS ARE THE RESPONSIBILITY OF THE CONTRACTOR. ALL TEMPORARY WORKS TO BE DESIGNED & DETAILED BY THE CONTRACTOR. SHORING/PROPPING ARRANGEMENTS TO BE ADEQUATE TO SUPPORT ALL APPLIED LOADS AND CONSIDERATION GIVEN TO THE ADJACENT STRUCTURE IN THE TEMPORARY CONDITION.

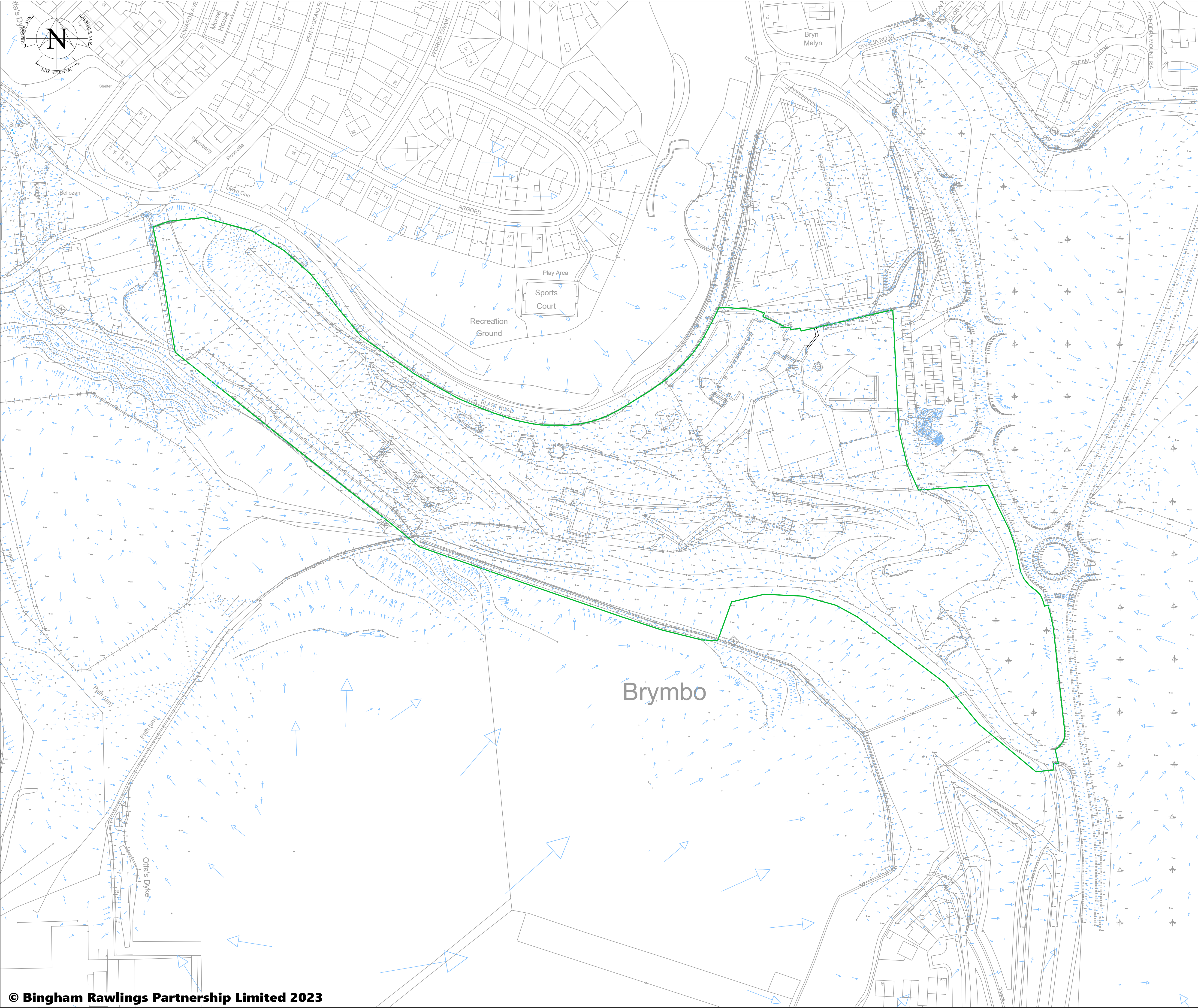
3. PRIOR TO COMMENCEMENT OF THE WORKS, CONTRACTOR TO ESTABLISH THE EXISTING FOUNDATION LEVELS OF THE ADJACENT PROPERTIES TO ASCERTAIN WHETHER FURTHER RETAINING STRUCTURES ARE REQUIRED.

4. ALL WORKS CONTAINED WITHIN THE HIGHWAY ARE SUBJECT TO HIGHWAY APPROVAL.

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APPENDIX C

Existing Flood Routing



NOTES

- DO NOT SCALE FROM THIS DRAWING.
- ALL LEVELS IN METERS UNLESS NOTED OTHERWISE ON DRAWING.
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- PLEASE REFER TO ARCHITECTS DRAWINGS FOR FINAL BUILDING LOCATION.

KEY

 DENOTES DIRECTION OF EXISTING ABOVE GROUND FLOOD ROUTING

 DENOTES PROPOSED SITE BOUNDARY

Revisions.				
Revision	Made by	Date	Checked	Description

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Project BRYMBO HERITAGE PROJECT

Drawing Title EXISTING ABOVE GROUND FLOOD ROUTING

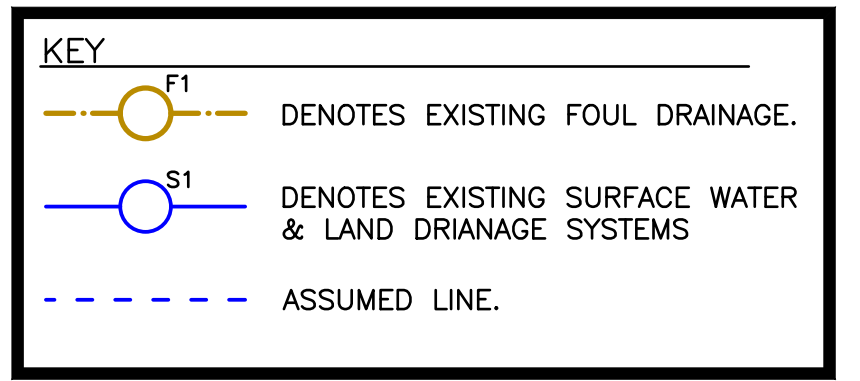
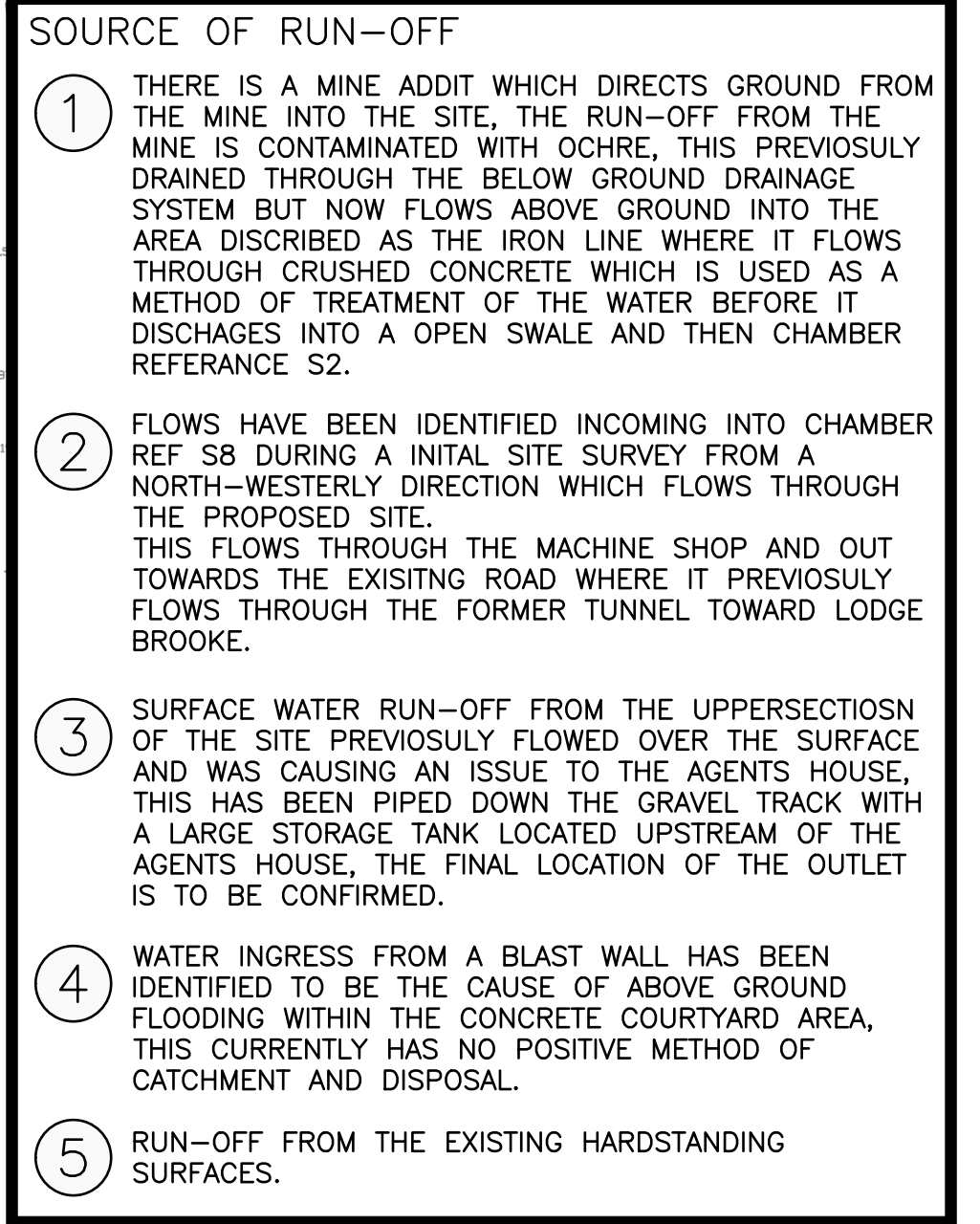
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Client	BRYMBO HERITAGE TRUST	
Scale	1/1000	Revision
Drawn	M.Jones	
Date	14.08.2023	
Checked	L.Rowlands	

4866

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APPENDIX D

Existing Topographic Survey and Drainage Layout

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b.r.p
Bingham
Rawlings
Partnership
Limited



Project BRYMBO HERITAGE PROJECT

Drawing Title	EXISTING TOPGRAPHIC SURVEY AND DRAINAGE LAYOUT
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Architect	TACP ARCHITECTURE
Client	BRYMBO HERITAGE TRUST

Scale	1/250		Revision
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Drawn	M.Jones
Date	14.08.2023

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Checked I.Rowlands						
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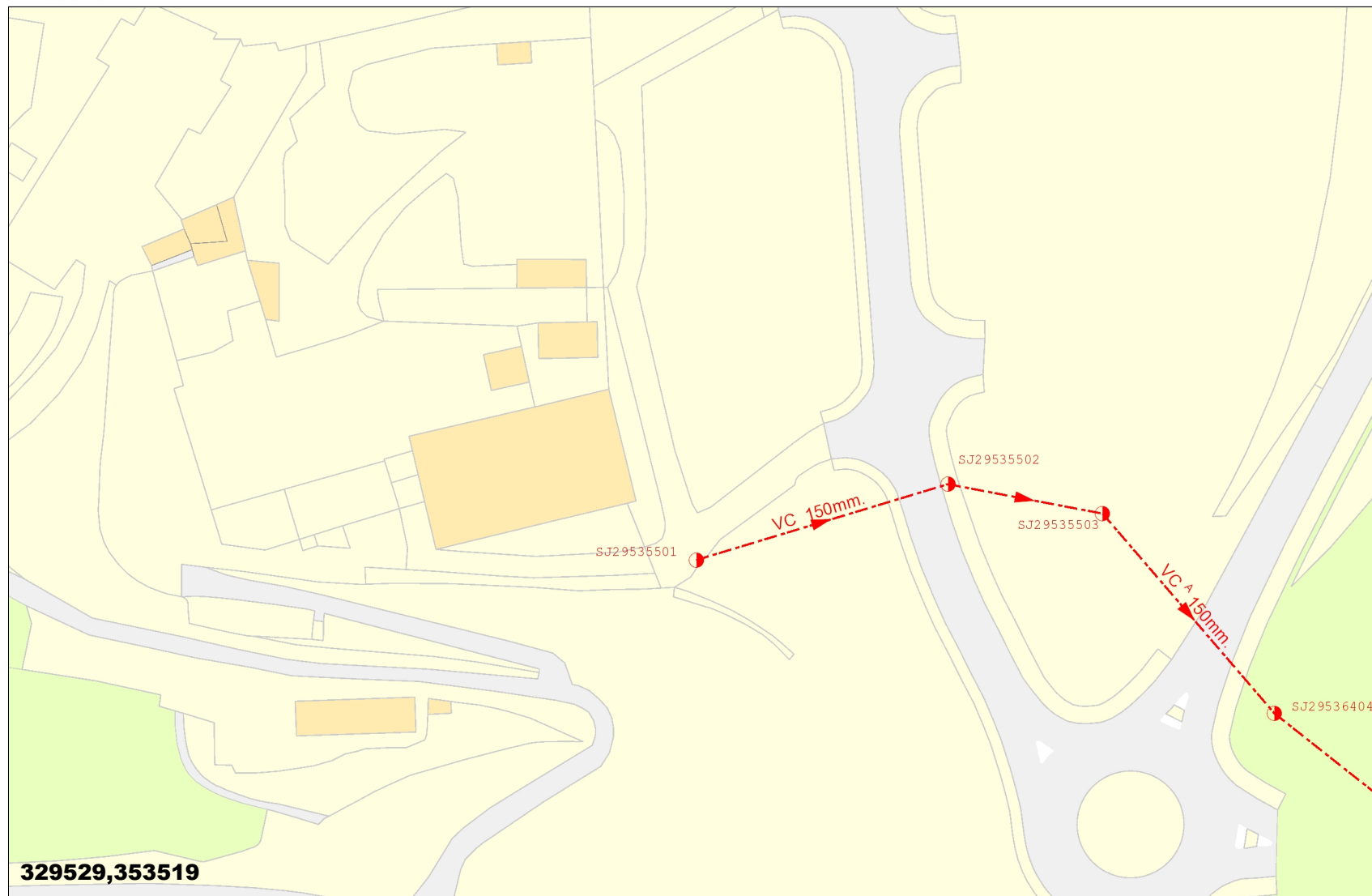
EXISTING DRAINAGE
ARRNAGEMENT TO BE
CONFIRMED BY CCTV SURVEY.

APPENDIX E

Dŵr Cymru / Welsh Water Apparatus Map



Scale: 1: 1033



329529,353519

LEGEND

Clean Water

- Sluice Val
- Air Val, SINGLE
- Tap
- Pressure Reducing Valve
- Meter
- BULK Meter
- FH
- Cap
- Existing Main
- NON COMPANY

Sewerage External

- Foul
- Surface Water
- Combined
- Rising Main
- Private
- Treatment Works
- Pumping Station
- Special Purpose
- Unknown End
- Change, Combined Overflow
- Outfall, FOUL
- Lamp Hole, Foul
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

Dwr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. The information which is supplied hereby the company, is done so in accordance with statutory requirements of sections 198 and 199 of the water industry Act 1991 based upon the best information available and in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a drain sewer or disposal main laid before 1 September 1989, or if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the company's right to be compensated for any damage to its apparatus.

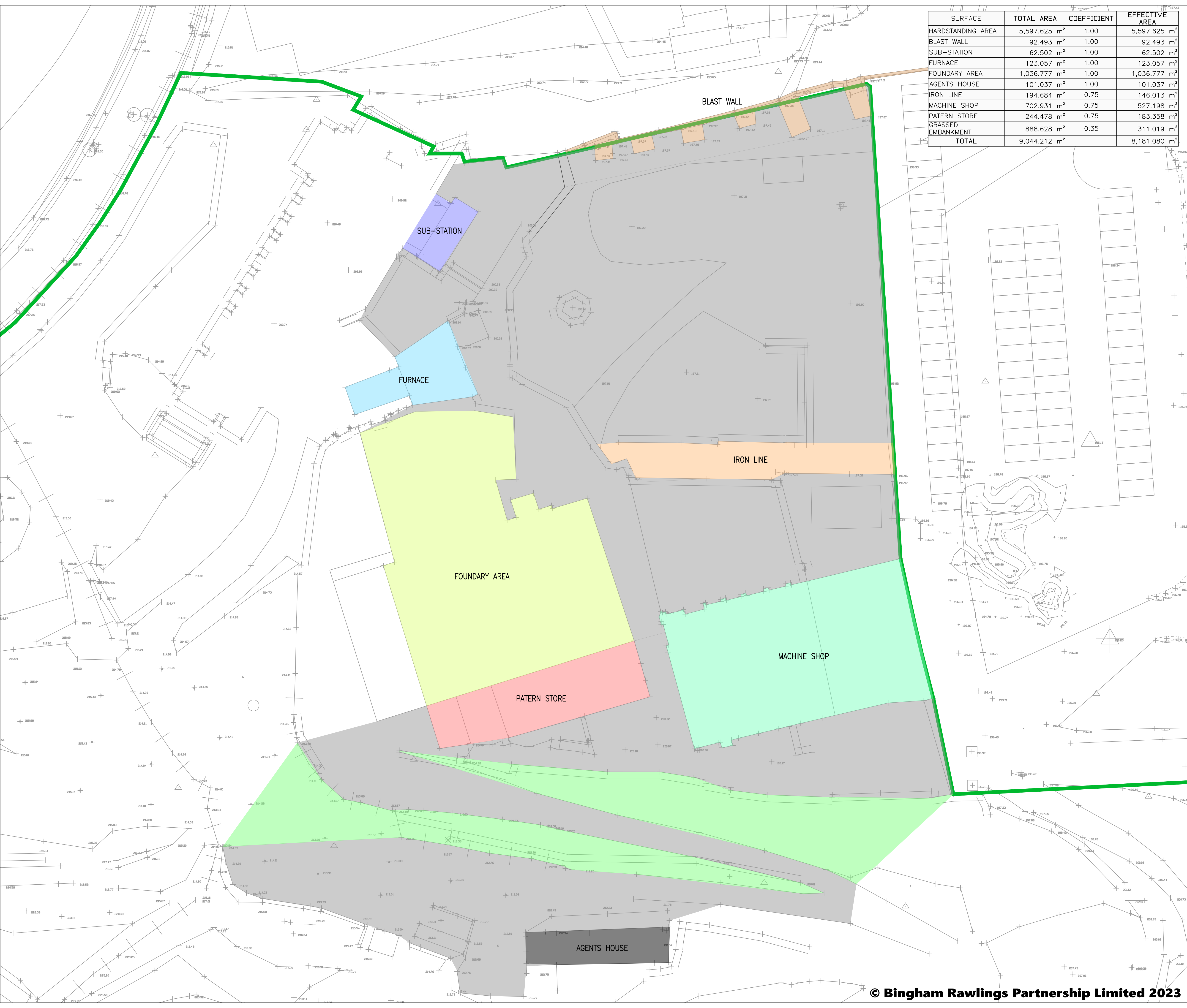
**EXACT LOCATION OF
ALL APPARATUS TO
BE DETERMINED ON
SITE**

Reproduced from the Ordnance Survey's maps with the permission of the Controller of Her Majesty's Stationary Office. Crown Copyright. Licence No: WU298565.

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be Asbestos Cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

APPENDIX F

Existing Area Plan



SURFACE	TOTAL AREA	Coefficient	EFFECTIVE AREA
HARDSTANDING AREA	5,597.625 m ²	1.00	5,597.625 m ²
BLAST WALL	92.493 m ²	1.00	92.493 m ²
SUB-STATION	62.502 m ²	1.00	62.502 m ²
FURNACE	123.057 m ²	1.00	123.057 m ²
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1. DO NOT SCALE FROM THIS DRAWING.

2. ALL LEVELS IN METERS UNLESS NOTED OTHERWISE ON DRAWING.

3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEER'S AND ARCHITECT'S DRAWINGS AND RELEVANT SPECIFICATION CLAUSES.

4. PLEASE REFER TO ARCHITECTS DRAWINGS FOR FINAL BUILDING LOCATION.

KEY

DENOTES PROPOSED SITE BOUNDARY.

DENOTES AREA OF EXISTING HARDSTANDING AREA.

DENOTES AREA OF EXISTING BLAST WALL

DENOTES AREA OF EXISTING SUB-STATION

DENOTES AREA OF EXISTING FURNACE

DENOTES AREA OF EXISTING FOUNDARY AREA

DENOTES AREA OF EXISTING AGENTS HOUSE

DENOTES AREA OF EXISTING IRON LINE

DENOTES AREA OF EXISTING MACHINE SHOP

DENOTES AREA OF EXISTING PATERN STORE

DENOTES AREA OF EXISTING GRASSED EMBANKMENT.

Revisions.				
Revision	Made by	Date	Checked	Description

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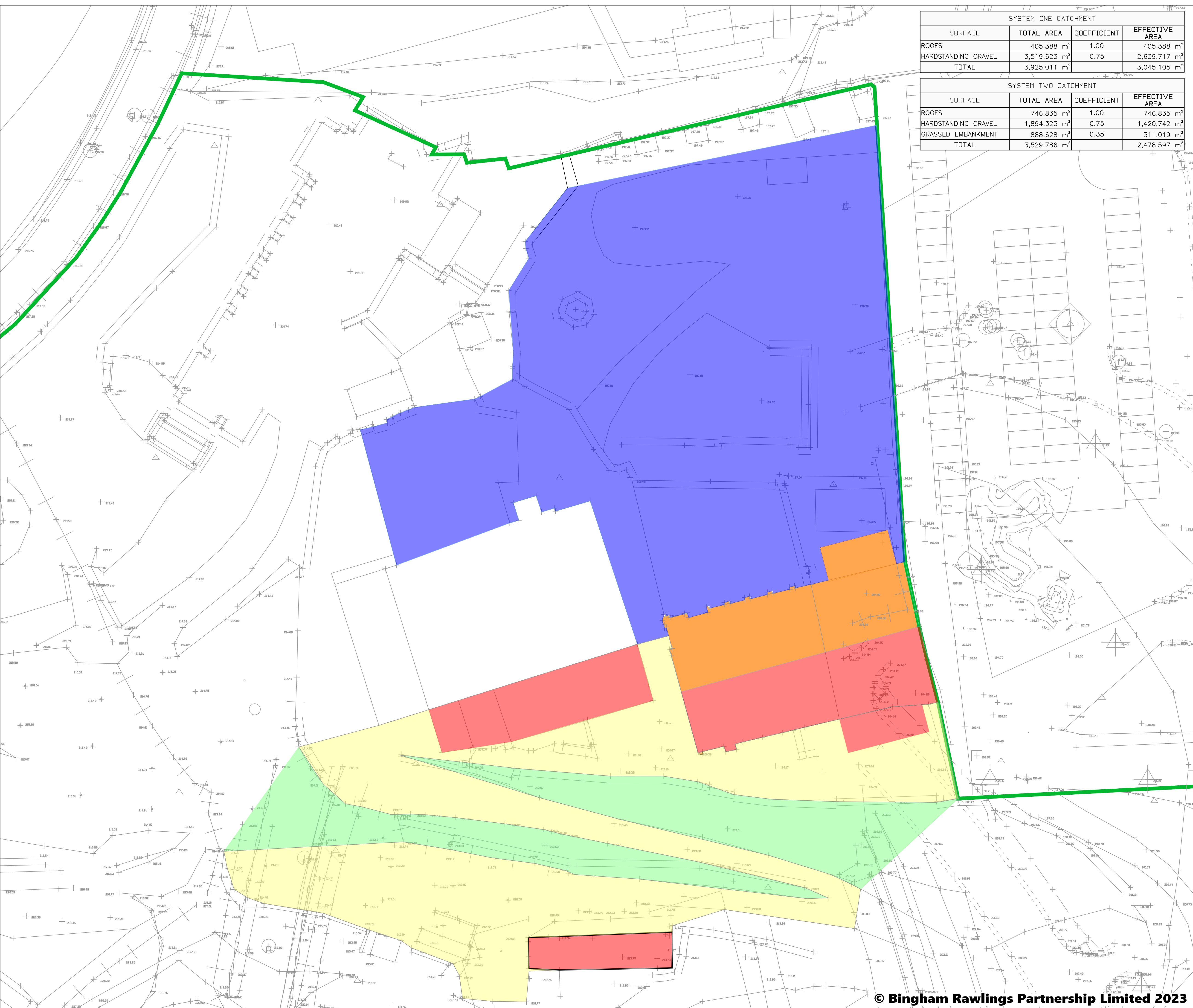
Project		BRYMBO HERITAGE PROJECT					
Drawing Title		EXISTING AREAS					
Architect		TACP ARCHITECTURE					
Client		BRYMBO HERITAGE TRUST					
Scale		1/250				Revision	
Drawn		B.Thorne					
Date		24.02.2023					
Checked		I.Rowlands					

APPENDIX G

Proposed Drainage Layout

APPENDIX H

Proposed Areas



SYSTEM ONE CATCHMENT			
SURFACE	TOTAL AREA	COEFFICIENT	EFFECTIVE AREA
ROOFS	405.388 m ²	1.00	405.388 m ²
HARDSTANDING GRAVEL	3,519.623 m ²	0.75	2,639.717 m ²
TOTAL	3,925.011 m ²		3,045.105 m ²

SYSTEM TWO CATCHMENT			
SURFACE	TOTAL AREA	COEFFICIENT	EFFECTIVE AREA
ROOFS	746.835 m ²	1.00	746.835 m ²
HARDSTANDING GRAVEL	1,894.323 m ²	0.75	1,420.742 m ²
GRASSED EMBANKMENT	888.628 m ²	0.35	311.019 m ²
TOTAL	3,529.786 m ²		2,478.597 m ²

- NOTES
1. DO NOT SCALE FROM THIS DRAWING.

2. ALL LEVELS IN METERS UNLESS NOTED OTHERWISE ON DRAWING.

3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEER'S AND ARCHITECT'S DRAWINGS AND RELEVANT SPECIFICATION CLAUSES.

4. PLEASE REFER TO ARCHITECTS DRAWINGS FOR FINAL BUILDING LOCATION.
- KEY
- DENOTES PROPOSED SITE BOUNDARY.

— DENOTES AREA OF PROPOSED ROOFS IN SYSTEM ONE.

— DENOTES AREA OF PROPOSED HARDSTANDING IN SYSTEM ONE.

— DENOTES AREA OF PROPOSED ROOFS IN SYSTEM TWO.

— DENOTES AREA OF PROPOSED HARDSTANDING IN SYSTEM TWO.

— DENOTES AREA OF PROPOSED GRASSED EMBANKMENT IN SYSTEM TWO.

Revisions.				
Revision	Made by	Date	Checked	Description

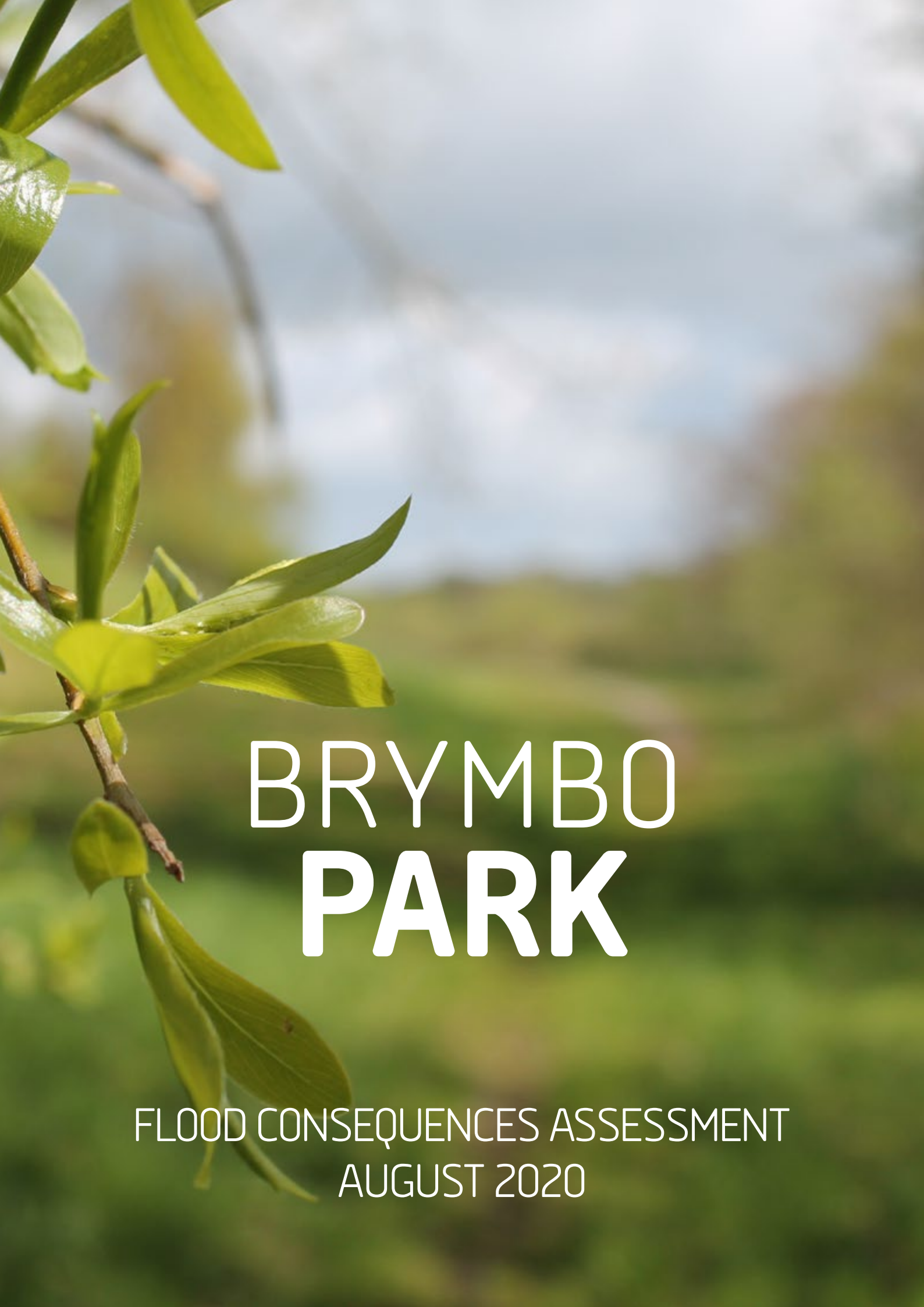
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Drawing Title		PROPOSED AREAS						
Architect		TACP ARCHITECTURE						
Client		BRYMBO HERITAGE TRUST						
Scale	1/250	4866 0006			Revision			
Drawn	M.Jones							
Date	15.08.2023							
Checked	I.Rowlands							

APPENDIX I

Wardell Armstrong Flood consequence assessment



BRYMBO PARK

FLOOD CONSEQUENCES ASSESSMENT
AUGUST 2020



BRYMBO DEVELOPMENTS LTD

FORMER BRYMBO STEELWORKS, WREXHAM

FLOOD CONSEQUENCE ASSESSMENT

AUGUST 2020

DATE ISSUED: AUGUST 2020

JOB NUMBER: ST16882

REPORT NUMBER: 0002

VERSION: V3.0

STATUS: FINAL

BRYMBO DEVELOPMENTS LTD

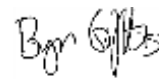
FORMER BRYMBO STEELWORKS, WREXHAM

FLOOD CONSEQUENCE ASSESSMENT

AUGUST 2020

PREPARED BY:

B Griffiths Senior Environmental Scientist



REVIEWED BY

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ENERGY AND CLIMATE CHANGE
ENVIRONMENT AND SUSTAINABILITY
INFRASTRUCTURE AND UTILITIES
LAND AND PROPERTY
MINING AND MINERAL PROCESSING
MINERAL ESTATES
WASTE RESOURCE MANAGEMENT

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3	DEVELOPMENT PROPOSALS	8
4	FLOOD CONSEQUENCE ASSESSMENT.....	10
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6	CONCLUSIONS.....	26

APPENDICES

Appendix 1	Welsh Water Public Sewer Records
Appendix 2	TAN15 Development Advice Map
Appendix 3	Lead Local Flood Authority Correspondence
Appendix 4	Drainage Network Modelling
Appendix 5	Surface Water Attenuation Calculations

DRAWINGS

ST16882-008 B	Site Location Plan
ST16882-006	Topographic Survey (Sheet 1 – 3)
ST16882-007 B	Indicative Surface Water Management Plan
ST16882-060	Overland Flow Routes
RG-M-04	Site Boundary (Revision B)
RG-M-05-1	Land Use Plan (Revision K)
P 47067923/43 Rev G	Site Wide Drainage Proposals

1 INTRODUCTION

1.1 General

1.1.1 Wardell Armstrong LLP has been commissioned to undertake a Flood Consequence Assessment (FCA) on behalf of Brymbo Developments Ltd, relating to the proposed mixed development of residential and commercial properties and a primary school along with areas of public open space at Brymbo, Wrexham as shown on Drawing No ST16882-008 '*Site Location Plan*'.

1.1.2 This assessment has been carried out in accordance with the guidance set out in the Welsh Government Technical Advice Note 15 '*Development and Flood Risk*' (TAN15).

1.2 Methodology

1.2.1 The methodology for this FCA has comprised a desktop study supplemented by liaison with the Lead Local Flood Authority (Wrexham County Borough Council) and Natural Resources Wales.

1.2.2 In accordance with TAN15, the following has been carried out in preparing this assessment:

- an assessment of the consequences of flooding to the development from a range of sources;
- an assessment of the consequences of flooding from the proposed development site; and
- consideration of recommendations for the management of the identified consequences.

1.2.3 In carrying out this assessment, reference has been made to relevant plans and documents, including:

- Planning Policy Wales (2004) *Technical Advice Note 15: Development and Flood Risk*;
- Wrexham Borough Council (2011) *Preliminary Flood Risk Assessment*;
- Wrexham Borough Council (2013) *Local Flood Risk Management Strategy*; and
- Wrexham County Borough Council (2016) *Flood Risk Management Plan 2016 – 2021*.

Planning Policy Wales

- 1.2.4 Technical Advice Note 15 (TAN15) “Development and Flood Risk” was published in July 2004 by the Welsh Assembly Government (WAG) and supplements the policy set out in Planning Policy Wales (PPW), 2016 (Edition 9). It gives guidance to planning authorities in Wales on how to respond on flood risk grounds to development proposals. TAN15 expects planning authorities to apply a risk-based approach to development planning and control through a Sequential Test involving location justification, type of development and flooding consequences.
- 1.2.5 In October 2017, the Welsh Government published the latest TAN15 Development Advice Maps (DAM’s) which show areas potentially at risk from flood events of a 0.1% annual probability for river, tidal or coastal areas (ie 1 in 1,000 year). The Development Advice Maps divide the land area of Wales into three flood risk zones. These are denoted A, B and C, with Zone C further sub-divided into Zones C1 and C2. The Flood Zones are described in further detail in Table 1 below.

Table 1: TAN15 Development Advice Map Flood Zones		
Zone	Description	Use within the precautionary framework
A	Considered to be at little or no risk of fluvial or tidal/coastal flooding.	Used to indicate that Justification Test is not applicable and no need to consider flood risk further.
B	Areas known to have been flooded in the past evidenced by sedimentary deposits.	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
C	Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal).	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the Justification Test including assessment of consequences.
C1	Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	Used to indicate that development can take place subject to application of Justification Test, including acceptability of consequences.
C2	Areas of the floodplain without significant flood defence infrastructure.	Used to indicate that only less vulnerable development should be considered subject to application of Justification Test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

- 1.2.6 Section 5 of TAN15 categorises development according to its vulnerability to flooding. There are three categories: emergency services; highly vulnerable development; and less vulnerable development. All residential premises and vulnerable industrial developments are categorised as highly vulnerable developments. Commercial, retail and general industrial development are categorised as less vulnerable developments.

Wrexham County Borough Council Preliminary Flood Risk Assessment

- 1.2.7 A Preliminary Flood Risk Assessment (PFRA) is a high-level screening exercise to identify areas where there is significant flood risk from local sources, namely ordinary watercourses, surface water runoff and groundwater. It does not directly consider flooding from main rivers or from sewers. PFRAs have been produced by Lead Local Flood Authorities (LLFAs) to fulfil statutory requirements in the Flood Risk Regulations 2009. In this case the LLFA is the Wrexham County Borough Council and the PFRA¹ was published in 2011.

Wrexham County Borough Council Local Flood Risk Management Strategy

- 1.2.8 The Local Flood Risk Management Strategy (LFRMS) report sets out the principles, objectives and measures for the management of local flood risk by Wrexham County Borough Council as the LLFA (where “local flood risk” is defined as “*surface water runoff, ground water and ordinary watercourses and included any lake, pond or other body of water that feeds from an ordinary watercourse*”). The report was published in April 2013.

Wrexham County Borough Council Local Flood Risk Management Plan 2016-2021

- 1.2.9 The Local Flood Risk Management Plan (LFRMP) was produced by Wrexham County Borough Council to build on the 2013 LFRMS report and aims to quantify the scale of the risk of local flooding across the County Borough and the relevant actions and measures required to reduce this within communities at risk. The plan was produced in July 2016.

¹ WREXHAM COUNTY BOROUGH COUNCIL (2011) *Preliminary Assessment Report*

2 SITE AND CATCHMENT CHARACTERISTICS

2.1 Site Description and Location

The site forms part of the wider land holding associated with the former Brymbo Steelworks in the village of Brymbo near Wrexham, some of which has already been significantly redeveloped. The site location is as shown on Drawing No ST16882-008 'Site Location Plan'.

Table 2: Site Summary	
Site Name	Iron Park (Former Brymbo Steelworks)
Site Address	Off Phoenix Drive, Brymbo, Wrexham, LL11 5BT
Site Area	13.41ha
National Grid Reference	329743, 353316 (approximate centre of site)
Proposed Development	Redevelopment of former steelworks
Local Planning Authority	Wrexham County and Borough Council
Lead Local Flood Authority	Wrexham County and Borough Council
Sewerage Undertaker	Welsh Water

- 2.1.1 The site area is approximately 13.41ha in size and irregular in shape. The former steelworks buildings which previously occupied this area have now been demolished and the land was the subject of a major land reclamation project from 2003 to 2005. The reclaimed area now generally consists of open ground and areas of rough vegetation.
- 2.1.2 The area is bounded to the north and east by open ground falling away from the site to the B5101 (New Road/Kent Road) and to the south by residential areas. Two link roads, Phoenix Drive and Blast Road run adjacent to the western boundary, meeting at a roundabout, with Phoenix Drive crossing the site area in a north-eastwards direction to join the B5101.
- 2.1.3 To the west of the site is the Ty Cerrig area separated from the site by an area of woodland. This area was formerly an opencast coal site during 1970s which was backfilled with the natural excavated materials and restored to open fields and hedgerows. Whilst Ty Cerrig formed part of the former steelworks development, this area is not included within the planning application and is not assessed further in this FCA.

- 2.1.4 This area of the site consists primarily of two gently-sloping plateaux separated by the Phoenix Drive link road (the “northern plateau” and “southern plateau”). The larger southern plateau falls generally northwards from a maximum elevation of approximately 203.40mAOD at the southern boundary to a minimum elevation of approximately 193.65mAOD at its northern extent at an approximate gradient of 1 in 60. At the northern and eastern extents, ground levels slope steeply away from the plateaux areas.
- 2.1.5 The northern plateau area is situated up to 2.0m lower than the unnamed adjacent access road to the west. Ground levels fall in a south-eastwards direction from a maximum elevation of 204.92mAOD adjacent to the unnamed access road in the north-western corner, down a 1 in 2.5 slope to a flatter area. Ground levels in this area also fall in a south-eastwards direction at a gradient of approximately 1 in 50 to a minimum elevation of 193.03mAOD adjacent to Phoenix Drive.
- 2.1.6 The topography of the site is shown on Drawing No ST16882-006 (Sheet 1 – 3) ‘*Topographic Survey*’.

2.2 Existing Drainage Regime

- 2.2.1 There are no Main Rivers within the site area. The nearest Main River is the River Cegidog (Afon Cegidog) located approximately 1.3km to the north of the site at its closest point. There are also no Ordinary Watercourses within the site areas.
- 2.2.2 Welsh Water’s public sewer records (see Appendix 1) show a public combined sewer flowing in a south-eastwards direction from an access road adjacent to the steelworks’ ‘heritage site’ buildings, crossing both plateaux areas and discharging to a public combined sewer in the B5101 approximately 300m to the east of the site.
- 2.2.3 The sewer is understood to have previously linked the former steelworks’ buildings within the heritage site to a sewage treatment plant located within the main steelworks’ site. The buildings of the Enterprise Centre to the north of the heritage site are served by a separate public combined sewer in Blast Road. The sewage treatment plant was demolished along with the steelworks and this sewer is considered to be redundant. There are no manholes or gullies shown along the route of the sewer on the topographic survey of the site (see Drawing No ST16882-006 (Sheet 1 – 3) ‘*Topographic Survey*’) and it is not known whether the sewer is still present following the reclamation works.

- 2.2.4 It is assumed that any private drainage network serving the former steelworks was removed during the reclamation works and it is considered, therefore, that these previously developed areas of the site now have characteristics similar to that of a greenfield site with surface water runoff dispersing by a combination of infiltration and evapotranspiration with no discharge to a private or public drainage network.
- 2.2.5 Public surface water, foul water sewers and highway drains are located along Phoenix Drive which runs adjacent to, and subsequently crosses, the site area as shown on Drawing No P 47067923/43 Rev G '*Site Wide Drainage Proposals*'. The sewers flow generally in a northwards direction within the road, with the surface water sewer discharging to an existing culvert flowing in a south-eastwards direction adjacent to the B5101. This culvert formerly received flows from the Brymbo Steelworks but this upstream catchment was closed off during the reclamation of the steelworks and it no longer receives flows from this catchment. The foul sewer connects to the existing public foul sewer flowing in a south-eastwards direction along the B5101.
- 2.2.6 Surface water and foul water stub connections in Phoenix Drive have been provided on the sewers in anticipation of the adjacent future development and do not currently accept any flows other than surface water road drainage. Following development at the site it is proposed that these are adopted by Welsh Water.

2.3 Ground Conditions

- 2.3.1 The British Geological Survey 'Geology of Britain Viewer', available online², shows that the majority of the site area is underlain by mudstone, siltstone and sandstone of the Pennine Lower Coal Measures Formation. Small areas in the north-eastern and south-western parts of the site are underlain by sandstone of the Pennine Lower Coal Measures Formation. The online DEFRA 'Magic' Map Application³ shows the bedrock is classified as a 'Secondary A' aquifer, defined as '*permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers*'.
- 2.3.2 A narrow section of superficial alluvium deposits is aligned along a north-west/south-east axis and extends into the north-eastern corner of the site area. These deposits are classified as a 'Secondary A' aquifer.

² BRITISH GEOLOGICAL SURVEY *Geology of Britain Viewer*. Available from <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

³ DEFRA *Magic Map Application* Available from: <http://magic.defra.gov.uk/MagicMap.aspx>

- 2.3.3 The online Cranfield Soil and Agrifood Institute 'Soilscales' viewer ⁴shows that soils at the site area are '*slowly permeable, seasonably wet acid loamy and clayey soils*'.
- 2.3.4 During the 240 years development of the Steelworks site, the natural strata were overtipped with waste iron/steel-making slags to create development plateaux for the expanding operations. The mudstones, siltstones excavated during the recent reclamation works, in particular an excavation in the central area of the site to recover the shallow residual coal and remove the risk of ground instability, were used subsequently to cover the slag wastes with a minimum of 5m cover of compacted material to facilitate subsequent built development. This has formed a relatively impermeable cover across the site such that it is considered that surface rainwater disperses more by runoff and evapotranspiration rather than infiltration.

⁴ CRANFIELD SOIL AND AGRIFOOD INSTITUTE *Soilscales*. Available from <http://www.landis.org.uk/soilscales/>
ST16882/0002/FINAL
AUGUST 2020

3 DEVELOPMENT PROPOSALS

3.1 Description of Proposals

- 3.1.1 Outline planning permission for up to 300 dwellings (Class C3 use), provision of a primary school (2-form entry), small district centre comprising up to 1,395sqm of Class A1 Retail, up to 372sqm of Class A3 Restaurant/Public House, up to 465sqm of Class D1 use, multi-functional green infrastructure, including children's play areas and informal open space, surface water attenuation, vehicle accesses, car parking, engineering works, public footpaths and hard and soft landscaping, underground services, and all ancillary and enabling works, with all matters reserved except for vehicular access from Brymbo Road.
- 3.1.2 The proposed layout is as shown on Drawing No RG-M-05 (Revision K) '*Land Use Plan*'.
- 3.1.3 In Figure 2 of TAN15, residential developments and public buildings such as schools are both categorised as '*Highly Vulnerable*' developments'. Commercial and retail developments are categorised as a '*Less Vulnerable*' development'.
- 3.1.4 The 'Development Advice Map' for flood risk obtained from the Natural Resources Wales website (see Appendix 2) shows that the majority of the site is located within Zone A, described in TAN15 as an area '*considered to be at little or no risk of fluvial or tidal/coastal flooding*'. A small section of the eastern boundary is shown to be located within Zone B, described in TAN15 as '*areas known to have been flooded in the past evidenced by sedimentary deposits*'.

3.2 Flood Risk Vulnerability

- 3.2.1 The nature of the proposed development, which includes residential premises and public buildings, is classified as a '*Highly Vulnerable*' development based on Section 5 of TAN15.

3.3 Justification Test

- 3.3.1 The Justification Test aims to direct new development away from Zone C and towards land in Zone A (or otherwise Zone B). A new '*Highly Vulnerable*' development would only be permitted within Zone C) if it is deemed to be justified in that location.
- 3.3.2 The majority of land within the site is located within Zone A. A small area of residential development in the eastern part of the site will, however, extend into the area of Zone B.

3.3.3 As all development will be located outside of Zone C, the Justification Test is considered to be passed.

4 FLOOD CONSEQUENCE ASSESSMENT

4.1 Historical Flooding

4.1.1 Historical flood mapping in the Wrexham County Borough Council LFRMS and PFRA reports and on the Natural Resource Wales Flood Risk website⁵ do not show any historic flooding incidents in the vicinity of the site.

4.1.2 Wrexham County Borough Council state in response to the enquiry submitted as part of this assessment (see Appendix 3) that they hold no information of any flooding events within the site boundary.

4.2 Consequences of Flooding to the Development

4.2.1 Flooding can occur from a range of sources including, but not limited to rivers, tidal waters and the sea, surface water runoff, groundwater, sewers and drains, and artificial sources such as canals and reservoirs. The presence of a potential flooding source does not, however, necessarily translate into a high risk of flooding. Following the source-pathway-receptor approach, flooding can only affect the site (receptor) if there is a pathway from the identified sources.

4.3 Flooding Consequences to the Proposed Development

Fluvial Flooding

4.3.1 The site is not located in the vicinity of a Main River or Ordinary Watercourse. The closest Main River to the site is located approximately 1.3km to the north of the site at its closest point and is situated approximately 100m lower than the lowest elevation of the site. Consequently, this watercourse is not considered to pose a risk of flooding to the site. The Natural Resources Wales 'Flood Risk Map' for fluvial flooding (see Figure 1) shows that an area of Flood Zone 3 is located adjacent to the River Gwenfrom approximately 1km to the south of the site. Areas of Flood Zone 3 are defined as land with a greater than 1 in 100 year annual probability of fluvial flooding. Due to the distance from the site and that the site is approximately 50m higher than the area of Flood Zone 3, it is not considered to pose a risk of flooding.

4.3.2 As shown on the Development Advice Map (see Appendix 2), a small area near the eastern boundary is shown to be located within Zone B. This is coincident with a section of alluvium bedrock extending to the River Gwenfro/Afon Gwenfro, located

⁵ NATIONAL RESOURCES WALES *Flood Risk Map* Available from: <https://www.naturalresources.wales/our-evidence-and-reports/maps/flood-risk-map/?lang=en>

approximately 1km to the south of the site. Based on the definition of Zone B in TAN15 'Areas known to have been flooded in the past evidenced by sedimentary deposits' it is considered that the Zone B classification is based on the presence of alluvium deposits only. As the River Gwenfro is situated approximately 30m lower than the site, it is not considered to pose a risk of fluvial flooding to the site.

Tidal Flooding

- 4.3.3 Due to the distance of the site from the sea and tidally-influenced watercourses, the risk of tidal flooding is discounted.

Surface Water Flooding

- 4.3.4 The Natural Resources Wales 'Flood Risk Map' for surface water flooding (see Figure 2) shows the majority of the site is not at risk of surface water flooding. Areas in the north are shown to be at risk of surface water flooding.

Groundwater Flooding

- 4.3.5 The Wrexham County Borough Council PFRA identifies no record of past groundwater flooding incidents and states that information ascertained from the British Geological Survey and Environment Agency shows the Wrexham County Borough Council area is not susceptible to groundwater flooding due to its geology.

Sewer Flooding

- 4.3.6 It is considered that any sewers serving the former steelworks in the site area have been removed during the reclamation works. Sewers and highway drainage are present in Phoenix Drive which runs adjacent to the western boundary as shown on Drawing No P 47067923/43 Rev G 'Site Wide Drainage Proposals'. Public sewer records (see Appendix 1) also show a public sewer crossing the site area from the former steelworks' buildings of the 'heritage site' to the B5101.

Artificial Flooding

- 4.3.7 The Natural Resources Wales 'Flood Risk Map' shows the site is not located in an area considered to be at risk from reservoir flooding. There are no canals or impounded bodies of water in the vicinity of the site.

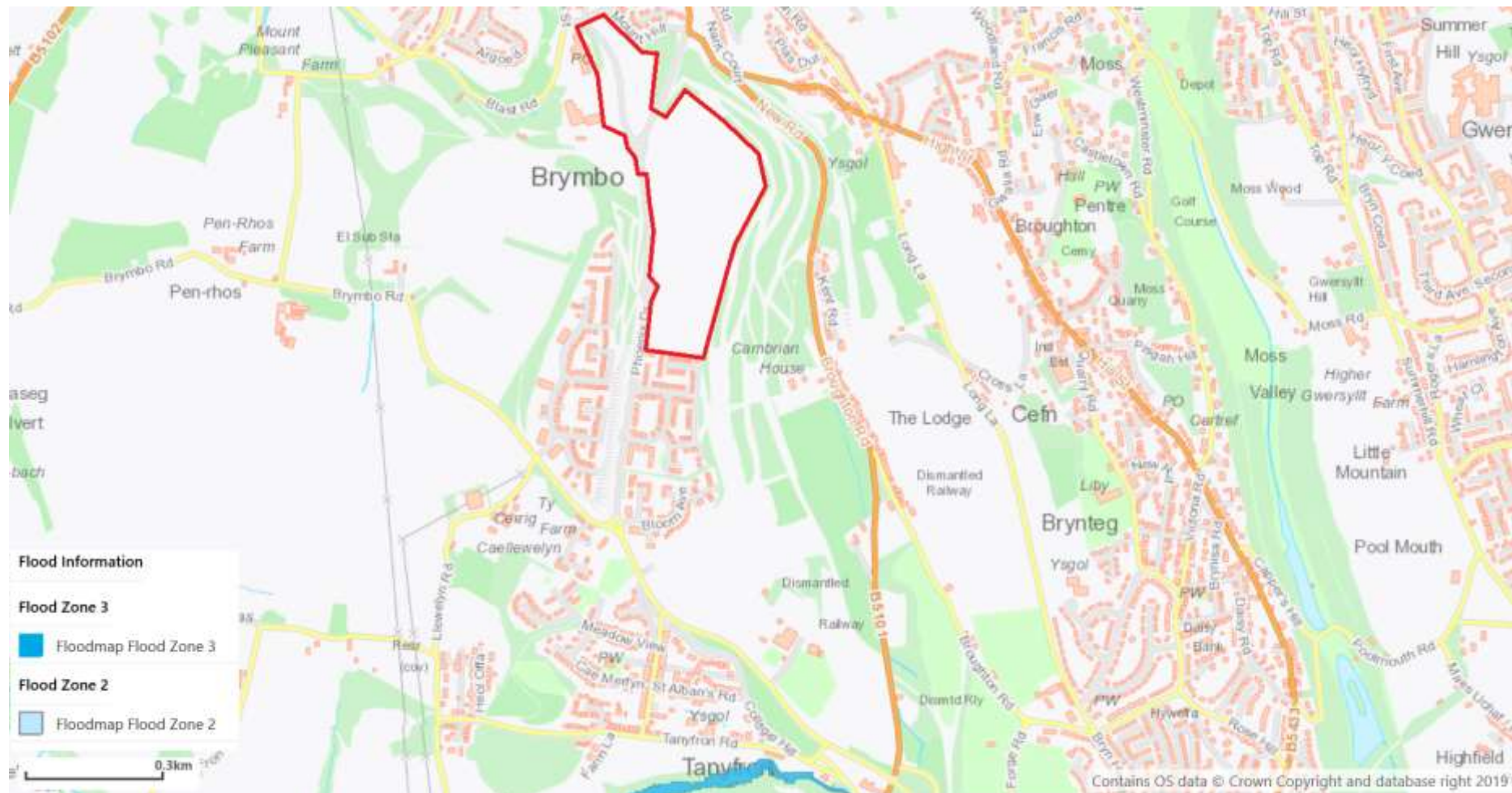


Figure 1. Fluvial Flood Risk



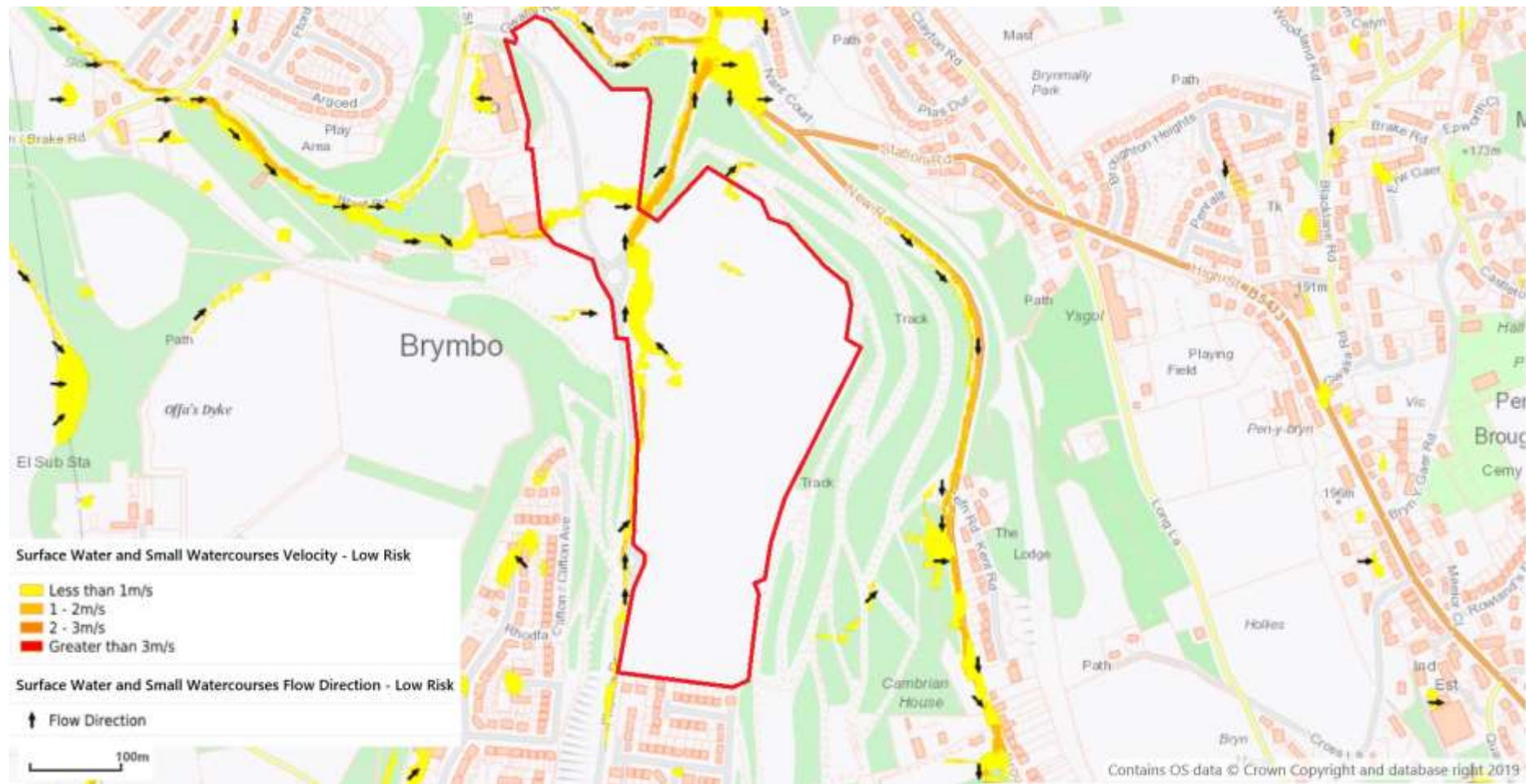


Figure 3. Surface Water Runoff (Overland Flow) Flooding Velocities

4.4 Potential Sources of Flooding

4.4.1 Table 2 summarises the flood consequences to the proposed development.

Table 2: Summary of Flood Consequences to the Site			
Type	Source	Pathway	Risk
Fluvial Flooding (Rivers)	N	N	n/a
Tidal Flooding	N	N	n/a
Surface Water Runoff	Y	Y	Low
Groundwater Flooding	Y	N	n/a
Sewer/Drain Flooding	Y	Y	Low
Artificial Flooding	N	N	n/a

4.4.2 The potential sources with a pathway to the site are, therefore, as follows:

- surface water; and
- sewers.

Surface Water Runoff (Overland Flow) Flooding

4.4.3 On land where there is impermeable surfacing or where the ground infiltration capacity is exceeded there is the potential for surface water runoff to occur.

4.4.4 Based on National Resources Wales mapping (see Figure 2), the majority of this area of the site and its vicinity are shown to be at a Very Low risk of surface water flooding (defined as an annual probability of flooding of less than 1 in 1000 (0.1%)). Small isolated areas in central and southern areas are shown to be at Low risk (defined as an annual probability of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%)) and are considered to be coincident with low-lying areas and do not represent a risk of flooding to the wider site area.

4.4.5 An area at the northern extent of the southern plateau is shown to be at Low risk and is the upstream extent of a small valley-like feature extending northwards from the site to the B5101. Any surface water runoff accumulating in this area would flow away from the site following the topography as indicated by the flow direction arrows on Figure 3.

- 4.4.6 A second area in the northern plateau is shown to be at Medium to High risk (where Medium risk is defined as an annual probability of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%), and High risk is defined as an annual probability of greater than 1 in 30 (3.3%)). This area extends eastwards from Blast Road, to the west of the site, through the area of historic buildings to the B5101 via Phoenix Drive crossing a narrow section of the northern plateau area of the site. The mapping would suggest that this is part of a wider overland flow route which follows the natural topography.
- 4.4.7 To confirm the presence of any overland flow routes crossing the site, a survey of the area between Blast Road and the site was undertaken in January 2020. The survey (see Drawing No ST16882-026 '*Overland Flow Routes*') indicates that based on topography, surface water runoff could accumulate to the rear of the existing buildings within the 'heritage site' and progress around the northern extent of the buildings onto land adjacent to Phoenix Drive as indicated on Figure 3. As this land is marginally lower than land to the east, there would be minimal opportunity for runoff to progress further into the wider site area in the majority of storm events. A bund could be constructed in this area to further limit pathways into the wider site area.
- 4.4.8 As shown on Drawing No ST16882-060 '*Overland Flow Routes*', a second potential pathway could exist for runoff to continue eastwards along a track towards an area of woodland. It is proposed that a soft landscape barrier is constructed in this area to divert flows northwards towards the heritage site.
- 4.4.9 The risk of surface water flooding in this area of the site is, therefore, considered to be **LOW**.

Sewer Flooding

- 4.4.10 Welsh Water's public sewer records (see Appendix 1) show a public combined sewer crossing in a south-eastwards direction from the heritage site through the site area. The depth of the sewer is not shown on the sewer records. The sewer previously served the buildings within the heritage site, connecting these to a sewage treatment plant within the main steelworks site. The status of this sewer is not known following the demolition and remediation works at the site. It is assumed that there are no remaining private sewers within the former steelworks area.
- 4.4.11 No manholes were recorded on the topographic survey of the site and it is considered that there would be no pathways for any flooding from sewers to emerge within the site area.

- 4.4.12 As shown on Drawing No P 47067923/43 Rev G '*Site Wide Drainage Proposals*', surface water and foul water sewers are present within Phoenix Drive which runs adjacent to the western boundary of the site area and crosses between the two plateau areas to join the B5101.
- 4.4.13 It is understood that these surface water sewers are over 1.2m below ground level. They are considered to be at a sufficient depth to assume that the risk of flooding from surcharged manholes is minimal. Furthermore, it is understood that the sewer network has been designed to receive flows from developed areas and highways within the site area only and has been suitably-sized (based on MicroDrainage modelling undertaken at the design stage) to accommodate all flows up to and including the 1 in 100 year storm event (including an allowance for climate change).
- 4.4.14 It is understood that the foul water sewers are over 1.4m below ground level. They are considered to be at a sufficient depth to assume that the risk of flooding is minimal. As with the surface water network, it is understood that the foul water sewer network will receive flows from the proposed development only and has been suitably-sized (based on MicroDrainage modelling).
- 4.4.15 Based on the available information, the risk of sewer flooding in this area is considered to be **LOW**.

4.5 **Flooding Consequences from the Proposed Development**

- 4.5.1 New development can pose a risk of flooding to neighbouring properties and areas downstream of the site often as a result of the loss of floodplain storage, an increase in impermeable area which has the effect of increasing the rate and volume of surface water runoff, or alterations to the surface water flow regime.

Fluvial Flooding

- 4.5.2 The proposed development is not located in the vicinity of a Main River and there will be no loss of floodplain storage or diversion of flood flows as a result of the proposed development.

Surface Water Flooding

- 4.5.3 The site currently consists of large areas of open ground and rough vegetation. Despite the brownfield nature of the site, it is considered that the site currently displays the characteristics of a 'greenfield' site in terms of surface water drainage, with surface water dispersing by a combination of infiltration and evapotranspiration.

- 4.5.4 As a result of the proposed development, the impermeable area of the site will increase and, as a result, the rate and volume of surface water runoff generated during storm events could also be expected to increase. Without mitigation, this could lead to an increase in flood risk to areas downstream of the site.

Climate Change

- 4.5.5 It is also necessary to take account of climate change for the lifetime of the development when assessing future flood risk. New climate change guidance was published by the Environment Agency in February 2016⁶. The guidance provides predictions of anticipated change to peak rainfall intensity. In assessing surface water runoff from the proposed development, the climate change predictions for peak rainfall intensity for the lifetime of the development need to be taken into account.
- 4.5.6 Wrexham County Borough Council (the Lead Local Flood Authority) state that an increased intensity of 30% is acceptable (see Appendix 3).
- 4.5.7 It is considered, therefore, that the risk of surface water flooding could increase as a result of the proposed development and that mitigation measures are required.

4.6 Flood Management Plan

Surface Water Management

- 4.6.1 To mitigate the potential increase in flood risk to areas downstream of the site, surface water runoff from the proposed development which exceeds the restricted discharge rates will be retained and attenuated within the site areas for all storm events up to and including the 1 in 100 year event, including a 30% allowance for climate change recommended by Wrexham County Borough Council in correspondence (see Appendix 3). To help to achieve this, Sustainable Drainage Systems (SuDS) will be incorporated into the development to provide attenuation. Further details are included in the Drainage Strategy (see Section 5).
- 4.6.2 Any incoming overland flow from higher land to the west of the site will be retained in open space within the site area for the majority of storm events. Were the capacity of this area to be exceeded during extreme storm events, any exceedance flows will progress through the site north-eastwards to the B5101 as indicated on Figure 2 without diversion to other off-site areas previously unaffected.

- 4.6.3 The risk of flooding to areas downstream of the site will not, therefore, increase as a result of the proposed development.

Residual Risk

- 4.6.4 There is always a possibility of a storm event that exceeds the design standards of the proposed flood risk management measures for new developments. Potential risks include exceedance of the on-site surface water attenuation facilities during storm events.
- 4.6.5 On-site attenuation will be provided for storm events up to and including the 1 in 100 year storm event, including an appropriate allowance for climate change. For storm events with an annual probability of occurrence greater than this the on-site attenuation may be exceeded. It is considered that the probability of the attenuation facilities being exceeded is extremely low (eg freeboard included within detention basins for safety reasons will provide additional temporary storage during extreme storm events). Furthermore, all SuDS features will be located within shared spaces and open ground away from properties. Were the attenuation capacity of these features to be exceeded, exceedance flows could be managed by landscaping and features such as kerbing or speed humps to prevent properties and off-site areas from being affected.

⁶ GOV.UK (February 2016). *Guidance – Flood Risk Assessments: Climate Change Allowances*. Available from: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

5 DRAINAGE STRATEGY

Surface Water Runoff Attenuation

- 5.1.1 Surface water runoff from the development will be controlled on site to ensure that there is no increase in the risk of flooding to areas downstream of the site, and to the development itself. To help to achieve this, Sustainable Drainage Systems (SuDS) will be incorporated into the development to provide attenuation.
- 5.1.2 An indicative Surface Water Management Plan is shown on Drawing No ST16882-007 '*Indicative Surface Water Management Plan*'.
- 5.1.3 The Building Regulations (2010) Part H stipulate a hierarchy for the disposal of surface water, which should be followed as part of any surface water drainage design. This hierarchy is as follows:
- i. an adequate soakaway or some other adequate infiltration system; or, where that is not practicable,
 - ii. a watercourse; or, where that is not practicable,
 - iii. a sewer.
- 5.1.4 Due to the historical land use at the former steelworks site and the large sub-surface volumes of Made Ground (including waste iron and steel slags), it is not considered feasible to use infiltration drainage within the area of the site. Surface water inundation of the sub-surface materials would risk unacceptable ground settlement and risk the mobilisation of any contaminants, which may be present.
- 5.1.5 It is proposed, therefore, to discharge surface water runoff from the site to the culverted watercourse located to the north of the site via the existing drainage network in Phoenix Drive, which was designed and constructed to serve future developments at the site.
- 5.1.6 Discharge from the sewer network to the culverted watercourse will be restricted to a rate of 769 l/s for all storm events up to the 1 in 100 year storm event (including an allowance for climate change), as agreed with Welsh Water in 2016 as part of a previous planning application and S106 Agreement.
- 5.1.7 This discharge rate is based on the rate at the outfall from the site for the 1 in 100 year storm event determined, from modelling undertaken by URS Infrastructure and Environment Ltd in 2015 (see Appendix 4). This models the sewer network within the

highways in the site area and includes runoff from the roads and incoming flows from the heritage site and enterprise centre located outside of the site boundary.

5.1.8 The model assigns nominal impermeable areas to six of the seven existing 'stub' connections into the main sewer within Phoenix Drive in order to calculate the flows entering the sewer network. These modelled flow rates are shown on Drawing No. P 47067923/43 Rev G 'Site Wide Drainage Proposals'

5.1.9 For the proposed surface water drainage strategy the site will be divided into seven subcatchments each discharging via an existing stub connection. The agreed discharge rate for each outfall and contributing impermeable areas within the associated subcatchment, based on the proposed site layout, is shown in Table 3 below.

5.1.10 The outfall from Catchment C does not have an agreed discharge rate and the proposed rate of 10 l/s for the 1 in 100 year storm event is based on the rate proposed for the "Ty Cerrig" catchment in the 2015 model. This area, located to the west of the site, will no longer be developed as part of the planning application and there will be no discharge into the Phoenix Drive drainage network.

Table 3: Restricted Discharge Rates and Contributing Areas				
Catchment	Contributing Impermeable Area		Discharge Rate (1 in 30 year)	Discharge Rate (1 in 100 year)
	Buildings/Infrastructure¹	Access Roads		
A	1.35 ha	0.30 ha	101.1 l/s	125 l/s
B	0.89 ha	0.55 ha	32.8 l/s	39 l/s
C ²	0.71 ha	0.27 ha	6.8 l/s	10 l/s
D	0.37 ha	-	18.7 l/s	22 l/s
E	0.39 ha	-	14.8 l/s	17 l/s
F	0.36 ha	-	62.4 l/s	72 l/s
Additional flows (off site areas and access roads)			484 l/s	484 l/s
Total	4.07 ha	1.12 ha	720.6 l/s	769 l/s
1. Impermeable area based on density of 35% for residential areas, 60% for district centre and 95% for retail and leisure 2. Discharge rate for outfall C not specified on Drawing No. P 47067923/43 Rev G. Proposed rate based on rate of nearby land of Ty Cerrig.				

5.1.11 It is proposed that flows in excess of the restricted discharge rate will be attenuated within each subcatchment or adjacent areas of public open space for all storm events up to and including the 1 in 100 year event (including an allowance for climate change). The required attenuation for each subcatchment was calculated using Causeway software. Calculations are contained in Appendix 5 and summarised in Table 4 below.

Table 4: Summary of Flood Consequences to the Site					
Catchment	Restricted Discharge Rate		Impermeable Area	Estimated Attenuation	
	1 in 30 year	1 in 100 year		1 in 30 year	1 in 100 year (+ 30% climate change)
A	101.1 l/s	125 l/s	1.65 ha	193	398
B	32.8 l/s	39 l/s	1.44 ha	285	569
C	6.8 l/s	10 l/s	0.98 ha	317	552
D	18.7 l/s	22 l/s	0.37 ha	49	102
E	14.8 l/s	17 l/s	0.39 ha	60	125
F	62.4 l/s	72 l/s	0.36 ha	20	47
Attenuation calculations exclude infiltration to provide a 'worst case' estimate					

5.1.12 An indicative surface water drainage strategy is shown on Drawing No. ST16882-007 '*Indicative Surface Water Management Plan*'. The management plan shows potential locations of larger attenuation features such as swales and detention basins within areas of open space, however, the internal layout within land parcels is unconfirmed and specific SuDS features feasible for use within each area are not specified at this stage.

5.1.13 A variety of SuDS techniques are discussed within The SUDS Manual⁷ (CIRIA 753) and many of these could, as outlined in Table 5, potentially be suitable for use of the site.

⁷ CIRIA (2015) *The SuDS Manual* (C753)

Table 5. Sustainable Drainage System (SuDS) Options and Suitability			
Type	Device	Description	Suitability
Source Control	Green roof	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.	Green roofs are not generally suitable for private dwellings within large scale development sites, however, may be suitable for non-residential buildings.
	Infiltration devices	Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground.	Due to the brownfield nature of the development and presence of Made Ground at the former steelworks site, the ground conditions are unsuitable for infiltration drainage.
	Pervious surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water or sewers.	Permeable paving would be suitable for roadways and parking areas within this site. This would allow surface water to be filtered through the paving before being collected underground and connected to attenuation areas.
	Bioretention systems	Shallow landscaped depressions (eg tree pits, rain gardens) generally used for intercepting, managing and treating runoff from frequent rainfall events.	Suitable for use in shared open space. Runoff would be filtered through soils and vegetation and collected in an underdrain system and discharged to attenuation areas.
	Rainwater harvesting	Rainwater harvesting reduces the amount of runoff from a site by re-using the water for non-potable uses.	Rainwater harvesting may potentially be suitable for use within the development.
Permeable Conveyance	Filter strips	These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.	Filter strips may potentially be suitable for use within the development.
	Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff and can infiltrate the water into the ground (if ground conditions allow).	Swales may potentially be suitable for use within land parcels as conveyance and storage. Site ground conditions do not facilitate ground infiltration.
Passive treatment/ end of pipe treatment	Infiltration basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.	Due to the brownfield nature of areas of the development and presence of Made Ground, the ground conditions are unsuitable for infiltration drainage.

Table 5. Sustainable Drainage System (SuDS) Options and Suitability			
Type	Device	Description	Suitability
	Detention basins	Detention basins are depressions which are designed to store runoff prior to discharge to a watercourse or sewer. They may also be landscaped to provide aesthetic and amenity value.	Detention basins are considered to be suitable within areas of open space at the site.
	Wet ponds	Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits.	Wet ponds may potentially be suitable for use within areas of open space at the site.
	Constructed wetlands	Constructed wetlands are ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.	Constructed wetlands may potentially be suitable for use on the site.
	Underground attenuation	Underground attenuation can be used where other forms of SuDS are not appropriate for the site. Underground attenuation stores water for volumes above the allowable discharge rate and releases the water at the restricted discharge rate.	Underground attenuation would be suitable for use on the site and could be used in conjunction with permeable paving. Unlined underground attenuation stores are not considered appropriate.

Surface Water Quality

5.1.14 In accordance with ‘good practice design’ in the SuDS Manual, the quality of surface water runoff will be managed within the proposed development to treat and remove pollutants to protect receiving waters downstream of the site. Treatment will be provided within SuDS features individually or as part of a chain of features forming a treatment ‘train’.

5.1.15 SuDS features provide treatment by ‘velocity control’ (sediment deposition and filtration by the control of velocities within SuDS components) and ‘retention time’ (removal of contaminants through settling, adsorption and other treatment over the time that the water is in contact with the ‘treatment media’ within the SuDS components).

- 5.1.16 SuDS features proposed in the Indicative Surface Water Management Plan which could be incorporated into the drainage strategy for the site include swales, bioretention systems, permeable paving and detention basins.
- 5.1.17 Dividing the proposed development into subcatchments, each with its own drainage network, will allow runoff to be treated closer to the source rather than being conveyed downstream to a single site control feature and will allow more stages of treatment to be incorporated upstream of the discharge point.

6 CONCLUSIONS

- 6.1.1 This report gives details of the Flood Consequence Assessment, which has been carried out in accordance with TAN15. The majority of the site area is located within Zone A, described in TAN15 as an area '*considered to be at little or no risk of fluvial or tidal/coastal flooding*' on the Welsh Government's Development Advice Map. A small section adjacent to the eastern boundary is shown to be located within Zone B described in TAN15 as '*areas known to have been flooded in the past evidenced by sedimentary deposits*'.
- 6.1.2 The proposed development comprises a mixed use of residential and commercial properties and a primary school, along with areas of public open space. In Figure 2 of TAN15, residential developments and public buildings are categorised as 'Highly vulnerable' developments. Commercial and retail developments are categorised as 'Less vulnerable' developments. As the proposed development will be located within Zone A and Zone B the Justification Test, which aims to direct new developments away from land within Zone C, is considered to be passed.
- 6.1.3 Based on the source-pathway-receptor approach, the risk of flooding from fluvial, tidal, groundwater and artificial sources has been discounted as there is considered to be no pathway from the identified sources onto the site.
- 6.1.4 The existing sewer network within the Phoenix Drive access road has been designed as part of earlier works to serve the proposed development at the site and is considered to be suitably-sized to accommodate all flows., The risk of flooding from this source is considered to be Low.
- 6.1.5 Surface water flood risk mapping shows that the majority of the site is at a Very Low or Low risk of surface water flooding. Based on the topography, there are minimal pathways for runoff from higher ground to the west of the site to enter the site area. It is proposed that any overland flows from this area are retained within open ground within the site boundary and are not diverted to off-site areas previously unaffected by surface water runoff.
- 6.1.6 A Flood Management Plan will be implemented to ensure that the risk of flooding to areas downstream of the site is not increased as a result of the development. Surface water runoff will be managed in a sustainable manner. Ground conditions are not appropriate to infiltration due to the unacceptable risk of ground settlement and the potential mobilisation of contaminants. Surface water runoff, therefore, will be

discharged to the culverted watercourse via the existing surface water sewer network at a restricted rate of 742 l/s, as agreed with Welsh Water as part of a previous planning application.

- 6.1.7 The surface water management rationale is based on dividing the site area into six subcatchments each discharging to the wider surface water sewer network at a restricted rate via a flow control device. On-site attenuation will be provided within each subcatchment by Sustainable Drainage Systems (SuDS) features to accommodate flows in exceedance of the discharge rate in extreme storm events up to and including the 1 in 100 year storm event, including an appropriate allowance for climate change. Surface water runoff will be regulated by a system of flow control.
- 6.1.8 On the basis of the findings of this report it is concluded that the flooding consequences to and from the site are negligible and the Justification Test is passed. The site is, therefore, considered suitable for the type of development proposed.

APPENDICES

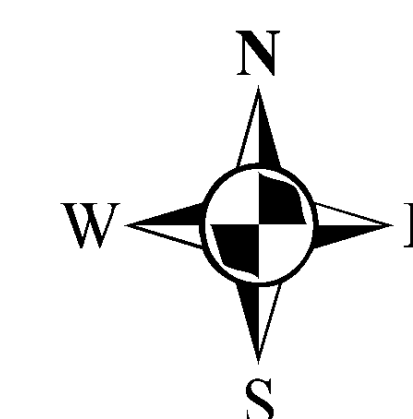
APPENDIX 1

Welsh Water Public Sewer Records



Dŵr Cymru
Welsh Water

Former Brymbo Steelworks



LEGEND(Representative of most common features)

- | | | | |
|---|-------------------------|---|---|
| ● | Foul chamber | ⌋ | Outfall |
| ○ | Surface water chamber | □ | Lamp hole |
| ● | Combined chamber | ⌋ | Storm Overflow |
| ⌋ | Combined sewer overflow | ⌋ | Rising main |
| ⌋ | Special purpose chamber | ⌋ | Gravity sewer |
| ⌋ | Treatment works | ⌋ | Private sewer |
| ⌋ | Pumping station | ⌋ | Private sewer subject to Sect. 104 adoption agreement |
- NB: Sewer symbol colour indicates the type.
RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)
- | | |
|---|------------------------|
| ⌋ | Private Sewer Transfer |
| ⌋ | Lateral Drain |
| ⌋ | Inspection Chamber |

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases, pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

Dŵr Cymru Cyllyngtyd (the Company) gives this information as to the position of the underground apparatus by way of general guidance only and on the basis of the best information available and to the best of its knowledge and belief. The Company is not responsible for any loss or damage to property or for any injury to persons or animals caused by the use of this information. The Company is not responsible for any loss or damage to property or for any injury to persons or animals caused by the use of this information. The Company is not responsible for any loss or damage to property or for any injury to persons or animals caused by the use of this information.

Service pipes are not generally shown but their presence should be anticipated.

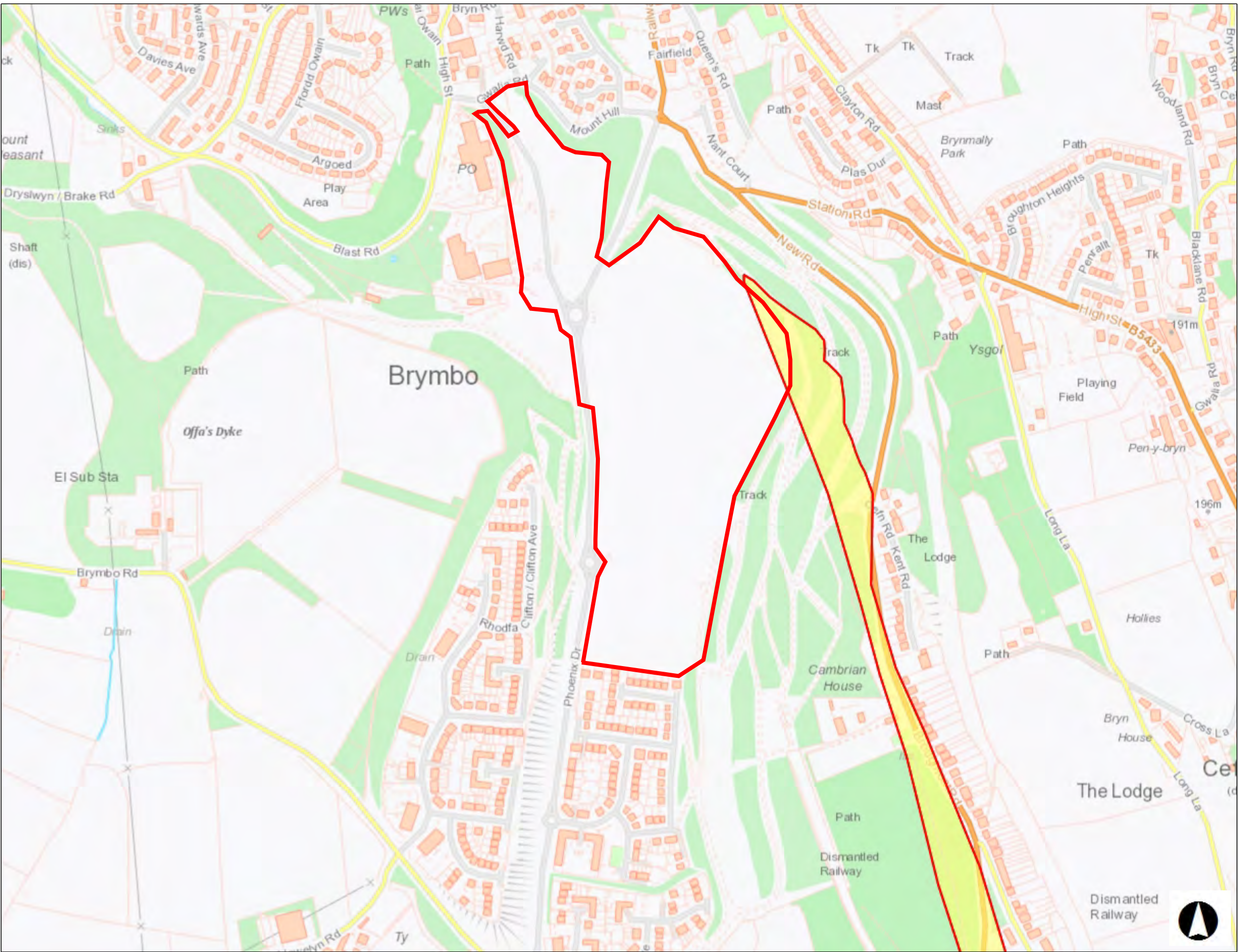
EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

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Map Ref: 329506,353267
Map scale: 1:1250
Printed by: John Emma
Printed on: 20 Sep 2018

APPENDIX 2

TAN15 Development Advice Map



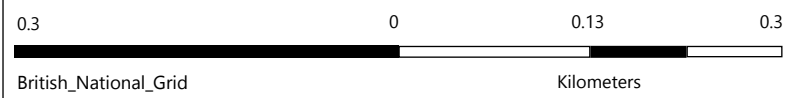
Allwedd / Map Key

Zone C1

Zone C2

Zone B

Zone A



APPENDIX 3

Lead Local Flood Authority Correspondence

Griffiths, Bryn

From: Neil Taunt <Neil.Taunt@wrexham.gov.uk>
Sent: 18 September 2018 12:04
To: Griffiths, Bryn
Cc: Sharon Williams; Matthew Phillips
Subject: RE: Flood Consequence Assessment guidance - Brymbo, Wrexham
Attachments: Former Brymbo Steelworks.pdf; Management of Surface Water Generated from New Dev_E.pdf

Categories: Saved

Good Afternoon Bryn,

In response to your request for flood related information for the above site, I can provide the following comments:

The attached plan outlines the latest flood related information for the site. We hold no specific information relating to flood incidents within the site boundary.

With regards to surface water management for the site I have attached a guidance note detailing the level of information normally required to support any planning application.

In addition to the attached guidance note there is a significant change to drainage requirements will impact new developments from January 2019.

From January 7th 2019, all new developments of at least 2 properties or over 100m² of construction area will require sustainable drainage to manage on-site surface water. The Surface water drainage systems must be designed and built in accordance with national standards for sustainable drainage published by Welsh Ministers. These systems must be approved by the local authority acting in its SuDS Approving Body (SAB) role before construction work begins. The SAB will have a duty to adopt compliant systems that serve more than one property.

Schedule 3 of the Flood and Water Management Act (FWMA) 2010 requires surface water drainage for new developments to comply with mandatory National Standards for sustainable drainage (SuDS). The statutory standards will be published by Welsh Government in the autumn but in the meantime, we recommend that you refer to the Non-Statutory Ministerial National Standards and the CIRIA 753: The SuDS Manual . Schedule 3 also places a duty on local authorities as SuDS Approving Body to approve, adopt and maintain systems compliant with section 17 of the Act. For further information on the legislation, please go to the Schedule 3 of the Flood & Water Management Act.

If you anticipate an application being made after the 7th January 2019, or that any reserved matters or conditions would not be discharged prior to 7th January 2020, you will be required to obtain SAB approval prior to the commencement of any development. If it is likely that SAB approval will be required then consideration of how the development will incorporate sustainable drainage and demonstrate compliance with the nation standards should be made at the earliest possible stage.

Many thanks

Neil

Neil Taunt MCIWEM C.WEM CEnv CSci
Uwch Swyddog Rheoli Llifogydd / Senior Flood Management Officer



☎ 01978 729734 / 07808 787632

✉ Amgylchedd a Chynllunio, Cyngor Bwrdeistref Sirol Wrexham, De Ffordd yr Abaty, Ystad Ddiwydiannol Wrexham, Wrexham LL13 9PW

📄 Environment & Planning, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW

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From: Sharon Williams

Sent: 11 September 2018 14:08

To: Neil Taunt

Cc: bgriffiths@wardell-armstrong.com

Subject: FW: Flood Consequence Assessment guidance - Brymbo, Wrexham

Hi Neil,

Please see email below asking for your comments I would be grateful if you could copy Matthew Phillips in Planning into any response you may have.

Regards

Sharon

Sharon Williams

Business Support Officer (Development Control)



☎ 01978 298785

✉ Cyngor Bwrdeistref Sirol Wrexham, Adran Amgylchedd a Chynllunio, 16 Stryt yr Arglwydd, Wrexham LL11 1LG

📄 Wrexham County Borough Council, Environment and Planning Department, 16 Lord Street, Wrexham LL11 1LG

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From: Griffiths, Bryn [<mailto:bgriffiths@wardell-armstrong.com>]

Sent: 10 September 2018 12:46

To: planning

Subject: Flood Consequence Assessment guidance - Brymbo, Wrexham

Good afternoon,

I am working on a Flood Consequence Assessment for a mixed commercial and residential development at the former Brymbo Steelworks in Brymbo, Wrexham, LL11 5BT – approximate grid reference 329743, 353316, (see attached Development Advice Map). As shown on the Development Advice Map, the majority of the site is located within Zone A, with a small area within Zone B, which appears to coincide with a section of alluvial deposits in this area.

In order to assist with the assessment, I would welcome any pre-planning comments that you wish to make with respect to flood risk and drainage at the site. In particular, if you have any local knowledge of historic flood incidents or drainage problems with respect to ordinary watercourses, surface water and groundwater, I would be grateful if you could comment. I would also be grateful for any advice on local guidance and policies relating to surface water management/SuDS in this area.

Please let me know if you require any further information to assist you. Also, if this is not the correct department to contact with this enquiry it would be very much appreciated if you could forward this on to the team able to advise on this request.

Regards,
Bryn

Bryn Griffiths | Senior Environmental Scientist
Wardell Armstrong LLP
Sir Henry Doulton House, Forge Lane, Etruria, Staffordshire, UK
t: 01782 276700 m: 07469 856653



Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn www.wreccsam.gov.uk. Arbedwch bapur - meddylwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad ydy cyfeirir atynt yn unig. Am yr amodau llawn ynglŷn ? chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at www.wreccsam.gov.uk/top_navigation/disclaimersw.htm

We welcome correspondence in Welsh. We will respond to any correspondence in Welsh and this will not lead to any delay.

Take a look - you can pay, report, request, have your say and find information online at www.wrexham.gov.uk. Save paper - think before you print!

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Legend

★ Flood Events to date Symology

— Main River

— Ordinary Watercourse

DAM

Zone_B

Zone_C1

Zone_C2

Surface Water

1 in 30

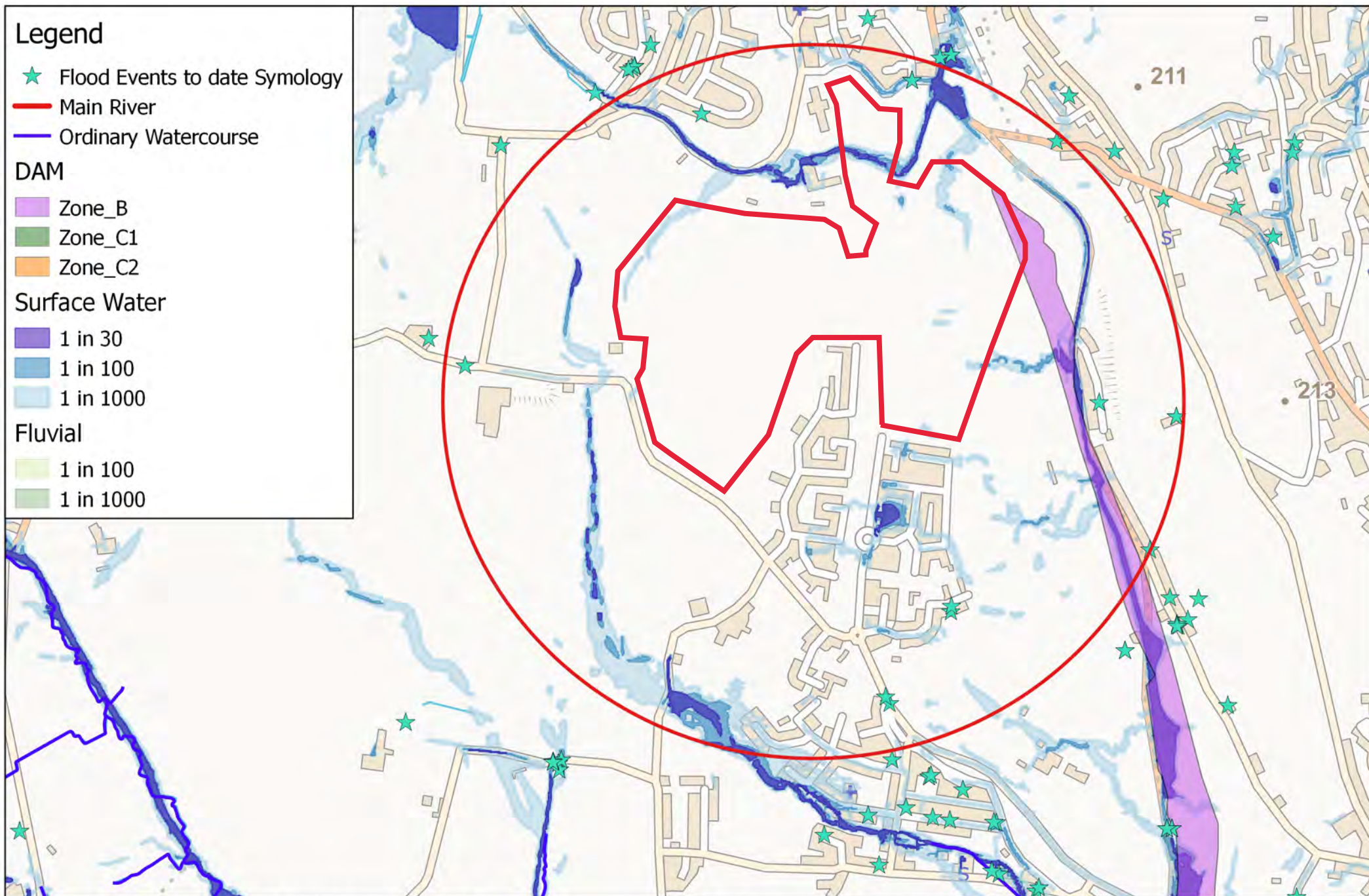
1 in 100

1 in 1000

Fluvial

1 in 100

1 in 1000



Former Brymbo Steelworks in Brymbo, Wrexham, LL11 5BT

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Griffiths, Bryn

From: Neil Taunt <Neil.Taunt@wrexham.gov.uk>
Sent: 11 October 2018 07:47
To: Griffiths, Bryn
Subject: RE: Flood Consequence Assessment guidance - Brymbo, Wrexham

Categories: Saved

Hi Bryn,

We normally accept a minimum 30% increase unless a more appropriate figure can be evidenced as being appropriate.

Thanks

Neil

From: Griffiths, Bryn [mailto:bgriffiths@wardell-armstrong.com]
Sent: 09 October 2018 11:11
To: Neil Taunt
Subject: RE: Flood Consequence Assessment guidance - Brymbo, Wrexham

Hi Neil,

Thank you for the information provided last month. I have also been consulting with Natural Resources Wales as part of my FCA. One thing I was looking for clarification on to assist with designing suitably-sized SuDS features for the drainage strategy is the a climate change allowance to use in runoff calculations. My experience is primarily in Flood Risk Assessments in England where we would apply an allowance of 40% to models based on guidance in the February 2016 "Flood risk assessments: climate change allowances" report. The reports states this is only applicable to English sites.

I have been on the Welsh Government website "CL-03-16 - Climate change allowances for Planning purposes" and looked at the report "Flood Consequence Assessments: Climate change allowances". This gives allowances for river flow and sea level height but not for rainfall intensity. I spoke with Daniel Davies at NRW but he said that they do not have a specific allowance for rainfall intensity to be applied to calculations, but he advised me to speak with yourself to see if the LLFA in the Wrexham area has a preferred rainfall intensity percentage to apply in an FCA for a residential development.

Regards,

Bryn

Bryn Griffiths | Senior Environmental Scientist
Wardell Armstrong LLP
Sir Henry Doulton House, Forge Lane, Etruria, Staffordshire, UK
t: 01782 276700 m: 07469 856653



From: Neil Taunt <Neil.Taunt@wrexham.gov.uk>
Sent: 18 September 2018 12:04
To: Griffiths, Bryn <bgriffiths@wardell-armstrong.com>
Cc: Sharon Williams <Sharon.Williams@wrexham.gov.uk>; Matthew Phillips <Matthew.Phillips@wrexham.gov.uk>
Subject: RE: Flood Consequence Assessment guidance - Brymbo, Wrexham

Good Afternoon Bryn,

In response to your request for flood related information for the above site, I can provide the following comments:

The attached plan outlines the latest flood related information for the site. We hold no specific information relating to flood incidents within the site boundary.

With regards to surface water management for the site I have attached a guidance note detailing the level of information normally required to support any planning application.

In addition to the attached guidance note there is a significant change to drainage requirements will impact new developments from January 2019.

From January 7th 2019, all new developments of at least 2 properties or over 100m² of construction area will require sustainable drainage to manage on-site surface water. The Surface water drainage systems must be designed and built in accordance with national standards for sustainable drainage published by Welsh Ministers. These systems must be approved by the local authority acting in its SuDS Approving Body (SAB) role before construction work begins. The SAB will have a duty to adopt compliant systems that serve more than one property.

Schedule 3 of the Flood and Water Management Act (FWMA) 2010 requires surface water drainage for new developments to comply with mandatory National Standards for sustainable drainage (SuDS). The statutory standards will be published by Welsh Government in the autumn but in the meantime, we recommend that you refer to the Non-Statutory Ministerial National Standards and the CIRIA 753: The SuDS Manual . Schedule 3 also places a duty on local authorities as SuDS Approving Body to approve, adopt and maintain systems compliant with section 17 of the Act. For further information on the legislation, please go to the Schedule 3 of the Flood & Water Management Act.

If you anticipate an application being made after the 7th January 2019, or that any reserved matters or conditions would not be discharged prior to 7th January 2020, you will be required to obtain SAB approval prior to the commencement of any development. If it is likely that SAB approval will be required then consideration of how the development will incorporate sustainable drainage and demonstrate compliance with the nation standards should be made at the earliest possible stage.

Many thanks

Neil

Neil Taunt MCIWEM C.WEM CEnv CSci

Uwch Swyddog Rheoli Llifogydd / Senior Flood Management Officer



☎ 01978 729734 / 07808 787632

✉ Amgylchedd a Chynllunio, Cyngor Bwrdeistref Sirol Wreccsam, De Ffordd yr Abaty, Ystad Ddiwydiannol Wreccsam, Wreccsam LL13 9PW

✉ Environment & Planning, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW

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From: Sharon Williams
Sent: 11 September 2018 14:08
To: Neil Taunt
Cc: bgriffiths@wardell-armstrong.com
Subject: FW: Flood Consequence Assessment guidance - Brymbo, Wrexham

Hi Neil,

Please see email below asking for your comments I would be grateful if you could copy Matthew Phillips in Planning into any response you may have.

Regards

Sharon

Sharon Williams
Business Support Officer (Development Control)



01978 298785
Cyngor Bwrdeistref Sirol Wrexham, Adran Amgylchedd a Chynllunio, 16 Stryt yr Arglwydd, Wrexham LL11 1LG
Wrexham County Borough Council, Environment and Planning Department, 16 Lord Street, Wrexham LL11 1LG
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From: Griffiths, Bryn [<mailto:bgriffiths@wardell-armstrong.com>]
Sent: 10 September 2018 12:46
To: planning
Subject: Flood Consequence Assessment guidance - Brymbo, Wrexham

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Click [here](#) if the original attachments are required (justification needed).

Good afternoon,

I working on a Flood Consequence Assessment for a mixed commercial and residential development at the former Brymbo Steelworks in Brymbo, Wrexham, LL11 5BT – approximate grid reference 329743, 353316, (see attached Development Advice Map). As shown on the Development Advice Map, the majority of the site is located within Zone A, with a small area within Zone B, which appears to coincide with a section of alluvial deposits in this area.

In order to assist with the assessment, I would welcome any pre-planning comments that you wish to make with respect to flood risk and drainage at the site. In particular, if you have any local knowledge of historic flood

incidents or drainage problems with respect to ordinary watercourses, surface water and groundwater, I would be grateful if you could comment. I would also be grateful for any advice on local guidance and policies relating to surface water management/SuDS in this area.

Please let me know if you require any further information to assist you. Also, if this is not the correct department to contact with this enquiry it would be very much appreciated if you could forward this on the team able to advise on this request.

Regards,
Bryn

Bryn Griffiths | Senior Environmental Scientist
Wardell Armstrong LLP
Sir Henry Doulton House, Forge Lane, Etruria, Staffordshire, UK
t: 01782 276700 m: 07469 856653



Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn www.wreccsam.gov.uk. Arbedwch bapur - meddylwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad y'i cyfeirir atynt yn unig. Am yr amodau llawn ynglŷn ? chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at www.wreccsam.gov.uk/top_navigation/disclaimersw.htm

We welcome correspondence in Welsh. We will respond to any correspondence in Welsh and this will not lead to any delay.

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APPENDIX 4

Drainage Network Modelling

URS Infrastructure & Environment UK Ltd		Page 0
Scott House Alencon Link Basingstoke RG21 7PP		
Date 05/10/2015 12:32 File No D Road ModelA flow a...	Designed by 32961sjc Checked by	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for NO D ROAD MODELA.SWS

Pipe Sizes NO D ROAD MODELA Manhole Sizes NO D ROAD MODELA

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	10
M5-60 (mm)	18.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.322	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	0.75
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for NO D ROAD MODELA.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S1.000	70.724	1.469	48.1	0.128	5.00	0.0	0.600	0	225	
S1.001	55.001	0.917	60.0	0.103	0.00	0.0	0.600	0	225	
S2.000	24.540	0.282	87.0	0.062	5.00	0.0	0.600	0	225	
S1.002	51.978	0.711	73.1	0.108	0.00	0.0	0.600	0	300	
S1.003	35.591	0.487	73.1	0.039	0.00	0.0	0.600	0	300	
S1.004	65.542	0.906	72.3	0.101	0.00	0.0	0.600	0	300	
S3.004	15.217	0.076	200.2	0.000	0.00	0.0	0.600	0	300	
S1.005	55.431	1.500	37.0	0.060	0.00	0.0	0.600	0	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	0.00	5.62	200.113	0.128	0.0	0.0	0.0	1.89	75.1	0.0
S1.001	0.00	6.17	198.644	0.231	0.0	0.0	0.0	1.69	67.3	0.0
S2.000	0.00	5.29	198.009	0.062	0.0	0.0	0.0	1.40	55.8	0.0
S1.002	0.00	6.64	197.652	0.401	0.0	0.0	0.0	1.84	130.1	0.0
S1.003	0.00	6.96	196.941	0.440	0.0	0.0	0.0	1.84	130.2	0.0
S1.004	0.00	7.55	196.454	0.541	0.0	0.0	0.0	1.85	130.8	0.0
S3.004	0.00	6.48	195.624	1.900	0.0	0.0	0.0	1.11	78.3	0.0
S1.005	0.00	7.90	195.548	2.501	0.0	0.0	0.0	2.59	183.4	0.0

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Network Design Table for NO D ROAD MODELA.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S4.005	15.059	0.075	200.8	0.000	0.00	0.0	0.600	o	300	
S5.002	14.360	0.084	171.0	0.000	0.00	0.0	0.600	o	225	
S1.006	68.961	0.575	119.9	0.098	0.00	0.0	0.600	o	525	
S1.007	38.127	0.379	100.6	0.070	0.00	0.0	0.600	o	675	
S6.000	26.414	2.247	11.8	0.062	5.00	0.0	0.600	o	225	
S7.005	10.515	1.945	5.4	0.000	0.00	0.0	0.600	o	225	
S6.001	31.534	1.757	17.9	0.037	0.00	0.0	0.600	o	225	
S6.002	36.208	2.017	18.0	0.074	0.00	0.0	0.600	o	225	
S6.003	40.412	2.251	18.0	0.042	0.00	0.0	0.600	o	225	
S6.004	30.619	1.480	20.7	0.043	0.00	0.0	0.600	o	225	
S8.005	16.767	0.099	169.4	0.000	0.00	0.0	0.600	o	225	
S6.005	73.915	0.863	85.6	0.104	0.00	0.0	0.600	o	375	
S9.005	16.991	0.085	199.9	0.000	0.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	
S4.005	0.00	7.74	194.123	0.355		0.0	0.0	0.0	1.11	78.2	0.0
S5.002	0.00	5.49	194.207	0.300		0.0	0.0	0.0	1.00	39.6	0.0
S1.006	0.00	8.47	193.823	3.254		0.0	0.0	0.0	2.04	442.5	0.0
S1.007	0.00	8.71	193.098	3.324		0.0	0.0	0.0	2.61	935.1	0.0
S6.000	0.00	5.11	205.144	0.062		0.0	0.0	0.0	3.84	152.6	0.0
S7.005	0.00	5.58	204.842	0.498		0.0	0.0	0.0	5.67	225.3	0.0
S6.001	0.00	5.75	202.897	0.597		0.0	0.0	0.0	3.10	123.4	0.0
S6.002	0.00	5.95	201.140	0.671		0.0	0.0	0.0	3.10	123.4	0.0
S6.003	0.00	6.16	199.123	0.713		0.0	0.0	0.0	3.10	123.4	0.0
S6.004	0.00	6.34	196.872	0.756		0.0	0.0	0.0	2.89	114.9	0.0
S8.005	0.00	6.17	195.491	0.200		0.0	0.0	0.0	1.00	39.8	0.0
S6.005	0.00	6.97	195.242	1.060		0.0	0.0	0.0	1.96	216.4	0.0
S9.005	0.00	6.29	194.539	0.520		0.0	0.0	0.0	1.11	78.3	0.0

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Network Design Table for NO D ROAD MODELA.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S1.021	26.061	0.052	501.2	0.081	0.00	0.0	0.600	0	900	
S1.022	24.978	0.624	40.0	0.000	0.00	0.0	0.600	0	925	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.021	0.00	10.46	169.727	6.374	0.0	0.0	0.0	1.39	886.0	0.0
S1.022	0.00	10.54	169.650	6.374	0.0	0.0	0.0	5.05	3390.3	0.0

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Simulation Criteria for NO D ROAD MODELA.SWS

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	8	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.322		

Summary of Results for 30 minute 2 year Winter (NO D ROAD MODELA.SWS)

	PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	
			Level (m)	Depth (m)	Volume (m³)			Flow (l/s)		
Catchment A	S1.000	S1	200.183	-0.155	0.000	0.21	0.0	15.3	OK	
	S1.001	S2	198.745	-0.124	0.000	0.41	0.0	26.6	OK	
	S2.000	S3	198.066	-0.168	0.000	0.15	0.0	7.5	OK	
	S1.002	S4	197.779	-0.173	0.000	0.37	0.0	45.8	OK	
	S1.003	S5	197.076	-0.165	0.000	0.42	0.0	49.8	OK	
	S1.004	S6	196.602	-0.152	0.000	0.48	0.0	60.5	OK	
	S3.000	S7	196.399	-1.475	0.000	0.01	0.0	55.8	OK	
	S3.001	S57	196.399	-1.317	0.000	0.02	0.0	75.6	OK	
	S3.002	S58	196.398	-1.182	0.000	0.02	0.0	79.7	OK	
	S3.003	S60	196.396	-1.068	0.000	0.03	0.0	84.1	OK	
	S3.004	S59	196.395	0.471	0.000	1.16	0.0	76.5	SURCHARGED	
Catchment B	S1.005	S8	195.750	-0.098	0.000	0.79	0.0	136.8	OK	
	S4.000	S9	194.724	-0.674	0.000	0.02	0.0	8.5	OK	
	S4.001	S65	194.657	-0.663	0.000	0.03	0.0	16.0	OK	
	S4.002	S61	194.507	-0.634	0.000	0.04	0.0	22.3	OK	
	S4.003	S62	194.443	-0.542	0.000	0.05	0.0	24.0	OK	
	S4.004	S63	194.436	-0.461	0.000	0.08	0.0	25.2	OK	
		S4.005	S64	194.434	0.011	0.000	0.37	0.0	24.5	SURCHARGED
	S5.000	S10	194.922	-0.863	0.000	0.01	0.0	22.1	OK	
	S5.001	S134	194.922	-0.823	0.000	0.01	0.0	18.7	OK	
	S5.002	S135	194.922	0.490	0.000	0.15	0.0	5.2	SURCHARGED	
	S1.006	S11	194.062	-0.286	0.000	0.43	0.0	172.9	OK	
	S1.007	S12	193.325	-0.448	0.000	0.23	0.0	179.1	OK	
	S6.000	S13	205.177	-0.192	0.000	0.05	0.0	7.5	OK	
	S7.000	S14	212.464	-0.741	0.000	0.02	0.0	20.0	OK	
	S7.001	S66	212.273	-0.713	0.000	0.05	0.0	38.4	OK	
	S7.002	S67	212.115	-0.668	0.000	0.06	0.0	56.7	OK	
	S7.003	S68	212.093	0.160	0.000	0.33	0.0	50.2	SURCHARGED	
	S7.004	S69	211.943	3.540	0.000	0.20	0.0	37.9	SURCHARGED	
	S7.005	S70	204.910	-0.157	0.000	0.20	0.0	37.9	OK	
	S6.001	S15	202.998	-0.124	0.000	0.42	0.0	48.3	OK	
Catchment D	S6.002	S16	201.251	-0.114	0.000	0.48	0.0	56.5	OK	
	S6.003	S17	199.239	-0.109	0.000	0.52	0.0	61.1	OK	
	S6.004	S18	197.000	-0.097	0.000	0.61	0.0	65.9	OK	
	S8.000	S19	195.821	-0.708	0.000	0.01	0.0	4.8	OK	
	S8.001	S71	195.788	-0.638	0.000	0.02	0.0	8.4	OK	
	S8.002	S72	195.786	-0.582	0.000	0.02	0.0	11.1	OK	
	S8.003	S73	195.785	-0.518	0.000	0.03	0.0	12.5	OK	
	S8.004	S74	195.783	-0.477	0.000	0.04	0.0	14.3	OK	
		S8.005	S75	195.783	0.067	0.000	0.40	0.0	14.0	SURCHARGED
	S6.005	S20	195.416	-0.201	0.000	0.44	0.0	89.5	OK	
S9.000	S21	194.935	-1.093	0.000	0.01	0.0	12.1	OK		
S9.001	S76	194.926	-0.987	0.000	0.02	0.0	19.1	OK		
S9.002	S77	194.925	-0.966	0.000	0.02	0.0	28.9	OK		
S9.003	S78	194.921	-0.859	0.000	0.04	0.0	28.6	OK		
S9.004	S79	194.920	-0.840	0.000	0.05	0.0	36.4	OK		

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Summary of Results for 30 minute 2 year Winter (NO D ROAD MODELA.SWS)

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S9.005	S80	194.919	0.080	0.000	0.53	0.0	35.6	SURCHARGED
S6.006	S22	194.508	-0.246	0.000	0.42	0.0	128.8	OK
S6.007	S23	194.075	-0.272	0.000	0.33	0.0	134.9	OK
S1.008	S24	193.213	-0.181	0.000	1.04	0.0	312.7	OK
S1.009	S44	193.158	-0.213	0.000	0.86	0.0	319.8	OK
S1.010	S45	192.996	-0.332	0.000	0.60	0.0	319.9	OK
S1.011	S46	192.979	-0.152	0.000	0.91	0.0	324.6	OK
S1.012	S47	192.759	-0.245	0.000	0.66	0.0	326.0	OK
S1.013	S47A	192.353	-0.406	0.000	0.23	0.0	328.8	OK
S10.000	S140	192.667	-0.536	0.000	0.01	0.0	3.7	OK
S10.001	S122	192.651	-0.498	0.000	0.03	0.0	6.9	OK
S10.002	S123	192.648	-0.485	0.000	0.05	0.0	10.2	OK
S10.003	S124	192.637	-0.458	0.000	0.08	0.0	16.4	OK
S10.004	S125	192.626	-0.063	0.000	0.12	0.0	14.8	OK
Catchment E S10.005	S126	192.613	0.641	0.000	0.09	0.0	13.1	SURCHARGED
S1.014	S48	190.205	-0.406	0.000	0.23	0.0	344.0	OK
S1.015	S49	187.950	-0.424	0.000	0.19	0.0	347.5	OK
S11.000	S50	190.145	-1.396	0.000	0.00	0.0	10.9	OK
S11.001	S127	190.136	-1.344	0.000	0.01	0.0	31.2	OK
S11.002	S128	190.106	-1.310	0.000	0.03	0.0	51.4	OK
S11.003	S129	190.073	-1.312	0.000	0.04	0.0	71.6	OK
S11.004	S130	189.917	-1.423	0.000	0.01	0.0	71.3	OK
S11.005	S131	188.801	-1.433	0.000	0.01	0.0	71.4	OK
S11.006	S132	187.768	-0.976	0.000	0.01	0.0	66.3	OK
Catchment F S11.007	S133	187.768	1.239	0.000	0.15	0.0	43.5	SURCHARGED
S1.016	S51	184.253	-0.419	0.000	0.20	0.0	394.7	OK
S1.017	S52	177.418	-0.394	0.000	0.26	0.0	396.6	OK
S1.018	S53	175.036	-0.397	0.000	0.25	0.0	399.2	OK
S1.019	S54	172.594	-0.300	0.000	0.50	0.0	400.9	OK
S1.020	S55	172.053	-0.201	0.000	0.78	0.0	400.7	OK
S1.021	S56	170.252	-0.375	0.000	0.64	0.0	404.4	OK
S1.022	S200	169.940	-0.635	0.000	0.22	0.0	404.9	OK

Catchment C not modelled

Summary of Results for 30 minute 30 year Winter (NO D ROAD MODELA.SWS)

			Water	Surcharged	Flooded			Pipe	
		US/MH	Level	Depth	Volume	Flow /	Overflow	Flow	
	PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Status
Catchment A	S1.000	S1	200.212	-0.126	0.000	0.40	0.0	29.1	OK
	S1.001	S2	198.800	-0.069	0.000	0.81	0.0	52.4	OK
	S2.000	S3	198.089	-0.145	0.000	0.28	0.0	14.2	OK
	S1.002	S4	197.846	-0.106	0.000	0.74	0.0	90.5	OK
	S1.003	S5	197.179	-0.062	0.000	0.82	0.0	98.1	OK
	S1.004	S6	196.887	0.133	0.000	0.90	0.0	111.8	SURCHARGED
Catchment B	S3.004	S59	196.827	0.903	0.000	1.54	0.0	101.1	SURCHARGED
	S1.005	S8	196.185	0.337	0.000	1.11	0.0	192.8	SURCHARGED
Catchment B	S4.005	S64	194.618	0.195	0.000	0.50	0.0	32.8	SURCHARGED
	S5.002	S135	195.404	0.972	0.000	0.20	0.0	6.8	SURCHARGED
Catchment D	S1.006	S11	194.119	-0.229	0.000	0.60	0.0	245.2	OK
	S1.007	S12	193.457	-0.316	0.000	0.33	0.0	256.9	OK
	S6.000	S13	205.192	-0.177	0.000	0.10	0.0	14.2	OK
	S7.005	S70	204.912	-0.155	0.000	0.22	0.0	40.7	OK
	S6.001	S15	203.015	-0.107	0.000	0.54	0.0	61.9	OK
	S6.002	S16	201.277	-0.088	0.000	0.68	0.0	79.0	OK
	S6.003	S17	199.271	-0.077	0.000	0.76	0.0	88.7	OK
	S6.004	S18	197.042	-0.055	0.000	0.92	0.0	98.8	OK
	S8.005	S75	195.963	0.247	0.000	0.53	0.0	18.7	SURCHARGED
	S6.005	S20	195.469	-0.148	0.000	0.67	0.0	138.2	OK
Catchment D	S9.005	S80	195.167	0.328	0.000	0.73	0.0	48.5	SURCHARGED
	S6.006	S22	194.561	-0.193	0.000	0.62	0.0	188.9	OK
	S6.007	S23	194.120	-0.227	0.000	0.49	0.0	201.2	OK
	S1.008	S24	193.411	0.017	0.000	1.52	0.0	456.9	SURCHARGED
	S1.009	S44	193.371	0.000	0.000	1.28	0.0	474.4	OK
	S1.010	S45	193.245	-0.083	0.000	0.88	0.0	472.9	OK
	S1.011	S46	193.208	0.077	0.000	1.35	0.0	482.7	SURCHARGED
	S1.012	S47	192.879	-0.125	0.000	0.98	0.0	488.0	OK
	S1.013	S47A	192.402	-0.357	0.000	0.35	0.0	495.0	OK
	S10.005	S126	192.855	0.883	0.000	0.11	0.0	14.8	SURCHARGED
Catchment E	S1.014	S48	190.253	-0.358	0.000	0.34	0.0	515.2	OK
	S1.015	S49	187.992	-0.382	0.000	0.28	0.0	522.6	OK
Catchment F	S11.007	S133	189.330	2.801	0.000	0.21	0.0	62.4	SURCHARGED
	S1.016	S51	184.295	-0.377	0.000	0.30	0.0	589.1	OK
Catchment F	S1.017	S52	177.470	-0.342	0.000	0.38	0.0	592.1	OK
	S1.018	S53	175.087	-0.346	0.000	0.37	0.0	598.2	OK
	S1.019	S54	172.687	-0.207	0.000	0.75	0.0	602.6	OK
	S1.020	S55	172.323	0.069	0.000	1.17	0.0	603.2	SURCHARGED
	S1.021	S56	170.430	-0.197	0.000	0.96	0.0	609.0	OK
	S1.022	S200	170.012	-0.563	0.000	0.32	0.0	610.9	OK

Catchment C not modelled

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<u>Simulation Criteria for NO D ROAD MODELA.SWS</u> <table> <tr> <td>Volumetric Runoff Coeff</td> <td>0.840</td> <td>Additional Flow - % of Total Flow</td> <td>20.000</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.000</td> <td>MADD Factor * 10m³/ha Storage</td> <td>0.000</td> </tr> <tr> <td>Hot Start (mins)</td> <td>0</td> <td>Inlet Coefficient</td> <td>0.800</td> </tr> <tr> <td>Hot Start Level (mm)</td> <td>0</td> <td>Flow per Person per Day (l/per/day)</td> <td>0.000</td> </tr> <tr> <td>Manhole Headloss Coeff (Global)</td> <td>0.500</td> <td>Run Time (mins)</td> <td>60</td> </tr> <tr> <td>Foul Sewage per hectare (l/s)</td> <td>0.000</td> <td>Output Interval (mins)</td> <td>1</td> </tr> </table> <table> <tr> <td>Number of Input Hydrographs</td> <td>0</td> <td>Number of Storage Structures</td> <td>0</td> </tr> <tr> <td>Number of Online Controls</td> <td>8</td> <td>Number of Time/Area Diagrams</td> <td>0</td> </tr> <tr> <td>Number of Offline Controls</td> <td>1</td> <td>Number of Real Time Controls</td> <td>0</td> </tr> </table> <u>Synthetic Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Profile Type</td> <td>Winter</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>18.000</td> <td>Storm Duration (mins)</td> <td>30</td> </tr> <tr> <td>Ratio R</td> <td>0.322</td> <td></td> <td></td> </tr> </table>			Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	20.000	Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000	Hot Start (mins)	0	Inlet Coefficient	0.800	Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000	Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60	Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1	Number of Input Hydrographs	0	Number of Storage Structures	0	Number of Online Controls	8	Number of Time/Area Diagrams	0	Number of Offline Controls	1	Number of Real Time Controls	0	Rainfall Model	FSR	Profile Type	Winter	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	18.000	Storm Duration (mins)	30	Ratio R	0.322		
Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	20.000																																																							
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Summary of Results for 30 minute 100 year Winter (NO D ROAD MODELA.SWS)

	PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe	Status
								Flow (l/s)	
Catchment A	S1.000	S1	200.249	-0.089	0.000	0.62	0.0	45.5	OK
	S1.001	S2	199.861	0.992	0.000	1.06	0.0	68.5	SURCHARGED
	S2.000	S3	198.978	0.744	0.000	0.39	0.0	20.2	SURCHARGED
	S1.002	S4	198.941	0.989	0.000	0.90	0.0	110.8	SURCHARGED
	S1.003	S5	198.376	1.135	0.000	0.98	0.0	117.7	SURCHARGED
	S1.004	S6	197.909	1.155	0.000	1.14	0.0	141.8	SURCHARGED
	S3.004	S59	197.429	1.505	0.000	1.91	0.0	125.9	FLOOD RISK
	S1.005	S8	196.760	0.912	0.000	1.27	0.0	220.6	SURCHARGED
Catchment B	S4.005	S64	194.813	0.390	0.000	0.59	0.0	39.0	SURCHARGED
	S5.002	S135	197.133	2.701	0.000	0.31	0.0	10.7	FLOOD RISK
Catchment D	S1.006	S11	194.148	-0.200	0.000	0.70	0.0	282.8	OK
	S1.007	S12	193.670	-0.103	0.000	0.39	0.0	300.5	OK
	S6.000	S13	205.203	-0.166	0.000	0.16	0.0	22.2	OK
	S7.005	S70	204.916	-0.151	0.000	0.24	0.0	44.6	OK
	S6.001	S15	203.032	-0.090	0.000	0.66	0.0	76.7	OK
	S6.002	S16	201.334	-0.031	0.000	0.88	0.0	102.7	OK
	S6.003	S17	199.833	0.485	0.000	0.97	0.0	114.0	SURCHARGED
	S6.004	S18	197.701	0.604	0.000	1.19	0.0	127.4	SURCHARGED
	S8.005	S75	196.178	0.462	0.000	0.65	0.0	23.0	SURCHARGED
	S6.005	S20	195.517	-0.100	0.000	0.88	0.0	180.6	OK
Catchment E	S9.005	S80	195.435	0.596	0.000	0.88	0.0	59.0	SURCHARGED
	S6.006	S22	194.613	-0.141	0.000	0.81	0.0	247.0	OK
	S6.007	S23	194.162	-0.185	0.000	0.65	0.0	265.2	OK
	S1.008	S24	193.614	0.220	0.000	1.83	0.0	551.1	SURCHARGED
	S1.009	S44	193.556	0.185	0.000	1.53	0.0	570.4	SURCHARGED
	S1.010	S45	193.468	0.140	0.000	1.06	0.0	571.1	SURCHARGED
	S1.011	S46	193.415	0.284	0.000	1.63	0.0	583.3	SURCHARGED
	S1.012	S47	193.075	0.071	0.000	1.19	0.0	588.6	SURCHARGED
	S1.013	S47A	192.429	-0.330	0.000	0.42	0.0	597.5	OK
	S10.005	S126	193.239	1.267	0.000	0.12	0.0	17.3	SURCHARGED
Catchment F	S1.014	S48	190.280	-0.331	0.000	0.41	0.0	621.8	OK
	S1.015	S49	188.017	-0.357	0.000	0.34	0.0	632.1	OK
	S11.007	S133	190.491	3.962	0.000	0.25	0.0	72.6	SURCHARGED
	S1.016	S51	184.321	-0.351	0.000	0.36	0.0	717.6	OK
	S1.017	S52	177.501	-0.311	0.000	0.47	0.0	723.7	OK
	S1.018	S53	175.118	-0.315	0.000	0.46	0.0	732.9	OK
	S1.019	S54	173.050	0.156	0.000	0.92	0.0	738.4	SURCHARGED
	S1.020	S55	172.505	0.251	0.000	1.44	0.0	738.8	SURCHARGED
	S1.021	S56	170.627	0.000	0.000	1.19	0.0	755.4	OK
	S1.022	S200	170.057	-0.518	0.000	0.40	0.0	755.8	OK

Catchment C not modelled

APPENDIX 5

Surface Water Attenuation Calculations

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall A 1 in 30 year and 1 in 100 year storm event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	☒ 0.750
Winter CV	☒ 0.840
Analysis Speed	Normal
Skip Steady State	☐
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
☒ Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
☐ Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	1.650
Peak Discharge (l/s)	101.100
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	125
to	261
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	1.650
Peak Discharge (l/s)	125.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	264
to	532
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 193m³ of storage would be required to attenuate for the 1 in 30 year storm event and 398m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall B 1 in 30 year and 1 in 100 year event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	☒ 0.750
Winter CV	☒ 0.840
Analysis Speed	Normal
Skip Steady State	☐
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
☒ Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
☐ Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	1.440
Peak Discharge (l/s)	32.800
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	203
to	366
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	1.440
Peak Discharge (l/s)	39.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	424
to	713
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 285m³ of storage would be required to attenuate for the 1 in 30 year storm event and 569m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall C 1 in 30 year and 1 in 100 year storm event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	☒ 0.750
Winter CV	☒ 0.840
Analysis Speed	Normal
Skip Steady State	☐
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
☒ Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
☐ Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	0.960
Peak Discharge (l/s)	6.800
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	241
to	393
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	0.960
Peak Discharge (l/s)	10.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	431
to	672
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 317m³ of storage would be required to attenuate for the 1 in 30 year storm event and 552m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
CALCULATION		CALC. BY:	APPROVED BY:
Attenuation Calculation - Outfall D 1 in 30 year and 1 in 100 year storm event		(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
		P Maddock	
		DATE: 12/02/2020	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	☒ 0.750
Winter CV	☒ 0.840
Analysis Speed	Normal
Skip Steady State	☐
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
☒ Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
☐ Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	0.370
Peak Discharge (l/s)	18.700
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	32
to	65
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	0.370
Peak Discharge (l/s)	22.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	70
to	134
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 49m³ of storage would be required to attenuate for the 1 in 30 year storm event and 102m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall E 1 in 30 year and 1 in 100 year storm event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	☒ 0.750
Winter CV	☒ 0.840
Analysis Speed	Normal
Skip Steady State	☐
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
☒ Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
☐ Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	0.390
Peak Discharge (l/s)	14.800
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	41
to	79
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	0.390
Peak Discharge (l/s)	17.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	88
to	161
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 60m³ of storage would be required to attenuate for the 1 in 30 year storm event and 125m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall F 1 in 30 year and 1 in 100 year storm event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	☒ 0.750
Winter CV	☒ 0.840
Analysis Speed	Normal
Skip Steady State	☐
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
☒ Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
☐ Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

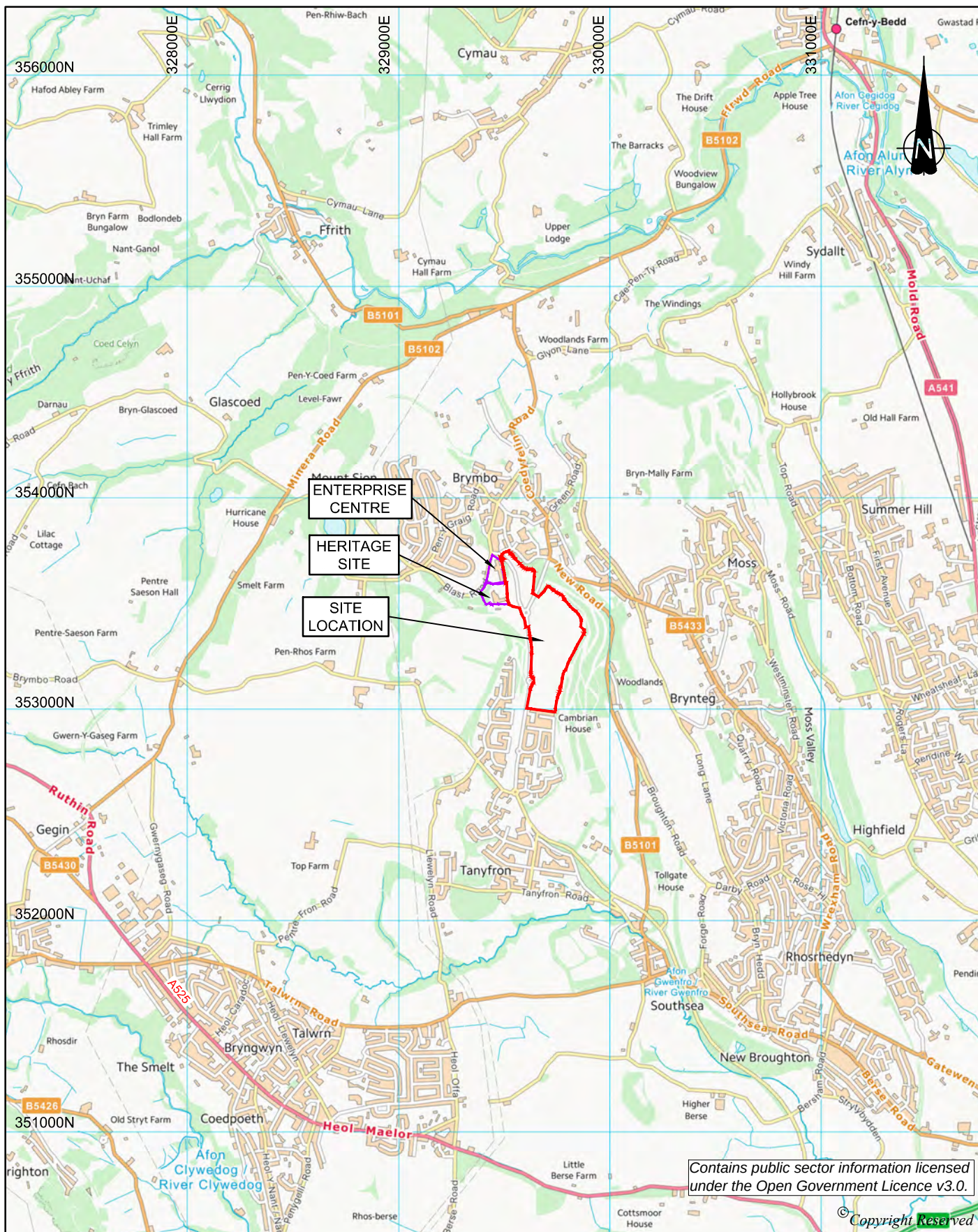
Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	0.360
Peak Discharge (l/s)	62.400
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	9
to	31
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	0.360
Peak Discharge (l/s)	72.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	25
to	68
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 20m³ of storage would be required to attenuate for the 1 in 30 year storm event and 47m³ of storage would be required to attenuate for the 1 in 100 year storm event.

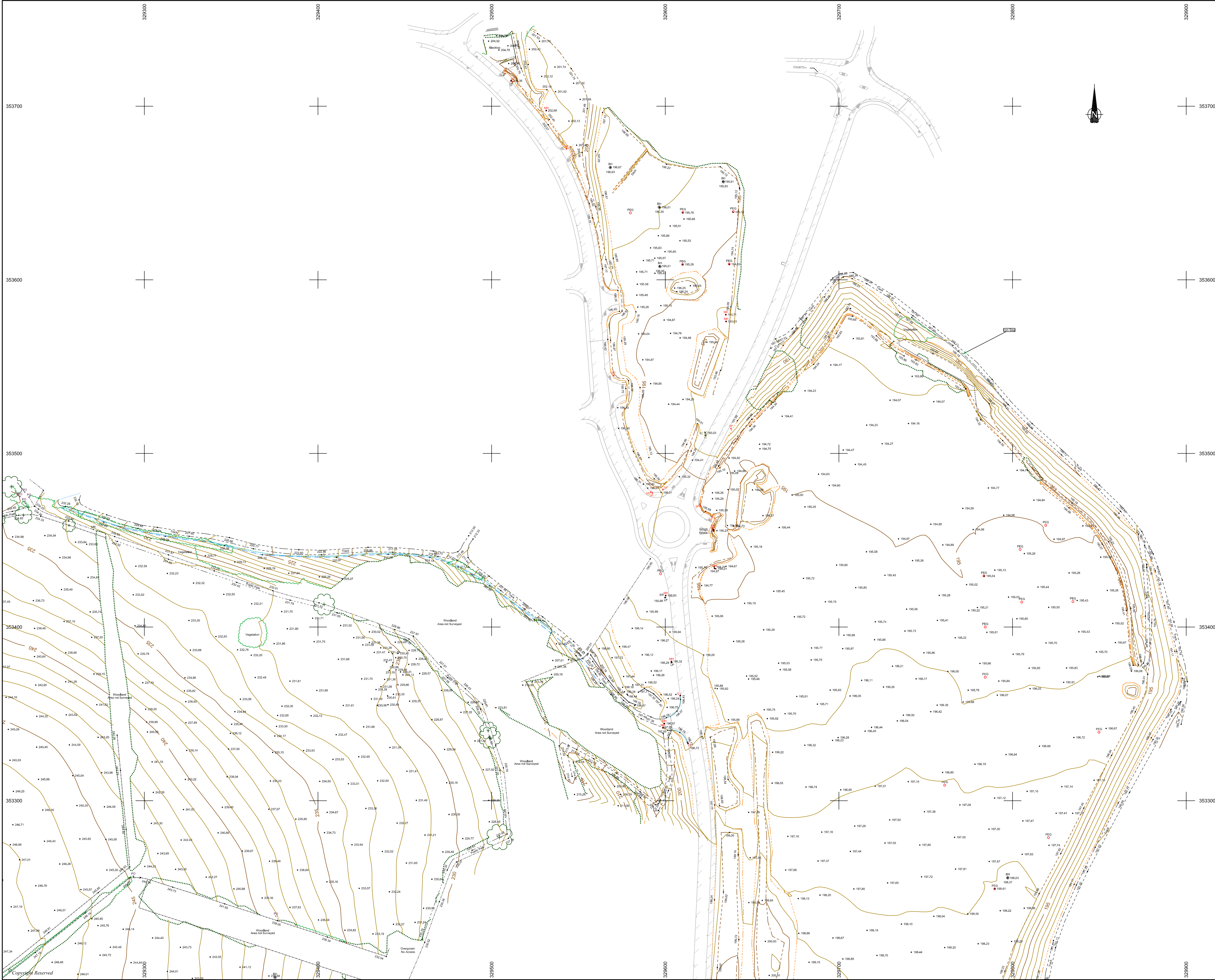
DRAWINGS



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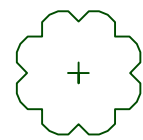
CLIENT Parkhill Estates	DRG No. ST16882-008	REV A
PROJECT Former Brymbo Steelworks, Wrexham: Link Road Development Module	SIZE A4	SCALE 1:25,000
DRAWING TITLE Site Location	DRAWN BY DR	CHECKED BY BG
		DATE 07-11-18 APPROVED BY JG



DO NOT SCALE FROM THIS DRAWING

KEY

- Post and Wire Fence 1.0m height
- Wooden Fence 1.0m height
- Canopy
- Bottom of Bank
- Top of Bank
- Tarmac Edge
- Wall
- Crash Barrier
- Gate
- Vegetation
- Palisade Security Fencing 2.10m
- Ditch
- Building
- Bottom Kerb
- Drop Kerb
- Overhead Cable
- Normal Contours 1m interval
- Prominent Contours 5m interval



Iron Peg

Borehole

Manhole

Spot Level

Post

Inspection Cover

Eave Height

Stop Valve

Wash Out

Electric Pole

Marker Point

Gas Valve

Inspection Box

Bollard

Sign Post

Earth Rod

Gully

GRID AND LEVELS TO NATIONAL GRID
PROJECTION OSTN 15 AND OSGM 15

Note:
As Built drawing in Light Grey provided by Parkhill Estates

REVISION	DETAILS	DATE	DRAWN	CHECKED	APP'D
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CLIENT

Parkhill Estates

PROJECT

Former Brymbo Steelworks, Wrexham

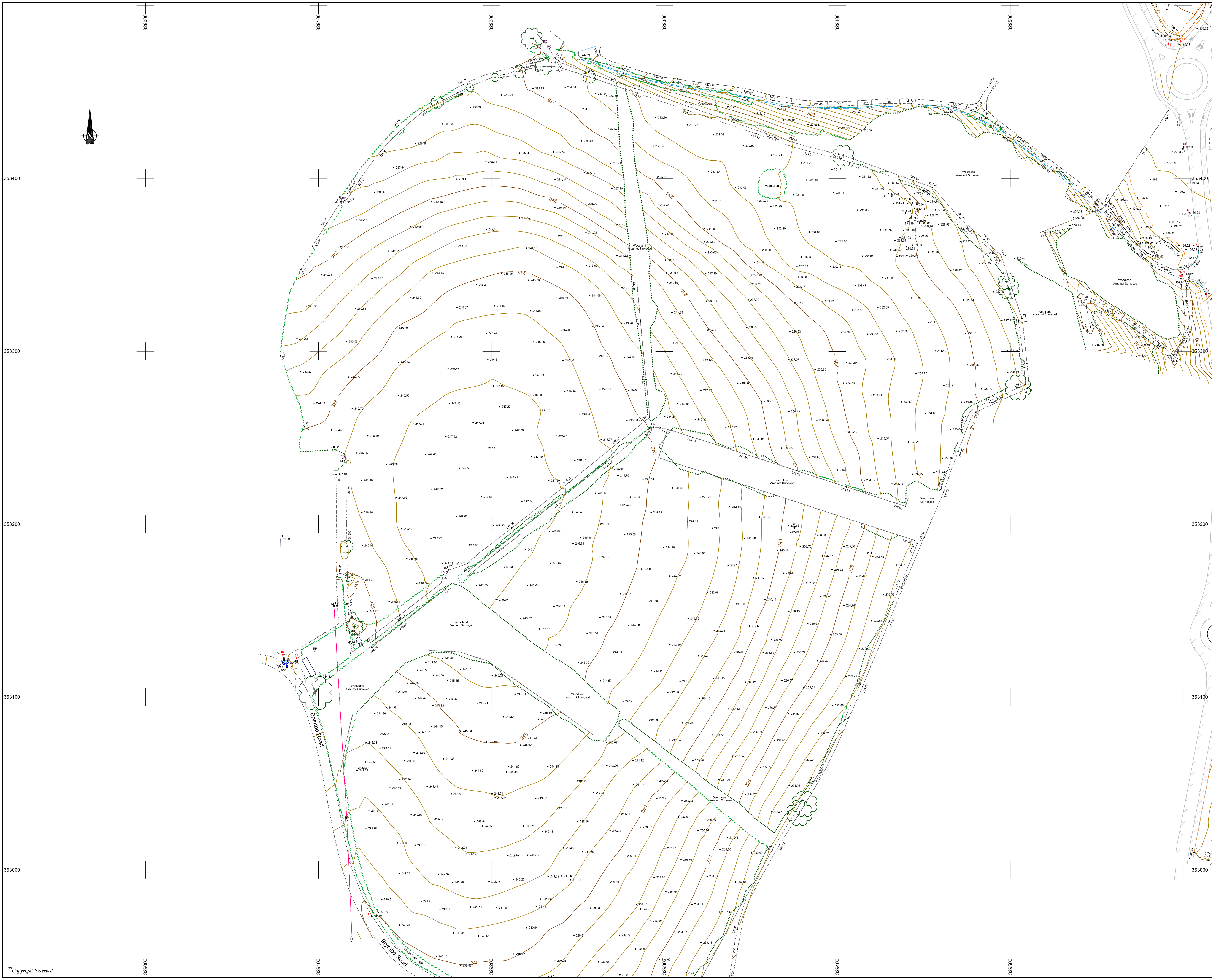
DRAWING TITLE

Topographic Survey
Date of Survey 14 - 08 - 2018

DRG No.	ST16882-006 1 of 3	REV	
DRG SIZE	A1	SCALE	1:1000
DRAWN BY	GP	CHECKED BY	SR
		APPROVED BY	SW

☐ BIRMINGHAM	☐ CARLISLE	☐ CROYDON
☐ EDINBURGH	☐ GLASGOW	☐ LEIGH
☐ MANCHESTER	☐ NEWCASTLE UPON TYNE	☐ SHEFFIELD
		☐ TAUNTON

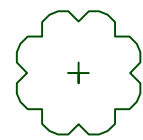




DO NOT SCALE FROM THIS DRAWING

KEY

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- Ditch
- Building
- Bottom Kerb
- Drop Kerb
- Overhead Cable
- Normal Contours 1m interval
- Prominent Contours 5m interval



Trees

PEG

BH

MH

Spot Level

Post

Inspection Cover

Eave Height

Stop Valve

Wash Out

Electric Pole

Marker Point

Gas Valve

Inspection Box

Bollard

Sign Post

Earth Rod

Gully

239.84

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GRID AND LEVELS TO NATIONAL GRID
PROJECTION OSTN 15 AND OSGM 15

Note:
As Built drawing in Light Grey provided by Parkhill Estates

REVISION	DETAILS	DATE	DRAWN	CHECKED	APP'D
CLIENT	Parkhill Estates				
PROJECT	Former Brymbo Steelworks, Wrexham				
DRAWING TITLE	Topographic Survey Date of Survey 14 - 08 - 2018				

DRG No.	ST16882-006 2 of 3	REV	
DRG SIZE	A1	SCALE	1:1000
DRAWN BY	GP	CHECKED BY	SR
DATE	31 - 08 - 2018	APPROVED BY	SW

STOKES-ON-TRENT (HEAD OFFICE)	TEL 01782 278700	WEB WWW.WARDELL-ARMSTRONG.COM
BIRMINGHAM	CARDIFF	CARLISLE
EDINBURGH	GLASGOW	LEIGH
MANCHESTER	NEWCASTLE UPON TYNE	SHEFFIELD

CRUICKSHANK	CRUICKSHANK	CRUICKSHANK
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CRUICKSHANK	CRUICKSHANK	CRUICKSHANK
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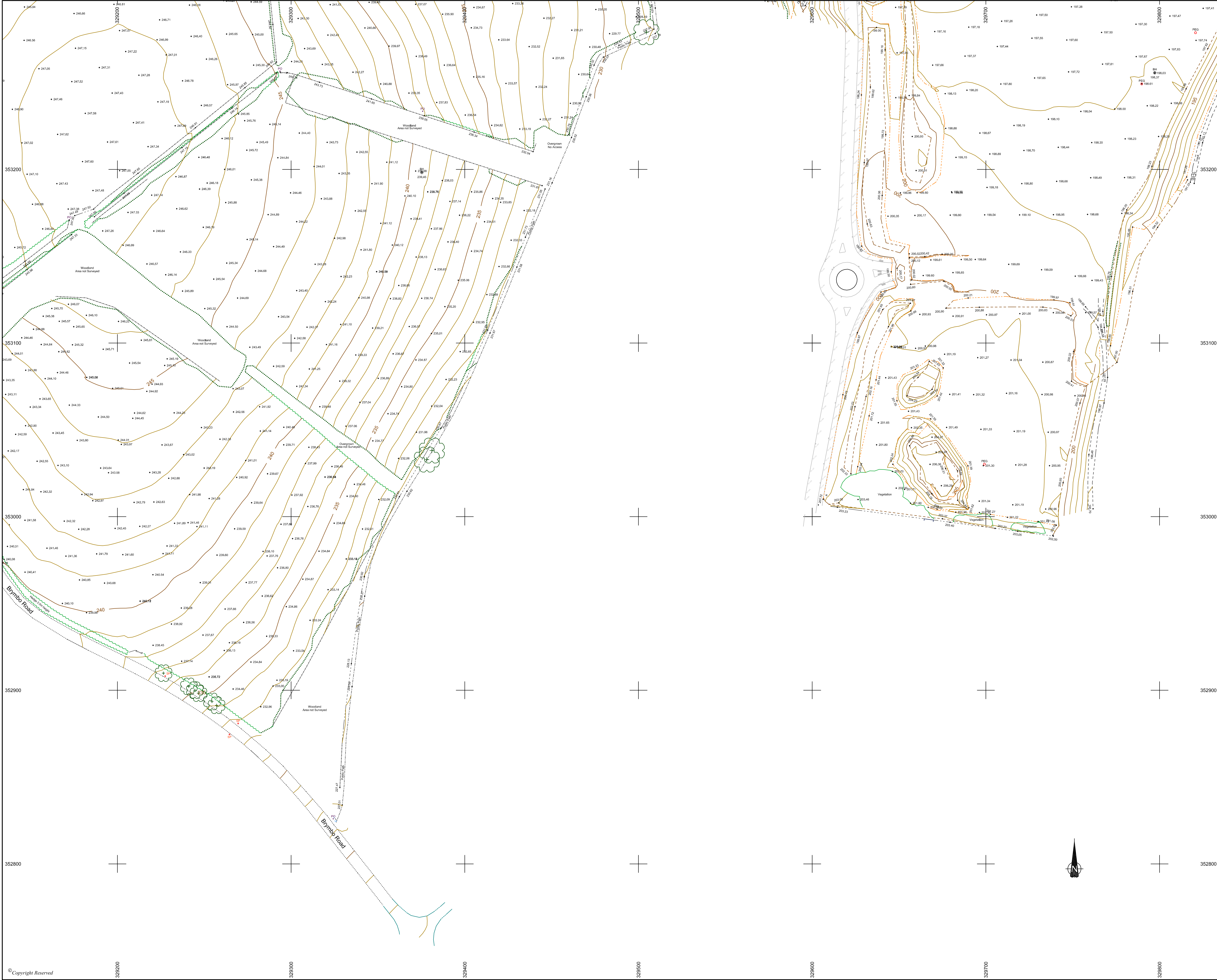
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DO NOT SCALE FROM THIS DRAWING

- KEY
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 - Ditch
 - Building
 - Bottom Kerb
 - Drop Kerb
 - Overhead Cable
 - Normal Contours 1m interval
 - Prominent Contours 5m interval
 - Trees
 - PEG
 - BH
 - MH 202.68
 - 194.23
 - PO
 - IC
 - EH 249.0
 - SV
 - WO
 - EP
 - MR
 - GV
 - IB
 - B
 - SP
 - ER
 - G
 - 239.84

GRID AND LEVELS TO NATIONAL GRID
PROJECTION OSTN 15 AND OSGM 15

Note:
As Built drawing in Light Grey provided by Parkhill Estates

REVISION	DETAILS	DATE	DRAWN	CHECKED	APPROVED
1					

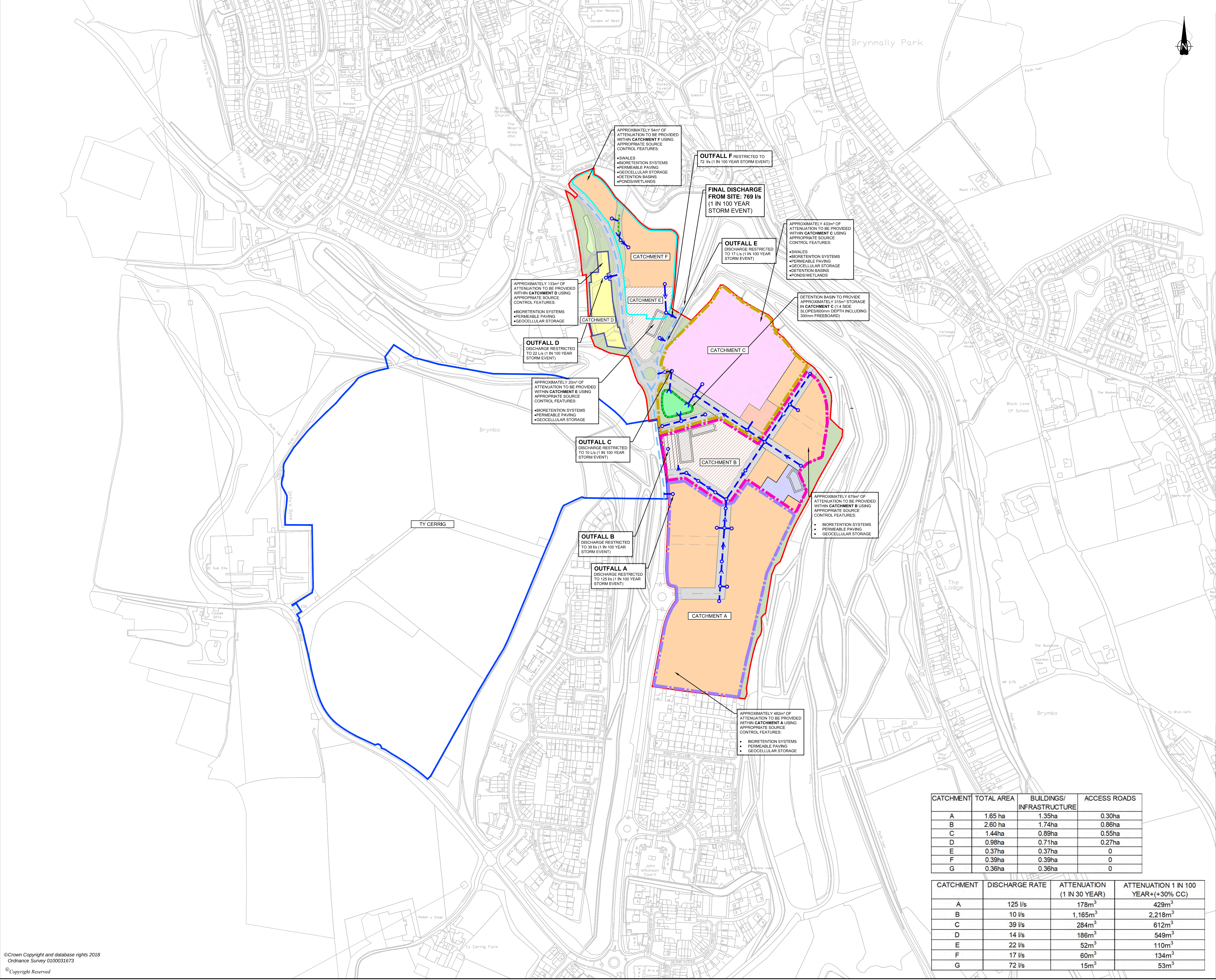
CLIENT
Parkhill Estates

PROJECT
Former Brymbo Steelworks, Wrexham

DRAWING TITLE
Topographic Survey
Date of Survey 14 - 08 - 2018

DRG No.	ST16882-006 3 of 3	REV	
DRG SIZE	A1	SCALE	1:1000
DRAWN BY	GP	CHECKED BY	SR
		APPROVED BY	SW
STOKES-ON-TRENT (HEAD OFFICE) TEL 01782 278700 WEB WWW.WARDELL-ARMSTRONG.COM			
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☐ MANCHESTER	☐ NEWCASTLE UPON TYNE	☐ SHEFFIELD	☐ TAUNTON





DO NOT SCALE FROM THIS DRAWING

NOTES

1. TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT REPORT.

2. DRAINAGE STRATEGY IS INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN.

KEY

SITE BOUNDARY

ADJACENT LAND IN APPLICANT OWNERSHIP

PROPOSED SURFACE WATER DRAIN

EXISTING SURFACE WATER DRAIN

PROPOSED DETENTION BASIN

PROPOSED SWALE (CONVEYANCE)

PROPOSED HEADWALL

RESIDENTIAL (0.35 DENSITY)

RESIDENTIAL DISTRICT CENTRE (0.60 DENSITY)

RETAIL AND LEISURE (0.95 DENSITY)

HEALTH CENTRE (0.95 DENSITY)

PRIMARY SCHOOL (0.2 DENSITY)

ACCESS / INFRASTRUCTURE

SHARED CAR PARKING AND PUBLIC REALM (0.95 DENSITY)

PUBLIC OPEN SPACE

FOOTPATH NETWORK

REVISIONS

B	Catchment Areas Ty Cerrig Catchment Removed	24/02/25	PM		
A	First Issue	25/03/19	5.8	BG	TJP

CLIENT

Parkhill Estates

PROJECT

Former Brymbo Steelworks, Wrexham:
Link Road Development Module

DRAWING TITLE

Indicative Surface Water Management Plan

DRG No.

ST16882-007

REV

A

DRG SIZE

A1

SCALE

1:2500

DATE

15-10-18

DRAWN BY

DR

CHECKED BY

BG

APPROVED BY

TJP

STOKE ON TRENT (TEL: 01782 278700)

WWW.WARDELL-ARMSTRONG.COM

BIRMINGHAM

BOLTON

CARDIFF

CHESHIRE

EDINBURGH

GLASGOW

LONDON

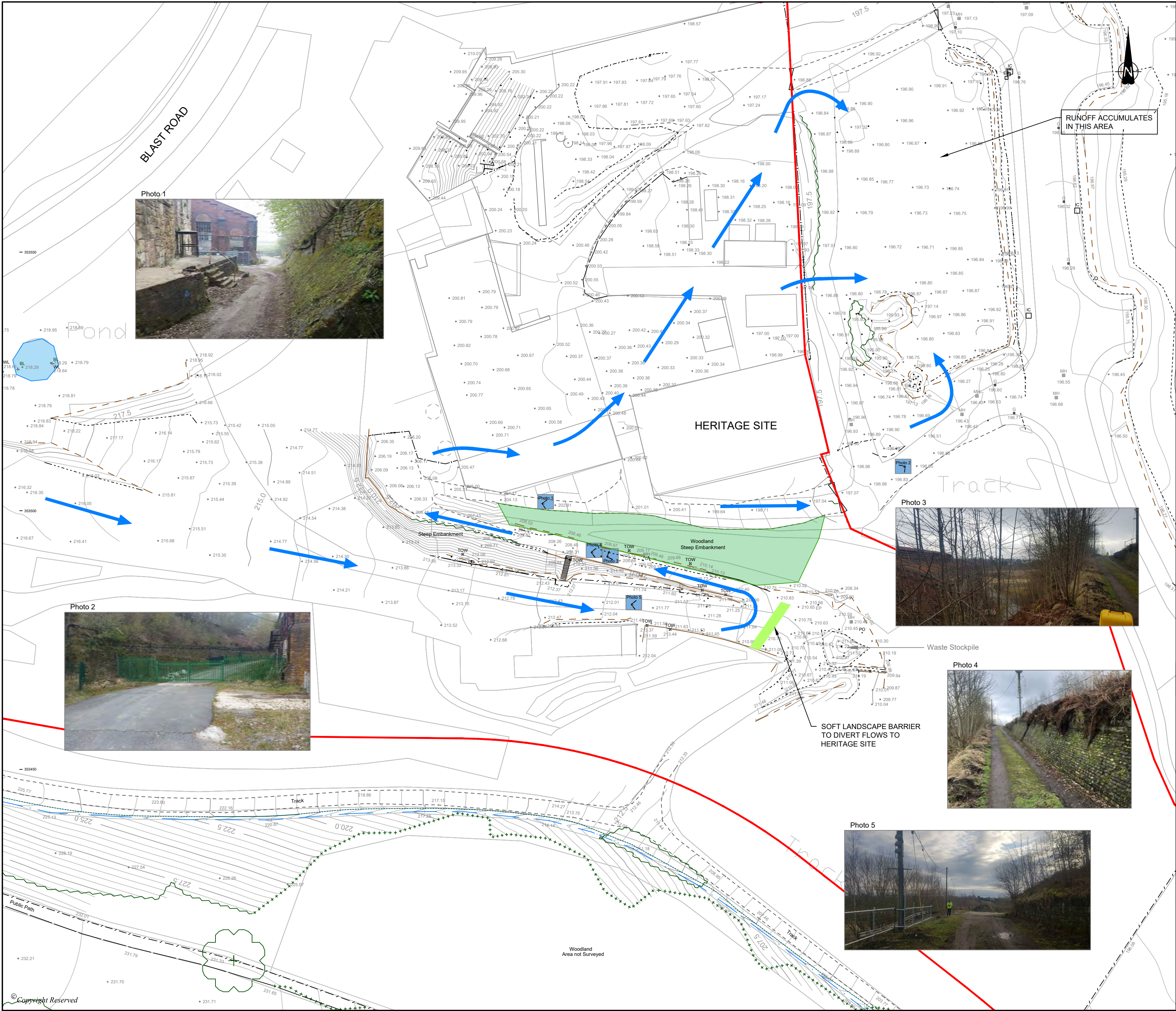
MANCHESTER

MANCHESTER (UPON TYNE)

SHEFFIELD

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N:\ST16882 - FORMER BRYMBO STEELWORKS\3 - DESIGN\AUTOCAD\SCRATCH\ST16882-007-3 - INDICATIVE SURFACE WATER MANAGEMENT PLANNING



DO NOT SCALE FROM THIS DRAWING

- NOTES:
- TO BE READ IN CONJUNCTION WITH FLOOD CONSEQUENCE ASSESSMENT REPORT (REF ST16882-0002).
 - TOPOGRAPHY BASED ON TOPOGRAPHICAL SURVEYS UNDERTAKEN BY WARDELL ARMSTRONG IN 2019 AND 2020.

- KEY
- SITE BOUNDARY
 - EXISTING OVERLAND FLOW ROUTE (INDICATIVE)
 - PROPOSED SOFT LANDSCAPE BARRIER

RUNOFF ACCUMULATES IN THIS AREA

HERITAGE SITE

Track

SOFT LANDSCAPE BARRIER TO DIVERT FLOWS TO HERITAGE SITE

Waste Stockpile

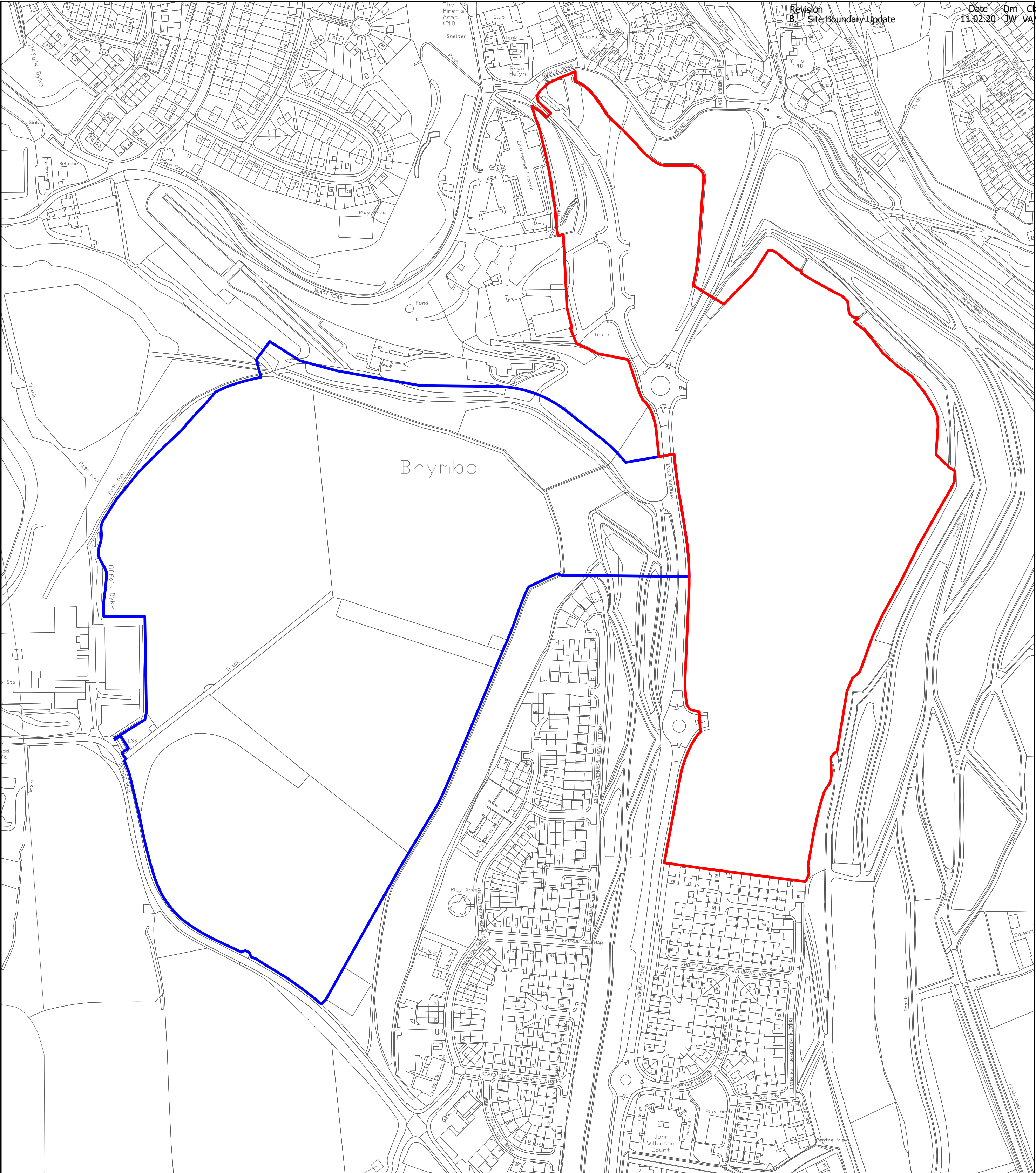
Woodland Area not Surveyed

A	FIRST ISSUE	03-03-20	DR	BG	JG
REVISION	DETAILS	DATE	DRAWN	CHKD	APPD
CLIENT					
PARKHILL ESTATES LTD					
PROJECT					
FORMER BRYMBO STEELWORKS, WREXHAM LINK ROAD DEVELOPMENT MODULE					
DRAWING TITLE					
OVERLAND FLOW ROUTES					
DRG No.	ST16882-060	REV	A		
DRG SIZE	A2	SCALE	1:500	DATE	02-03-20
DRAWN BY	DR	CHECKED BY	BG	APPROVED BY	JG

wardell armstrong

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Revision
B Site Boundary Update

Date
11.02.20

Drm
JW

Ckd
VA/JH



Site Boundary



Adjacent Land in Applicant Ownership

Project
Brymbo Park

Drawing Title
Site Boundary

Date
06.09.18

Scale
1:2500@A2

Drawn by
ALC

Check by
VA

Project No
27968

Drawing No
RG-M-04

Revision
B

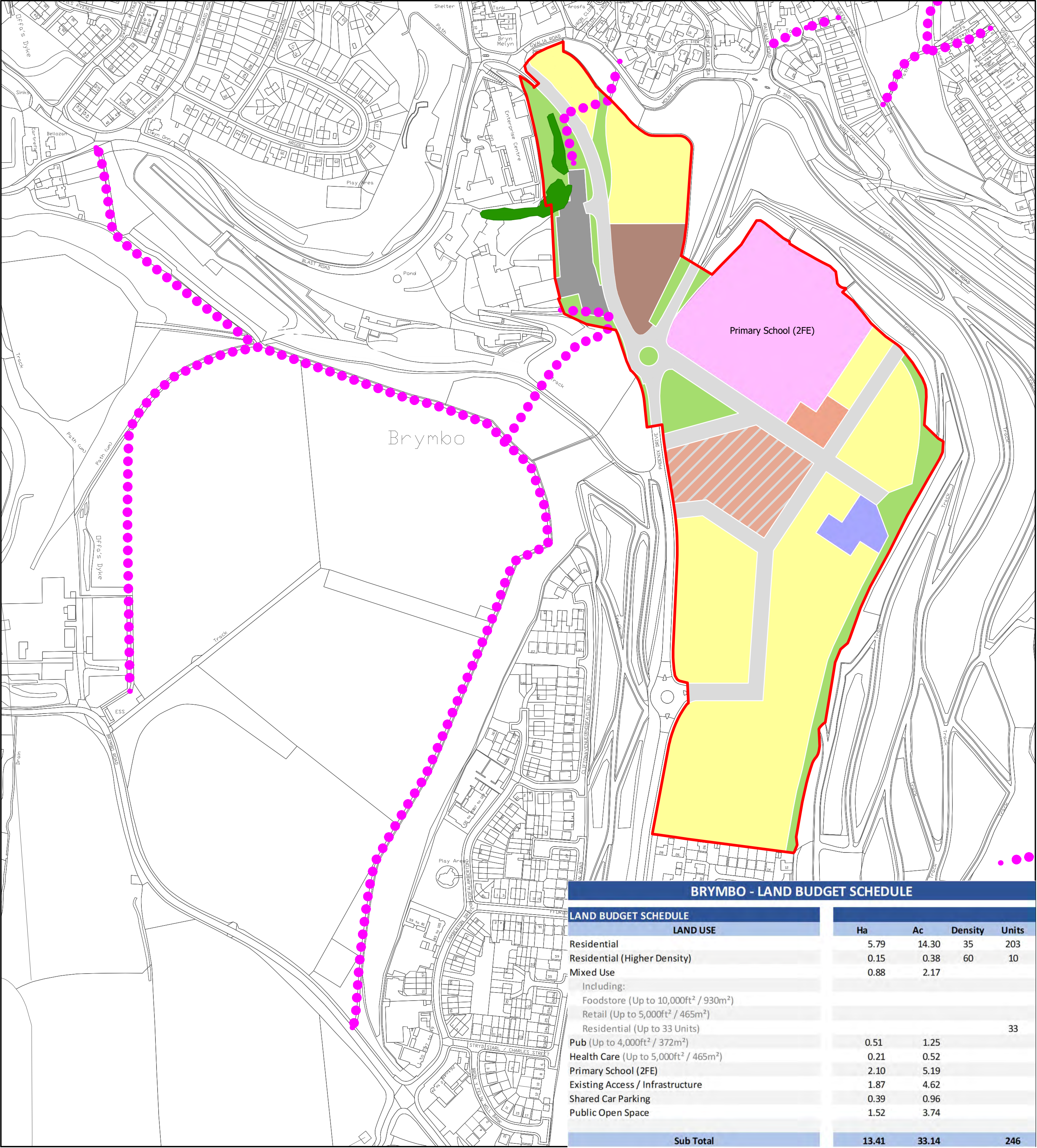


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- Site Boundary Boundary
-
- Residential

Project
Brymbo Park

Drawing Title
Land Use Plan

Date
06.09.18

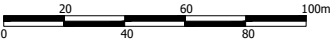
Scale
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Project No
27968

Drawn by
ALC

Check by
VA

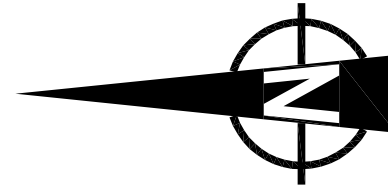
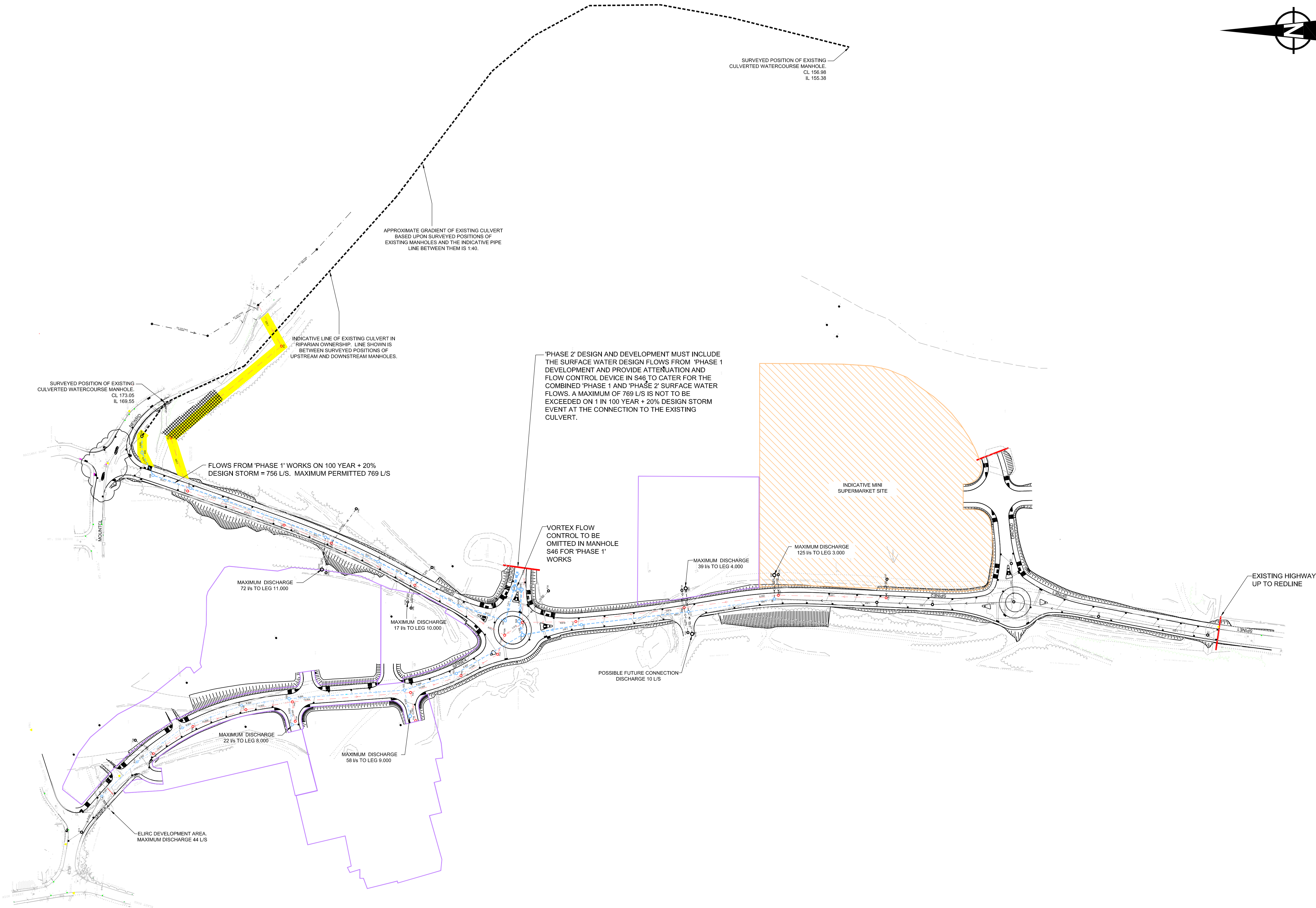
Revision
K



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KEY

- PROPOSED S104 SURFACE WATER DRAIN.
- PROPOSED S104 FOUL WATER DRAINAGE.
- PROPOSED GULLY AND CONNECTION.
- PROPOSED HIGHWAY DRAIN.
- PRIVATE FOUL WATER CONNECTION.
- PRIVATE STORM WATER CONNECTION.
- PROPOSED S104 SEWER EASEMENT.
- DRAINAGE AREA BOUNDARIES.
- CULVERT IN RIPARIAN OWNERSHIP

NOTES

- IF RECEIVED ELECTRONICALLY IT IS THE RECIPIENT'S RESPONSIBILITY TO PRINT TO THE CORRECT SCALE. ONLY WRITTEN DIMENSIONS SHALL BE USED.
- ALL ADOPTABLE DRAINAGE WORKS TO BE INCLUDED IN THE S104 AGREEMENT IS TO BE IN ACCORDANCE WITH 'SEWERS FOR ADOPTION 8th EDITION' AND ALL REQUIREMENTS OF DWR CYMRU WELSH WATER AS THE STATUTORY SEWERAGE UNDERTAKER.
- THE CONTRACTOR IS TO CONFIRM POSITION LEVELS & SIZE OF EXISTING DRAINAGE & WATERCOURSES PRIOR TO THE COMMENCEMENT OF DRAINAGE WORKS, WHERE APPLICABLE.
- THE FOLLOWING PIPE TYPES & BEDDING HAVE BEEN ASSUMED IN THE DESIGN:
 - (i) CARRIER DRAIN 150MM DIA VITRIFIED CLAY TO BS EN 295, MIN CRUSHING STRENGTH 28 KNM ON TYPE S TRENCH & BEDDING (DEPTH OF COVER 1.2M OR GREATER), OR 150MM CONCRETE BED AND SURROUND (DEPTH OF COVER LESS THAN 1.2M).
 - (ii) CARRIER DRAIN 225 & 300MM DIA VITRIFIED CLAY TO BS EN 295, MIN STRENGTH CLASS 160 ON TYPE S TRENCH & BEDDING (DEPTH OF COVER 1.2M OR GREATER), OR 150MM CONCRETE BED AND SURROUND (DEPTH OF COVER LESS THAN 1.2M, OR AS SPECIFIED ON RELEVANT LONG SECTIONS.
 - (iii) CARRIER DRAINS 375mm DIA AND ABOVE TO COMPRISE CONCRETE CLASS 120 ON TRENCH AND BEDDING AS SPECIFIED ON RELEVANT LONGITUDINAL SECTIONS.
 - (iv) GULLY CONNECTIONS TO COMPRISE 150MM DIA VITRIFIED CLAY TO BS EN 295, MIN STRENGTH 28KN/m WITH 150MM CONCRETE BED AND SURROUND WHERE COVER IS LESS THAN 1.2M.
- BACKFILLING OF DRAINS AND SEWERS SITUATED BELOW CARRIAGEWAYS, PAVED AREAS AND FOOTWAYS SHALL BE WITH TYPE 1 SUBBASE TO SHW CLAUSE 803.
- EXISTING ROADS TO BE REINSTATED IN ACCORDANCE WITH THE SPECIFICATION FOR THE REINSTATEMENT OF OPENINGS IN HIGHWAYS SECOND EDITION DATED JUNE 2002, ROAD CATEGORY TYPE 2 ALL PERMANENT WHERE APPLICABLE.
- FOR COVER AND INVERT LEVELS REFER TO THE LONGITUDINAL SECTIONS AND CHAMBER SCHEDULES.
- ALL HIGHWAY DRAINS TO BE ADOPTED AS PART OF THE SECTION 38 AGREEMENT ARE TO BE CONSTRUCTED TO THE HIGHWAY AUTHORITY (WREXHAM BC) STANDARDS.

DRAWING UPDATED TO URS BORDER AND JOB NUMBER. UPDATED TOPOGRAPHICAL SURVEY ADDED ALIGNMENTS AND DRAINAGE ADJUSTED TO SUIT. DRAINAGE REVISED TO SUIT PHASE 1 TO ROAD REMOVED.	SJ/CJ/CH	12.02.14	G
SURFACE WATER OUTFALL AMENDED EXISTING CULVERT INFORMATION ADDED.	SJ/CJ/AL	26.01.12	F
PLOT REFERENCES ADDED.	SJ/CJ/AL	02.06.11	E
EASEMENT AT SURFACE WATER OUTFALL EXTENDED 3m. CULVERTED WATERCOURSE COLOUR AMENDED.	SJ/CJ/AL	12.06.11	D
STRT AMENDMENTS. FOUL OUTFALL AMENDED TO SUIT. REVISED OUTFALL POINT.	SJ/CJ/AL	27.01.11	C
MINOR REVISIONS TO SURFACE AND FOUL WATER NETWORKS.	SJ/CJ/AL	20.05.10	B
DRAINAGE RE-DESIGN PLAN AMENDED TO SUIT.	SJ/CJ/AL	14.12.09	A

Revision Details	By	Check	Date	Suffix
------------------	----	-------	------	--------

Drawing Status
P - PRELIMINARY

Client
BRYMBO DEVELOPMENTS LTD

Project Title
**BRYMBO DEVELOPMENT
BRYMBO
WREXHAM**

Drawing Title
**SITE WIDE DRAINAGE
PROPOSALS**

Drawn SJC	Checked CEH	Approved	Date 16/12/13
URS Internal Project No. 47067923	Subsidiary N/A		
Scale @ A1 1:500	Zone / Mileage N/A		

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Telford, Shropshire, TF3 3AP
Telephone (01952) 235600
Fax (01952) 235650
www.urs.com



Drawing Number P 47067923/43	Rev G
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Forge Lane
Etruria
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ST1 5BD
Tel: +44 (0)1782 276 700

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Middlebrook
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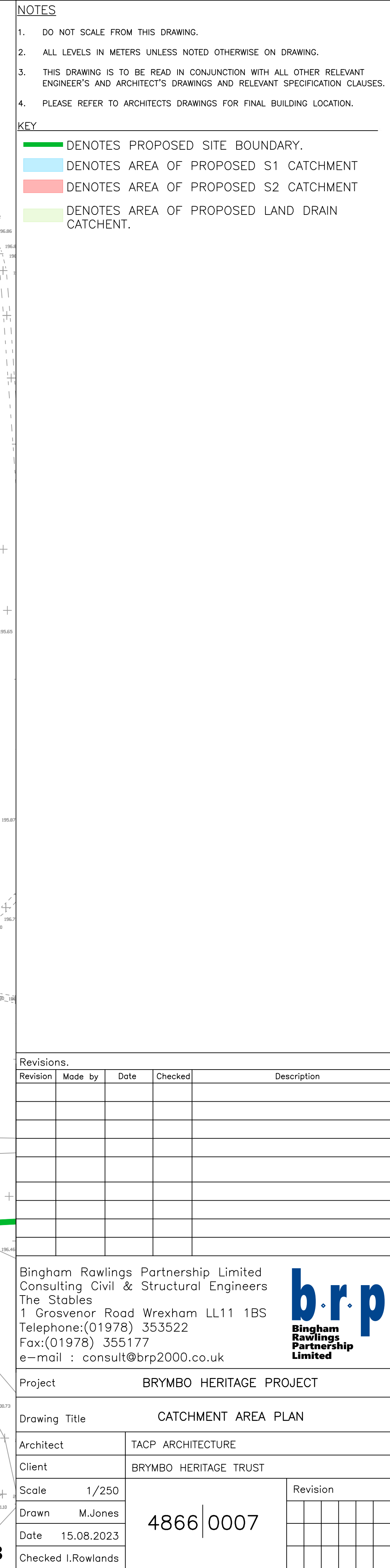
29/6 Satpaev Avenue
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APPENDIX J

Catchment Area Plan



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