

Caulmert Limited

Engineering, Environmental & Planning
Consultancy Services

Llanrwst Road, Gyffin

ADRA

Housing Development

Flood Consequences Assessment and Drainage Statement

APPROVAL

Prepared by:

Caulmert Limited

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APPROVAL RECORD

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Client: ADRA

Project Title: Housing Development

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Flood Consequences Assessment and Drainage Statement**TABLE OF CONTENTS**

1.0	INTRODUCTION AND DEVELOPMENT PROPOSALS.....	1
1.1	Background	1
1.2	Existing Site Features	1
1.3	Flood Risk.....	4
1.4	Proposed Development	5
1.5	Acceptability of Flooding Consequences	6
2.0	PROPOSED SUSTAINABLE DRAINAGE.....	7
2.1	Project Approach to Sustainable Drainage	7
2.2	S1. Surface Water Runoff Destination	7
2.3	S1. Surface Water Runoff Destination, Priority 1: Runoff Collected for Use	7
2.4	S1. Surface Water Runoff Destination, Priority 2: Infiltration to Ground.....	8
2.6	S1. Surface Water Runoff Destination, Priority 4: Discharge to a Surface Water Sewer ...	8
2.7	S1. Surface Water Runoff Destination, Priority 5: Discharge to a Combined Sewer.....	8
2.8	S2. Surface Water Runoff Hydraulic Control	8
2.9	S3. Water Quality	10
2.10	S4. Amenity and S5. Biodiversity	11
2.11	S6. Design of Drainage for Construction, Operation and Maintenance	11
3.0	FOUL DRAINAGE	12
3.1	General Considerations	12
4.0	FLOOD RISK AND PROPOSED DRAINAGE – SUMMARY.....	13
4.1	Flood Risk.....	13
4.3	Foul Drainage	13

APPENDICES

Appendix 1	Topographical Survey
Appendix 2	Existing Drainage Layout
Appendix 3	Proposed Site Layout
Appendix 4	Proposed Drainage Layout
Appendix 5	Greenfield Runoff Calculations
Appendix 6	Pollution Control Calculations

1.0 INTRODUCTION AND DEVELOPMENT PROPOSALS

1.1 Background

1.1.1 Adra, North Wales's largest Housing Association is proposing to construct 95 new houses on the site.

1.1.2 Caulmert has been appointed to prepare a Drainage Statement and Flood Consequences Assessment to support a planning application for the development. This considers the risk of flooding at the site, and the disposal of surface water and domestic foul effluent. The strategy for the disposal of surface water follows the approach recommended in the Sustainable Drainage Systems Standards for Wales (SuDS Standards) and the CIRIA SuDS manual. The criteria for the management of foul flows are in accordance with the Building Regulations, relevant British Standards, and the requirements of Dwr Cymru Welsh Water (DCWW).

1.1.3 The site has an area of approximately 5.37ha and is situated to the south of Gyffin village, south of Conwy. The site is located to the east of the B5106 Llanrwst Road. The plan below shows the location of the site, edged red.

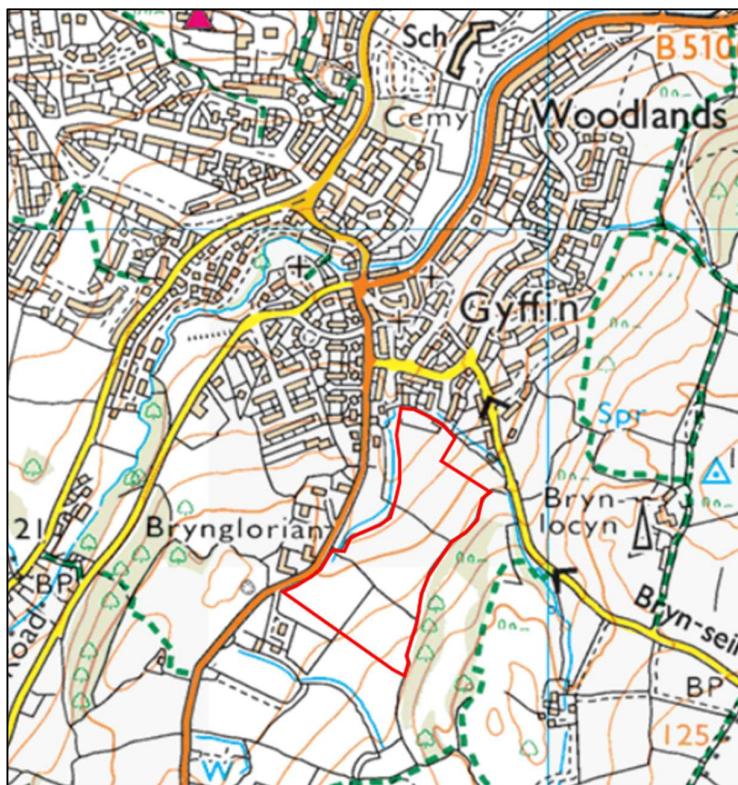


Figure 1: Site Location Plan

1.2 Existing Site Features

1.2.1 The site comprises of undeveloped greenfield land with an existing housing estate bordering the northern boundary. The B5106 Llanrwst Road borders the southern part of the western

boundary of the site, with the northern part of that boundary being an un-named watercourse that is a tributary of the Afon Gyffin. Undeveloped green field land border the eastern and southern boundaries.

- 1.2.2 Access to the site is from Isgoed to the northwest of the site boundary and Llanrwst Road the B5106 to the southwest of the site.
- 1.2.3 The land slopes steeply down from east to west and also from south to north. The highest point on site is 84.35m in the southeast of the site and lowest point on the site is 21.48m in the northwest of the site.
- 1.2.4 The satellite imagery below shows the context and setting of the site.



Figure 2: Site Context Plan

- 1.2.5 A topographical survey has been undertaken, and a copy is enclosed in Appendix 1.
- 1.2.6 A drainage investigation has been carried out and is included in Appendix 2. The drainage survey has confirmed that no existing below ground foul water or surface water drainage is located within the site boundary.

1.2.7 The drainage survey undertaken (Appendix 2) notes that existing watercourses are present. One located along the western boundary flowing south to north. It flows through a pipe located in the highway verge, before issuing into the open channel on the west of the site. The second located along the northern boundary flows from east to west. It is partly culverted in the north of the site, where it discharges via a concrete headwall structure into the un-named watercourse. Both water courses consist of both culverted areas and open channel.

1.2.8 The nearest existing foul water connection point is located approximately 31 metres from the site boundary within Isgoed, an access road for the existing housing estate to the northwest of the site. The sewer is 150mm diameter public sewer as can be seen from the extract in Appendix 2

1.3 Flood Risk

1.3.1 Welsh Government's Flood Map for Planning shows areas around the site to be in Flood Zone 2 and 3 from Surface Water and small Watercourses.

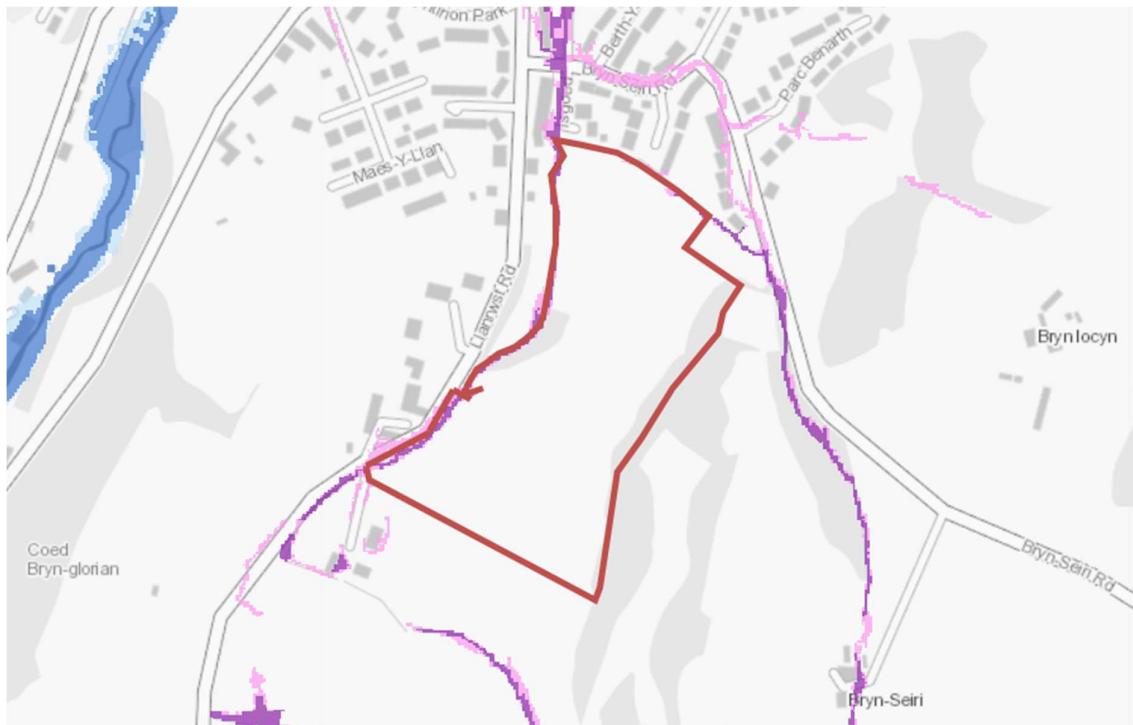


Figure 3: Extract from the Flood Map for Planning

1.3.2 Figure 3 shows the site as being at very low risk of flooding from rivers, sea and reservoirs.

1.3.3 Figure 3 shows the northern and western boundaries of the site to be within flood zones 2 and 3 for Surface Water and Small Watercourses.

1.3.3.1 Surface Water and Small Watercourses – Flood Zone 2

Areas with 0.1% to 1% (1 in 1000 to 1 in 100) chance of flooding from surface water and/or small watercourses in a given year, including the effects of climate change.

1.3.3.2 Surface Water and Small Watercourses – Flood Zone 3

Areas with more than 1% (1 in 100) chance of flooding from surface water and/or small watercourses in a given year, including the effects of climate change

1.3.4 Ground water seepage was encountered in one trial pit located in the southeast corner of the site at a depth of 2.3m (TP101) as noted in Caulmert Ground Investigation Summary dated 23rd July 2025. It should be noted that the groundwater investigation was undertaken after a period of several months of dry weather and groundwater levels may vary with time.

1.4 Proposed Development

1.4.1 The proposed development will comprise the construction of 95No. new houses including access roads, public spaces, retaining walls and proposed drainage. Figure 4 below shows the proposals. A full size plan is included in Appendix 3.

1.4.2 The total developable area is 3 hectares.

1.4.3 Greenfield run off calculations have been completed using the HR Wallingford greenfield calculation tool. The calculated Qbar greenfield run off is 21.9 litres per second (l/s). the results are included in Appendix 5.



Figure 4: Proposed Development Layout

1.5 Acceptability of Flooding Consequences

1.5.1 This Assessment presents an understanding of the potential risks and consequences of development and identifies how these can be safely managed.

1.5.2 The scope of the FCA needs to consider if there is:

- Risk to life
- Disruption to people living and working in the area
- Impact on flood risk generally and
- Disruption to the sustainable management of resources

Risk to Life

1.5.3 Isolated areas of the site are noted as being in flood zone 2 and 3 due to the risk of surface water flooding. These areas are located immediately adjacent to the existing small watercourses on the western and northern boundary.

1.5.4 On the west boundary the existing culverted watercourse will be retained, and the existing potential surface water flow path retained. Houses and public spaces are not located within these areas.

1.5.5 On the northern boundary houses are set away from the potential surface water flow path.

1.5.6 In both locations, the infrastructure construction will be designed so as to be resilient to the effects of surface water flooding.

Disruption to People

1.5.7 In the event of the surface water flooding occurring there would be minor disruption. The small nature of the watercourses and their associated small catchments would mean that the duration of any surface water flooding would be short. The topography is such that standing water would not be expected.

Impact on Flood Risk to Others

1.5.8 The proposed development drainage follows the sustainable drainage principles. These reflect Welsh Government's SuDS standards, and will subject to a separate approval process through an application to the SuDS Approving Body.

1.5.9 The proposed surface water drainage is to discharge at two locations into the existing watercourse at rates controlled to the present day greenfield Qbar runoff. This is shown on the drawing in Appendix 4.

1.5.10 The following Section 2 "Proposed Sustainable Drainage" provides more detail.

2.0 PROPOSED SUSTAINABLE DRAINAGE

2.1 Project Approach to Sustainable Drainage

2.1.1 This section summarises the outline design for the disposal of surface water from the site. The approach recommended in the Sustainable Drainage Systems Standards for Wales (the Standards) and the CIRIA SuDS manual is to manage the quality and quantity of rainwater runoff close to where it falls and to allow its use in a manner which provides amenity benefits to site users and also encourages biodiversity.

2.1.2 The Standards are split into six sections which need to be addressed. These are:

- S1. Surface water runoff destination
- S2. Surface water runoff hydraulic control
- S3. Water Quality
- S4. Amenity
- S5. Biodiversity

2.1.3 Subsequent paragraphs of this section of the report outline how these objectives can be achieved within the drainage design for the proposed new development and modifications of the existing drainage.

2.2 S1. Surface Water Runoff Destination

2.2.1 The standard has five priority levels for surface water runoff. These are:

- Priority 1: Surface water runoff collected for use
- Priority 2: Surface water runoff is infiltrated to ground
- Priority 3: Surface water runoff is discharged to a surface water body
- Priority 4: Surface water runoff is discharged to a surface water sewer, highway drain or another drainage system
- Priority 5: Surface water runoff is discharged to a combined sewer

Information has been gathered specific to the site and is considered against these priorities below.

2.3 S1. Surface Water Runoff Destination, Priority 1: Runoff Collected for Use

2.3.1 Priority 1 is to collect water for reuse. It is not cost effective to capture and store rainwater for use in most domestic appliances within buildings. The nature of the development is such that rain water butts for garden irrigation would be suitable on a plot by plot basis. Collection of rainwater for use in appliances within the buildings is not considered viable.

2.4 S1. Surface Water Runoff Destination, Priority 2: Infiltration to Ground

- 2.4.1 Further ground investigations will need to be carried out to determine the infiltration properties of the existing ground strata following ground works to formation levels
- 2.4.2 During ground works to formation levels, some areas of the site may need to be cut into bedrock which may affect the ability for these areas to utilize soakaways.
- 2.4.3 On the basis that the existing ground can be used for infiltration, this may be used as a suitable means of managing surface water from roof and hard landscaped areas including car parking.
- 2.4.4 Shallow areas of soils could be suitable for infiltration and would require further investigation.
- 2.4.5 It is therefore proposed that blanket infiltration provision is made throughout the site, which will facilitate infiltration where it is possible. However, a conservative and precautionary approach will be taken, whereby it will be assumed that infiltration does not occur, and the drainage network will be designed to convey runoff to a surface water body. See below.

2.5 S1. Surface Water Runoff Destination, Priority 3: Discharge to a Surface Water Body

- 2.5.1 An existing water body is located along the western boundary and the northern boundary. It has been determined that discharge to surface water body is the most suitable discharge location for surface water that has been unable to infiltrate into the ground.

2.6 S1. Surface Water Runoff Destination, Priority 4: Discharge to a Surface Water Sewer

- 2.6.1 It has been determined that discharge to below ground surface water network is not required for this site.

2.7 S1. Surface Water Runoff Destination, Priority 5: Discharge to a Combined Sewer

- 2.7.1 This option does not need to be considered.

2.8 S2. Surface Water Runoff Hydraulic Control

- 2.8.1 The constraints described in Section 1.5 limit the space of managing the runoff from the proposed development due to the steeply sloping site, and careful consideration is required.
- 2.8.2 The surface water discharge flow rate is not to exceed calculated Qbar greenfield runoff rate of 21.9 l/s. It is proposed to utilise two outfall locations into the existing watercourse with discharge rates of 15.5 l/s and 5.5 l/s (21.0 l/s).
- 2.8.3 It is proposed to manage the private drainage and highways drainage separately so far as is practicable, to reduce the amount of drainage that needs to be adopted.
- 2.8.4 Individual house drainage is to be managed by individual attenuation tanks (17m³ to 21m³ per every pair of plots) with an orifice plate flow control discharge limited to 0.5 litres per second.

These will have a permeable liner to facilitate infiltration. The rainfall that does not infiltrate will discharge into the private surface water drainage network.

- 2.8.5 Private roads are to be drained by permeable paving with high level overflow perforated pipes. These overflow pipes will be connected to the surface water drainage network.
- 2.8.6 Private and highway drainage is collected into two separate networks noted as SW N1 and SW N2 on the proposed drainage GA in Appendix 4.
- 2.8.7 Highway drainage is to be collected via spaces between kerb units to allow flow through. The water then enters bioretention areas which are then drained by high level perforated pipes into filtration trenches with perforated pipes located adjacent to the highway.
- 2.8.8 Due to the proposed layout of the site, some areas of the road network are not able to be drained as noted in 2.8.7, and these areas are to be traditionally drained by gullies and kerb channels.
- 2.8.9 Due to the steep gradient of the site, each highway drainage chamber located on the filtration trenched highways drains has an orifice flow control system restricted to 7.5 litres per second. This will allow the large diameter pipes to be used as highways attenuation.
- 2.8.10 Private drainage networks and highways drainage networks will combine prior to discharge into watercourse.
- 2.8.11 The proposed surface water discharge in the northwestern area of the site (SW N1) will discharge at 15.5 litres per second with a Hydrobrake flow control into existing watercourse.
- 2.8.12 SW N1 will have surface water attenuation located close to the outfall. A crate type attenuation tank of 73m³ will be provided, along with an attenuation basin with a crate type attenuation tank in the base with approximately 73m³ volume.
- 2.8.13 The proposed surface water discharge in the southwestern area of the site (SW N2) will discharge at 5.5 litres per second with a Hydrobrake flow control into the existing watercourse.
- 2.8.14 SW N2 will have a crate type attenuation tank at 43m³ close to outfall as shown in appendix 4.
- 2.8.15 Capacity within the proposed surface water system has been calculated to ensure suitability. Due to the steep gradients of the site, multiple flow controls are required to reduce the velocity of the surface water flow. This will be subject to alteration following infiltration testing.
- 2.8.16 The proposed discharge restrictions of 15.5 l/s and 5.5 l/s (21.0 l/s total) are to be utilized through the storm periods of 2 years, 30 years and 100 years (including climate change of 40%). The betterment compared to existing greenfield runoff is indicated in Table 1.

Greenfield run off rates have been taken from the HR Wallingford Greenfield Runoff calculations in Appendix 5

Storm Events	Existing Greenfield Run off Rate (l/s)	Proposed Discharge Rate (l/s)	SW Rate	% Betterment
QBar	21.9	21.0		4.1%
2 years	20.4	21.0		-2.8%
30 years	39.0	21.0		46%
100 years	47.8	21.0 (+40% climate change)		56%

Table 1 – Surface Water discharge Betterment

2.8.17 Table 1 indicates a significant betterment of discharge over existing greenfield runoff for the Qbar, 30 year and 100 year storm events. This will reduce the flow into the existing watercourse and reduce flood risk in comparison to existing.

2.9 S3. Water Quality

- 2.9.1 The proposed road areas are classified as a cul-de-sac and considered to be low pollution hazard index. The roads will be drained via spacings between kerb sections which lead onto planted bioretention areas. The bioretention areas will have high level overflow perforated pipes to drain the bioretention areas into filter drains beneath. The filter drains have large diameter perforated pipes to enable additional storage.
- 2.9.2 The roof areas of the plots have a very low pollution hazard index. The roof drainage will discharge through infiltration trenches and/or rain gardens prior to discharge into surface water drainage network.
- 2.9.3 The car parking areas are classed as residential parking with frequent changes. As such the pollution hazard is considered to be low. The spaces will instead drain via permeable paving with over-flow perforated pipes to collect any excess and drain them into the main surface water network. This adequately mitigates the pollution risk.
- 2.9.4 Shallow bunds with uphill swales are proposed to intercept overland flow from the landscaped areas up-slope from the site, which are to remain undeveloped. The swales will have type 3 bedding material and perforated pipes in the base to channel the flow northwards. The swales

are to be connected. The swales will discharge via an unrestricted outfall headwall into the existing watercourse along the northern boundary as shown in appendix 4.

2.9.5 Water quality and pollution index calculations are included in Appendix 6.

2.10 S4. Amenity and S5. Biodiversity

2.10.1 The guidance in the Standards encourages the use of 'softer' drainage solutions. The opportunity for incorporating larger softer SuDS features on the site is limited due to the site constraints.

2.10.2 Areas of the proposed highway are to be drained via bioretention areas adjacent to the carriageway with infiltration trenches beneath.

2.10.3 The detention basin in the north of the site will provide amenity and biodiversity benefit.

2.10.4 The shallow bunds that with the filter drain will intercept uphill runoff will provide biodiversity benefits.

2.11 S6. Design of Drainage for Construction, Operation and Maintenance

2.11.1 The properties on the site will be wholly Adra social housing. As such, surface water drainage that serves only the social housing will remain the responsibility of Adra to operate and maintain. Drainage serving only the highway will be highway asset, and their responsibility to operate and maintain. When private and highway drainage combines, the asset will be adopted by the SuDS Approving Body, and will be operated and maintained by them. A management and maintenance schedule will be provided.

3.0 FOUL DRAINAGE

3.1 General Considerations

- 3.1.1 At present no existing foul water drainage is located within the site boundary. The closest existing public foul water sewer is located 30m outside of the site boundary to the north in Isgoed.
- 3.1.2 A pre development enquiry with Welsh Water has confirmed they can accept foul effluent from the site into their network.
- 3.1.3 The proposed foul drainage is to be collected from each plot and discharged into the proposed foul water drainage network as shown in Appendix 4. A typical private foul water layout is shown by the red lines in Figure 5 below.

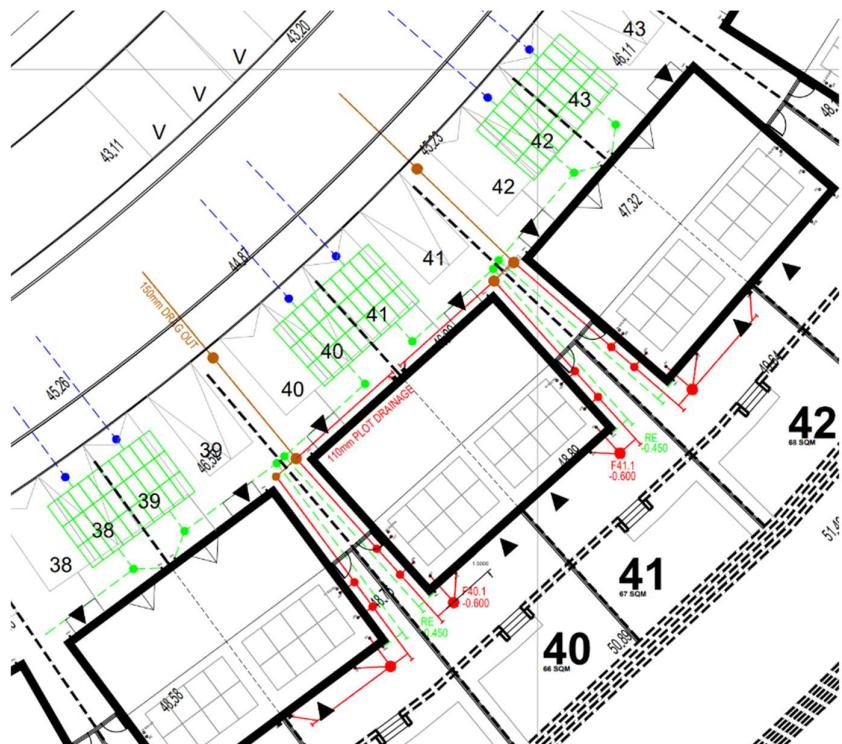


Figure 5: Typical Private Foul Water Drainage Layout

4.0 FLOOD RISK AND PROPOSED DRAINAGE – SUMMARY

4.1 Flood Risk

- 4.1.1 The site is not at risk of fluvial or tidal flooding and is noted as having areas within flood zone 2 and 3 for small watercourses.
- 4.1.2 The development will not adversely affect flood risk but instead will reduce the risk of flooding downstream of the site, because the new drainage system will be designed to limit the discharge from the site.

4.2 Surface Water Drainage

- 4.2.1 The management of surface water drainage will be in compliance with the Welsh Government SuDS Standards. The proposals will be separately submitted to the SAB for approval.
- 4.2.2 The proposed surface water system will enable rainwater to discharge first via infiltration. Rainfall that does not infiltrate will be collected and conveyed to two discharge at controlled rates into the into the existing watercourse.
- 4.2.3 Car parking runoff is to be collected via permeable paving with high level overflow collection.
- 4.2.4 Highway drainage is to be collected through bioretention areas, filtration trenches and traditional gullies/kerb drainage.

4.3 Foul Drainage

- 4.3.1 Proposed foul water to be collected by the proposed adoptable foul water network which discharges into the existing Welsh Water public sewer located in Isgoed, to the north of the site.
- 4.3.2 Private drainage is to be designed on a plot by plot basis and connected into the adoptable foul water network.

APPENDIX 1
Topographical Survey



Title:
TOPOGRAPHIC SURVEY
LAND OFF LLANRWST ROAD
GYFFIN
CONWY

Client:

Notes:
1. Grid - tied into OS grid using OSGB 36
2. Datum - tied into OS datum using OSGB 36
3. Contour vertical interval = 1m
4. Survey orientated to grid north

SCALE: 1:1000@A1 DATE: 18/07/22 CHECKED: SR DWG NO. 22_110/01

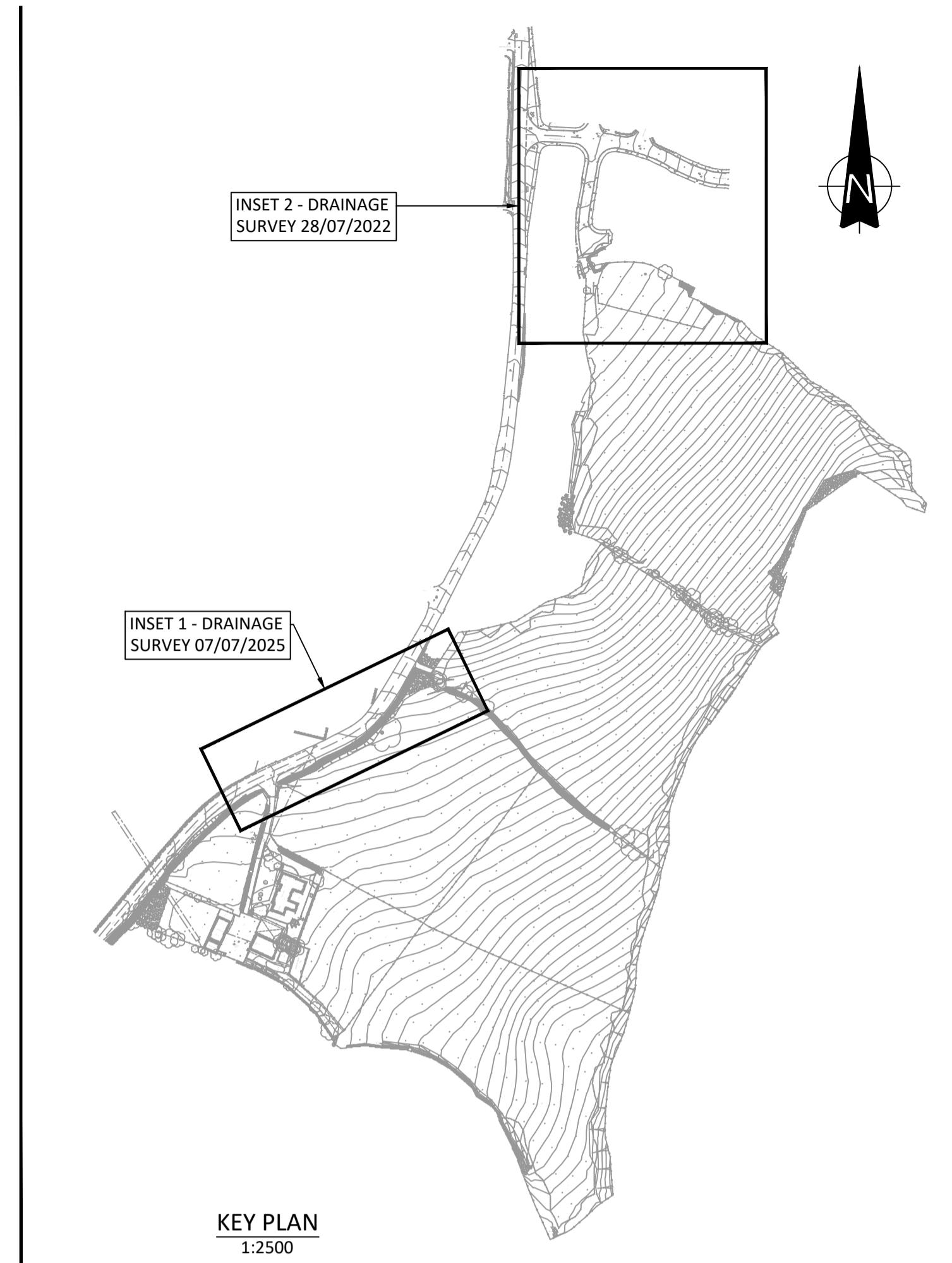
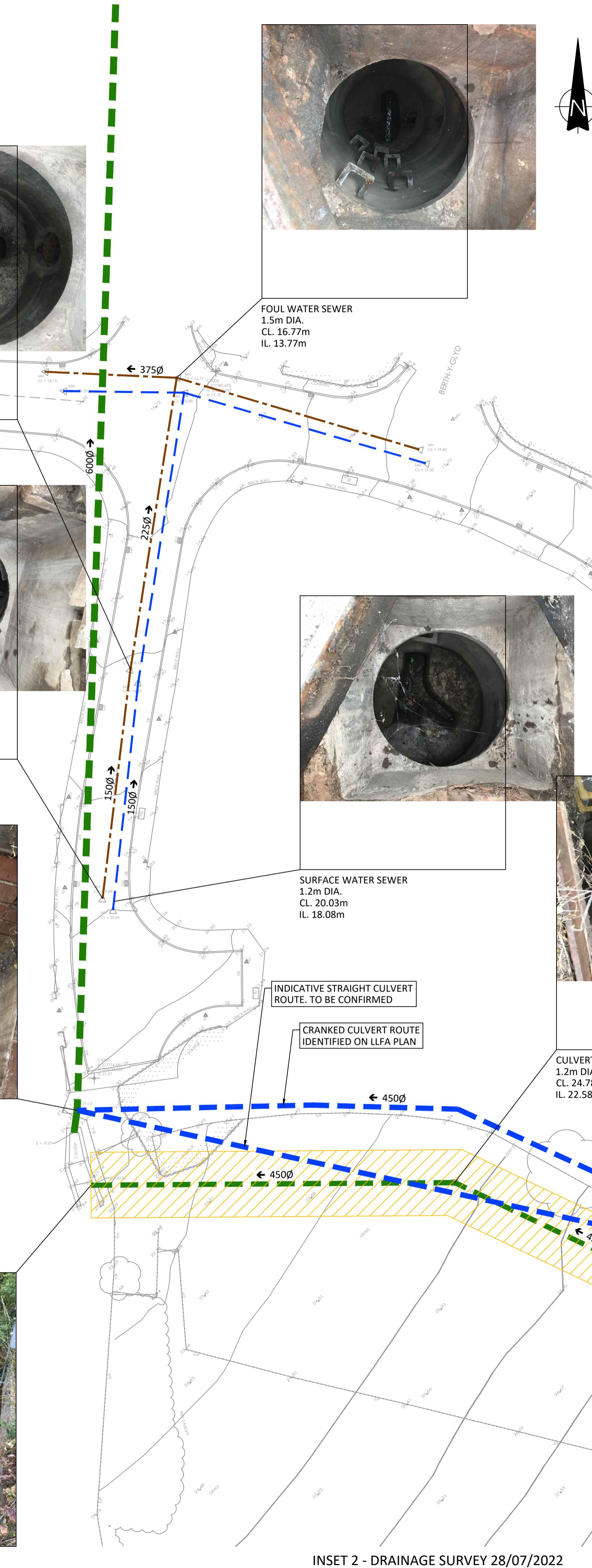
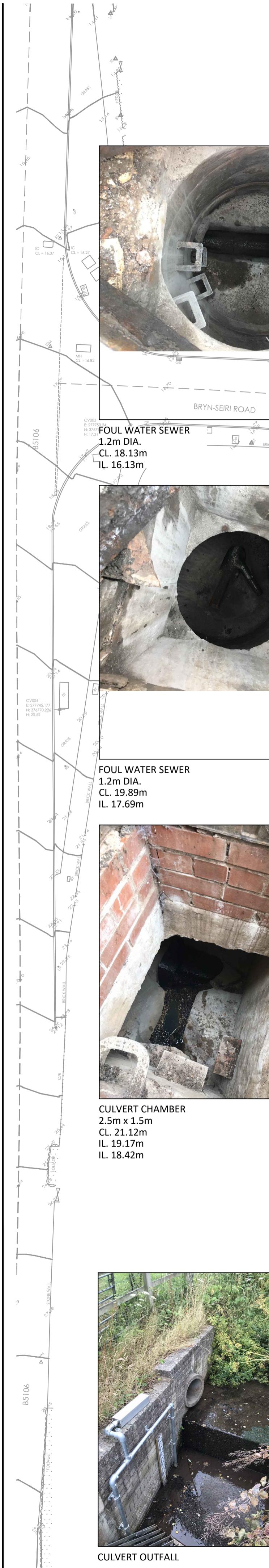
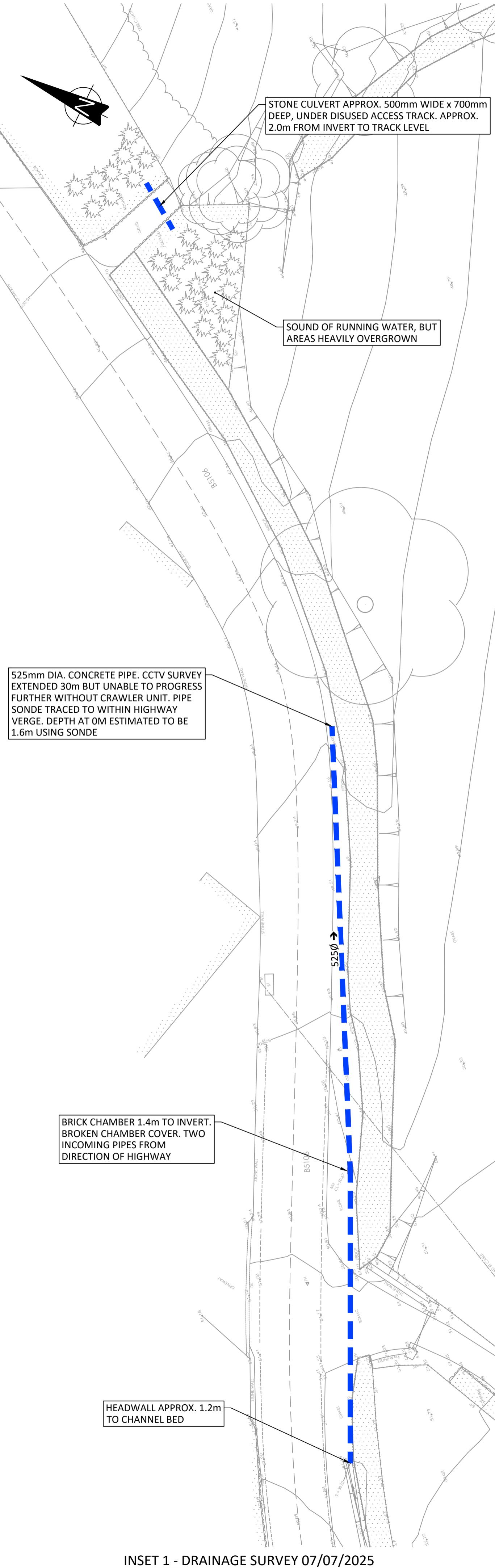
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APPENDIX 2

Existing Drainage



DRAFT

P02	07/07/2025 DRAINAGE SURVEY RESULTS ADDED	JE	JES JES 11.12.25
P01	ISSUED FOR INFORMATION	CR	JES JES 17.02.22
REV	MODIFICATIONS	BY	RE AP DATE
PURPOSE OF ISSUE FOR INFORMATION		STATUS S2	
CLIENT: Adra			
PROJECT: LLANRWST ROAD, GYFFIN			
TITLE: EXISTING DRAINAGE SURVEY			
DESIGNED BY CR	DRAWN BY CR	REVIEWED BY JES	AUTHORISED BY JES
DATE JULY 2022	SCALE @1:1	JOB REF: 5388	REVISION P02
DRAWING NUMBER 5388-CAU-XX-XX-DR-C-1600			
Caulmert engineering environmental planning			

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NOTES

- DO NOT SCALE FROM THIS DRAWING, WORK FROM FIGURED DIMENSIONS ONLY. ALL DIMENSIONS ARE IN METRES AND ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM UNLESS NOTED OTHERWISE.
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS.

APPENDIX 3

Development Layout

HOUSE TYPE	DESCRIPTION	NO. OF BEDROOMS	FLOOR AREA m ²	INTERNAL GARAGE AREA m ²	NUMBER
A/B	2P1B APT	1	51 m ²	NO	30
C	4P2B	2	83 m ²	NO	10
D	4P2B	2	83 m ²	NO	12
E	3P2B APT	2	65 m ²	NO	13
F	3P2B BUNG	2	59 m ²	NO	2
G	5P3B	3	93 m ²	NO	1
H	5P3B	3	96 m ²	NO	2
J	5P3B	3	96 m ²	NO	1
K	6P4B	3	114 m ²	NO	4
L	8P5B	3	131 m ²	NO	1
	TOTAL		95		

NOTES / KEY:

- PROPOSED LANDSCAPING, SPECIES TO BE AGREED.
- TREES TO BE RETAINED AND PROTECTION.
- SF DENOTES SCREEN FENCE.
- ZIBILITY SPLAYS AT JUNCTIONS.
- PARKING BAYS 2.6M X 4.8M MIN.
- HEDGE TO BE RETAINED AND PROTECTION.
- TURFED AREAS OR GRASS SEEDED.
- MONA PRECAST PERMEABLE PAVING - COLOUR CO.
- MONA PRECAST PERMEABLE PAVING - COLOUR NATURAL.
- TARMAC.
- CONCRETE BLOCK PAVING AROUND PROPERTIES.

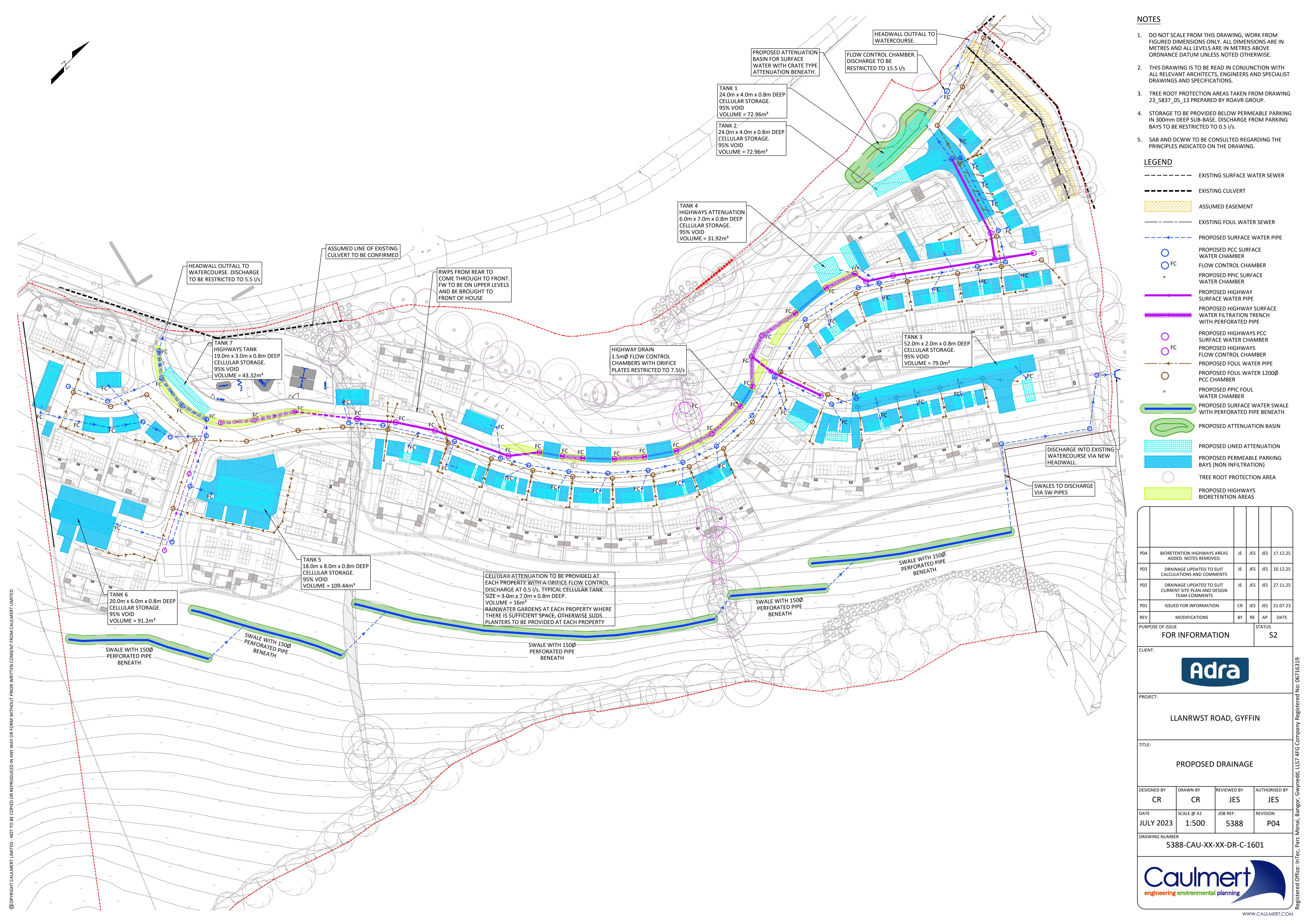
TREES TO BE REMOVED.

- PROPOSED ORNAMENTAL SHRUB AND GROUNDCOVER PLANTING.
- PROPOSED NATIVE HEDGE - SPECIES / MIX AS INDICATED.
- PROPOSED NATIVE SHRUB - SPECIES / MIX AS INDICATED.



APPENDIX 4

Proposed Drainage



APPENDIX 5

Greenfield Run Off Calculations

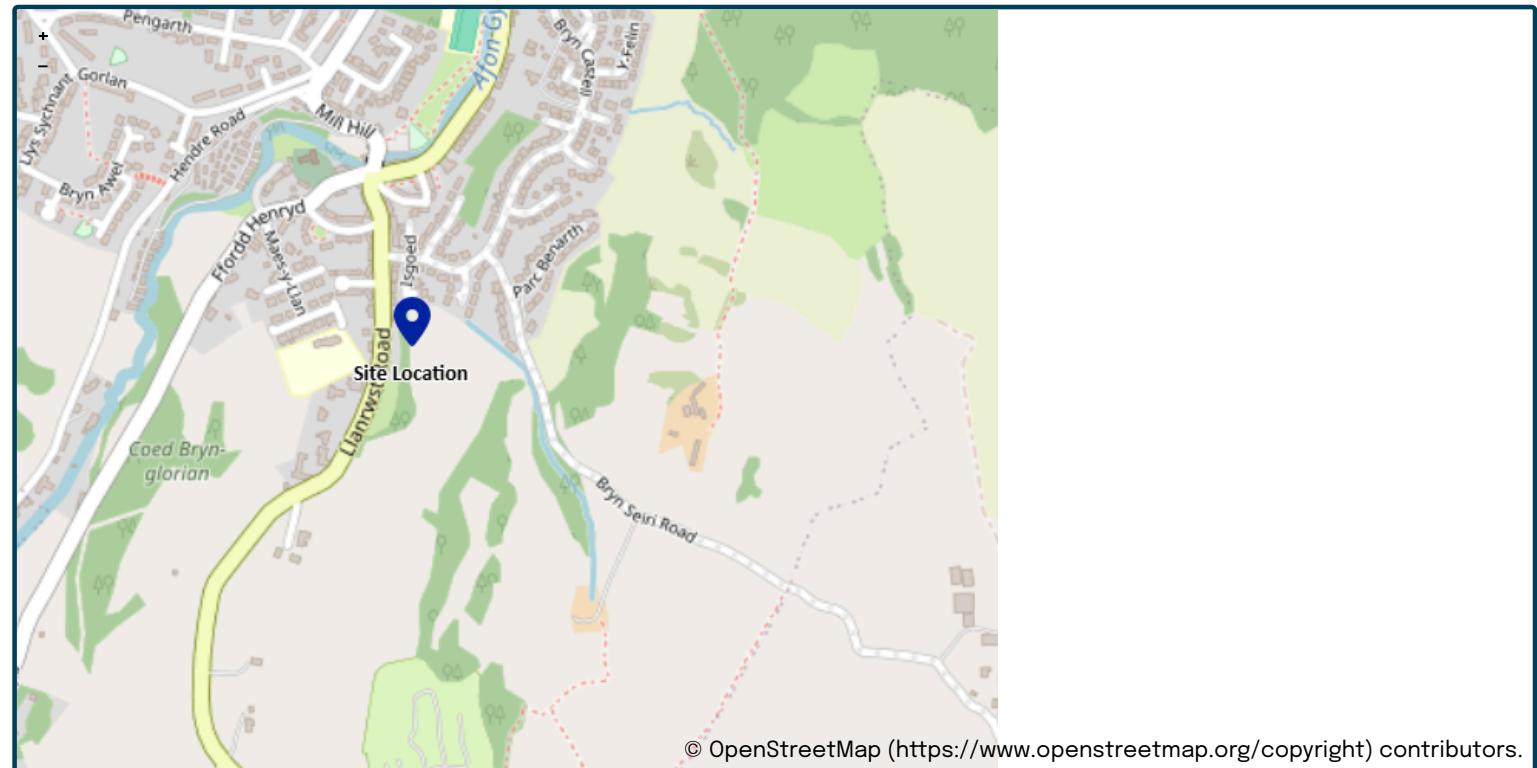
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	15/12/2025
Calculated by	JE
Reference	5388
Model version	2.2.2

Location

Site name	LLANRWST ROAD
Site location	GYFFIN



Site easting (British National Grid)

277779

Site northing (British National Grid)

376643

Site details

Total site area (ha)

3

ha

Greenfield runoff

Method

Method	IH124
--------	-------

IH124

	My value	Map value
SAAR (mm)	997	mm
How should SPR be derived?	WRAP soil type	
WRAP soil type	4	2
SPR	0.47	
QBar (IH124) (l/s)	21.9	l/s

Growth curve factors

	My value	Map value
Hydrological region	9	9
1 year growth factor	0.88	
2 year growth factor	0.93	
10 year growth factor	1.42	
30 year growth factor	1.78	
100 year growth factor	2.18	
200 year growth factor	2.46	

Results

Method	IH124
Flow rate 1 year (l/s)	19.3
Flow rate 2 year (l/s)	20.4
Flow rate 10 years (l/s)	31.1
Flow rate 30 years (l/s)	39.0
Flow rate 100 years (l/s)	47.8
Flow rate 200 years (l/s)	53.9

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.2) developed by HR Wallingford and available at [uksuds.com](https://www.eksuds.com/) (<https://www.eksuds.com/>). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [uksuds.com/terms-conditions](https://www.eksuds.com/terms-conditions) (<https://www.eksuds.com/terms-conditions>). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

APPENDIX 6

Pollution Index Calculations

CALCULATION SHEET

Client: ADRA	Site: Llanrwst Road	Project: Drainage Design		
Made by: Jim Emmerson	Date: 16.12.25	Checked by: Jon Sykes	Date: 16.12.25	Sheet no.: 1

Water Quality Summary

Water quality assessed using Simple Index Approach as described in Section 26.7.1 of the SuDS Manual.

Land Use Type	low traffic road (residential)	residential Parking	Residential Roof	
Pollution Hazard Level	Low	Low	Very Low	
Pollution Hazard Indices				
TSS	0.50	0.50	0.20	
Metals	0.40	0.40	0.20	
Hydrocarbons	0.40	0.40	0.05	
SuDS components proposed				
Component 1	Bioretention	Permeable Paving	Filter Strip	
Component 2	Filter Drain			
Component 3				
SuDS Pollution Mitigation Indices				
TSS	1.2	0.7	0.4	
Metals	1.2	0.6	0.4	
Hydrocarbons	1.2	0.7	0.4	
Groundwater Protection Type	None	None	None	
GW protection Pollution Mitigation Indices				
TSS	0	0	0	
Metals	0	0	0	
Hydrocarbons	0	0	0	
Combined Pollution Mitigation Indices				
TSS	1.2	0.7	0.4	
Metals	1.2	0.6	0.4	
Hydrocarbons	1.2	0.7	0.4	
Acceptability of Pollution Mitigation				
TSS	Sufficient	Sufficient	Sufficient	
Metals	Sufficient	Sufficient	Sufficient	
Hydrocarbons	Sufficient	Sufficient	Sufficient	

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