



TRANSPORT PLANNING

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1 HENFAES ROAD, TONNA, NEATH

Flood Consequences Assessment

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REVISIONS

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1 Executive Summary

Description	Summary
Location	1 Henfaes/Neath Road, Tonna, Neath Port Talbot, Wales. Nearest Post code SA11 3FF. National Grid Reference 276961, 198661.
Lead Local Flood Authority	Neath Port Talbot Council
Site Area	The total site area is approximately 0.64ha.
Current / Existing Land Use	The site is a brownfield site with a number of dilapidated buildings on the development site.
Rivers and Sea Flood Risk	Very Low. The site is outside of risk of flooding from rivers and sea using Welsh Water classification for Flood Zones.
Fluvial Flood Risk	Very Low
Groundwater Flood Risk	Low
Surface Water Flood Risk	Low
Sewers Flood Risk	Low
Artificial Source Flood Risk	Low / Unlikely in this area
Development Proposals	The proposals are to construct up to 8 dwellings with associated roads, parking areas, sustainable drainage features and soft landscaping areas.
Greenfield Runoff rate	QBar – 1.0l/s (for the adoptable road discharging to road option). All private areas are to discharge at a conservative infiltration rate of 7.7×10^{-5} m/s
Climate Change Allowance	45%
Surface Water Drainage Strategy	The surface water drainage strategy for the site for the private areas is to discharge surface water to ground by utilising infiltration at a conservative rate of 7.7×10^{-5} m/s. The access road will be offered for adoption and will either drain to ground or to the highway sewer subject to Neath and Port Talbot Council agreement and subject to a CCTV survey of received survey if this option is chosen. The Surface water management (SuDs) Plan can be found within Section 5.

Foul Water Drainage Strategy	There is a public foul sewer that runs through the site. The proposals are to divert the public foul sewer with a Section 185 agreement. The proposals are for the foul drainage to connect into the existing public foul sewer within Henfaes Road by utilising a connection on the line and level of the existing sewer.
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2 Introduction

2.1 Background

2.1.1 IMA Transport Planning Ltd have been appointed to prepare a Flood Consequences Assessment (FCA) and drainage strategy to support the planning application for the development of 8 dwellings.

2.1.2 This assessment is undertaken in accordance with guidance as set out in Technical Advice Note 15 (TAN15) and associated technical guidance.

2.1.3 Reference has been made to Natural Resource Wales (NRW) and Welsh Water (DCWW) advice and flood/asset mapping.

2.2 Scope of work

2.2.1 The site is identified in relation to its topographical and geographical location, identifying any drainage outfalls and watercourses within the vicinity of the development site. Refer to Appendix A for the site location plan.

2.2.2 The flood risk from river, tidal, land/surface, groundwater, sewer and artificial sources will be assessed and, where necessary and feasible, appropriate mitigation measures suggested.

2.2.3 The existing surface water drainage mechanisms will be assessed together with the sources of any potential flooding.

2.2.4 A proposal for a surface water drainage system serving the development site will be assessed in the context of identifying any site constraints. Sustainable Drainage Systems (SuDS) will be recommended and employed to reduce or remove any flood risks, as required and where possible.

2.2.5 The existing foul drainage system will be assessed together with recommendations on new connections and or diversions that may be required as a result of the redevelopment of the site.

2.3 Site Description

2.3.1 The development site is located within a residential area of Neath, located south off the B4434 Henfaes/Neath Road. The site has an area of 0.64ha and is centred about OS Grid reference 276961, 198661. A plan showing the location of the site can be found in Appendix A.

The development site is bounded by development on three sides, with accesses directly off the northern boundary on the B4434 Neath Road. There are a number of existing dilapidated building on the site. Levels vary across the site with low points of approximately 32.50 in the southwestern and eastern area. A topographical survey is included at Appendix B of this report.

- 2.3.2 With regard to Ordnance Datum levels, these are indicated on the topographical survey in Appendix B. The highest point of the site is in the northwestern section having a level of approximately 34.5m AOD. The levels vary quite considerably across the site with the lowest point on site being approximately 32.50m AOD at the southwestern and eastern end of the site.
- 2.3.3 There is an existing stream located to the northeastern corner of the site running in a north-westerly direction along the boundary. The stream has headwalls located to the north and southern boundary. The stream appears to drain into the adjacent property to the north of the development site.
- 2.3.4 The development site lies within the catchment of the River Neath, which flows south-west bound approximately 180m to the north-west of the site.

3 Review of Sources of Flooding

There are several different ways in which flooding can occur. These different ways reflect the source of the floodwater and how it moves across the landscape. The different sources of flooding can occur individually, or they can be combined.

This section investigates the risks associated with all sources of flooding at the development site and surrounding catchment area. Associate flood mapping can be found in Appendix D.

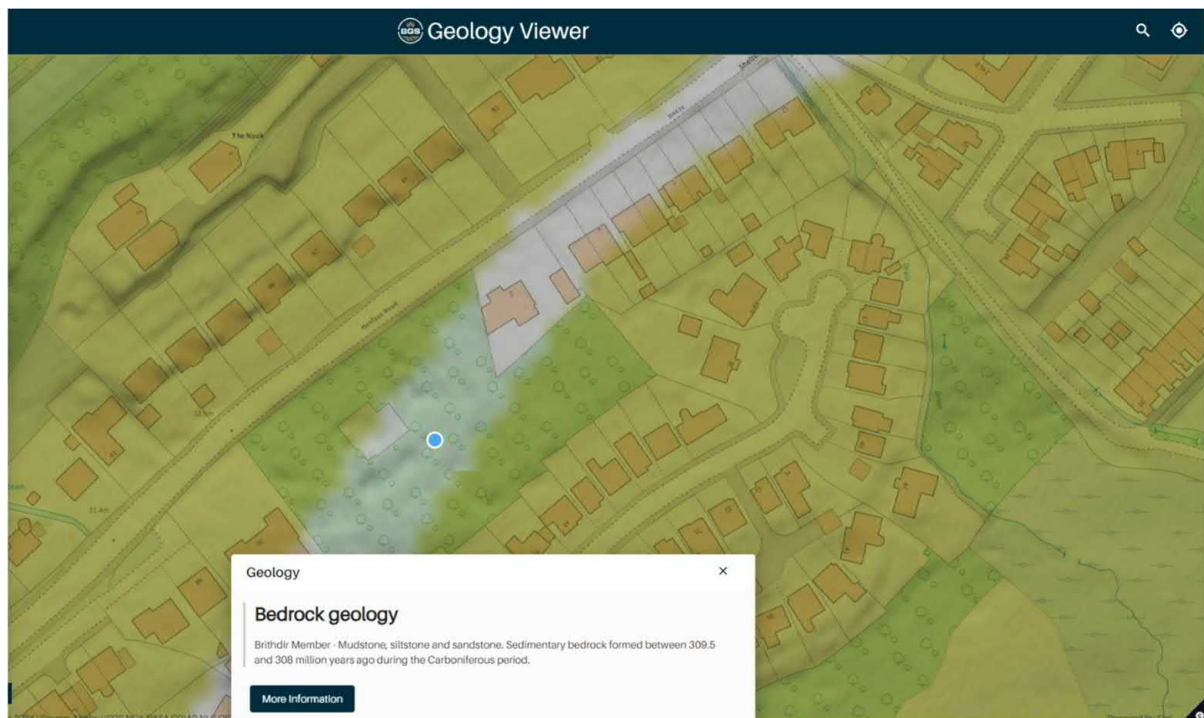
3.1 Rivers/Fluvial and Sea/Tidal

- 3.1.1 Flooding from rivers occurs when the water levels in the river rise to a point that the river cannot cope with the amount of water draining into it from the surrounding land, leading to overtopping or breach of the riverbank.
- 3.1.2 The development site is located approximately 8km from the nearest coastline and at an approximately level of 32.5mAoD, therefore the risk of flooding from sea/tidal sources is not considered to present a risk to the development site.
- 3.1.3 The NRW Flood Mapping identifies the extent of flooding from rivers and sea, taking into account the effects of flood defences, and categorises them according to the risk of flooding. The risk assessment scale contains four levels from 'High' to 'Very Low'.
- 3.1.4 With reference to the NRW Flood Mapping for Rivers and Sea, the site is located within a 'Very Low' risk zone, with an annual probability of exceedance [AEP] less than 0.1%. Refer to Appendix D.
- 3.1.5 Flooding from river sources is therefore not considered a risk to the development site.
- 3.1.6 It is important to note that under TAN15 guidance it is stated that existing flood defences are aimed at reducing the risk of flooding to existing development and are not available to provide defence in anticipation of future developments. Therefore, the assessment of the risk of flooding from sea/river for a proposed development should be undertaken with the effects of existing flood defences excluded.
- 3.1.7 NRW provide alternative mapping, in the form of Development Advice Mapping (DAM), to cover this assessment requirement. The mapping provides four zones, A, B, C1 and C2, with zone A representing the areas with the lowest risk of flooding from rivers and seas. Refer to Appendix D.
- 3.1.8 With reference to the NRW DAM, the site is located within Zone A.
- 3.1.9 In tandem with the DAM mapping, a vulnerability category is assigned to the proposed development, based on the nature of the development. All residential developments are considered to be highly vulnerable and therefore the development in question is highly vulnerable.
- 3.1.10 A matrix in Section 9 of TAN15 confirms the acceptability of development based upon the DAM zoning and vulnerability category.
- 3.1.11 The site, being located in DAM Zone A and considered highly vulnerable, is acceptable, subject to condition that flood risk is not increased elsewhere as a result of the development.

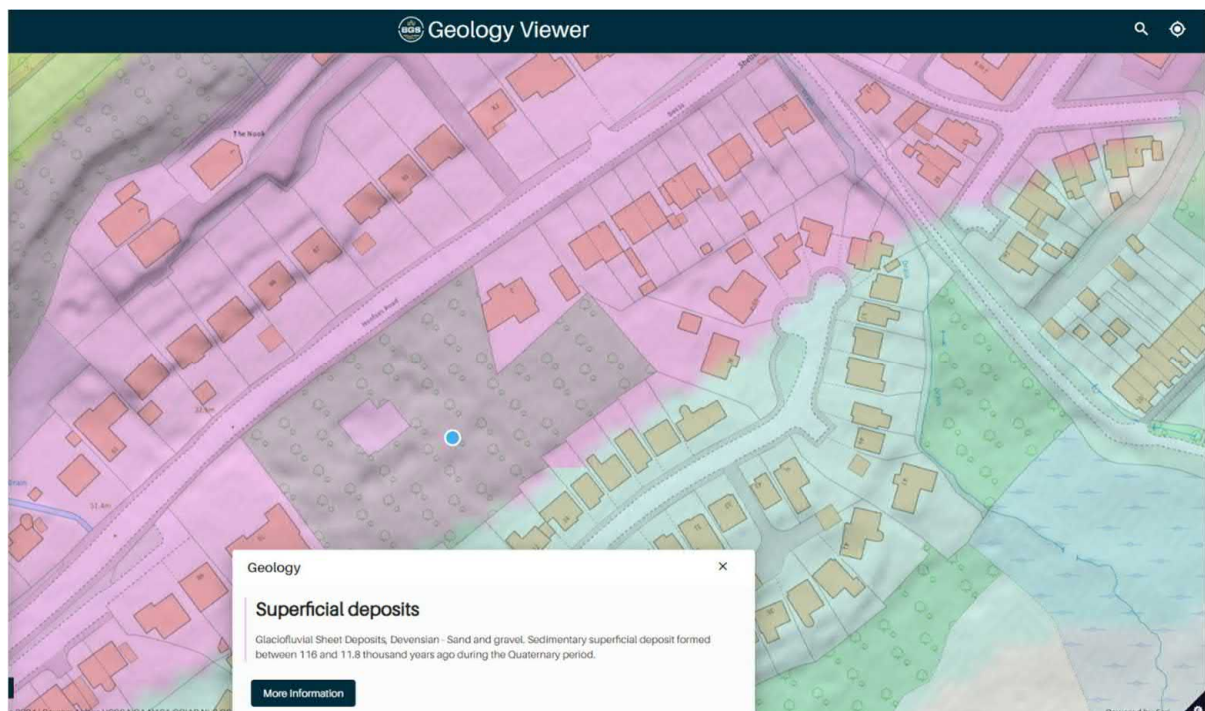
3.2 Groundwater

- 3.2.1 Groundwater flooding is caused by a rise in water table levels and the emergence of water originating from sub-surface permeable strata at the surface. Groundwater floods may emerge from either single point, or multiple widespread locations, and are usually long duration events.
- 3.2.2 With reference to BGS Maps superficial deposits have been recorded as Glaciofluvial Sheet Deposits, Devensian Sand and Gravel. Bedrock has been recorded as Brithdir Member – Mudstone, siltstone and sandstone.

BGS Maps - Bedrock



BGS Maps – Superficial Deposits



- 3.2.3 The site investigation confirms the superficial deposits comprising of boulder to gravel size pebbles with some sub angular and angular rock debris. Groundwater was not encountered during excavation of any of the trial holes and the report notes that there is unlikely to be a general standing water table at a depth likely to affect the development.
- 3.2.4 Flood risk from ground water is therefore considered to be low.
- 3.3 Surface water
- 3.3.1 Surface flooding is primarily caused by surface water running off the land, often when intense, short duration storms occur and rainfall is unable to enter drainage systems or soak into the ground.
- 3.3.2 NRW mapping for this source of flooding contains data on three risk bands of surface water flooding: High, Medium and Low. Within each risk band, data is available on the potential depth, velocity and direction of flooding. Areas not included within these risk bands are considered very low risk, with an annual probability of flooding of less than 0.1% (1 in 1000).
- 3.3.3 Reference to the NRW Mapping confirms that there is low surface water flood risk beyond the site boundary on the northeastern corner of the development site where the existing stream discharges onto the adjacent land. Please note this is external to the development site boundary and levels within this area will be unchanged.
- 3.3.4 There are areas of high surface water flood risk for an area to the southwest of the site and then on the southwestern boundary external to the site boundary. The area within the site is likely due to this being a localised low point on the site. A site visit concluded that there was no standing water noted during a site walkover. Trial pits concluded that the area also has good infiltration potential. Flow exceedance routing and a positive drainage network will be

provided as part of the proposals, so surface water flood risk is therefore considered to be low.

3.4 Sewers

3.4.1 Flooding from sewers can result when the sewer is overwhelmed by heavy rainfall resulting in surcharging, becomes blocked or is of inadequate capacity. Flooding from sewers is defined as flooding in an urban area with a comprehensive sewer network.

3.4.2 Welsh Water Asset Mapping, found in Appendix C, confirms that there are public sewers located within the site boundary however topographically, the site is located at a higher level than the sewers located within Henfaes Road. There will be a new drainage network provided for the site.

3.4.3 Based on the above information it is considered that the flood risk to the development site from sewer sources is low.

3.5 Reservoirs, Canals and Other artificial sources

3.5.1 Artificial sources include reservoirs, canals and lakes where water is retained above natural ground level. Overtopping, leakage or a breach in the canal/reservoir structure is considered an artificial source of flooding.

3.5.2 Breach is a catastrophic failure of a water retaining structure, normally leading to rapid loss of all impounded water unless emergency measures are taken. Breach is considered to be of low probability, but of high consequence and for this reason it is identified as a most significant flood mechanism.

3.5.3 Reference to the NRW Mapping indicates that the site is not at risk from flooding from reservoirs.

3.6 Recorded flood extents data

3.6.1 Recorded flood extents mapping obtained from NRW Recorded Flood Extents mapping indicates that the proposed development site has no recorded history of flooding. Refer to Appendix D.

3.7 Strategic Flood Consequence Assessment (SFCA)

3.7.1 A strategic flood risk assessment for the Southwest Wales area was prepared in November 2022 by JBA Consulting. This details specific food risk information for the area and helps assist the council in managing and reducing flood risk for its residents and businesses.

3.8 Access and Egress to development

3.8.1 During flood events safe access to and egress from the site shall be achievable via the main site accesses off Henfaes Road.

3.9 Summary of Flood Risk

Receptor	Residential Development						
	Source	Rivers/ Fluvial	Sea/ Tidal	Surface/ Pluvial	Groundwater	Sewers	Artificial
Vulnerability Class	Low	✓	✓	✓	✓	✓	✓
	Medium						
	High						

3.9.1 From the above table, the overall flood risk associated with the development site is considered to be low.

4 Development Proposals

4.1 Site Layout

- 4.1.1 An illustrative site layout based upon an 8-unit development can be found in Appendix E.
- 4.1.2 Based upon the illustrative plans that accompany this application, the impermeable surface areas for roofs, hardstanding, and parking have been measured for the proposed development site and are indicated on the drainage areas plan in Appendix F of the report.
- 4.1.3 The proposed surface water and foul drainage scheme can be found within Appendix G.
- 4.1.4 As a minimum, in accordance with Building Regulations, all external levels shall be set a minimum of 150mm below the building level. Based on this information, overland flow strategies for the site have been shown on the drainage layout.

4.2 Existing Surface Water Conditions: Brownfield Run-off

- 4.2.1 For the purposes of this assessment, as the site was previously developed, it is classified as a brownfield site.
- 4.2.2 In order to provide a betterment upon the brownfield runoff regime of the existing site, and make allowances for future climate change predications, the proposed development should afford a minimum of 30% betterment over existing brownfield flows as a minimum.
- 4.2.3 To achieve this, we propose that most of the development utilises infiltration with the proposed highway drainage to utilise the pre-development greenfield run-off rates set out below as the performance target. (refer 3.2.5 below)
- 4.2.4 The FEH method has been used to determine the greenfield runoff rate for the area of proposed adoptable highway.
- 4.2.5 Using this method, the existing runoff from the development site has been calculated and the results shown in the table below.

Site Catchment Characteristics					
Area (Ha)	0.070	SAAR (mm)	1480	Region	9
Results					
Return Period			Run-off		
Q _{bar}			1.02 l/s		
Q _{1 year}			0.9 l/s		
Q _{30 year}			1.82 l/s		
Q _{100 year}			2.23 l/s		

- 4.2.6 As per Welsh Government guidance in “Recommended non-statutory standards for SuDS” the rate of storm water runoff for a new development should mimic the existing flow regime. This is equivalence rule is achieved by assessing and designing to the 1 in 1 year and 1 in 100 year events. There are three storage types should be used to control the discharge offsite. These are:

- Interception Storage – Runoff from storm events of less than 5mm should be discharged onsite. *(Designed to increase water quality and reduce pollution to receiving waters)*
- Attenuation Storage – Runoff from intermediate storms should be temporarily retained onsite to limit discharge rate offsite. *(Designed to reduce the rate of runoff, matching greenfield conditions)*
- Long-term Storage (LTS) – Runoff from large storms (greater than 1 in 100, 6hr storm) should be retained and discharged onsite or discharged at a low rate of 2l/s/ha. *(Designed to prevent additional runoff volume reaching receiving waters, matching greenfield conditions)*

4.2.7 The requirement for LTS is accepted as being difficult to meet in some circumstances. For this development site, due to its small size and assumed poor/low infiltration rate, it is considered to be unfeasible to provide LTS. As a trade-off for non-compliance, the discharge limit for 1 in 100 year storm is set to Q_{BAR} , in effect 'over attenuating' on site in place of preventing an increase in runoff volume.

4.3 Surface Water Drainage - Planning Policy

- 4.3.1 The future development of this site should in no way cause a greater flood risk to the site, or the downstream catchment area that already exists and should where practicably reduce flood risk, both now and in the future.
- 4.3.2 Natural Resource Wales guidance states that residential developments should be allocated a minimum 100-year design life, therefore any storm water attenuation features should be designed to meet this requirement.
- 4.3.3 There are indications that the climate in the UK is already changing. Current expert opinion suggests that higher intensity, short duration storms will occur more frequently as a result of climate change. Periods of prolonged rainfall are also likely to occur more frequently. The potential impacts of climate change on the site are likely to be as a result of increased rainfall intensity and duration.

- 4.3.4 Natural Resource Wales have undertaken assessments of the effect of climate change on natural water systems. TAN 15 (Section 2.5) states that by 2080, winter precipitation may increase by up to 30%. It is on this basis that the climate change allowance has been applied for the site.
- 4.3.5 The proposed development should be approached with a view to managing the surface water run-off, taking in to account water quantity (flooding), water quality (pollution) and amenity issues, all being collectively referred to as Sustainable Drainage Systems (SuDS).
- 4.3.6 SuDS are generally regarded as a management train, consisting of control structures and strategies that are designed to efficiently and sustainably drain surface water run-off, while minimising pollution and managing the impact on water quality of local water bodies and groundwater aquifers below.
- 4.3.7 Therefore, in the first instance and in keeping with SuDS planning hierarchy, the proposed drainage scheme for the development site should be designed with a view to utilising SuDS drainage techniques, returning as much of the surface water run-off to ground as close to the source as possible, i.e. utilising infiltration.
- 4.3.8 Where this is not feasible, a discharge to a surface water body, such as a main river, ordinary watercourse or local land drainage feature is the preferred approach to surface water treatment. Where a surface water body is not available, a connection to a surface water sewer, highway drain or suitable receiving drainage system may be considered. Ultimately, although prior approval will be required, a connection to a combined sewer may be considered although this should be considered a last resort.
- 4.3.9 The proposed SuDS features may also be considered for adoption by the Local Authority for adoption, as the Lead Local Flood Authority (LLFA), and should be designed in accordance with current LLFA guidance and advice/requirements.
- 4.3.10 The design of all SuDS infrastructure shall be approved by the LLFA or relevant approving body at the time of design, prior to commencing construction and may then subsequently be considered for adoption. Where adoption of the SuDS features does not take place, a management/maintenance company shall be set up or appointed to manage the ongoing maintenance of these features.
- 4.3.11 The design/sizing of the SuDS features and drainage network shall be confirmed at detailed design, following modelling of the proposed development drainage system and shall be designed to meet the greenfield performance of the site.
- 4.4 Surface Water Drainage – Development Proposals
- 4.4.1 With reference to the infiltration testing undertaken by Geo-testing in November 2024 soakage tests were undertaken in accordance with BRE 365. Testing confirmed that infiltration is a suitable discharge method for surface water flows where possible. The results were averaged across the site and referenced with the laboratory tests. An average rate of 1.0×10^{-2} was then recorded within the report. Further Infiltration Rate Calculations have been undertaken for each of the test locations and can be found within Appendix K. The lowest rate of 7.7×10^{-5} m/s will be utilised for all infiltration devices as a conservative approach.

4.4.2 The drainage strategy is split into two separate sections:

Section 1

- 4.4.3 The proposed houses are intended to discharge to ground by collecting roof water via traditional guttering with down pipes discharging into the subbase of the permeable paving via permeavoid diffusers where possible. Plot 1 will discharge to two lined soakaway chambers.
- 4.4.4 Surface water runoff from roofs will be collected for re-use. Storage for rainwater will be provided by installing a single 200 L (minimum) water butt for each dwelling.
- 4.4.5 Utilising Flow to run an attenuated storage estimate, the impermeable surface area comprising roof, and permeable parking areas has been measured as 0.147 ha.
- 4.4.6 For minimum subbase reservoir depths refer to Appendix F -Catchment areas and Appendix H for hydraulic calculations. All calculations have now been based upon conservative recorded infiltration rates as shown on the catchment drawing.
- 4.4.7 A 10% allowance for urban creep has been allowed for within the calculations.

Section 2

- 4.4.8 The proposed adoptable road located to the east of the development site is intended to either discharge to ground subject to Neath and Port Talbot Council approval or discharge into the existing highway sewer network located within Henfaes Road subject to confirmation of suitable depth and capacity.
- 4.4.9 Utilising Flow to run an attenuated storage estimate, the impermeable surface area of the road and footway areas has been measured as 0.07 ha.
- 4.4.10 The allowable surface water discharge rate (Q_{BAR}) from the proposed development for the road, as noted in section 3.2, is 1.0 l/s. This has determined (as can be seen as in Appendix H) that between 34m³ and 59m³ of attenuation volume is required.
- 4.4.11 For the discharge to highway sewer a restricted attenuated discharge has been proposed utilising oversized pipes beneath the access road.
- 4.4.12 The final proposed drainage scheme will be confirmed at the detail design stage; however, the below strategy provides a feasible scheme based on the assumptions stated in this report.
- 4.4.13 The proposed scheme shall use a combination of interception features such as permeable paving, conveyance features such as pipes, and attenuation features such as oversize pipes and sub-base replacement in parking bays to achieve the SuDS objectives of water quality, quantity and amenity.
- Where possible it is suggested to connect rainwater downpipes to permeable paving subbases at suitable locations. This feature is designed to allow storm water to infiltrate into the ground.
 - Access road runoff will be directed towards gullies with sumps for silt interception prior to discharging to the existing highway sewer.

- All surface water systems will then be connected to a flow control chamber at the outfall which will contain a hydrobrake, or similar, to restrict the discharge from the site. During heavy rainfall events the system will surcharge and fill the attenuation structures and pipes.
- Runoff during exceedance events (ie greater than 1 in 100 + 45%) will be directed safely through the site and towards Henfaes Road as shown on the conceptual drainage layout.

4.5 Water Quality

4.5.1 Using the guidance within table 4.3 of Ciria C753 'The SuDS Manual', it has been determined that given the site's residential nature, proposed runoff will have a low pollution hazard level. As the site will be discharging to ground, it follows that the simple index approach is an appropriate assessment method.

4.5.2 The pollution hazard indices of the development proposals have been summarised below in line with the guidance in table 26.2 of the SuDS Manual:

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential Roofs	Very Low	0.2	0.2	0.05
Residential CarPark	Low	0.5	0.4	0.4

4.5.3 Table 2 below summarises the pollution mitigation indices assigned to each individual SuDS component. This table is based on the C753 Table 26.4 for discharge to ground.

Types of SuDS features	Total suspended solids (TSS)	Metals	Hydro-carbons
Permeable Pavement	0.7	0.6	0.7

Each of the proposed surface water treatment train permutations are as follows:

SuDS Treatment Train	Total suspended solids	Metals	Hydro-carbons
Permeable Pavement	0.7	0.6	0.7
Residential roof	0.2	0.2	0.05
Pass/fail	Pass	Pass	Pass

4.5.4 As all permutations of SuDS proposals and pollution hazards are acceptable for the receiving groundwater the drainage strategy is considered to meet the desirable water quality requirements.

4.5.5 Highway drainage discharge water quality to be addressed at detailed design stage and through agreement with Neath and Port Talbot Highways. Trapped Highway Gullies will be utilised for the discharge to sewer option which will provide an element of interception.

4.6 Amenity Value

- 4.6.1 In line with C753 'The SuDS Manual' and best practice, SuDS features should provide amenity value to local residents by offering multi-functionality, visual character, accessibility and legibility/engagement opportunities.
- 4.6.2 The SuDS features have been carefully designed to be integrated into the open spaces areas of the site.
- 4.6.3 Planting should be used to enhance the character of the raingardens as well as support biodiversity and support water quality treatment.
- 4.6.4 The permeable paving allows parking areas whilst providing attenuation and infiltration along with water quality benefits.

4.7 Biodiversity Benefits

- 4.7.1 The proposed raingardens and ecological maintenance zone will offer significant opportunities to support biodiversity through habitat provision, connectivity and resilience.
- 4.7.2 Refer to the Ecological Management Plan for details.

4.8 Foul Drainage

- 4.8.1 With reference to the Welsh Water asset map shown in Appendix C there is an existing 100mm private foul sewer serving properties to the south of the development site. It is shown entering the site approximately halfway along the southern site boundary and at that point running in a north-westerly direction across the development site. This is noted on the asset plans as a private sewer transfer in the key. This sewer then joins a section of 150mm adoptable combined sewer which then runs towards the northeast and towards 2 Henfaes Road where it then crosses underneath Henfaes Road towards the northwest.
- 4.8.2 As indicated on the drainage strategy, we intend to divert a section of the private foul sewer subject to approval under the Section 185 Agreement. The diverted sewer will run north along the new site access road before reconnecting into Henfaes Road. The existing drainage network is to be traced on site to confirm the line and level of the existing sewers onsite and through to proposed new connection prior to detailed design. For a feasible strategy we have noted required minimum tie-in levels.
- 4.8.3 The sewer is to be designed in accordance with Building Regulations and Design & Construction Guidance (DCG) for new sewers, connecting the proposed development to the existing 150mm combined sewer in Henfaes Road.
- 4.8.4 Based upon the proposed layout, it is estimated that the new residential development proposal will have a peak discharge rate of 0.37l/s from the 8 houses. This rate has been based on the DCG assumption of a design flow rate of 4000L / dwelling / day. However, the foul sewers will need to be sized to include the existing from the properties to the south development.
- 4.8.5 A capacity check will need to be undertaken on the existing public sewer by Welsh Water, to confirm that the existing sewer network has capacity to receive foul flows from the proposed development.

4.8.6 Details of the foul water drainage strategy can be found in Appendix G.

5 Future Maintenance

- 5.1.1 It is intended that part of the new foul and surface water drainage system serving the development will remain private at this stage and that the owners of the site will be responsible for the ownership and maintenance of the private drainage system.
- 5.1.2 It is intended that Shared Permeable Paving areas are to be maintained by a management company.
- 5.1.3 However, the sewers within the road will be offered for adoption under a S104 agreement.
- 5.1.4 It is proposed that a maintenance regime / schedule will be provided with the sales particulars. We would propose that any such sales particulars and maintenance manuals should outline the following information:
- 5.1.5 We would propose that the following information is included as a minimum:
- i. Clear details of ownership and responsibilities of drainage systems across the site.
 - ii. Copy of the installed as built drainage drawings.
 - iii. Copies of standard product specifications used for relevant drainage elements including *(but not limited to)*:
 - a. Inspection chambers/ manholes
 - b. Pipework
 - c. Access covers
 - d. Soakaways
 - e. Flow Control Devices
 - f. Channel Drainage
 - iv. Information relating to the SuDS features provided:
 - a. Manufacturers' details and specifications including design life.
 - b. Recommendation for inspections and maintenance.
 - c. Details of intended proper operation.
 - d. Potential safety issues.
 - v. Notes on warranties offered by the contractor as may be appropriate – for call out service.
 - vi. Contact details for Maintenance Company in event of blockage and emergency.
 - vii. Contact details for local pipe jetting / cleaning companies in event of blockage

Raingardens

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Removal of litter and debris	Monthly
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspection of inlets and outlets for blockages, and clear if required	Monthly
	Inspect inlets and surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year), then annually
Occasional Maintenance	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch.	As required
	Infill any holes or scour in the filter medium, improve erosion protection if required.	As required
Remedial Actions	Remove and replace filter medium and vegetation above.	As required, but likely to be > 20 years

Rainwater Harvesting

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, filters	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional Maintenance	Cleaning and/or replacement of any filters	Three monthly (or as required)
Remedial Actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Infiltration Systems

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter, debris and trash	Monthly
	Cut grass - for landscaped areas and access routes	Monthly (during growing season) or as required
	Cut grass - meadow grass in and around basin	Half yearly: spring (before nesting season) and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
Occasional Maintenance	Reseed areas of poor vegetation growth	Annually (or as required)
	Prune and trim trees and remove cuttings	As required

	Remove sediment from pre-treatment system when 50% full	As required
Remedial Actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc. for evidence of physical damage	Monthly
	Inspect inlets and pre-treatment systems for silt accumulation; establish appropriate silt removal frequencies	Half yearly
	Inspect infiltration surfaces for compaction and ponding	Monthly

Permeable Paving

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required based on site specific monitoring and observations.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements.
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required.
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48h after large storms in the first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

6 Recommendations and Conclusions

6.1 Recommendations

- 6.1.1 A CCTV Drainage survey should be carried out to confirm the location and routing/easements of the foul and combined sewers within the site boundary. A CCTV drainage survey will also be required to confirm the outfall levels for the highway (if chosen as a discharge option) and foul drainage outfall levels to confirm the current strategy.
- 6.1.2 Consultation with Welsh Water will be required. It is not envisaged that the routes of the sewers will differ greatly from the records provided but manhole positions should be located as this will inform requirements for any diversions.
- 6.1.3 We would suggest that the discharge option for the road could be dealt with through a planning condition.

6.2 Conclusions

- 6.2.1 The development site has been fully appraised in accordance with the guidance provided for assessing flood risk under the TAN15.
- 6.2.2 It has been concluded that the overall risk of flooding to the site is low.
- 6.2.3 Roof areas and parking areas are to utilise permeable paving to infiltrate into the ground in accordance with the SuDS hierarchy where possible with lined soakaway chambers to be utilised within gardens for rear downpipes for Plot 1.
- 6.2.4 The access road which is intended to be offered for adoption, is to drain to ground subject to Neath and Port Talbot Highways approval or via an attenuated restricted discharge to the existing highway sewer located within Henfaes Road (as shown on the drainage strategy drawing) subject to confirmation on the outfall depth. The discharge will be restricted to greenfield run off rate (Qbar) and attenuated with oversized pipes which have been designed to accommodate the 1:100 year + 45% climate change event.
- 6.2.5 The foul drainage design utilises a gravity network. Part of the existing private foul drainage is to be diverted through the site and along a new section of foul sewer to connect back into the public foul drainage system in Henfaes Road. The foul network is subject to confirmation of outfall depth/capacity and Welsh Water consent.
- 6.2.6 In line with Welsh Government interim advice, Sustainable Drainage Systems (SuDS) shall be implemented within the development proposals to manage surface water runoff from the proposed development and achieve greenfield runoff rates, representing a significant improvement upon the current brownfield contribution.
- 6.2.7 Based on this Flood Consequence Assessment, the proposed development is achievable in a sustainable manner, without increasing flood risk, and likely reducing flood risk, on the development site or the greater catchment area.

Appendix A

Site Location Plan



The red line indicates the boundary for the new development



TRANSPORT PLANNING
MONTREUX HOUSE, 18A JAMES STREET WEST
BATH BA1 2BT
t: 01225 444 011
www.ima-tp.com

CLIENT:	Emily Byrne
PROJECT:	1 Henfaes Road Neath, Tonna

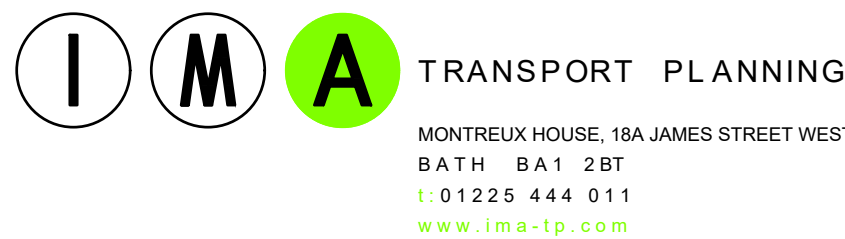
TITLE:	Site Location Plan
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SCALE: (A3) 1:1000	CHECKED: DS	APPROVED: DS
CAD FILE: IMA-24-077_SL01.dwg	DESIGN/DRAWN: PDI	DATE: December 2024
PROJECT No: IMA-24-077	DRAWING No: SL-01	REV: -

Appendix B

Topographical Survey

North



REV	DATE	BY	DESCRIPTION	CHK	APD

NOTES

CLIENT:

Emily Byrne

PROJEC

1 Henfaes Road
Tonna, Neath

TITLE:

Topographical Survey

This drawing has been based on survey information supplied by an independent surveying company. Whilst the information provided is believed to be accurate, IMA Transport Planning Ltd shall not be liable for any inaccuracies or deficiencies arising from it.

DRAWING STATUS:		for Planning	
SCALE: (A1)	CHECKED:	APPROVED:	
1:250	DS	DS	
CAD FILE:	DESIGN/DRAWING:	DATE:	
IMA-24-077_000.dwg	PDI	December 2024	
PROJECT NO:	DRAWING NO:	REV:	
IMA-24-077	000	-	

Appendix C

Welsh Water Asset Location Mapping



LEGEND(Representative of most common features)

	Foul chamber		Outfall
	Surface water chamber		Lamphole
	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.		Private Sewer Transfer
	RED - Combined		Lateral Drain
	GREEN - Surface Water		Inspection Chamber
	BROWN - Foul		
	Purple - Former S24 sewers (for indicative purposes only)		

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.

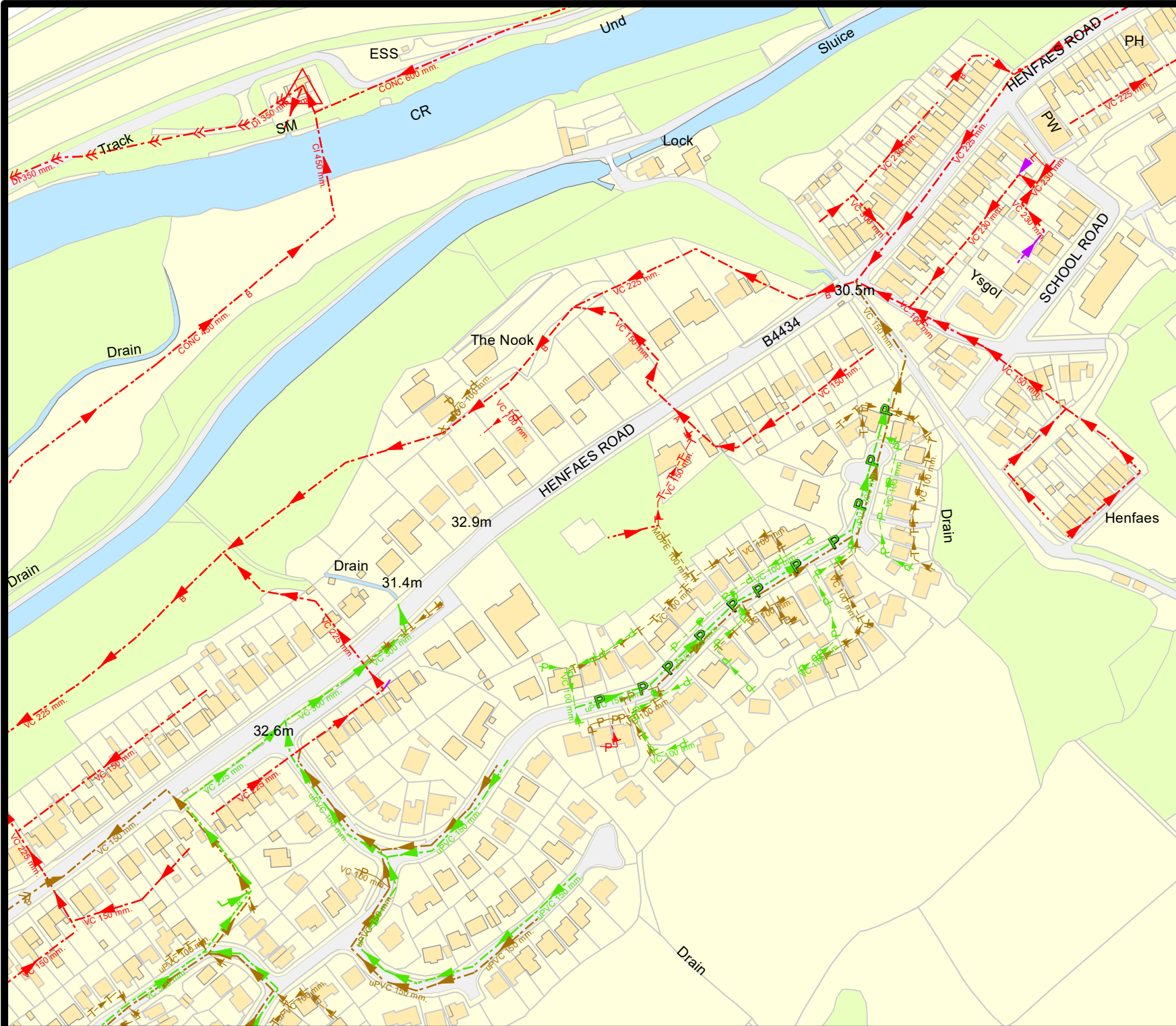
Dŵr Cymru Cymrydd (The Company) gives this information as to the position of its underground apparatus by way of general guidance only and on the understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The user of this information is advised to carry out any excavations made solely on their own. The information which is supplied by the Company is done so in accordance with statutory requirements of sections 105 and 106 of the Water Industry Act 1991 which in no way opens the liability of the Company for any inaccuracies, 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 water main, service pipe, sewer, lateral drain or discharge pipe and any associated apparatus, but before 1 September 1990, or if they do, the particular detail relating to their position, depth and size may not be accurate. It must be understood that the furnishing of this information is solely without prejudice to the provisions of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

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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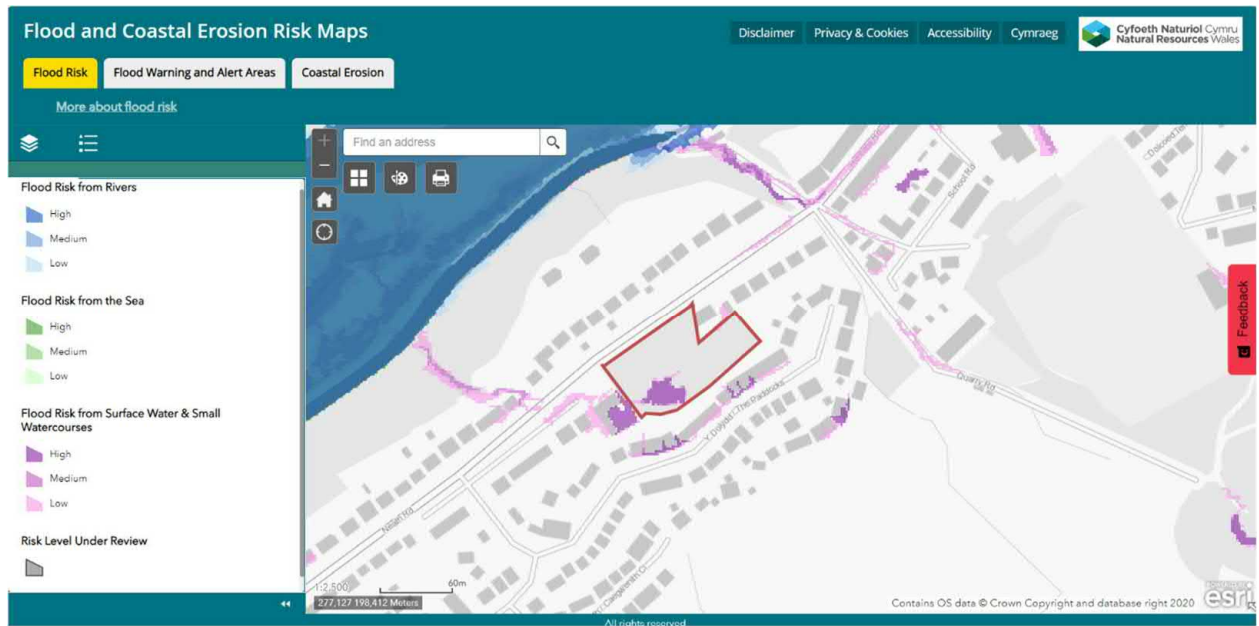
Map Ref: 276922,198613
Map scale: 1:2500
Printed by: Emily Marsden
Printed on: 11 Dec 2024



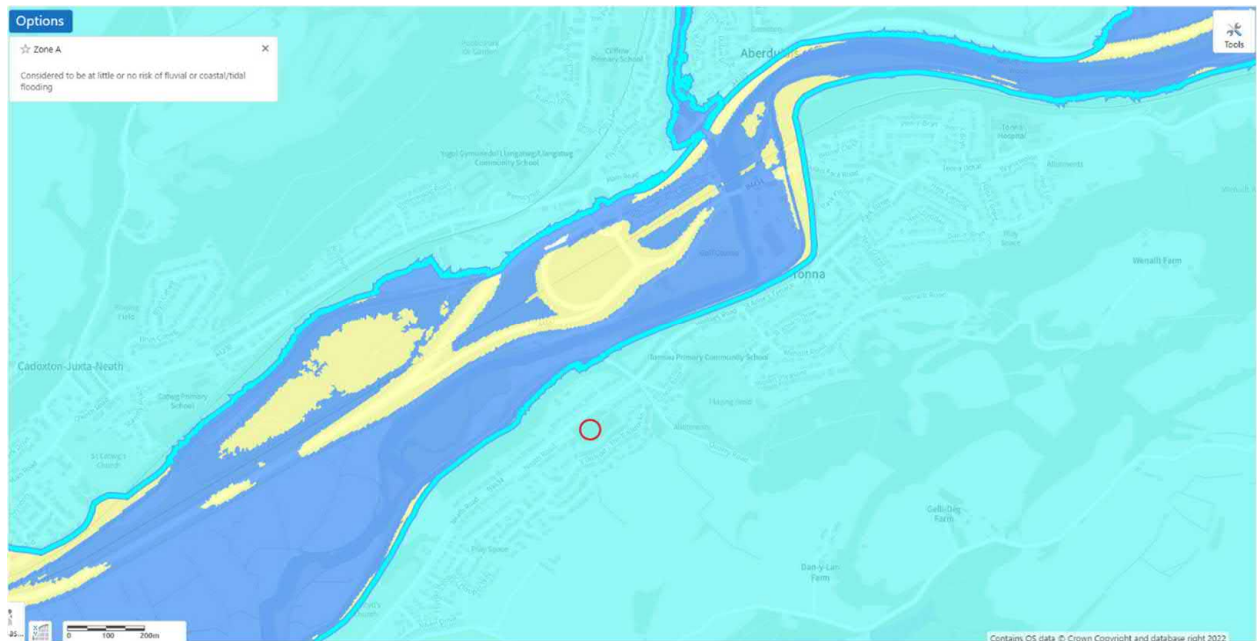
Appendix D

Natural Resources Wales – Flood Risk Mapping

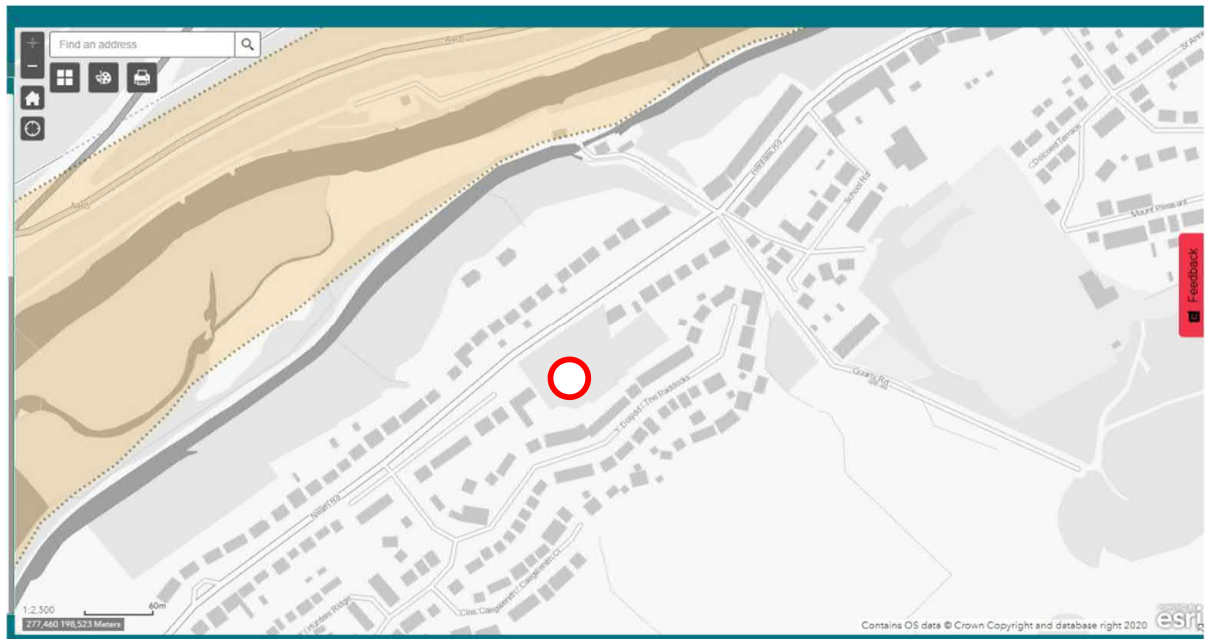
National Resources Wales - Flood Maps



Development Advice Map (DAM)



National Resource Wales – Recorded Flood Extents



Flood and Coastal Erosion Risk Maps

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Flood Risk

Flood Warning and Alert Areas

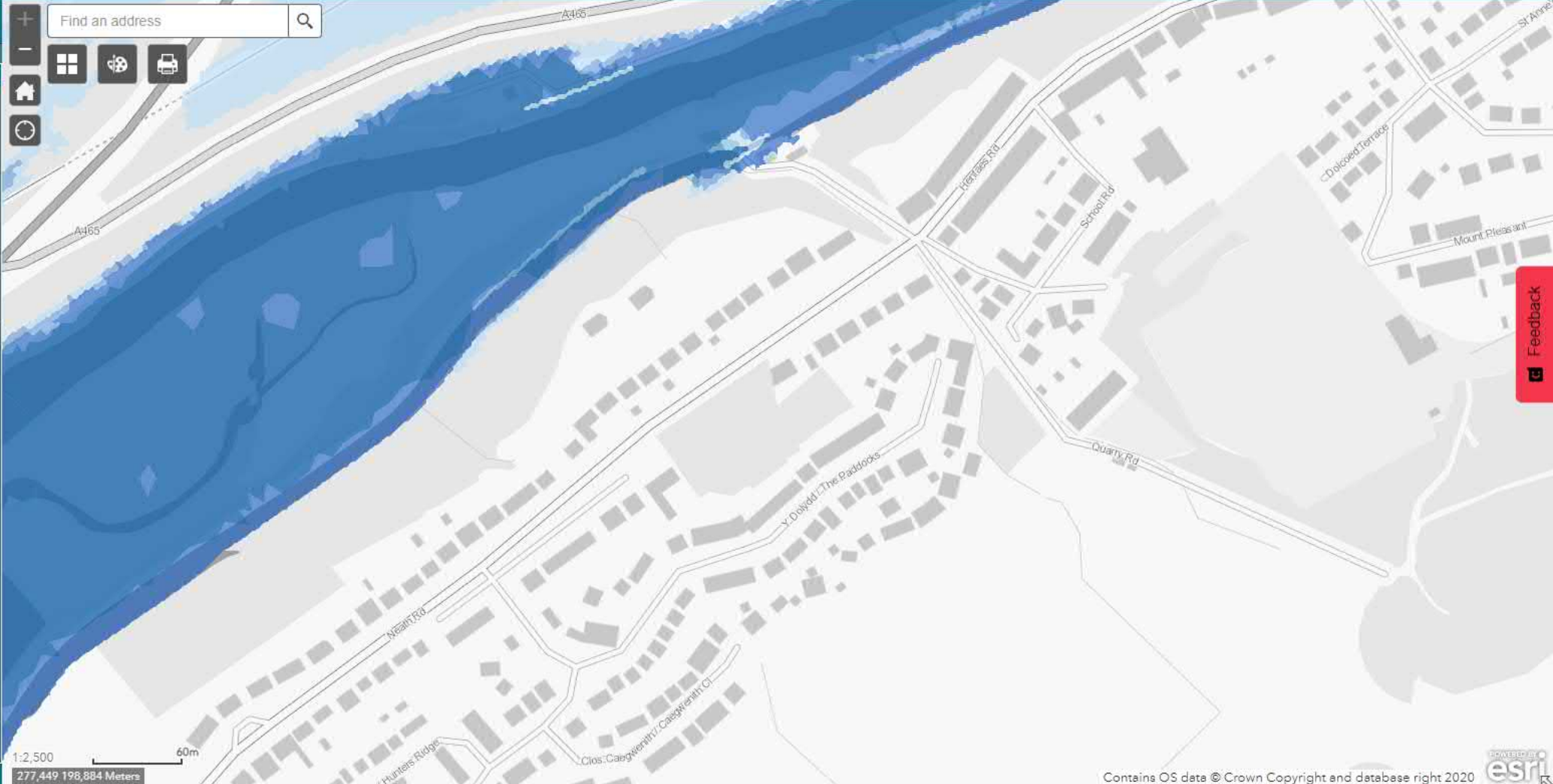
Coastal Erosion

[More about flood risk](#)



Layer List

- ☐ Low
- ☐ Flood Risk from the Sea
 - High
 - Medium
 - Low
- ☐ Flood Risk from Surface Water & Small Watercourses
 - High
 - Medium
 - Low
- ☐ Risk Level Under Review
- ☐ Recorded Flood Extents
- ☐ Flood Storage Areas
- ☒ Flood Risk from Reservoirs
- ☐ Main Rivers



Feedback

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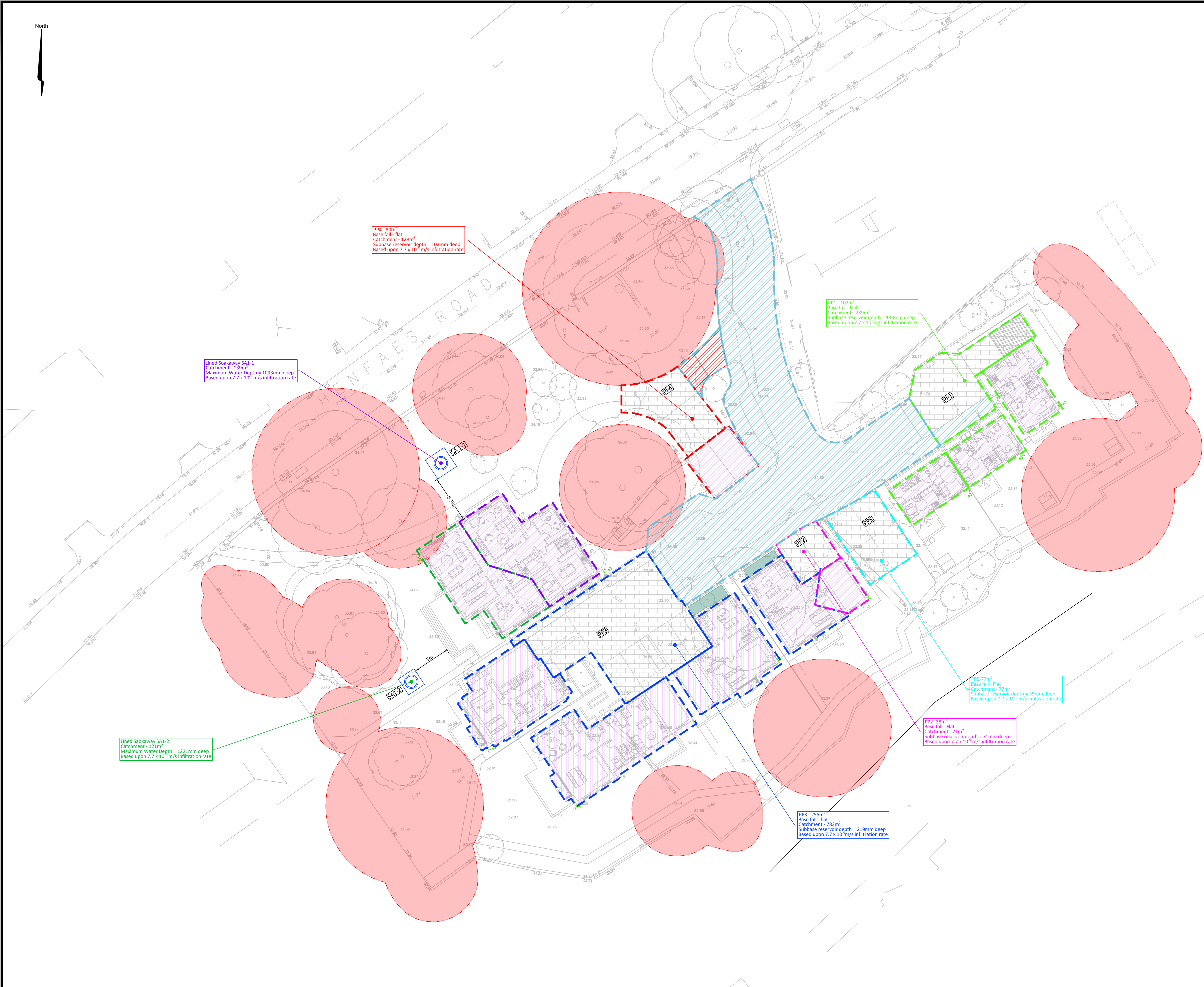
Appendix E

Proposed Site Layout



Appendix F

Impermeable Drainage Areas

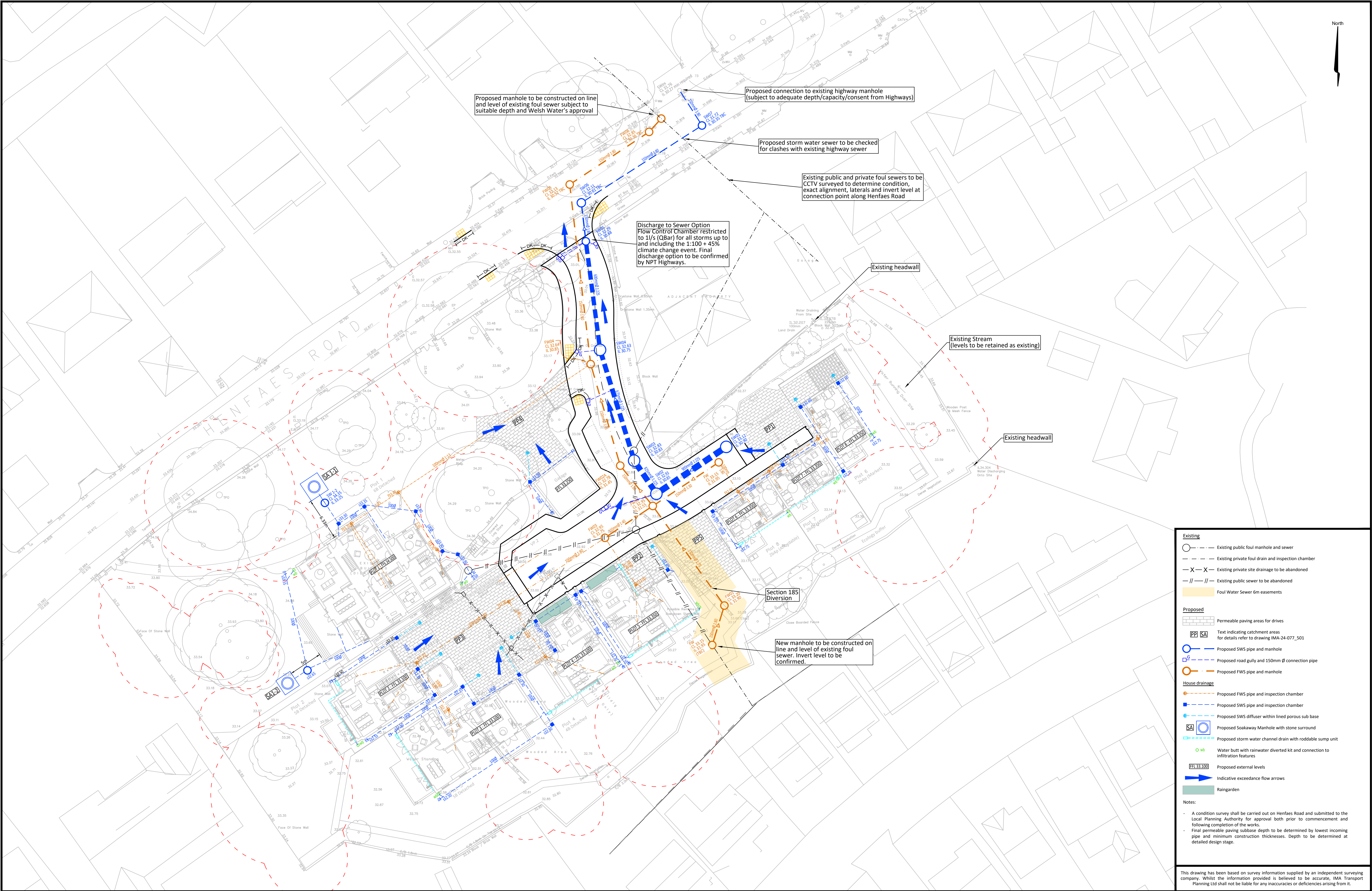


Legend:		
Drainage Catchments		Total (ha)
	Roof drained area:	
	Plot 1	0.025
	Plot 2	0.012
	Plot 3	0.017
	Plot 4	0.012
	Plot 5	0.012
	Plot 6-8	0.017
	Total roof area	0.095
	Areas of permeable paving:	
	PP1	0.010
	PP2	0.004
	PP3	0.025
	PP4	0.008
	PP5	0.008
	Total permeable area	0.052
	Areas of private impermeable area	0.001
	Highway & footpaths	0.065
	Existing hardstandings to be demolished	0.073
Waterbutt capacity calculation		
Section of Roof area x Rainfall (mm) x 0.9 (efficiency factor) = Litres collected		
Roof drained area (m²):	Total (Litres)	
Plot 1a - 40 x 5 x 0.9 =	180	
Plot 1b - 41 x 5 x 0.9 =	185	
Plot 2 - 19 x 5 x 0.9 =	85.5	
Plot 3 - 15 x 5 x 0.9 =	67.5	
Plot 4 - 12 x 5 x 0.9 =	54	
Plot 5 - 16 x 5 x 0.9 =	72	
Plot 6 - 38 x 5 x 0.9 =	171	
Plot 7 & 8 - 25 x 5 x 0.9 =	112.5	

I M A TRANSPORT PLANNING MONTREUX HOUSE, 18A JAMES STREET WEST BATH BA1 2BT T: 01225 444 011 www.ima-t-p.com						NOTES:	CLIENT: Emily Byrne	TITLE: Catchment Areas	DRAWING STATUS: for Planning		
	E	22/06/2026	PDI	Re-issued for Planning Approval	DS				DS	SCALE (A1): 1:250	CHECKED: DS
	D	06/01/2025	ND	Catchments updated to suit SAB comments	DS		DS	CAD FILE: IMA-24-077_501.dwg	DESIGN/DRAWN: PDI	DATE: December 2024	
	C	17/11/2025	PDI	Site layout revised	DS		DS	PROJECT NO: IMA-24-077	DRAWING NO: 501	REV: E	
	B	10/11/2025	ND	Site layout revised	DS		DS				
	A	07/11/2025	ND	Areas updated to suit latest layout	DS		DS				
	REV	DATE	BY	DESCRIPTION	CHK		APPD				

Appendix G

Conceptual Drainage Layout



Existing

Existing public foul manhole and sewer

Existing private foul drain and inspection chamber

X

Existing private site drainage to be abandoned

||

Existing public sewer to be abandoned

Foul Water Sewer 6m easements

Proposed

Permeable paving areas for drives

PP SA

Text indicating catchment areas
for details refer to drawing IMA-24-077_501

Proposed SWS pipe and manhole

Proposed road gully and 150mm Ø connection pipe

Proposed FWS pipe and manhole

House drainage

Proposed FWS pipe and inspection chamber

Proposed SWS pipe and inspection chamber

Proposed SWS diffuser within lined porous sub base

SA

Proposed Soakaway Manhole with stone surround

Proposed storm water channel drain with roddable pump unit

Water butt with rainwater diverted kit and connection to infiltration features

PFL 33.100

Proposed external levels

Indicative exceedance flow arrows

Raingarden

Notes:

-

A condition survey shall be carried out on Henfaes Road and submitted to the Local Planning Authority for approval both prior to commencement and following completion of the works.

-

Final permeable paving subbase depth to be determined by lowest incoming pipe and minimum construction thicknesses. Depth to be determined at detailed design stage.

I M A TRANSPORT PLANNING MONTREUX HOUSE, 18A JAMES STREET WEST BATH BA1 2BT 01226 444 011 www.ima-tp.com				NOTES:				CLIENT: Emily Byrne		TITLE: Conceptual Drainage Strategy		DRAWING STATUS: for Planning																																				
<table><tr><td>REV</td><td>DATE</td><td>BY</td><td>DESCRIPTION</td><td>CHK</td><td>APP</td></tr><tr><td>E</td><td>25/06/2026</td><td>PDI</td><td>Re-issued for Planning Approval</td><td>DS</td><td>DS</td></tr><tr><td>D</td><td>19/12/2025</td><td>ND</td><td>Drainage Strategy updated to suit SAB comments</td><td>DS</td><td>DS</td></tr><tr><td>C</td><td>18/11/2025</td><td>PDI</td><td>Site layout revised</td><td>DS</td><td>DS</td></tr><tr><td>B</td><td>10/11/2025</td><td>PDI</td><td>Site layout revised</td><td>DS</td><td>DS</td></tr><tr><td>A</td><td>17/02/2025</td><td>PDI</td><td>Revised in line with Council's observations 21/01/2024</td><td>DS</td><td>DS</td></tr></table>				REV	DATE	BY	DESCRIPTION	CHK	APP	E	25/06/2026	PDI	Re-issued for Planning Approval	DS	DS	D	19/12/2025	ND	Drainage Strategy updated to suit SAB comments	DS	DS	C	18/11/2025	PDI	Site layout revised	DS	DS	B	10/11/2025	PDI	Site layout revised	DS	DS	A	17/02/2025	PDI	Revised in line with Council's observations 21/01/2024	DS	DS	PROJECT: 1 Henfaes Road Tonna, Neath		SCALE (A1): 1:250		CHECKED: DS	APPROVED: DS	CAD FILE: IMA-24-077_500.dwg	DESIGN/DRAWN: PDI	DATE: December 2024
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D	19/12/2025	ND	Drainage Strategy updated to suit SAB comments	DS	DS																																											
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A	17/02/2025	PDI	Revised in line with Council's observations 21/01/2024	DS	DS																																											
						PROJECT NO: IMA-24-077		DRAWING NO: 500		REV: E																																						

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Appendix H

Greenfield runoff rate and Attenuation volume calculations

Calculated by:

neil doble

Site name:

24-077 – Tonna Neath

Site location:

Neath

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.

Site Details

Latitude:

51.67273° N

Longitude:

3.78134° W

Reference:

1462214986

Date:

Dec 16 2024 10:54

Runoff estimation
approach

FEH Statistical

Site characteristics

Total site area (ha):

0.07

Methodology

Q_{MED} estimation method:

Calculate from BFI and SAAR

BFI and SPR method:

Specify BFI manually

HOST class:

N/A

BFI / BFIHOST:

0.458

Q_{MED} (l/s):

Q_{BAR} / Q_{MED} factor:

1.08

Hydrological
characteristics

	Default	Edited
SAAR (mm):	1527	1480
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):		1.02
1 in 1 year (l/s):		0.9
1 in 30 years (l/s):		1.82
1 in 100 year (l/s):		2.23
1 in 200 years (l/s):		2.52

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of 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, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.000
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SW01		5.00	33.123	1800	276965.330	198619.342	2.214
SW02			32.927	1800	276955.041	198612.435	2.073
S6			32.828	1800	276951.453	198617.083	2.000
SW04			32.631	1800	276946.946	198633.680	1.880
SW05	0.066	5.00	32.294	1200	276944.666	198649.597	1.614
SW06			32.109	1350	276944.005	198655.275	1.499
SW07			31.717	1350	276961.756	198666.656	1.370
Ex			31.711	1350	276958.465	198671.827	1.441

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	0.0		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	45	0	0

Node SW05 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	30.680	Product Number	CTL-SHE-0046-1000-1040-1000
Design Depth (m)	1.040	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Results for 2 year Critical Storm Duration. Lowest mass balance: 91.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	SW01	176	30.997	0.088	0.2	0.2241	0.0000	OK
240 minute winter	SW02	176	30.997	0.143	0.6	0.3641	0.0000	OK
240 minute winter	S6	176	30.997	0.169	1.0	0.4302	0.0000	OK
240 minute winter	SW04	176	30.997	0.246	1.5	0.6262	0.0000	OK
240 minute winter	SW05	176	30.997	0.317	2.6	0.3586	0.0000	SURCHARGED
30 minute winter	SW06	22	30.631	0.021	0.8	0.0296	0.0000	OK
30 minute summer	SW07	25	30.368	0.021	0.8	0.0303	0.0000	OK
30 minute summer	Ex	25	30.291	0.021	0.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	SW01	1.000	SW02	-0.2	-0.022	0.000	0.5971	
240 minute winter	SW02	1.001	S6	-0.6	-0.064	-0.001	0.4109	
240 minute winter	S6	1.002	SW04	-1.0	-0.028	-0.002	1.6108	
240 minute winter	SW04	1.003	SW05	-1.5	0.030	-0.003	2.0888	
240 minute winter	SW05	1.004	SW06	0.8	0.539	0.041	0.0086	
30 minute winter	SW06	1.005	SW07	0.8	0.559	0.041	0.0314	
30 minute summer	SW07	1.006	Ex	0.8	0.544	0.040	0.0091	4.6

Results for 30 year Critical Storm Duration. Lowest mass balance: 91.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SW01	288	31.233	0.324	0.4	0.8240	0.0000	OK
360 minute winter	SW02	288	31.233	0.379	1.0	0.9639	0.0000	OK
360 minute winter	S6	288	31.233	0.405	1.7	1.0301	0.0000	OK
360 minute winter	SW04	288	31.233	0.482	2.6	1.2261	0.0000	OK
360 minute winter	SW05	288	31.233	0.553	3.7	0.6252	0.0000	SURCHARGED
15 minute summer	SW06	10	30.631	0.021	0.8	0.0297	0.0000	OK
600 minute winter	SW07	255	30.368	0.021	0.8	0.0303	0.0000	OK
600 minute winter	Ex	255	30.291	0.021	0.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	SW01	1.000	SW02	-0.4	-0.021	0.000	2.8400	
360 minute winter	SW02	1.001	S6	-1.0	-0.033	-0.001	1.4641	
360 minute winter	S6	1.002	SW04	-1.7	-0.022	-0.003	4.2641	
360 minute winter	SW04	1.003	SW05	-2.6	-0.019	-0.006	4.1327	
360 minute winter	SW05	1.004	SW06	0.8	0.539	0.041	0.0086	
15 minute summer	SW06	1.005	SW07	0.8	0.636	0.041	0.0314	
600 minute winter	SW07	1.006	Ex	0.8	0.544	0.040	0.0091	33.7

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 91.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	SW01	312	31.763	0.854	2.7	2.1735	0.0000	OK
480 minute winter	SW02	320	31.785	0.931	6.5	2.3704	0.0000	SURCHARGED
360 minute winter	S6	240	31.783	0.955	4.6	2.4304	0.0000	SURCHARGED
360 minute winter	SW04	240	31.769	1.018	5.9	2.5913	0.0000	SURCHARGED
240 minute winter	SW05	176	31.772	1.092	8.2	1.2348	0.0000	SURCHARGED
360 minute winter	SW06	240	30.633	0.023	1.0	0.0331	0.0000	OK
360 minute winter	SW07	240	30.371	0.024	1.0	0.0340	0.0000	OK
360 minute winter	Ex	240	30.293	0.023	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	SW01	1.000	SW02	-2.7	-0.017	-0.002	7.7796	
480 minute winter	SW02	1.001	S6	-6.5	-0.029	-0.006	3.1306	
360 minute winter	S6	1.002	SW04	-4.6	-0.019	-0.007	6.1393	
360 minute winter	SW04	1.003	SW05	-5.9	-0.021	-0.013	4.5294	
240 minute winter	SW05	1.004	SW06	1.0	0.576	0.052	0.0101	
360 minute winter	SW06	1.005	SW07	1.0	0.579	0.051	0.0369	
360 minute winter	SW07	1.006	Ex	1.0	0.582	0.051	0.0107	30.2

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	0.014	5.00	34.350	17.501	66.742	1.350

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	40	0	0
100	45	10	0

Node Depth/Area 1 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.27700	Invert Level (m)	33.000	Pit Length (m)	3.000
Side Inf Coefficient (m/hr)	0.27700	Time to half empty (mins)	44	Depth (m)	
Safety Factor	1.5	Ring Diameter (m)	1.500	Inf Depth (m)	
Porosity	0.30	Pit Width (m)	3.000	Number Required	1

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	24	33.132	0.132	1.4	0.5213	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
30 minute winter	Depth/Area 1	Infiltration	0.5					

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	Depth/Area 1	47	33.704	0.704	3.3	2.7731	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
60 minute winter	Depth/Area 1	Infiltration	0.9					

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	Depth/Area 1	48	34.093	1.093	4.7	4.3035	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
60 minute winter	Depth/Area 1	Infiltration	1.1					

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	0.012	5.00	33.250	17.489	66.736	1.750

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	40	0	0
100	45	10	0

Node Depth/Area 1 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.27700	Invert Level (m)	31.500	Pit Length (m)	2.500
Side Inf Coefficient (m/hr)	0.27700	Time to half empty (mins)	54	Depth (m)	
Safety Factor	1.5	Ring Diameter (m)	1.500	Inf Depth (m)	
Porosity	0.30	Pit Width (m)	2.500	Number Required	1

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute summer	Depth/Area 1	74	31.667	0.167	0.9	0.5210	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
120 minute summer	Depth/Area 1	Infiltration	0.4

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	Depth/Area 1	48	32.306	0.806	2.8	2.5079	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
60 minute winter	Depth/Area 1	Infiltration	0.7					

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Depth/Area 1	88	32.721	1.221	2.6	3.8001	0.0000	OK
Link Event (Upstream Depth)		US Node		Link	Outflow (l/s)			
120 minute winter		Depth/Area 1		Infiltration	0.9			

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	0.028	5.00	0.0	33.200	22.919	70.136	0.750

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	40	0	0
100	45	10	0

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.27700	Safety Factor	1.5	Invert Level (m)	32.450
Side Inf Coefficient (m/hr)	0.27700	Porosity	0.30	Time to half empty (mins)	21

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	102.0	102.0	0.750	102.0	128.9	0.751	0.0	128.9

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Depth/Area 1	13	32.471	0.021	3.4	0.6472	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
15 minute winter	Depth/Area 1	Infiltration	2.2					

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	22	32.527	0.077	9.0	2.3568	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
30 minute winter	Depth/Area 1	Infiltration	5.3

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	23	32.587	0.137	12.7	4.1864	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
30 minute winter	Depth/Area 1	Infiltration	5.4					

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	0.007	5.00	0.0	33.150	22.924	70.136	0.600

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	45	10	0

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.27700	Safety Factor	1.5	Invert Level (m)	32.550
Side Inf Coefficient (m/hr)	0.27700	Porosity	0.30	Time to half empty (mins)	14

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	38.0	38.0	0.450	38.0	47.8	0.451	0.0	47.8

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Depth/Area 1	13	32.564	0.014	0.9	0.1649	0.0000	OK
Link Event (Upstream Depth)		US Node	Link	Outflow (l/s)				
15 minute winter		Depth/Area 1	Infiltration	0.6				

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	21	32.582	0.032	1.6	0.3653	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
30 minute winter	Depth/Area 1	Infiltration	1.2					

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	22	32.621	0.071	3.2	0.8041	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
30 minute winter	Depth/Area 1	Infiltration	2.0					

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	0.078	5.00	0.0	33.000	22.993	70.136	1.000

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	45	10	0

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.27700	Safety Factor	3.0	Invert Level (m)	32.000
Side Inf Coefficient (m/hr)	0.27700	Porosity	0.30	Time to half empty (mins)	64

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	255.0	255.0	0.600	255.0	289.0	0.601	0.0	289.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	22	32.035	0.035	7.8	2.6680	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
30 minute winter	Depth/Area 1	Infiltration	4.6					

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	24	32.095	0.095	17.9	7.2467	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
30 minute winter	Depth/Area 1	Infiltration	6.6					

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	Depth/Area 1	47	32.274	0.274	26.0	20.9596	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
60 minute winter	Depth/Area 1	Infiltration	6.9					

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	0.013	5.00	0.0	33.100	22.958	70.153	0.600

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	45	10	0

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.27700	Safety Factor	3.0	Invert Level (m)	32.500
Side Inf Coefficient (m/hr)	0.27700	Porosity	0.30	Time to half empty (mins)	28

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	80.0	80.0	0.450	80.0	94.3	0.451	0.0	94.3

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	22	32.518	0.018	1.3	0.4422	0.0000	OK
Link Event (Upstream Depth)		US Node	Link	Outflow (l/s)				
30 minute winter		Depth/Area 1	Infiltration	0.8				

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	22	32.543	0.043	3.0	1.0219	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
30 minute winter	Depth/Area 1	Infiltration	1.7					

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	Depth/Area 1	43	32.602	0.102	4.3	2.4374	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
60 minute winter	Depth/Area 1	Infiltration	2.1					

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	0.008	5.00	0.0	33.100	22.924	70.130	0.600

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	45	10	0

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.27700	Safety Factor	1.5	Invert Level (m)	32.500
Side Inf Coefficient (m/hr)	0.27670	Porosity	0.30	Time to half empty (mins)	14

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	77.0	77.0	0.450	77.0	91.0	0.451	0.0	91.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Depth/Area 1	13	32.508	0.008	1.0	0.1890	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
15 minute winter	Depth/Area 1	Infiltration	0.6					

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Depth/Area 1	13	32.518	0.018	2.2	0.4187	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
15 minute winter	Depth/Area 1	Infiltration	1.4

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Depth/Area 1	21	32.535	0.035	3.6	0.8138	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
30 minute winter	Depth/Area 1	Infiltration	2.8					