Penrhys Village – Phase 1A

Proposed Drainage Strategy

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Trivallis

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Table of Contents

List of Tables

List of Figures

List of Appendices

1 Introduction

Stantec have been commissioned by Trivallis to provide a proposed drainage strategy for Phase 1A of the proposed Penrhys Village as redevelopment of the existing residential Penrhys estate on land off Penrhys Road (B4512), Ferndale, Rhondda Cynon Taf.

This report is required to support the SAB pre-application submission and planning process.

The objectives of the report are to;

- Review the existing drainage arrangements on site for both surface and foul water;
- Assess the feasibility of Sustainable Drainage Systems (SuDS) features within the development to control and discharge surface water runoff in line with the requirements of the statutory National Standards for Sustainable Drainage Systems;
- Assess the options for the disposal of foul water from the development; and
- Provide a preliminary design for surface water (SuDS) systems including indicative sizing of storage/attenuation features and conceptual plan suitable for inclusion in a pre-application submission to the local authority.
- Capture the feedback from the SAB at pre-application stage and present a drainage strategy incorporating comments where applicable to support the planning application for the development.

The following tasks have been undertaken to complete this report;

- A desktop investigation of the site's existing foul and surface water drainage arrangements;
- Outlined anticipated solutions for foul sewage disposal, and the sustainable management of surface water runoff. This includes preliminary calculations, in order that the conceptual designs may be agreed with the relevant authorities;
- Determined the area of impermeable surfaces added by the proposed development and estimated the predevelopment run-off rates for the site area;
- Assessed the feasibility of using infiltration as a disposal method, based on available information for the ground and site conditions;
- Estimated the size of storm water storage needed to manage run-off from the site post-development, using industry standard drainage design software (InfoDrainage);
- Identified areas of the site for SuDS and provided general information on their maintenance requirements.

Several sources of information have been used to compile this drainage strategy. Whilst Stantec believe them to be trustworthy we are unable to guarantee the accuracy of the information that has been provided by others.

This report is based on information available at the time of preparation. Consequently, there is potential for further information to become available. These changes may lead to future alteration to the conclusions drawn in this report for which Stantec cannot be held responsible.

2 Existing Site

2.1 Site Location and Description

Phase 1A of the Penrhys Village redevelopment is shown by the red line boundary in Figure 1. This phase of redevelopment forms part of the wider existing Penrhys village indicated by the orange boundary.

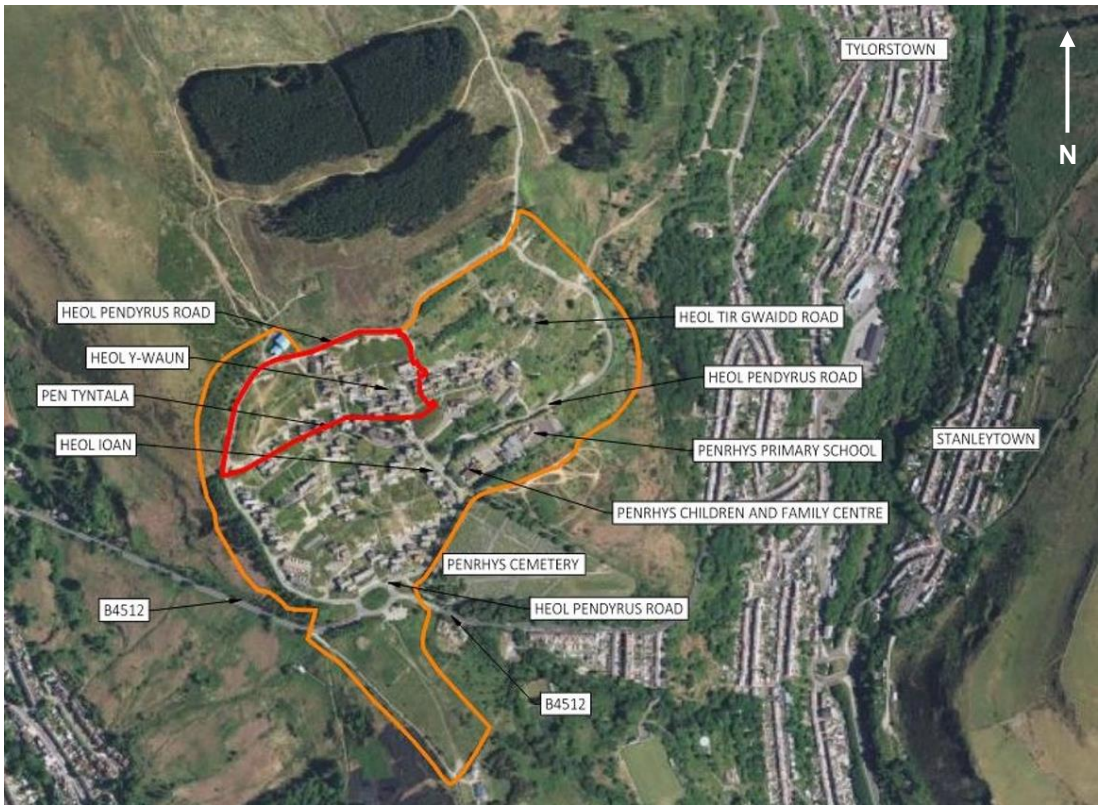


Figure 1: Site Location (ref Open Street Map)

2.1.1 Wider village

Situated near the top of a hill to the west of Pontygwaith there is an existing housing association residential development in a state of disrepair that forms the village of Penrhys. The site is served by an existing road network, where it is accessed from the south via a roundabout, with two main roads encircling the site. The topography of the site is notably steep (varies typ. 1:5-1:8) with levels falling from north to south. To the south of the roundabout the site continues down the hill in the form of a field with a small amphitheatre and statue.

The existing housing estate includes approximately 300 buildings of an original 950, of which the majority are one to three bedroom properties over two to three storeys in staggered terraced fashion. As part of the estate there is the Llanfair Uniting Church, Penrhys Primary School, Penrhys Children and Family Centre and Penrhys Cemetery. Many of these houses and community buildings have already been demolished with limited visible above ground remanences of their existence other than minor infrastructure elements left behind such as slabs, garden retaining walls, streetlighting columns and unallocated parking areas.

The most northern road encompassing the main part of Penrhys village reaches 350m AOD. The most southern point of the road at the roundabout exit to Penrhys Road, following to Porth, sits at 290m AOD

representing a 60m change in level roughly north to south across the main part of the site. The development north to south stretches approximately 600m, this suggests an average gradient of 1 in 10. The localised gradient from east to west remains fairly irregular through the existing development but with a general trend of south eastern gradient on the eastern side and south western gradient of the western side.

An existing civil engineering constraints plan for the wider village is included in Appendix A.

2.1.2 Village History

OS Maps from 1919 - 1961, extracts of which are included Figure 3 and Figure 2 show Penrhys was predominantly open fields with the cemetery identifiable in the 1937-1961 version. The Penrhys Road is also shown to have been established over this time.

Figure 3: NLS 1919 - 1930 OS Map - ref National Library of Scotland

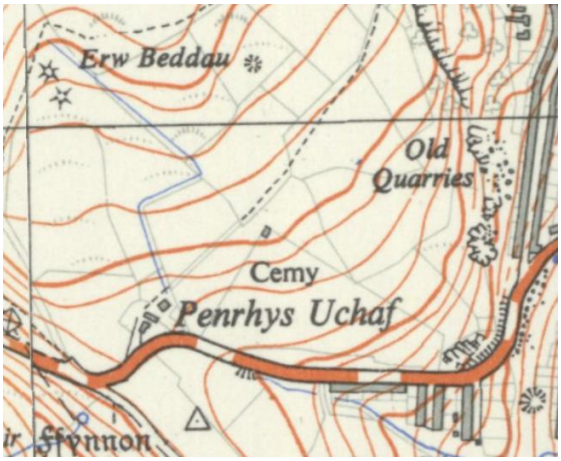


Figure 2: NLS 1937 - 1961 OS Map - ref National Library of Scotland

Figure 4 shows an extract of OS Mapping from 1949 - 1972. Notably the cemetery is more established and a number of buildings adjacent to Penrhys Road have been constructed which is around the later half of what was considered the mining boom in the wider area. The OS Map also indicates 'Drain's' running through the site which were likely land drainage ditches/watercourses routed along the land parcel boundaries.

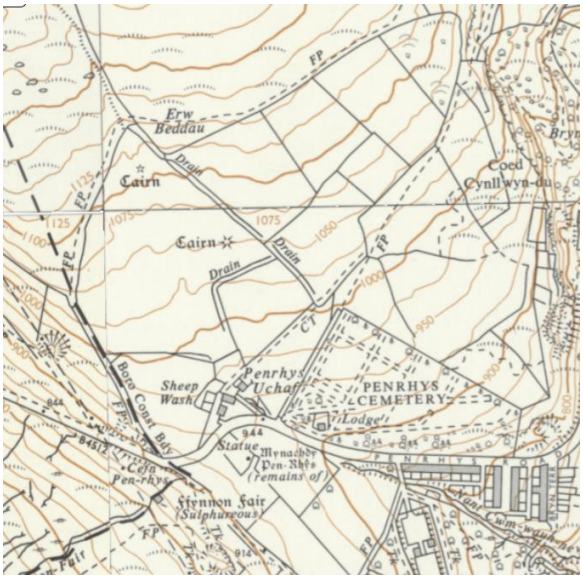


Figure 4: NLS 1949 - 1972 OS Map - ref National Library of Scotland

The modern village of Penrhys was first developed in 1966 as a new modern council housing development. It was constructed between 1966 and 1969 and officially opened in 1968, consisting of 951 houses. The OS Map in **Error! Reference source not found.** does not yet show the village. The image in Figure 5 shows the full extent of Penrhys as of 1994.

Demolition of many of the buildings began in the 1990's with the current Penrhys village now consisting of around 300 buildings. Figure 6 shows the extent of the buildings that had been removed by 2001, Figure 7 shows the extent of the buildings that had been removed by 2006 and finally Figure 8 shows the site as of August 2023 with more buildings having been removed over that period.

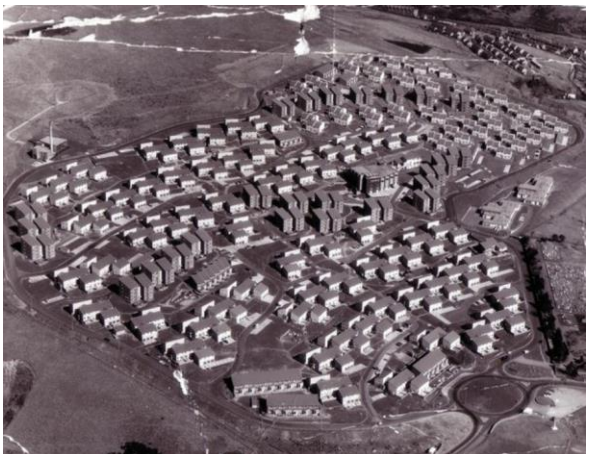


Figure 5: Penrhys July 1994 - ref Wales Online Article 2017

Figure 6: Extract of Google Earth 2001 imagery, accessed Jul 23

Figure 7: Extract of Google Earth 2006 imagery, accessed Jul 23

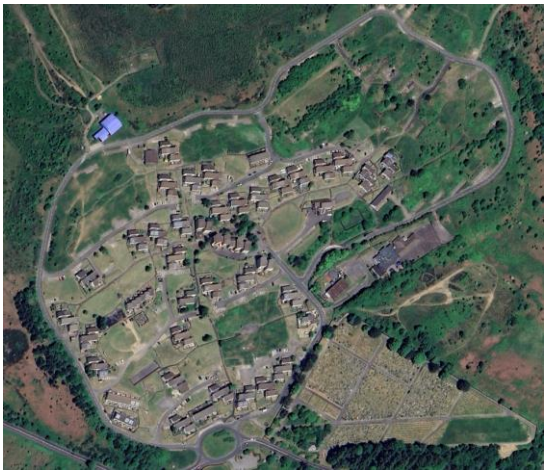


Figure 8: Extract of Google Earth 2023 imagery, accessed Aug 23

2.1.3 Phase 1A

Phase 1A of the village has been identified by the client and design team and comprises the most north westerly area. It is defined largely by the north western section of Heol Pendyrus road, the steep Heol- Y Waun road to the east and Pen Tyntyla road to the south. There are a limited number of existing properties mainly within the central part of the site area with the large majority having been demolished in the past. It is characterised by steeply banked swathes of grassland, pockets of parking areas, and intersecting foot paths.

Of note is that immediately to the north of the site on the opposite side of the road is a large area of NRW managed woodland, a disused district heating centre building/boiler house, and a heavy duty inlet headwall which accepts flows from a land drainage ditch that serves land to the north and conveys into a

piped surface water culvert beneath the site. This is one of three culverts that take runoff from the north and pass them beneath the wider village southwards. The next and central inlet is situated opposite the top of Heol Pendyrus road.

Table 1: Site Information

Address	Pen Tyntyla, Stanleytown, Tylorstown, Penrhys, Rhondda Cynon Taf, Wales, CF43 3RB
Grid Reference	X- 300131, Y- 195039
What3Words	descended.stays.chart
Datum (AOD)	334.5m AOD

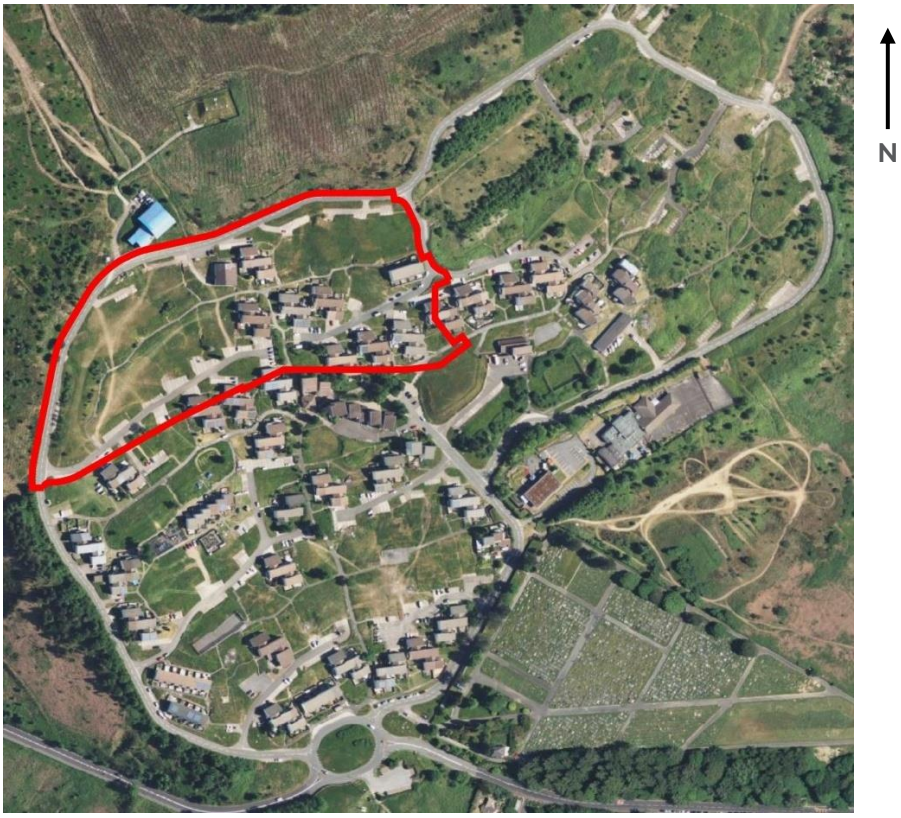


Figure 9: Phase 1A site location satellite image (ref Bing Maps)

2.2 Flood Risk

As shown from the extract of the NRW Flood Map for Planning (Figure 10), the whole site area is situated outside an area subject to flood risk from rivers or sea which is considered to be at little or no risk of fluvial or coastal/tidal flooding.

Figure 10: Extract of NRW Flood Map for Planning (River & Sea)

The NRW Surface Water runoff and Small Watercourse flood risk mapping (Figure 11) shows that the site is predominantly at no/low risk from surface water runoff and small watercourse flooding. There is an overland flow path, formed by runoff from the land to the north which follows a route through the centre of the phase and predevelopment likely formed sections of an active small watercourse through the area. Any future redevelopment of the area should give due consideration to this flood risk and its safe management as a potential blue-green corridor through the site particularly in the winter months/after periods of heavy rainfall where exceedance of drainage systems could be seen.

Figure 11: Extract of NRW Flood Map of surface Water & Small Watercourse

2.3 Existing Drainage Arrangements

2.3.1 Public Sewers

Dwr Cymru Welsh Water (DCWW) asset records for the site show that for the majority of the site there are no public sewers crossing the site area. The are areas of public foul sewer shown between the central and eastern dwellings within the southern half of the site. This are fragmented and the information largely appears to be incomplete. Outside the site boundary, dedicated public foul sewers are present which serve domestic discharge from residential properties to the south and east. There appear to be no public surface water sewers within the phase or wider area. An extract of the DCWW mapping which shows this is included in Figure 12.

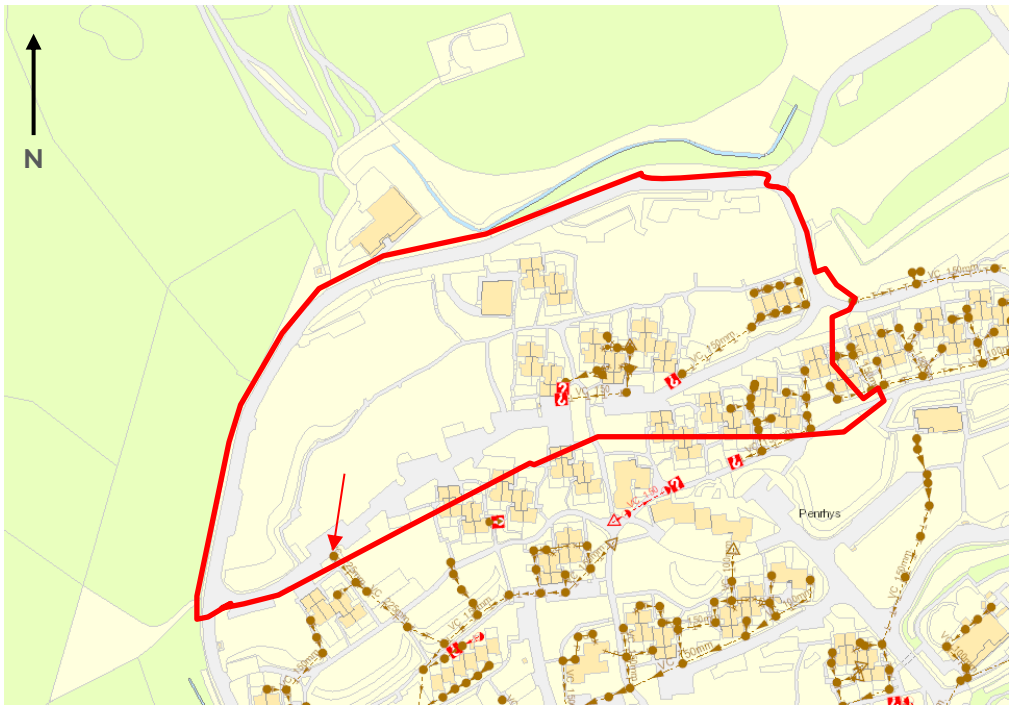


Figure 12: Extract of DCWW Asset Record Mapping

GPR services survey has been undertaken to support the design development of this and future phases. This survey has shown that dedicated surface and foul water drainage exists throughout the phase. An existing drainage plan has been prepared which presents a combination of the DCWW asset mapping, GPR services survey, and also the results of CCTV connectivity surveys – refer to Appendix B.

From this, it can be seen that despite the historical demolition of dwellings across the phase as discussed in Section 2.1.2, more drainage infrastructure remains than is shown by the DCWW mapping. It is anticipated that this drainage is considered as public sewers as a result of the Public Sewer Transfer Regs 2011 and that the DCWW records are incomplete to reflect this. The exception being any single curtilage drainage connections.

Of note is the routing of the public foul water sewer network which directs flows south west to Pen Tyntyla where the sewer changes direction and directs flows south east through the wider village. An arrow marked in Figure 12 shows the location of foul sewer connection for this phase to the wider network. Ultimately this sewer directs flows back out onto Heol Pendyrus before discharging to the public combined sewer on situated on the east side of the roundabout before heading down Penrhsy Road.

In addition, a network of dedicated surface water sewers are present across the Phase 1A site which includes a connection to the land drainage ditch inlet north of Heol Penyrus adjacent to the old boiler

house. As this network serves multiple curtilages, it is anticipated to be adopted also following the implementation of sewer transfer regulations mentioned. The surface water network largely runs parallel with the foul drainage and also directs flows south west to Pen Tyntyla road before heading further south through the village. The surface water runoff from this phase is discharged unattenuated to a 525mm dia concrete culvert that also passes west to east beneath the roundabout at the south of the village before conveying flows west via Penrhys Road. The ultimate discharge point is expected to be to a tributary of the Rhondda River.

2.3.2 Foul Water (Private)

Private foul drainage within the Phase 1A site area is expected to be limited to those connections that serve single curtilages only owing to the Private Sewer Transfer Regs 2011. Some limited private foul drains remain as they are understood to serve a single curtilage – refer to the existing drainage plan included in Appendix B – Existing Drainage Plan. It is noted that there are some discrepancies shown in the DCWW mapping records where drainage is marked as 'private'; however, this is expected to be out of date information.

2.3.3 Surface Water (Private)

As with the foul drainage, limited extents of surface water drainage is anticipated within the Phase 1A site local to existing single curtilage properties.

2.3.4 Highway Drainage

Heol Pendyrus, PenTyntla, and Heol-Y-Waun, are served by traditional highway gullies which can be seen on site and from the survey information available. These gullies direct the runoff into the surface water drainage network that serves the properties across the Phase 1A extent and wider village – refer to Figure 13.

Figure 13: An example of a traditional gully serving Heol Pendyrus road

2.4 Existing Contributing Areas and Run-Off Rates

In accordance with the statutory Sustainable Drainage Systems Standards for Wales (SDSSW)– designing, constructing, operating and maintaining surface water drainage systems:

> *G2.24 For previously developed sites, site runoff rates should be reduced to the greenfield rates wherever possible. Because the critical duration for the attenuation storage system for the proposed development will be much longer than the storm duration used for sizing pipework for the previously developed site, there is a risk that, by allowing previously developed runoff rates to occur (for a much longer duration) receiving watercourse damage and flood risk could be made considerably worse. Thus, betterment of at least 30% should be considered as a minimum requirement (this will need to be established and agreed with the drainage approving body) and strong consideration should still be given to controlling volumes of runoff to greenfield equivalents.*

The Brownfield run-off rates have been calculated and Table 2 summarises the runoff rates for each return period (2, 30 & 100). Model calculations detailing the derivation of the values in the table using FEH are available in Appendix C.

Consultation with SAB has been ongoing regarding establishing the brownfield runoff rate. SAB requested a drainage model of the existing drainage arrangements to accurately determine the brownfield runoff rate. The results of which are in Table 2.

Figure 14 shows an extract from email correspondence with SAB regarding the existing impermeable areas of the site and the proportions of that considered for Phase 1A to finalise the brownfield runoff rate.

In summery and including calculations:

(Using Model with Road Included – See Snip 1)

AREA's
IMP Outside Phase 1A = 0.344ha
IMP Road Outside/Above Phase 1A = 0.138ha
Existing IMP Area within Phase 1A = 1.596ha
Total Catchment (With Road) = 2.078ha

@S6 for 2year 15MIN Storm Event = 196.5 l/s

The proportion of Phase 1A Area within Calc = 76.8%

As a result, Brownfield Runoff for Phase 1A = 196.5 x 0.768 = 150.9 l/s

Figure 14: Extract from email correspondence with SAB

Table 2: Existing Brownfield Run-Off Rates by Return Period

Return Period	Run-off Rate (l/s)
2 yr	196.5
30 yr	395.3
100 yr	477.6

3 Proposed Development

3.1 Development Proposals

The proposed development of Phase 1A is to provide 121 no. residential units comprising a mixture of 2, 3, and 4 bed houses split between market and affordable housing and includes the provision of a block of flats. These residential units are grouped approximately into four quarters of the phase site area split centrally by a green landscape corridor and north to south by new roads. The phase incorporates and maintains the existing Heol Pendyrus road to the northern boundary incorporating some parking bays and traffic calming measures along with the realignment of Pen Tyntyla which forms the southern boundary. The development seeks to incorporate public open spaces (POS) intersected by pedestrian foot paths to link the different areas of the site, open attenuation basins, and an area for children's play. Figure 15 includes an extract of the proposed Phase 1A site layout.

Figure 15: Illustrative sketch layout, Sept 2025

3.2 Foul Water Drainage

A new foul water drainage system will be required to serve the domestic fouls from the proposed residential dwellings. Having reviewed the existing infrastructure, it is considered that the discharge of foul water from the site will be to the public foul water sewer situated within Pen Tyntyla. It is considered that a gravity connection to the sewer from the site can be achieved by a new foul drainage network whilst maintaining self-cleansing velocities.

All works to the existing public foul sewer is subject to confirmation from DCWW as the asset owner. All on site sewerage systems will be designed and constructed to comply with building regulations requirements with any adopted elements in accordance with the latest edition of “Sewers for Adoption”.

Based on the projected number of residential units (121 units), the estimated peak foul flow rate is 5.6l/s. This will be subject to DCWW consent and approval via S106 Agreement.

All on site sewerage systems will be designed and constructed to comply with building regulations requirements with any adopted elements in accordance with the latest edition of “Sewers for Adoption” and any of the adopting authority’s (DCWW) specific requirements.

3.3 Surface Water Drainage

The aim of the surface water drainage strategy is to mimic the natural catchment processes as closely as possible and adopt the principles of water management schemes as stated in Section 2 of the Sustainable Drainage Systems Standards for Wales (SDSSW) document, 2018. Schedule 3 of the Flood and Water Management Act has been implemented by the Welsh Government which requires any development of more than 1 unit or where the construction area is greater than 100m² to comply with the SuDS Approving Bodies (SAB’s) design guidance and ministers’ standards which will require all sites to adopt SuDS in their design. The standards are listed below:

- S1 – Surface Water Runoff Destination
- S2 – Surface Water Runoff Hydraulic Control
- S3 – Water Quality
- S4 – Amenity
- S5 – Biodiversity
- S6 – Design of Drainage for Construction, Operation and Maintenance

The Standards listed will need to be met by the design to comply with the SDSSW. S1 is a hierarchy standard with standards S2-S6 being fixed.

The proposed SuDS & drainage strategy layout can be found in Appendix D.

3.3.1 S1 - Surface Water Run-off Destination

In determining a suitable methodology for disposal of surface water flows from this development, it is necessary to explore the technical options outlined under Standard S1 of the SDSSW 2018 document published by Welsh Government. This states that disposal should be made through the hierarchical approach which are, in order of preference; surface water runoff collected for use, infiltration methods, discharge to surface water body, discharge to a surface water sewer, highway sewer or another drainage system and finally discharge to a combined sewer.

Table 3 presents the discharge hierarchy considering all the available information obtained in preparation of this report.

Table 3: Surface Water runoff discharge hierarchy appraisal

Level	Destination Option	Means	Considerations
1.	Collected for Re-use	Collection, temporary storage and reuse (e.g. rainwater harvesting)	• The development is considered to have low demand for grey water and the use of a grey water system would not be suitable due to there being periods of very low demand which may result in legionella issues. Due to the nature of the development rain water harvesting is not deemed suitable for the site. • Basic forms of rainwater harvesting could be incorporated into the development in the form of rainwater butts that will collect water from rainwater downpipes and store it for irrigation of the soft landscaped areas and planting beds.
2.	Infiltrates to Ground	Infiltration SuDS techniques (e.g. infiltration basin)	A site investigation has been undertaken to inform the drainage strategy development. As such: • A site specific site investigation has included soakaway testing in general accordance with BRE365. This resulted in a range of infiltration rates from 2.94x10-6 to 7.06x10-6 and failures. None of the rest locations were able to achieve the 3 test runs required. • Due to the nature and topography of the site, infiltration is deemed unsuitable as primary means of discharge. It has been noted that there is a potential for increased infiltration to cause spring lines down slope and there is sloping ground below the level of proposed infiltration that could result in unintended break-out of water at the ground surface. • Unlined SuDS features are possible outside of pockets of recorded made ground and away from large structural retaining walls to support interception compliance and reduce offsite discharge volume where they do not pose a risk to the site below the level of infiltration, to be confirmed by geotechnical/structural engineer.
3.	Discharge to surface water body	Conveyance via SuDS techniques (e.g. swale) or piped outfall	• The nearest watercourse is the River Thaw that is located approximately 460m south east of the proposed site. • It is deemed unsuitable as a surface water runoff destination as it is remote from the site.
4.	Discharge to surface water sewer	Piped connection	• The existing site was generally served by a dedicated surface water drainage system. • The existing drainage included a 525mm dia culvert running through the site, serving both the site and land to the north. • It is proposed to continue to discharge the surface water to the surface water culvert but at a betterment compared to existing.
5.	Discharge to combined water sewer	Piped connection	• Discharge to a combined sewer is not considered due to the presence of the dedicated surface water drainage system.

Considering the appraisal of the surface water runoff destination for the Phase 1A development, it is proposed that a connection to the existing 525mm dia culvert is to be pursued. There are no suitable alternative and more sustainable means of surface water runoff discharge available for the site.

3.3.2 S2 - Surface Water Run-off Hydraulic Control

This standard requires surface water to be managed to prevent as far as possible any discharge from the development for rainfall events of less than 5mm and that the surface water runoff rate and volume for up to a 1 in 100-year return period should be managed to protect people, properties, and the receiving water body. Consideration is also required to the risk associated with runoff from events greater than a 1 in 100-year return period with mitigating proposals developed for the scheme.

3.3.2.1 Interception of Run-off

Interception will need to be considered under the statutory standards. Interception aims to mimic greenfield runoff conditions by preventing runoff from the majority of all small rainfall events leaving the site. This can contribute to reducing pollution load to receiving surface water bodies. Meeting the interception criterion is not expected during particularly wet periods, when permeable surfaces and subsoils are saturated, so a suggested target is that 80% compliance should be achieved during the summer and 50% in winter. Reference should be made to Table G2.1 in the Statutory Standards for Sustainable Drainage Systems 2018 document published by Welsh Government for details of interception mechanisms and their assumed compliance with the standards.

Table 4 summarises the strategy for achieving interception compliance for the scheme outlining the source of runoff and the feature that will intercept it:

Table 4: Interception Strategy Summary

Area (source of runoff)	SuDS feature (for interception compliance)
Building (roofs)	Rain garden areas & basins
Footways	Rain gardens areas & permeable paving
Road	Rain gardens, basins & permeable paving
Parking bays	Permeable paving

The features will be sized in order to comply with the applicable standard and the aforementioned Table G2.1. In coordination with the landscape architect these will be integrated into the site layout considering levels, access, maintenance, etc.

3.3.2.2 Hydraulic Control and Storage

In order to meet the applicable standards, this report has adopted the simple approach outlined in the statutory standards of restricting all runoff from the new build element of the development site for all return periods up to and including the 1 in 100-year event to 30% betterment on existing brownfield 2 year return period rate.

Consultation with SAB on the proposed discharge rate for the site had been undertaken. At time of writing a 30% betterment on the existing brownfield 2 year return period rate has been put forward to SAB and an agreement in principle is awaiting. The proposed discharge rate is 105l/s for all storms up to and including the 1 in 100 year + 40% climate change.

Figure 16 shows an extract from the current email correspondence with SAB regarding the existing brownfield rates and proposed discharge rate.

In summery and including calculations:

(Using Model with Road Included – See Snip 1)

AREA's
IMP Outside Phase 1A = 0.344ha
IMP Road Outside/Above Phase 1A = 0.138ha
Existing IMP Area within Phase 1A = 1.596ha
Total Catchment (With Road) = 2.078ha

@S6 for 2year 15MIN Storm Event = 196.5 l/s

The proportion of Phase 1A Area within Calc = 76.8%

As a result, Brownfield Runoff for Phase 1A = 196.5 x 0.768 = 150.9 l/s

With Betterment:
BFR-10% = 135.81 l/s
BFR-20% = 120.72 l/s
BFR-30% = 105.63 l/s – Which is comparable to our previous rates discussed.

From my understanding of our meeting last week, the betterment applied to the brownfield could be flexible for Phase 1A as a result the above rates are for comparison/discussion.

As previously outlined (within email below) any agreed Brownfield runoff rate would be deducted from the Masterplan calculations and then any agreed betterment applied to this for future phases.

Could you please review the above and what's included within the link and confirm if this discharge rate strategy is acceptable?

Figure 16: Extract from email correspondence with SAB

In accordance with statutory guidelines, the development of this site should not increase flood risk elsewhere and as such, all runoff from impermeable areas on site should be contained within the site boundary for up to and including a 1 in 100-year design period storm, plus 40% climate change with a 10% allowance for urban creep made due to the nature of the development.

Surface water flows from the proposed development would need to be restricted via flow control chamber/s and flows attenuated within on-site attenuation provided, for surface water runoff for all rainfall events up to and including a 1 in 100-year event with 40% allowance for climate change. For this purpose, the proposed development has been split into 4 catchment areas; NE, NW, SE & SW. Each of these catchments has their own flow control chamber with the pro-rata flow rate based on the overall proposed discharge rate (105l/s) and impermeable areas and their own forms of attenuation. Table 5 summaries the proposed flow rate, impermeable catchment area, attenuation type and attenuation volume requirement. The storage volume has been modelled within InfoDrainage.

Table 5: Flow Rate & Attenuation Summary

Development Area	Impermeable Area (ha) (including 10% urban creep)	Flow Rate (l/s)	Attenuation Type	Attenuation Volume Requirement (m^3)
NE	0.712	33.1	Basin & Cellular Storage Tank	630
NW	0.541	25.2	Basin & Oversized Pipe	465
SE	0.33	15.4	Basin	245
SW	0.672	31.3	Basin & Oversized Pipe	585

3.3.2.3 Exceedance Flows and Flood Pathways

"It is inevitable that as a result of extreme rainfall the capacities of sewers, covered watercourses and other drainage systems will be exceeded on occasion. Periods of

exceedance occur when the rate of surface runoff exceeds the drainage system inlet capacity, when the pipe system becomes overloaded, or when the outfall becomes restricted due to flood levels in the receiving water. Underground conveyance cannot economically or sustainably be built large enough for the most extreme events and, as a result, there will be occasions when surface water runoff will exceed the design capacity of drains. When drainage exceedance capacity is exceeded the excess water (exceedance flow) is conveyed above ground, and will travel along streets and paths, between and through buildings and across open space. Indiscriminate flooding of property can occur when this flow of water is not controlled." (CIRIA C753).

Flood-flow pathways would be designed to convey the overland flows from rainfall events above a 1 in 100 year return period to suitable areas of open space, such as watercourses, landscaped areas, car parking areas and other hard surfaced areas in order to protect properties against flooding. Consideration should also be given to exceedance pathways from storage areas in the event of extreme rainfall or failure with allowance made to convey flows away from properties both on and off the site.

In the event of an extreme rainfall beyond the designed storm events, or poor maintenance of the surface water drainage system, flooding will occur within low points of the site (ie the south west corner), before re-entering the surface water culvert via the highway drainage network serving Heol Pendyrus.

3.3.2.4 Flood Risk to People

"People are at risk of suffering death or serious injury when flooding occurs. People are unable to stand in deep or fast flowing floodwater. Once they are unable to stand, there is a high risk of death or serious injury. Adults are unable to stand in still floodwater with a depth of about 1.5m or greater, although this is obviously affected by the height of a person. The depth of flowing floodwater where people are unable to stand is much less. For example, some people will be at risk when the water depth is only 0.5m, if the velocity is 1m/s (about 2 mph). If the velocity increases to 2m/s (about 4 mph) some people will be unable to stand in a depth of water of only 0.3m. Most people will be unable to stand when the velocity is 2m/s and the depth is 0.6m." (Defra/ Environment Agency, FD2321/TR2).

During the detailed design, a hydraulic model will be built to assist the design of the proposed surface water drainage networks. When an extreme storm event is simulated within the model, potential flooding locations will become evident and the flood flow pathways can be designed/defined based on the proposed layout and levels of the hard areas and landscaping. The depth and velocity of the overland flood water can be determined and then compared with *'Combinations of flood depth and velocity that cause danger to people*' in the Defra / EA Flood Risks to People publication. The velocity and depth as described above would then give a category of flood hazard and the corresponding risk to people. If the risk is deemed to be too high, then the design would require reassessment.

3.3.3 S3 - Water Quality

This standard requires treatment of surface water runoff to prevent negative impacts on the receiving water quality and/or to protect downstream drainage systems including sewers. The only exception to this standard is where drainage connects directly to a combined sewer, where the quality requirements are limited to preventing the discharge of oil and sediments to the sewer system.

The development is proposed to discharge runoff to a surface water culvert that is expected to ultimately conveys flows to a tributary of the Rhondda River. The aim of the surface water management strategy with regards to water quality is to follow the guiding principles of the SDSSW and use simple, natural processes that promote biodiversity and long-term sustainability. As such, it employs a SuDS management train approach, providing drainage components in series.

The management trains to be used on the project will be assessed using the Simple Index Assessment (SIA) tool available publicly (*http://www.ukSuDS.com/drainage-calculation-tools/water-quality-assessment-for-SuDS-developments*) which is built around the principles for simple assessment outlined in CIRIA C753 to assess the levels of treatment provided by the proposals.

Planting within the SuDS features should form part of the water quality strategy. SuDS components like rain gardens, permeable paving and basins will provide water quality improvements by reducing sediment and contaminants from runoff either through settlement or biological breakdown of pollutants as part of their interceptor function, so only robust and tolerant species of planting should be specified. Once these species establish this will decrease the flow rate of water travelling through and filter pollutants and contaminants before entering the downstream network.

3.3.4 S4 - Amenity

This standard requires that the design of the surface water management system should maximise amenity benefits.

The primary amenity focus of the SuDS scheme should be to improve the health and well-being of the students, staff and visitors. The scheme will be based on accessible natural forms that mimic natural landscapes found within the region and the vegetated rain garden planting areas are designed with locally contextual species that will encourage natural colonisation. Other key amenity benefits should include improving air quality around the development, increasing carbon sequestration, and improving water quality through removal of pollutants via the rain gardens and basins.

Notable work has been undertaken by the landscape architect in coordination with the civil engineer to integrate the proposed SuDS features throughout the scheme to create an engaging, attractive, and positive environment for the proposed use of the site. This will be continued through the next stage of design.

3.3.5 S5 - Biodiversity

This standard requires that the surface water management system should maximise biodiversity benefits. The SuDS scheme's biodiversity strategy will revolve around increasing the overall biodiversity of the site and ecological value. The inclusion of plant species that will enhance the general eco system and simultaneously act as a water filtration system to clean pollutants and contaminants will be used where possible.

The plant species selected should be both locally contextual and appropriate for the varied habitat zones including primary characteristics that shall ensure:

- Good soil binding and filtration species
- Minimised erosion
- Improved filtration via dense root and stem species
- Tolerance to seasonal variations including droughts and inundations

- Good suspended solids retention
- Pollutant tolerant
- Emergent and pioneering species for natural ecological colonisation
- The creation of diverse, self-sustaining, and resilient ecosystems for high species biodiversity
- Support for local and regional habitat strategies

In general, the proposed rain garden areas and basins will be the focal habitat points for the site and will enhance the site over the current site layout by adding areas of water and damp and vegetated soils. Exposed areas of the rain gardens and basins will attract certain species and trees will further enhance the varied ecosystem potential.

3.3.6 S6 - Design of Drainage for Construction and Maintenance and Structural Integrity

The surface water drainage system will be designed with the overriding ethos of simplicity in construction, use and maintenance. This then allows a very simple translation from the principles described within standard S6, namely that all elements of the surface water drainage system should be designed so that they can be constructed, as well as maintained and operated "…easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy)." (SDSSW).

The proposed system will be offered for adoption as it will serve multiple curtilages, therefore the maintenance of the drainage will be managed and maintained by SAB who will be responsible for all inspection and maintenance activities.

Information with regards to the construction methodology and requirements of the proposed system will be developed as part of the detailed design stage of the project, likewise the maintenance requirements and regime of the proposed system will be developed into the full maintenance strategy for the site during the next phase of design development. This will be developed in conjunction with SAB as it is not considered appropriate for these details to be developed by the design team in isolation from the end users. This will then need to be confirmed and submitted for approval to the SAB prior to construction commencing on site.

4 Statutory Approvals

4.1 Water Authority

4.1.1 Pre-Planning Advice (PPA)

In the later part of 2023, a PPA was placed with DCWW for the early consideration of redevelopment of the whole village based no circa 750 no. dwellings. This application confirmed:

- **Sewage Treatment** - The site drains to Cardiff Bay Wastewater Treatment Works. No problems are envisaged with the Wastewater Treatment Works for the treatment of domestic discharges from this site.
- **Wastewater** - At this time (as capacity can't be reserved), DCWW have no objection to the discharge of domestic foul flows which can be communicated to the public foul sewer. It was suggested that the flows can be communicated at or downstream of the 225mm public combined sewer at or downstream of manhole ST00942602 located in Penrhys Road.
- **Surface water** – Referred to Schedule 3 and the need for SAB consultation. This is a standard response since SAB was introduced and expected. See Section 4.2 for further information.
- **Water supply –** The water supply system in the immediate vicinity has insufficient capacity to serve the development and will also cause detriment to existing customers' water supply. A hydraulic modelling assessment is required to establish the scope of any reinforcement works to be completed.
- **Protection Zones** – The proposed development site is crossed by a number of public sewers with the approximate positions being marked on the attached Statutory Public Sewer Record. DCWW has rights of access to its apparatus at all times. No part of any building or sustainable drainage feature will be permitted within 3 metres either side of the centreline of the public sewers. It was recommended that the site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application.

More recently a Phase 1A specific PPA was requested and the DCWW response can be found in Appendix E. In summary:

- **Sewage Treatment** - The site drains to Cardiff Bay Wastewater Treatment Works. No problems are envisaged with the Wastewater Treatment Works for the treatment of domestic discharges from this site.
- **Wastewater** - At this time (as capacity can't be reserved), DCWW have no objection to the discharge of domestic foul flows which can be communicated to the public foul sewer. It was suggested that the flows can be communicated to the foul sewer located in Heol y Waun.
- **Surface water** – Referred to Schedule 3 and the need for SAB consultation. This is a standard response since SAB was introduced and expected. See Section 4.2 for further information.
- **Water supply –** The water supply system in the immediate vicinity has insufficient capacity to serve the development and will also cause detriment to existing customers' water supply. A hydraulic modelling assessment is required to establish the scope of any reinforcement works to be completed.
- **Protection Zones** – The proposed development site is crossed by a number of public sewers with the approximate positions being marked on the attached Statutory Public Sewer Record. DCWW has rights of access to its apparatus at all times. No part of any building will be permitted within 3 metres either side of the centreline of the public sewers. A separate note containing 'conditions for development near water mains' was also included with the response which set out minimum requirements for the various water mains assets they are aware of in the area.

4.1.2 Section Agreements

Works associated with new connections or amendments to the existing public sewer network require water authority consent. As such:

- Any connection to a public sewer is subject to confirmation of available downstream capacity and a Section 106 agreement with DCWW - the detail of which should also include any proposed changes to the existing chamber to accept new connections.
- A Section 104 agreement is typically be required for any drainage that serves more than one curtilage. For this scheme, it is expected that a notable Section 104 application be required to include all of the adoptable sewer that serve the proposed residential dwellings.
- The DCWW records do not indicate many adopted sewers within the phase boundary. However as discussed in Section 2.3.1, from the services survey information which has identified dedicated foul and surface water drainage serving multiple properties it is considered that these would have transferred to DCWW under the private sewer transfer regs 2011. As such, it is considered that the DCWW mapping records are incomplete.

  It is anticipated therefore that a notable S185 application with be required to abandon, remove, and some cases divert much of the existing sewers within this phase extent. A drawing of the necessary abandonments and removals of the existing drainage and sewers to enable this phase of development has been prepared and is included in Appendix F for reference.

4.2 SuDS Approval Body

The proposed development is subject to the Schedule 3 requirements and therefore subject to SAB approval. The role of the SAB is also to adopt SuDS features and maintain them for the lifetime of the development; although in some areas where Trivallis housing association retain ownership of buildings, SuDS features may not be adopted by the SAB as sections of the development will fall within the single managed curtilage.

Early engagement with the SAB is recommended to ensure feedback is taken account of at an early stage to provide confidence that an agreeable surface water drainage strategy can be adequately accounted for in the spatial planning of any development.

Initial high level consultation with the SAB started in November 2024 looking at the masterplan plan and discussing the SAB strategy, site wide constraints and requirements to determine a approach for a SAB compliant drainage strategy with the official report response found in Appendix E.

Following on from this, focused discussions and workshops have been taking place to agree a Brownfield runoff rate strategy taking into account the history of the site and current extent and condition of the development and surface water system. Further site investigation has been required to detail the existing drainage system and various stages of modelling to determine a reliable site Brownfield agreeable to RCT SAB the final detail of which is still ongoing, extracts of which can be found in Figure 8 & 10.

An informal SAB Pre-Application meeting focusing on Phase 1A specifically took place on 10/07/2025 with the purpose of introducing the proposed development, discussing the site constraints – in particular the findings of the infiltration test results and general ground conditions as part of the site investigation, and discuss early principles around surface water discharge destination, interception and water quality constraints and discharge rate requirements.

A formal SAB Pre-Application consultation specifically for a detailed Phase 1A proposal is recommended and has been indicated to the SAB as the next stage as an appropriate course of action in order to check on the interception compliance of the scheme and its updated strategy following agreement in principle of the runoff destination.

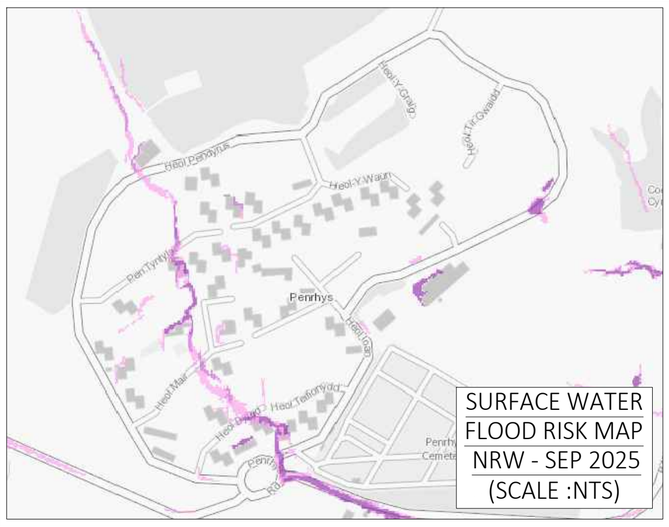
5 Conclusion

It is considered that the proposed SuDS and drainage layout has been well considered to date based on a detailed appraisal of the existing drainage arrangements and site constraints/conditions. As part of the proposals a scheme of SuDS is proposed which will provide interception, water quality, flow reduction, amenity and biodiversity benefits in line with best practice and the applicable national standards. A gravity based foul drainage solution is also proposed. As such, it is considered that the proposed means of drainage for the proposed development do not constitute a barrier to planning permission.

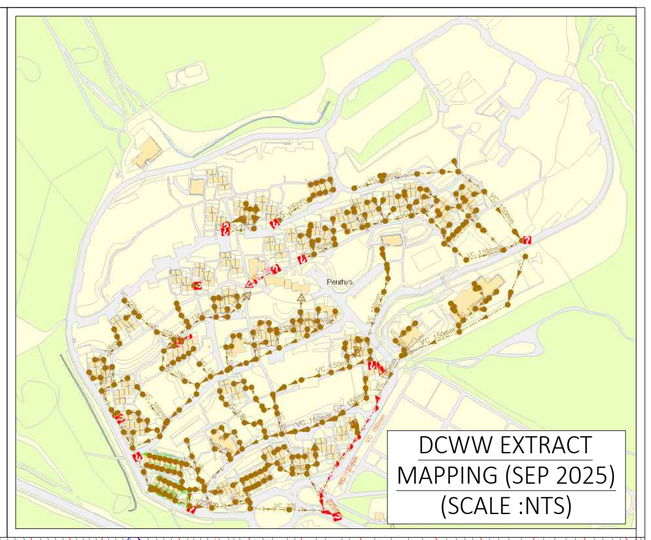
Appendices

A.1 Appendix A – Constraints Plan

OS NORTH



SURFACE WATER FLOOD RISK MAP
NRW - SEP 2025
(SCALE :NTS)



DCWW EXTRACT MAPPING (SEP 2025)
(SCALE :NTS)

IMAGE 1 : EXISTING HEAVY DUTY HEADWALL

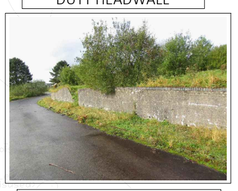


IMAGE 2: RETAINING WALL IN THE NORTH-EAST OF THE SITE IN POOR CONDITION, WITH INSUFFICIENT DRAINAGE CAUSING BLOCK WASHOUT.

IMAGE 3: RETAINING WALL IN THE PREVIOUSLY DEMOLISHED AREA OF THE SITE

IMAGE 4: FOUNDATIONS OF FORMER HOUSES

IMAGE 5

IMAGE 5

GENERAL NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT DRAWINGS AND WITH THE HEALTH AND SAFETY INFORMATION PROVIDED AND/OR WITHIN THE PRE-CONSTRUCTION INFORMATION.
2. USE OF THIS DRAWING DOES NOT ABSOLVE THE CLIENT FROM HIS RESPONSIBILITIES UNDER THE HEALTH AND SAFETY: THE CONSTRUCTION DESIGN AND MANAGEMENT REGULATIONS 2015. THE PRINCIPAL DESIGNER IS REQUIRED TO CONTACT HYDROCK CONSULTANTS PRIOR TO PERMITTING THIS DRAWING TO BE USED IN CONNECTION WITH ANY CONSTRUCTION WORKS.
3. INFORMATION REGARDING THE LOCATION AND DEPTH OF EXISTING SERVICES CANNOT BE GUARANTEED BY THE STATUTORY UNDERTAKER.
4. THE DRAWING SHALL BE USED FOR THE INTENDED PURPOSE ONLY AND THIS DRAWING HAS BEEN BASED ON INFORMATION PROVIDED BY OTHER PARTIES AND HYDROCK DO NOT WARRANT THE ACCURACY OF THIS INFORMATION. DIMENSIONS SHALL NOT BE SCALED FROM THE DRAWING.
5. ALL FIGURED LEVELS ARE IN METRES AND RELATED TO EXISTING SURVEY GRID & DATUM UNLESS NOTED OTHERWISE
6. ALL FIGURED DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
7. ANY EXISTING SEWERS TO REMAIN THAT ARE SITED OUTSIDE OF A PROPOSED PUBLIC HIGHWAY EXTENT WOULD BE SUBJECT TO DCWW NO BUILD EASEMENT REQUIREMENTS WHICH COULD CONSTRAINT THE REDEVELOPMENT/SITE LAYOUT PROPOSALS. THE EASEMENT WIDTH WOULD NEED TO BE CONFIRMED FOLLOWING A SURVEY.

THIS DRAWING HIGHLIGHTS THE MAIN CIVIL ENGINEERING CONSTRAINTS ONLY AS IDENTIFIED FROM REVIEW OF AVAILABLE INFORMATION BY OTHERS, SITE WALKOVERS AND SURVEY INFORMATION. IT IS NOT EXHAUSTIVE AND SOME CONSTRAINTS MAY NOT YET BE KNOWN SUBJECT TO FURTHER INVESTIGATION AND FINDINGS ON SITE. REFER TO DOCUMENTS AND DRAWING BY OTHER TEAMS FOR FURTHER CONSTRAINTS.

The former boiler house, date of construction (c.1968) and associated network of buried pipework potentially utilised asbestos insulation on boilers, calorifiers and pipework. A full demolition asbestos survey of the district heating network is required.
Fly tipped asbestos tile was observed on site near the boiler house which may be associated with its former operation. (Refer image 5)

The Retaining wall in poor condition between concreted area associated with former structures, and the level of the ring road above. (Refer image 6)

Boiler house
Existing heavy duty Headwall
Community hall
Highest lvl :349.183
Lowest lvl :289.359
Lowest lvl : 179.00 (from Lidar)
REFER IMAGE 1
REFER IMAGE 2
REFER IMAGE 3
REFER IMAGE 4
Llanfair Uniting Church URC
Penrhys Primary School
Penrhys Children and Family Centre
Penrhys Cemetery
Abondoned Quarry
Abondoned Quarry
Abondoned Quarry
PENRHYS ROAD B4512
PENRHYS ROAD B4512
Heritage asset statue.
Rhondda river

DCWW KEY

- CASING
- EXISTING COMBINED SEWER
- EXISTING MINOR CONTOUR AT 1.0M INTERVAL
- 345.00 EXISTING MAJOR CONTOUR AT 5M INTERVAL
- EXITING GRADIENT GREATER THAN 1 IN 3
- -1:9 EXITING GRADIENT
- SITE BOUNDARY
- EXISTING COMBINED SEWER
- EXISTING FOUL SEWER
- EXISTING FOUL WATER FITTING
- EXISTING WATER MAIN

KEY

- EXISTING UNDERPASS
- ABONDONED QUARRY
- EXISTING WATER COURSE / RIVER
- X POTENTIAL ASBESTOS AFFECTED AREAS
- E ELECTRICITY SUB STATION
- HISTORIC LANDSLIDE LOCATION
- POSSIBLE PEAT LOCATION
- POSSIBLE BELL PIT LOCATION
- EXISTING SURFACE WATER FLOW (BASED ON GPR SURVEY)

REVISIONS

Rev.	Revision Notes	Date	Drawn By	Checked | Approved
P03	Issue For PAC	05/09/25	BM	CD | CD
P02	DCWW ammendments	08/11/24	BM	CD | CD
P01	First Issue	09/03/24	HS	JH | CD

Stantec

CLIENT: TRIVALLIS

PROJECT: PENRHYS

TITLE: EXISTING SITE CONSTRAINTS PLAN

STANTEC PROJECT NO.: 333700566

SCALE @ A1: 1:2000

STATUS DESCRIPTION: SUITABLE FOR INFORMATION

STATUS: S2

DRAWING NO.: 00566-STN-1A-XX-DR-C-0500

REVISION: P03

Filename: U:\333700566\01_WIP\DR_Drawing\C\00566-STN-1A-XX-DR-C-0500 P01- Site Constraints Plan.dwg

A.2 Appendix B – Existing Drainage Plan

OS NORTH

DO NOT SCALE

KEY

PHASE 1A SITE BOUNDARY

DRAINAGE WORKS - PHASE 1A KEY

SUBJECT TO REMOVAL

DCWW SEWERS (POSITION CONFIRMED BY BOTH MAPPING AND GPR SURVEY) KEY

FOUL WATER SEWER
FOUL WATER CHAMBER
COMBINED WATER SEWER
COMBINED WATER CHAMBER
PRIVATE FOUL WATER SEWER
PRIVATE FOUL WATER CHAMBER

DCWW SEWERS (POSITION CONFIRMED GPR SURVEY ONLY) KEY

FOUL WATER SEWER
FOUL WATER CHAMBER

DCWW SEWERS (POSITION CONFIRMED DCWW MAPPING ONLY) KEY

FOUL WATER SEWER
FOUL WATER CHAMBER
FOUL WATER FITTING
PRIVATE FOUL WATER SEWER
PRIVATE FOUL WATER CHAMBER
FOUL WATER PRIVATE FITTING

SURFACE WATER DRAINAGE KEY (POSITION AND CONNECTIVITY CONFIRMED BY DRAINTECH DYE AND BANG TESTING)

SURFACE WATER DRAINAGE
SURFACE WATER CHAMBER

SURFACE WATER DRAINAGE KEY (POSITION CONFIRMED BY GPR)

SURFACE WATER DRAINAGE
SURFACE WATER CHAMBER
SURFACE WATER GULLY
FOUL WATER DRAINAGE
FOUL WATER CHAMBER

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT DRAWINGS AND SPECIFICATIONS
2. ALL FIGURED LEVELS ARE IN METRES AND RELATED TO EXISTING SURVEY GRID & DATUM UNLESS NOTED OTHERWISE
3. ALL FIGURED DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE, DIMENSION ARE NOT TO BE SCALED.
4. THE DRAWING SHALL BE USED FOR THE INTENDED PURPOSE ONLY AND THIS DRAWING HAS BEEN BASED ON INFORMATION PROVIDED BY OTHER PARTIES AND STANTEC DO NOT WARRANT THE ACCURACY OF THIS INFORMATION.
5. WORKS WILL REQUIRE DCWW COMMENT AND CONFIRMATION BEFOREHAND.

REVISIONS

Rev.	Revision Notes	Date	Drawn By	Checked | Approved
P01	Issue For PAC	08/09/25	BM	SP | CD

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CLIENT
TRIVALLIS

PROJECT
PENRHYS

TITLE
EXISTING DRAINAGE WORKS - PHASE 1A

STANTEC PROJECT NO.	SCALE @ A1
333700566	1:500

STATUS DESCRIPTION	STATUS
SUITABLE FOR INFORMATION	S2

DRAWING NO.	REVISION
00566-STN-1A-XX-DR-C-1500	P01

Filename: \\333700566\01_WIP\08_Drawing\C\00566-STN-1A-XX-DR-C-1500 - Phase 1A Existing Drainage Works.dwg

A.3 Appendix C – Brownfield Model Calculations

Project:	Date:		
Penrhys Phase 1A	18/06/2025		
	Designed by:	Checked by:	Approved By:
	smparry		
Report Title:	Company Address:		
Rainfall Analysis Criteria	Stantec		

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Default
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FEH

Type: FEH

Site Location	GB 300192 194699 ST 00192 94699
Rainfall Version	2022
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
2.0	0.000
30.0	0.000
100.0	0.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60

Project: Penrhys Phase 1A	Date: 18/06/2025		
	Designed by: smparry	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address: Stantec		

FEH: 2 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m³)
RED3	FEH: 2 years: +0 %: 15 mins: Summer	0.05	6.2	2.705
RED6	FEH: 2 years: +0 %: 15 mins: Summer	0.05	6.2	2.705
RED4	FEH: 2 years: +0 %: 15 mins: Summer	0.05	6.2	2.705
RED5	FEH: 2 years: +0 %: 15 mins: Summer	0.04	5.4	2.378
RED7	FEH: 2 years: +0 %: 15 mins: Summer	0.04	5.5	2.381
RED2	FEH: 2 years: +0 %: 15 mins: Summer	0.05	6.2	2.705
RED1	FEH: 2 years: +0 %: 15 mins: Summer	0.05	6.2	2.705
RED14	FEH: 2 years: +0 %: 15 mins: Summer	0.05	6.2	2.705
RED8	FEH: 2 years: +0 %: 15 mins: Summer	0.04	5.5	2.399
RED9	FEH: 2 years: +0 %: 15 mins: Summer	0.04	5.5	2.381
RED11	FEH: 2 years: +0 %: 15 mins: Summer	0.04	5.5	2.381
RED10	FEH: 2 years: +0 %: 15 mins: Summer	0.04	5.5	2.381
IPM13	FEH: 2 years: +0 %: 15 mins: Winter	0.02	2.2	1.024
RED12	FEH: 2 years: +0 %: 15 mins: Winter	0.01	1.5	0.716
RED13	FEH: 2 years: +0 %: 15 mins: Summer	0.03	4.3	1.875
IPM8	FEH: 2 years: +0 %: 15 mins: Winter	0.04	5.6	2.588
IPM6	FEH: 2 years: +0 %: 15 mins: Summer	0.02	3.1	1.369
IPM4	FEH: 2 years: +0 %: 15 mins: Winter	0.04	5.8	2.702
IPM5	FEH: 2 years: +0 %: 15 mins: Winter	0.04	5.8	2.687
IPM2	FEH: 2 years: +0 %: 15 mins: Winter	0.04	5.7	2.672

IPM1	FEH: 2 years: +0 %: 15 mins: Winter	0.03	4.1	1.899
IPM3	FEH: 2 years: +0 %: 15 mins: Winter	0.04	5.7	2.669
IPM10	FEH: 2 years: +0 %: 15 mins: Winter	0.03	4.0	1.851
IPM7	FEH: 2 years: +0 %: 15 mins: Winter	0.01	1.5	0.719
IPM9	FEH: 2 years: +0 %: 15 mins: Winter	0.04	5.7	2.672
IPM12	FEH: 2 years: +0 %: 15 mins: Winter	0.01	1.1	0.512
ROAD4	FEH: 2 years: +0 %: 15 mins: Summer	0.03	4.3	1.878
ROAD3	FEH: 2 years: +0 %: 15 mins: Summer	0.04	6.7	2.917
ROAD11	FEH: 2 years: +0 %: 15 mins: Summer	0.01	1.0	0.449
ROAD6	FEH: 2 years: +0 %: 15 mins: Summer	0.05	8.6	3.774
ROAD5	FEH: 2 years: +0 %: 15 mins: Summer	0.02	3.2	1.381
ROAD1	FEH: 2 years: +0 %: 15 mins: Summer	0.31	50.6	22.119
ROAD9	FEH: 2 years: +0 %: 15 mins: Summer	0.02	2.8	1.231
ROAD8	FEH: 2 years: +0 %: 15 mins: Summer	0.01	1.5	0.668
ROAD7	FEH: 2 years: +0 %: 15 mins: Summer	0.02	3.0	1.321
IMP14	FEH: 2 years: +0 %: 15 mins: Summer	0.01	1.5	0.659
IMP11	FEH: 2 years: +0 %: 15 mins: Summer	0.01	1.3	0.569
IMP11OUT	FEH: 2 years: +0 %: 15 mins: Summer	0.03	4.2	1.818
IPM12OUT	FEH: 2 years: +0 %: 15 mins: Summer	0.03	4.4	1.932
IMP15OUT	FEH: 2 years: +0 %: 15 mins: Summer	0.04	5.5	2.390
IMPCHURCH	FEH: 2 years: +0 %: 15 mins: Summer	0.04	4.9	2.138
IMP14OUT	FEH: 2 years: +0 %: 15 mins: Summer	0.03	4.1	1.773
IMP16OUT	FEH: 2 years: +0 %: 15 mins: Summer	0.04	5.6	2.450

IMP13OUT	FEH: 2 years: +0 %: 15 mins: Summer	0.03	3.5	1.542
IMPRD6	FEH: 2 years: +0 %: 15 mins: Summer	0.06	9.2	4.034
IMPRD7	FEH: 2 years: +0 %: 15 mins: Summer	0.04	6.2	2.714
IPM10OUT	FEH: 2 years: +0 %: 15 mins: Summer	0.01	1.6	0.716
ROAD22	FEH: 2 years: +0 %: 15 mins: Summer	0.05	6.2	2.723
ROAD23	FEH: 2 years: +0 %: 15 mins: Summer	0.06	7.7	3.348
ROAD21	FEH: 2 years: +0 %: 15 mins: Summer	0.06	8.6	3.738
IMPRD1	FEH: 2 years: +0 %: 15 mins: Summer	0.05	8.6	3.774
IMPRD2	FEH: 2 years: +0 %: 15 mins: Summer	0.03	4.2	1.818
IMPRD3	FEH: 2 years: +0 %: 15 mins: Summer	0.03	4.5	1.962
IMPRD4	FEH: 2 years: +0 %: 15 mins: Summer	0.03	5.3	2.324

Project: Penrhys Phase 1A	Date: 18/06/2025		
	Designed by: smparry	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address: Stantec		

FEH: 30 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m^3)
RED3	FEH: 30 years: +0 %: 15 mins: Summer	0.05	13.1	5.725
RED6	FEH: 30 years: +0 %: 15 mins: Summer	0.05	13.1	5.725
RED4	FEH: 30 years: +0 %: 15 mins: Summer	0.05	13.1	5.728
RED5	FEH: 30 years: +0 %: 15 mins: Summer	0.04	11.5	5.033
RED7	FEH: 30 years: +0 %: 15 mins: Summer	0.04	11.6	5.045
RED2	FEH: 30 years: +0 %: 15 mins: Summer	0.05	13.1	5.725
RED1	FEH: 30 years: +0 %: 15 mins: Summer	0.05	13.1	5.725
RED14	FEH: 30 years: +0 %: 15 mins: Summer	0.05	13.1	5.725
RED8	FEH: 30 years: +0 %: 15 mins: Summer	0.04	11.7	5.087
RED9	FEH: 30 years: +0 %: 15 mins: Summer	0.04	11.6	5.051
RED11	FEH: 30 years: +0 %: 15 mins: Summer	0.04	11.6	5.051
RED10	FEH: 30 years: +0 %: 15 mins: Summer	0.04	11.6	5.051
IPM13	FEH: 30 years: +0 %: 15 mins: Winter	0.02	4.7	2.169
RED12	FEH: 30 years: +0 %: 15 mins: Winter	0.01	3.3	1.519
RED13	FEH: 30 years: +0 %: 15 mins: Summer	0.03	9.1	3.978

IPM8	FEH: 30 years: +0 %: 15 mins: Winter	0.04	11.8	5.482
IPM6	FEH: 30 years: +0 %: 15 mins: Summer	0.02	6.7	2.906
IPM4	FEH: 30 years: +0 %: 15 mins: Winter	0.04	12.3	5.719
IPM5	FEH: 30 years: +0 %: 15 mins: Winter	0.04	12.3	5.698
IPM2	FEH: 30 years: +0 %: 15 mins: Winter	0.04	12.2	5.662
IPM1	FEH: 30 years: +0 %: 15 mins: Winter	0.03	8.7	4.026
IPM3	FEH: 30 years: +0 %: 15 mins: Winter	0.04	12.2	5.650
IPM10	FEH: 30 years: +0 %: 15 mins: Winter	0.03	8.5	3.921
IPM7	FEH: 30 years: +0 %: 15 mins: Winter	0.01	3.3	1.525
IPM9	FEH: 30 years: +0 %: 15 mins: Winter	0.04	12.2	5.668
IPM12	FEH: 30 years: +0 %: 15 mins: Winter	0.01	2.3	1.081
ROAD4	FEH: 30 years: +0 %: 15 mins: Summer	0.03	9.1	3.981
ROAD3	FEH: 30 years: +0 %: 15 mins: Summer	0.04	14.2	6.177
ROAD11	FEH: 30 years: +0 %: 15 mins: Summer	0.01	2.2	0.956
ROAD6	FEH: 30 years: +0 %: 15 mins: Summer	0.05	18.3	7.992
ROAD5	FEH: 30 years: +0 %: 15 mins: Summer	0.02	6.7	2.924
ROAD1	FEH: 30 years: +0 %: 15 mins: Summer	0.31	107.5	46.872

ROAD9	FEH: 30 years: +0 %: 15 mins: Summer	0.02	6.0	2.612
ROAD8	FEH: 30 years: +0 %: 15 mins: Summer	0.01	3.3	1.423
ROAD7	FEH: 30 years: +0 %: 15 mins: Summer	0.02	6.4	2.801
IMP14	FEH: 30 years: +0 %: 15 mins: Summer	0.01	3.2	1.390
IMP11	FEH: 30 years: +0 %: 15 mins: Summer	0.01	2.8	1.213
IMP11OUT	FEH: 30 years: +0 %: 15 mins: Summer	0.03	8.8	3.858
IPM12OUT	FEH: 30 years: +0 %: 15 mins: Summer	0.03	9.4	4.092
IMP15OUT	FEH: 30 years: +0 %: 15 mins: Summer	0.04	11.6	5.063
IMPCHURCH	FEH: 30 years: +0 %: 15 mins: Summer	0.04	10.4	4.523
IMP14OUT	FEH: 30 years: +0 %: 15 mins: Summer	0.03	8.6	3.760
IMP16OUT	FEH: 30 years: +0 %: 15 mins: Summer	0.04	11.9	5.185
IMP13OUT	FEH: 30 years: +0 %: 15 mins: Summer	0.03	7.5	3.274
IMPRD6	FEH: 30 years: +0 %: 15 mins: Summer	0.06	19.6	8.552
IMPRD7	FEH: 30 years: +0 %: 15 mins: Summer	0.04	13.2	5.755
IPM10OUT	FEH: 30 years: +0 %: 15 mins: Summer	0.01	3.5	1.516
ROAD22	FEH: 30 years: +0 %: 15 mins: Summer	0.05	13.2	5.767
ROAD23	FEH: 30 years: +0 %: 15 mins: Summer	0.06	16.3	7.091

ROAD21	FEH: 30 years: +0 %: 15 mins: Summer	0.06	18.2	7.914
IMPRD1	FEH: 30 years: +0 %: 15 mins: Summer	0.05	18.3	7.992
IMPRD2	FEH: 30 years: +0 %: 15 mins: Summer	0.03	8.8	3.855
IMPRD3	FEH: 30 years: +0 %: 15 mins: Summer	0.03	9.5	4.152
IMPRD4	FEH: 30 years: +0 %: 15 mins: Summer	0.03	11.3	4.931

Project: Penrhys Phase 1A	Date: 18/06/2025		
	Designed by: smparry	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address: Stantec		

FEH: 100 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m³)
RED3	FEH: 100 years: +0 %: 15 mins: Summer	0.05	16.0	6.974
RED6	FEH: 100 years: +0 %: 15 mins: Summer	0.05	16.0	6.974
RED4	FEH: 100 years: +0 %: 15 mins: Summer	0.05	16.0	6.977
RED5	FEH: 100 years: +0 %: 15 mins: Summer	0.04	14.1	6.139
RED7	FEH: 100 years: +0 %: 15 mins: Summer	0.04	14.1	6.145
RED2	FEH: 100 years: +0 %: 15 mins: Summer	0.05	16.0	6.974
RED1	FEH: 100 years: +0 %: 15 mins: Summer	0.05	16.0	6.974
RED14	FEH: 100 years: +0 %: 15 mins: Summer	0.05	16.0	6.974
RED8	FEH: 100 years: +0 %: 15 mins: Summer	0.04	14.2	6.198
RED9	FEH: 100 years: +0 %: 15 mins: Summer	0.04	14.1	6.156
RED11	FEH: 100 years: +0 %: 15 mins: Summer	0.04	14.1	6.156
RED10	FEH: 100 years: +0 %: 15 mins: Summer	0.04	14.1	6.156
IPM13	FEH: 100 years: +0 %: 15 mins: Winter	0.02	5.7	2.640
RED12	FEH: 100 years: +0 %: 15 mins: Winter	0.01	4.0	1.849
RED13	FEH: 100 years: +0 %: 15 mins: Summer	0.03	11.1	4.850

IPM8	FEH: 100 years: +0 %: 15 mins: Winter	0.04	14.4	6.681
IPM6	FEH: 100 years: +0 %: 15 mins: Summer	0.02	8.1	3.541
IPM4	FEH: 100 years: +0 %: 15 mins: Winter	0.04	15.0	6.969
IPM5	FEH: 100 years: +0 %: 15 mins: Winter	0.04	14.9	6.939
IPM2	FEH: 100 years: +0 %: 15 mins: Winter	0.04	14.9	6.897
IPM1	FEH: 100 years: +0 %: 15 mins: Winter	0.03	10.6	4.908
IPM3	FEH: 100 years: +0 %: 15 mins: Winter	0.04	14.8	6.885
IPM10	FEH: 100 years: +0 %: 15 mins: Winter	0.03	10.3	4.779
IPM7	FEH: 100 years: +0 %: 15 mins: Winter	0.01	4.0	1.855
IPM9	FEH: 100 years: +0 %: 15 mins: Winter	0.04	14.9	6.903
IPM12	FEH: 100 years: +0 %: 15 mins: Winter	0.01	2.8	1.318
ROAD4	FEH: 100 years: +0 %: 15 mins: Summer	0.03	11.1	4.853
ROAD3	FEH: 100 years: +0 %: 15 mins: Summer	0.04	17.3	7.523
ROAD11	FEH: 100 years: +0 %: 15 mins: Summer	0.01	2.7	1.165
ROAD6	FEH: 100 years: +0 %: 15 mins: Summer	0.05	22.3	9.740
ROAD5	FEH: 100 years: +0 %: 15 mins: Summer	0.02	8.2	3.565
ROAD1	FEH: 100 years: +0 %: 15 mins: Summer	0.31	131.0	57.110

ROAD9	FEH: 100 years: +0 %: 15 mins: Summer	0.02	7.3	3.182
ROAD8	FEH: 100 years: +0 %: 15 mins: Summer	0.01	4.0	1.735
ROAD7	FEH: 100 years: +0 %: 15 mins: Summer	0.02	7.8	3.409
IMP14	FEH: 100 years: +0 %: 15 mins: Summer	0.01	3.9	1.696
IMP11	FEH: 100 years: +0 %: 15 mins: Summer	0.01	3.4	1.480
IMP11OUT	FEH: 100 years: +0 %: 15 mins: Summer	0.03	10.8	4.701
IPM12OUT	FEH: 100 years: +0 %: 15 mins: Summer	0.03	11.4	4.988
IMP15OUT	FEH: 100 years: +0 %: 15 mins: Summer	0.04	14.1	6.162
IMPCHURCH	FEH: 100 years: +0 %: 15 mins: Summer	0.04	12.6	5.512
IMP14OUT	FEH: 100 years: +0 %: 15 mins: Summer	0.03	10.5	4.581
IMP16OUT	FEH: 100 years: +0 %: 15 mins: Summer	0.04	14.5	6.318
IMP13OUT	FEH: 100 years: +0 %: 15 mins: Summer	0.03	9.1	3.990
IMPRD6	FEH: 100 years: +0 %: 15 mins: Summer	0.06	23.9	10.423
IMPRD7	FEH: 100 years: +0 %: 15 mins: Summer	0.04	16.1	7.013
IPM10OUT	FEH: 100 years: +0 %: 15 mins: Summer	0.01	4.2	1.845
ROAD22	FEH: 100 years: +0 %: 15 mins: Summer	0.05	16.1	7.022
ROAD23	FEH: 100 years: +0 %: 15 mins: Summer	0.06	19.8	8.637

ROAD21	FEH: 100 years: +0 %: 15 mins: Summer	0.06	22.1	9.647
IMPRD1	FEH: 100 years: +0 %: 15 mins: Summer	0.05	22.3	9.740
IMPRD2	FEH: 100 years: +0 %: 15 mins: Summer	0.03	10.8	4.698
IMPRD3	FEH: 100 years: +0 %: 15 mins: Summer	0.03	11.6	5.063
IMPRD4	FEH: 100 years: +0 %: 15 mins: Summer	0.03	13.8	6.007

FEH: 2 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Outflow

Project:	Date:		
Penrhys Phase 1A	18/06/2025		
	Designed by:	Checked by:	Approved By:
	smparry		
Report Details:	Company Address:		
Type: Junctions Summary Storm Phase: Phase	Stantec		

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Inlet Headwall	FEH: 2 years: +0 %: 15 mins: Summer	341.759	340.034	340.068	0.033	17.2	0.059	0.000	17.0	7.539	OK
S1	FEH: 2 years: +0 %: 15 mins: Summer	337.227	333.527	333.580	0.052	33.7	0.093	0.000	32.9	14.821	OK
S2	FEH: 2 years: +0 %: 15 mins: Summer	333.421	331.171	331.231	0.060	39.0	0.105	0.000	37.5	17.507	OK
S3	FEH: 2 years: +0 %: 15 mins: Summer	328.349	325.089	325.153	0.064	58.7	0.113	0.000	56.5	26.785	OK
S4	FEH: 2 years: +0 %: 15 mins: Summer	322.262	319.112	319.245	0.133	137.7	0.235	0.000	133.0	70.725	OK
S5	FEH: 2 years: +0 %: 15 mins: Summer	321.025	317.845	317.949	0.103	138.5	0.183	0.000	135.2	73.067	OK
S38	FEH: 2 years: +0 %: 15 mins: Summer	334.553	332.053	332.077	0.024	3.1	0.027	0.000	3.1	1.368	OK
S37	FEH: 2 years: +0 %: 15 mins: Summer	331.204	329.714	329.754	0.040	8.6	0.045	0.000	8.3	3.765	OK
S22	FEH: 2 years: +0 %: 15 mins: Summer	327.585	326.385	326.658	0.273	27.4	0.309	0.000	21.7	12.316	Surcharged
S20	FEH: 2 years: +0 %: 15 mins: Summer	327.190	325.990	326.108	0.118	71.9	0.134	0.000	69.8	35.914	OK
S25	FEH: 2 years: +0 %: 15 mins: Summer	323.198	321.638	321.742	0.104	83.8	0.118	0.000	82.8	43.634	OK
S39	FEH: 2 years: +0 %: 15 mins: Summer	339.565	337.835	337.935	0.100	17.6	0.114	0.000	16.7	7.677	OK
EX2	FEH: 2 years: +0 %: 15 mins: Summer	334.800	333.600	333.676	0.076	31.4	0.086	0.000	30.8	14.617	OK
S6	FEH: 2 years: +0 %: 15 mins: Summer	313.292	311.152	311.290	0.138	203.5	0.156	0.000	196.5	107.603	OK
S7	FEH: 2 years: +0 %: 15 mins: Summer	310.894	308.494	308.625	0.130	196.5	0.000	0.000	197.2	107.603	OK
S29	FEH: 2 years: +0 %: 15 mins: Summer	313.614	311.864	312.021	0.158	73.5	0.178	0.000	71.4	34.688	OK
S27	FEH: 2 years: +0 %: 15 mins: Summer	314.743	313.573	313.673	0.100	44.5	0.113	0.000	42.9	21.024	OK
S34	FEH: 2 years: +0 %: 15 mins: Winter	322.059	319.479	319.549	0.070	29.6	0.079	0.000	28.8	14.580	OK
S31	FEH: 2 years: +0 %: 15 mins: Winter	325.107	322.747	322.858	0.111	20.0	0.126	0.000	19.4	9.322	OK
S40	FEH: 2 years: +0 %: 15 mins: Summer	338.161	336.961	337.022	0.061	22.2	0.069	0.000	21.6	10.051	OK
S41	FEH: 2 years: +0 %: 15 mins: Summer	335.671	334.471	334.558	0.087	21.6	0.098	0.000	20.9	10.038	OK
S21	FEH: 2 years: +0 %: 15 mins: Summer	331.239	330.039	330.107	0.068	40.4	0.077	0.000	39.2	18.883	OK
S36	FEH: 2 years: +0 %: 15 mins: Summer	329.973	327.983	328.043	0.060	13.8	0.068	0.000	13.3	6.146	OK
S23	FEH: 2 years: +0 %: 15 mins: Summer	325.971	324.271	324.415	0.145	69.8	0.163	0.000	67.7	35.895	OK
S24	FEH: 2 years: +0 %: 15 mins: Summer	324.471	323.131	323.258	0.127	67.7	0.144	0.000	66.0	35.856	OK
S44	FEH: 2 years: +0 %: 15 mins: Summer	334.287	331.357	331.357	0.000	0.0	0.000	0.000	0.0	0.000	OK
S26	FEH: 2 years: +0 %: 15 mins: Summer	322.068	319.836	319.992	0.157	82.8	0.177	0.000	80.2	43.585	OK
S45	FEH: 2 years: +0 %: 15 mins: Summer	337.880	336.270	336.309	0.039	9.8	0.044	0.000	9.6	4.291	OK
S32	FEH: 2 years: +0 %: 15 mins: Winter	324.442	322.562	322.626	0.064	19.4	0.072	0.000	18.8	9.307	OK
S33	FEH: 2 years: +0 %: 15 mins: Summer	322.856	321.264	321.330	0.066	24.8	0.074	0.000	24.2	11.400	OK
S35	FEH: 2 years: +0 %: 15 mins: Summer	320.213	317.343	317.415	0.072	33.7	0.082	0.000	32.6	15.881	OK
S28	FEH: 2 years: +0 %: 15 mins: Summer	314.635	313.025	313.113	0.088	53.9	0.100	0.000	53.1	25.785	OK
S30	FEH: 2 years: +0 %: 15 mins: Summer	313.967	311.507	311.686	0.179	71.4	0.203	0.000	68.4	34.660	OK

Project: Penrhys Phase 1A	Date: 18/06/2025		
	Designed by: smparry	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Phase	Company Address: Stantec		

FEH: 30 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Outflow

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Inlet Headwall	FEH: 30 years: +0 %: 15 mins: Summer	341.759	340.034	340.082	0.048	36.6	0.085	0.000	36.2	15.972	OK
S1	FEH: 30 years: +0 %: 15 mins: Summer	337.227	333.527	333.604	0.077	71.6	0.136	0.000	70.2	31.398	OK
S2	FEH: 30 years: +0 %: 15 mins: Summer	333.421	331.171	331.258	0.087	83.4	0.154	0.000	80.6	37.088	OK
S3	FEH: 30 years: +0 %: 15 mins: Summer	328.349	325.089	325.182	0.093	125.6	0.164	0.000	122.0	56.762	OK
S4	FEH: 30 years: +0 %: 15 mins: Summer	322.262	319.112	319.307	0.196	270.9	0.346	0.000	265.3	150.263	OK
S5	FEH: 30 years: +0 %: 15 mins: Summer	321.025	317.845	317.993	0.148	276.9	0.261	0.000	272.7	155.262	OK
S38	FEH: 30 years: +0 %: 15 mins: Summer	334.553	332.053	332.088	0.035	6.7	0.039	0.000	6.5	2.905	OK
S37	FEH: 30 years: +0 %: 15 mins: Summer	331.204	329.714	329.774	0.060	18.2	0.068	0.000	17.9	7.983	OK
S22	FEH: 30 years: +0 %: 15 mins: Summer	327.585	326.385	327.588	1.203	53.1	4.620	3.263	36.6	26.123	Flood
S20	FEH: 30 years: +0 %: 15 mins: Summer	327.190	325.990	326.571	0.581	132.3	0.658	0.000	120.6	76.185	Surcharged
S25	FEH: 30 years: +0 %: 15 mins: Summer	323.198	321.638	321.785	0.147	150.1	0.166	0.000	149.1	92.731	OK
S39	FEH: 30 years: +0 %: 15 mins: Summer	339.565	337.835	338.448	0.613	37.3	0.693	0.000	29.3	16.293	Surcharged
EX2	FEH: 30 years: +0 %: 15 mins: Summer	334.800	333.600	333.720	0.120	57.9	0.136	0.000	57.2	31.024	OK
S6	FEH: 30 years: +0 %: 15 mins: Summer	313.292	311.152	311.357	0.205	405.4	0.232	0.000	395.3	228.708	OK
S7	FEH: 30 years: +0 %: 15 mins: Summer	310.894	308.494	308.681	0.187	395.3	0.000	0.000	396.2	228.708	OK
S29	FEH: 30 years: +0 %: 15 mins: Summer	313.614	311.864	312.393	0.529	158.3	0.598	0.000	142.6	73.560	Surcharged
S27	FEH: 30 years: +0 %: 15 mins: Summer	314.743	313.573	313.732	0.159	95.6	0.180	0.000	92.9	44.576	OK
S34	FEH: 30 years: +0 %: 15 mins: Winter	322.059	319.479	319.587	0.109	63.3	0.123	0.000	62.0	30.919	OK
S31	FEH: 30 years: +0 %: 15 mins: Winter	325.107	322.747	322.927	0.180	42.6	0.204	0.000	41.3	19.763	OK
S40	FEH: 30 years: +0 %: 15 mins: Summer	338.161	336.961	337.049	0.088	40.9	0.099	0.000	40.2	21.319	OK
S41	FEH: 30 years: +0 %: 15 mins: Winter	335.671	334.471	334.616	0.145	38.2	0.164	0.000	36.1	21.324	OK

S21	FEH: 30 years: +0 %: 15 mins: Summer	331.239	330.039	330.137	0.098	77.7	0.111	0.000	77.1	40.062	OK
S36	FEH: 30 years: +0 %: 15 mins: Summer	329.973	327.983	328.171	0.188	29.6	0.213	0.000	23.2	13.037	Surcharged
S23	FEH: 30 years: +0 %: 30 mins: Summer	325.971	324.271	325.022	0.751	116.6	0.849	0.000	116.6	110.690	Surcharged
S24	FEH: 30 years: +0 %: 15 mins: Summer	324.471	323.131	323.424	0.293	114.3	0.332	0.000	117.7	76.287	Surcharged
S44	FEH: 30 years: +0 %: 15 mins: Summer	334.287	331.357	331.357	0.000	0.0	0.000	0.000	0.0	0.000	OK
S26	FEH: 30 years: +0 %: 15 mins: Summer	322.068	319.836	320.078	0.242	149.1	0.274	0.000	146.8	92.685	OK
S45	FEH: 30 years: +0 %: 15 mins: Summer	337.880	336.270	336.327	0.058	20.8	0.065	0.000	20.5	9.091	OK
S32	FEH: 30 years: +0 %: 15 mins: Winter	324.442	322.562	322.659	0.097	41.3	0.109	0.000	40.3	19.743	OK
S33	FEH: 30 years: +0 %: 15 mins: Summer	322.856	321.264	321.365	0.100	53.0	0.114	0.000	51.8	24.152	OK
S35	FEH: 30 years: +0 %: 15 mins: Summer	320.213	317.343	317.453	0.111	72.3	0.125	0.000	70.5	33.663	OK
S28	FEH: 30 years: +0 %: 15 mins: Summer	314.635	313.025	313.159	0.133	116.2	0.151	0.000	115.0	54.681	OK
S30	FEH: 30 years: +0 %: 15 mins: Summer	313.967	311.507	311.993	0.486	142.6	0.550	0.000	132.7	73.602	Surcharged

Project: Penrhys Phase 1A	Date: 18/06/2025		
	Designed by: smparry	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Phase	Company Address: Stantec		

FEH: 100 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Outflow

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Inlet Headwall	FEH: 100 years: +0 %: 15 mins: Summer	341.759	340.034	340.087	0.053	44.6	0.093	0.000	44.1	19.467	OK
S1	FEH: 100 years: +0 %: 15 mins: Summer	337.227	333.527	333.613	0.085	87.3	0.151	0.000	85.7	38.272	OK
S2	FEH: 100 years: +0 %: 15 mins: Summer	333.421	331.171	331.267	0.096	101.7	0.170	0.000	98.5	45.205	OK
S3	FEH: 100 years: +0 %: 15 mins: Summer	328.349	325.089	325.192	0.103	153.4	0.182	0.000	149.2	69.187	OK
S4	FEH: 100 years: +0 %: 15 mins: Summer	322.262	319.112	319.324	0.213	311.3	0.376	0.000	305.7	183.174	OK
S5	FEH: 100 years: +0 %: 15 mins: Summer	321.025	317.845	318.004	0.159	319.9	0.282	0.000	315.8	189.258	OK
S38	FEH: 100 years: +0 %: 15 mins: Summer	334.553	332.053	332.091	0.038	8.1	0.044	0.000	8.0	3.541	OK
S37	FEH: 100 years: +0 %: 15 mins: Summer	331.204	329.714	329.781	0.066	22.2	0.075	0.000	21.8	9.726	OK
S22	FEH: 100 years: +0 %: 30 mins: Winter	327.585	326.385	327.595	1.210	53.2	11.089	9.732	36.7	49.196	Flood
S20	FEH: 100 years: +0 %: 15 mins: Summer	327.190	325.990	327.048	1.058	138.3	1.197	0.000	131.2	92.878	Flood Risk
S25	FEH: 100 years: +0 %: 15 mins: Summer	323.198	321.638	321.794	0.156	163.4	0.177	0.000	163.5	113.044	OK
S39	FEH: 100 years: +0 %: 15 mins: Summer	339.565	337.835	338.945	1.110	45.5	1.255	0.000	35.0	19.856	Surcharged
EX2	FEH: 100 years: +0 %: 15 mins: Winter	334.800	333.600	333.738	0.138	64.3	0.156	0.000	62.6	37.840	OK
S6	FEH: 100 years: +0 %: 15 mins: Summer	313.292	311.152	311.382	0.231	488.4	0.261	0.000	477.6	278.829	OK
S7	FEH: 100 years: +0 %: 15 mins: Summer	310.894	308.494	308.702	0.207	477.6	0.000	0.000	479.6	278.829	OK
S29	FEH: 100 years: +0 %: 15 mins: Summer	313.614	311.864	312.987	1.124	178.0	1.271	0.000	175.9	89.680	Surcharged
S27	FEH: 100 years: +0 %: 15 mins: Summer	314.743	313.573	313.754	0.181	116.5	0.205	0.000	113.9	54.277	OK
S34	FEH: 100 years: +0 %: 15 mins: Summer	322.059	319.479	319.601	0.123	76.8	0.139	0.000	75.3	35.521	OK
S31	FEH: 100 years: +0 %: 15 mins: Summer	325.107	322.747	322.965	0.218	51.4	0.247	0.000	48.7	22.426	OK
S40	FEH: 100 years: +0 %: 15 mins: Summer	338.161	336.961	337.062	0.101	49.2	0.114	0.000	48.4	25.978	OK

S41	FEH: 100 years: +0 %: 30 mins: Summer	335.671	334.471	335.094	0.623	44.0	0.704	0.000	43.5	38.386	Surcharged
S21	FEH: 100 years: +0 %: 15 mins: Summer	331.239	330.039	330.143	0.105	86.4	0.118	0.000	86.1	48.852	OK
S36	FEH: 100 years: +0 %: 15 mins: Summer	329.973	327.983	328.497	0.515	36.0	0.582	0.000	29.3	15.876	Surcharged
S23	FEH: 100 years: +0 %: 15 mins: Summer	325.971	324.271	325.280	1.009	131.2	1.141	0.000	125.2	92.912	Surcharged
S24	FEH: 100 years: +0 %: 30 mins: Summer	324.471	323.131	323.765	0.635	123.4	0.718	0.000	122.6	137.271	Surcharged
S44	FEH: 100 years: +0 %: 15 mins: Summer	334.287	331.357	331.357	0.000	0.0	0.000	0.000	0.0	0.000	OK
S26	FEH: 100 years: +0 %: 15 mins: Summer	322.068	319.836	320.102	0.266	163.5	0.301	0.000	159.5	112.990	OK
S45	FEH: 100 years: +0 %: 15 mins: Summer	337.880	336.270	336.334	0.064	25.4	0.073	0.000	25.0	11.079	OK
S32	FEH: 100 years: +0 %: 15 mins: Winter	324.442	322.562	322.670	0.108	48.7	0.122	0.000	48.3	24.061	OK
S33	FEH: 100 years: +0 %: 15 mins: Summer	322.856	321.264	321.377	0.113	64.0	0.127	0.000	62.8	29.419	OK
S35	FEH: 100 years: +0 %: 15 mins: Summer	320.213	317.343	317.467	0.125	87.9	0.141	0.000	85.9	41.012	OK
S28	FEH: 100 years: +0 %: 15 mins: Winter	314.635	313.025	313.178	0.152	138.2	0.172	0.000	130.7	68.951	OK
S30	FEH: 100 years: +0 %: 15 mins: Summer	313.967	311.507	312.420	0.913	175.9	1.033	0.000	172.7	89.740	Surcharged

Project: Penrhys Phase 1A	Date: 18/06/2025		
	Designed by: smparry	Checked by:	Approved By:
Report Details: Type: Connections Summary Storm Phase: Phase	Company Address: Stantec		

FEH: 2 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Flow

Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
CULV1	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Inlet Headwall	S1	341.759	340.068	0.043	7.539	2.0	0.01	17.0	OK
CULV2	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S1	S2	337.227	333.580	0.056	14.821	2.6	0.02	32.9	OK
CULV3	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S2	S3	333.421	331.231	0.062	17.507	2.6	0.03	37.5	OK
CULV4	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S3	S4	328.349	325.153	0.099	26.785	2.0	0.03	56.5	OK
CULV5	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S4	S5	322.262	319.245	0.118	70.725	3.6	0.12	133.0	OK
SW21	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S38	S37	334.553	332.077	0.032	1.368	1.1	0.06	3.1	OK
SW24	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S22	S20	327.585	326.658	0.150	12.316	1.2	1.13	21.7	Surcharged
CULV6	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S5	S6	321.025	317.949	0.121	73.067	3.6	0.09	135.2	OK
CULV7	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S6	S7	313.292	311.290	0.134	107.603	4.5	0.14	196.5	OK
SW1	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S39	S40	339.565	337.935	0.081	7.677	1.7	0.68	16.7	OK
SW2	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S40	S41	338.161	337.022	0.074	10.051	2.5	0.35	21.6	OK
SW3	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S41	EX2	335.671	334.558	0.081	10.038	2.1	0.57	20.9	OK
SW4	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	EX2	S21	334.800	333.676	0.072	14.617	3.6	0.47	30.8	OK
SW5	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S21	S20	331.239	330.107	0.093	18.883	2.5	0.2	39.2	OK
SW22	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S37	S36	331.204	329.754	0.050	3.765	1.6	0.16	8.3	OK
SW23	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S36	S22	329.973	328.043	0.150	6.146	0.8	0.34	13.3	OK
SW7	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S20	S23	327.190	326.108	0.131	35.914	2.9	0.52	69.8	OK
SW8	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S23	S24	325.971	324.415	0.136	35.895	2.7	0.66	67.7	OK
SW9	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S24	S25	324.471	323.258	0.116	35.856	3.2	0.54	66.0	OK

SW13	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S44	S21	334.287	331.357	0.034	0.000	0.0	0	0.0	OK
SW10	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S25	S26	323.198	321.742	0.131	43.634	2.8	0.26	82.8	OK
SW11	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S26	S4	322.068	319.992	0.145	43.585	2.4	0.47	80.2	OK
SW12	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S45	S21	337.880	336.309	0.054	4.291	1.7	0.15	9.6	OK
SW30	FEH: 2 years: +0 %: 15 mins: Winter	Pipe	S31	S32	325.107	322.858	0.088	9.322	1.4	0.44	19.4	OK
SW31	FEH: 2 years: +0 %: 15 mins: Winter	Pipe	S32	S33	324.442	322.626	0.065	9.307	2.0	0.17	18.8	OK
SW32	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S33	S34	322.856	321.330	0.068	11.400	2.4	0.18	24.2	OK
SW33	FEH: 2 years: +0 %: 15 mins: Winter	Pipe	S34	S35	322.059	319.549	0.071	14.580	2.7	0.2	28.8	OK
SW34	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S35	S27	320.213	317.415	0.086	15.881	2.3	0.22	32.6	OK
SW35	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S27	S28	314.743	313.673	0.094	21.024	2.3	0.21	42.9	OK
SW36	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S28	S29	314.635	313.113	0.123	25.785	1.9	0.19	53.1	OK
SW37	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S29	S30	313.614	312.021	0.168	34.688	1.7	0.45	71.4	OK
SW38	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	S30	S6	313.967	311.686	0.159	34.660	1.8	0.58	68.4	OK

Project: Penrhys Phase 1A	Date: 18/06/2025		
	Designed by: smparry	Checked by:	Approved By:
Report Details: Type: Connections Summary Storm Phase: Phase	Company Address: Stantec		

FEH: 30 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Flow

Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
CULV1	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Inlet Headwall	S1	341.759	340.082	0.062	15.972	2.5	0.02	36.2	OK
CULV2	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S1	S2	337.227	333.604	0.082	31.398	3.3	0.05	70.2	OK
CULV3	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S2	S3	333.421	331.258	0.090	37.088	3.3	0.06	80.6	OK
CULV4	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S3	S4	328.349	325.182	0.144	56.762	2.5	0.07	122.0	OK
CULV5	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S4	S5	322.262	319.307	0.172	150.263	4.3	0.24	265.3	OK
SW21	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S38	S37	334.553	332.088	0.047	2.905	1.4	0.12	6.5	OK
SW24	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S22	S20	327.585	327.588	0.150	26.123	2.1	1.9	36.6	Flood
CULV6	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S5	S6	321.025	317.993	0.177	155.262	4.3	0.18	272.7	OK
CULV7	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S6	S7	313.292	311.357	0.196	228.708	5.4	0.27	395.3	OK
SW1	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S39	S40	339.565	338.448	0.150	16.293	1.7	1.19	29.3	Surcharged
SW2	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S40	S41	338.161	337.049	0.130	21.319	2.5	0.64	40.2	OK
SW3	FEH: 30 years: +0 %: 15 mins: Winter	Pipe	S41	EX2	335.671	334.616	0.132	21.324	2.2	0.98	36.1	OK
SW4	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	EX2	S21	334.800	333.720	0.109	31.024	4.2	0.88	57.2	OK
SW5	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S21	S20	331.239	330.137	0.225	40.062	2.1	0.4	77.1	OK

SW22	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S37	S36	331.204	329.774	0.124	7.983	1.4	0.33	17.9	OK
SW23	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S36	S22	329.973	328.171	0.150	13.037	1.3	0.6	23.2	Surch arged
SW7	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S20	S23	327.190	326.571	0.225	76.185	3.0	0.9	120.6	Surch arged
SW8	FEH: 30 years: +0 %: 30 mins: Summer	Pipe	S23	S24	325.971	325.022	0.225	110.690	2.9	1.13	116.6	Surch arged
SW9	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S24	S25	324.471	323.424	0.211	76.287	3.4	0.96	117.7	Surch arged
SW13	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S44	S21	334.287	331.357	0.049	0.000	0.0	0	0.0	OK
SW10	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S25	S26	323.198	321.785	0.195	92.731	3.1	0.47	149.1	OK
SW11	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S26	S4	322.068	320.078	0.219	92.685	2.8	0.86	146.8	OK
SW12	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S45	S21	337.880	336.327	0.078	9.091	2.2	0.31	20.5	OK
SW30	FEH: 30 years: +0 %: 15 mins: Winter	Pipe	S31	S32	325.107	322.927	0.139	19.763	1.6	0.93	41.3	OK
SW31	FEH: 30 years: +0 %: 15 mins: Winter	Pipe	S32	S33	324.442	322.659	0.098	19.743	2.4	0.36	40.3	OK
SW32	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S33	S34	322.856	321.365	0.104	24.152	2.9	0.39	51.8	OK
SW33	FEH: 30 years: +0 %: 15 mins: Winter	Pipe	S34	S35	322.059	319.587	0.109	30.919	3.2	0.44	62.0	OK
SW34	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S35	S27	320.213	317.453	0.135	33.663	2.8	0.48	70.5	OK
SW35	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S27	S28	314.743	313.732	0.146	44.576	2.7	0.45	92.9	OK
SW36	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S28	S29	314.635	313.159	0.300	54.681	1.9	0.41	115.0	OK
SW37	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S29	S30	313.614	312.393	0.300	73.560	2.0	0.91	142.6	Surch arged

SW38	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	S30	S6	313.967	311.993	0.300	73.602	1.9	1.13	132.7	Surcharged

Project: Penrhys Phase 1A	Date: 18/06/2025		
	Designed by: smparry	Checked by:	Approved By:
Report Details: Type: Connections Summary Storm Phase: Phase	Company Address: Stantec		

FEH: 100 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Flow

Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
CULV1	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Inlet Headwall	S1	341.759	340.087	0.069	19.467	2.6	0.02	44.1	OK
CULV2	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S1	S2	337.227	333.613	0.091	38.272	3.4	0.06	85.7	OK
CULV3	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S2	S3	333.421	331.267	0.100	45.205	3.4	0.07	98.5	OK
CULV4	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S3	S4	328.349	325.192	0.158	69.187	2.7	0.09	149.2	OK
CULV5	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S4	S5	322.262	319.324	0.186	183.174	4.5	0.27	305.7	OK
SW21	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S38	S37	334.553	332.091	0.052	3.541	1.4	0.14	8.0	OK
SW24	FEH: 100 years: +0 %: 30 mins: Winter	Pipe	S22	S20	327.585	327.595	0.150	49.196	2.1	1.91	36.7	Flood
CULV6	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S5	S6	321.025	318.004	0.195	189.258	4.3	0.2	315.8	OK
CULV7	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S6	S7	313.292	311.382	0.219	278.829	5.6	0.33	477.6	OK
SW1	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S39	S40	339.565	338.945	0.150	19.856	2.0	1.42	35.0	Surcharged
SW2	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S40	S41	338.161	337.062	0.150	25.978	2.7	0.78	48.4	OK
SW3	FEH: 100 years: +0 %: 30 mins: Summer	Pipe	S41	EX2	335.671	335.094	0.150	38.386	2.5	1.18	43.5	Surcharged
SW4	FEH: 100 years: +0 %: 15 mins: Winter	Pipe	EX2	S21	334.800	333.738	0.121	37.840	4.1	0.96	62.6	OK
SW5	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S21	S20	331.239	330.143	0.225	48.852	2.2	0.44	86.1	OK

SW22	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S37	S36	331.204	329.781	0.150	9.726	1.4	0.41	21.8	OK
SW23	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S36	S22	329.973	328.497	0.150	15.876	1.7	0.76	29.3	Surch arged
SW7	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S20	S23	327.190	327.048	0.225	92.878	3.3	0.98	131.2	Flood Risk
SW8	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S23	S24	325.971	325.280	0.225	92.912	3.1	1.22	125.2	Surch arged
SW9	FEH: 100 years: +0 %: 30 mins: Summer	Pipe	S24	S25	324.471	323.765	0.225	137.271	3.5	1	122.6	Surch arged
SW13	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S44	S21	334.287	331.357	0.052	0.000	0.0	0	0.0	OK
SW10	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S25	S26	323.198	321.794	0.211	113.044	3.1	0.52	163.5	OK
SW11	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S26	S4	322.068	320.102	0.239	112.990	2.8	0.93	159.5	OK
SW12	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S45	S21	337.880	336.334	0.084	11.079	2.4	0.38	25.0	OK
SW30	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S31	S32	325.107	322.965	0.163	22.426	1.6	1.1	48.7	OK
SW31	FEH: 100 years: +0 %: 15 mins: Winter	Pipe	S32	S33	324.442	322.670	0.110	24.061	2.5	0.43	48.3	OK
SW32	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S33	S34	322.856	321.377	0.118	29.419	3.0	0.47	62.8	OK
SW33	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S34	S35	322.059	319.601	0.124	35.521	3.4	0.53	75.3	OK
SW34	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S35	S27	320.213	317.467	0.153	41.012	3.0	0.59	85.9	OK
SW35	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S27	S28	314.743	313.754	0.177	54.277	2.6	0.55	113.9	OK
SW36	FEH: 100 years: +0 %: 15 mins: Winter	Pipe	S28	S29	314.635	313.178	0.300	68.951	2.0	0.47	130.7	OK
SW37	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S29	S30	313.614	312.987	0.300	89.680	2.5	1.12	175.9	Surch arged

SW38	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	S30	S6	313.967	312.420	0.300	89.740	2.4	1.47	172.7	Surcharged

A.4 Appendix D – Drainage Strategy Plan

OS NORTH

BLUE/GREEN ROOF ON THE FLATS TO BE CONSIDERED BY DESIGN TEAM

HEOL PENYDRUS ROAD SUBJECT TO TRAFFIC CALMING MEASURES AS PART OF THE PROPOSED SCHEME. THIS WILL SEE A REDUCTION OF HARD DRAINED AREA AND SuDS FEATURES WILL BE INCORPORATED

BASIN FOR INTERCEPTION, ATTENUATION, WATER QUALITY, AMENITY AND BIODIVERISTY BENEFITS. BASIN DEPTH AND SIZE TO BE MAXIMISED WHERE POSSIBLE CONSIDERING THE SHALLOW BEDROCK ON THE SITE. ADDITIONAL ATTENUATION TO BE PROVIDED IN CELLULAR STORAGE.
VOLUME STORAGE REQUIREMENT = 630m^3

FLOW CONTROL CHAMBER RESTICTED TO 33.1l/s FOR ALL STORMS UP TO AND INCLUDING 1 IN 100 YEAR + 40% CLIMATE CHANGE

LOCATION OF EXISTING HEADWALL TO BE CONFIRMED

EXISITNG CULVERT TO BE DIVERTED

HEOL PENYDRUS ROAD SUBJECT TO TRAFFIC CALMING MEASURES AS PART OF THE PROPOSED SCHEME. THIS WILL SEE A REDUCTION OF HARD DRAINED AREA AND SuDS FEATURES WILL BE INCORPORATED

RAIN GARDENS FOR INTERCEPTION, WATER QUALITY, AMENITY & BIODIVERISTY BENEFITS

BASIN FOR INTERCEPTION, ATTENUATION, WATER QUALITY, AMENITY AND BIODIVERISTY BENEFITS. BASIN DEPTH AND SIZE TO BE MAXIMISED WHERE POSSIBLE CONSIDERING THE SHALLOW BEDROCK ON THE SITE. ADDITIONAL ATTENUATION TO BE PROVIDED IN OVERSIZE PIPE.
VOLUME STORAGE REQUIREMENT = 465m^3

FLOW CONTROL CHAMBER RESTICTED TO 25.2l/s FOR ALL STORMS UP TO AND INCLUDING 1 IN 100 YEAR + 40% CLIMATE CHANGE

EAST SIDE OF SITE TO DISCHARGE TO THE CULVERT DIVERSION AT RESTRICTED RATES.

FLOW CONTROL CHAMBER RESTICTED TO 15.4l/s FOR ALL STORMS UP TO AND INCLUDING 1 IN 100 YEAR + 40% CLIMATE CHANGE

BASIN FOR INTERCEPTION, ATTENUATION, WATER QUALITY, AMENITY AND BIODIVERISTY BENEFITS.
BASIN DEPTH AND SIZE TO BE MAXIMISED WHERE POSSIBLE CONSIDERING THE SHALLOW BEDROCK ON THE SITE. ADDITIONAL ATTENUATION TO BE PROVIDED IN CELLULAR STORAGE.
VOLUME STORAGE REQUIREMENT = 245m^3

PERMEABLE PAVING FOR INTERCEPTION & WATER QUALITY BENEFITS

REFER TO EXISTING DRAINAGE WORK PROPOSAL DRAWING FOR FURTHER INFORMATION (REF: 30602-STN-1A-XX-DR-C-1500)

WEST SIDE OF SITE TO DISCHARGE TO THE EXISTING CULVERT AT RESTRICTED RATE

PROPOSED FOUL WATER DISCHARGE LOCATION SUBJECT TO CONFIRMATION OF INVERT LEVEL AND S106 AGREEMENT WITH DCWW

REFER TO EXISTING DRAINAGE DRAWING 30603-STN-1A-XX-DR-C-0400 FOR FURTHER DETAILS ON THE EXISTING DRAINAGE ARRANGEMENTS.

FLOW CONTROL CHAMBER RESTICTED TO 31.3l/s FOR ALL STORMS UP TO AND INCLUDING 1 IN 100 YEAR + 40% CLIMATE CHANGE

BASIN FOR INTERCEPTION, ATTENUATION, WATER QUALITY, AMENITY AND BIODIVERISTY BENEFITS. BASIN DEPTH AND SIZE TO BE MAXIMISED WHERE POSSIBLE CONSIDERING THE SHALLOW BEDROCK ON THE SITE. ADDITIONAL ATTENUATION TO BE PROVIDED IN OVERSIZED PIPE.
VOLUME STORAGE REQUIREMENT = 585m^3

DO NOT SCALE

PROPOSED KEY

- SURFACE WATER SEWER
- SURFACE WATER PERFORATED DRAIN
- SURFACE WATER MANHOLE
- SURFACE WATER FLOW CONTROL
- SURFACE WATER HEADWALL
- CELLULAR STORAGE TANK
- RAIN GARDEN
- PERMEABLE PAVING
- GREEN ROOF
- BASIN
- FOUL WATER SEWER (ADOPTABLE)
- FOUL WATER MANHOLE (ADOPTABLE)
- 6m SEWER EASEMENT
- CULVERT DIVERSION

EXISTING KEY

- SURFACE WATER SEWER
- SURFACE WATER MANHOLE
- FOUL WATER SEWER (DCWW)
- FOUL WATER MANHOLE (DCWW)
- EXISTING TO BE REMOVED / ABANDONED

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT DRAWINGS AND SPECIFICATIONS
2. ALL FIGURED LEVELS ARE IN METRES AND RELATED TO EXISTING SURVEY GRID & DATUM UNLESS NOTED OTHERWISE
3. ALL FIGURED DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE, DIMENSION ARE NOT TO BE SCALED.
4. THE DRAWING SHALL BE USED FOR THE INTENDED PURPOSE ONLY AND THIS DRAWING HAS BEEN BASED ON INFORMATION PROVIDED BY OTHER PARTIES AND STANTEC DO NOT WARRANT THE ACCURACY OF THIS INFORMATION. DIMENSIONS SHALL NOT BE SCALED FROM THE DRAWING.

REVISIONS

Rev.	Revision Notes	Date	Drawn By	Checked | Approved
P01	First revision	08/09/25	SP	CD | RB

Stantec
Third Floor, Wharton Place
13 Wharton Street
Cardiff
CF10 1GS
t: +44(0)2920 023665
e: cardiff@hydrock.com

CLIENT
TRIVALLIS

PROJECT
PENRHYS PHASE 1A

TITLE
DRAINAGE STRATEGY

STANTEC PROJECT NO.	SCALE @ A1
333700566	1:500

STATUS DESCRIPTION	STATUS
SUITABLE FOR INFORMATION	S2

DRAWING NO.	REVISION
00566-STN-1A-XX-DR-C-3000	P01

Filename: ...\\333700566\01_WIP\DR_Drawing\C\00566-STN-1A-XX-DR-C-3000 Phase 1A Drainage Strategy.dwg

A.5 Appendix E – DC/WW PPA

Dŵr Cymru
Welsh Water

Developer Services
PO Box 3146
Cardiff
CF30 0EH

Tel: +44 (0)800 917 2652
Fax: +44 (0)2920 740472
E.mail: developer.services@dwrcymru.com

Gwasanaethau Datblygu
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Ffôn: +44 (0)800 917 2652
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E.bost: developer.services@dwrcymru.com

Mr Meurig Hughes
Stantec
[redacted]

Date: 06/08/2025
Our Ref: PPA0009548

Dear Mr Hughes

Grid Ref: 300136 195020
Site Address: Heol Penyrus, Tylorstown, RCT
Development: Residential redevelopment to provide social housing,

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

Firstly, we note that the proposal relates to 109 dwellings at Penrhys and acknowledge that the site is not currently allocated in the Local Development Plan, however is a proposed allocation in the preferred strategy as part of a wider regeneration site.

PUBLIC SEWERAGE NETWORK

The proposed development site is located in the immediate vicinity of a separate/mixed sewerage system, comprising, foul and surface water public sewers, which drains to Cardiff Bay Wastewater Treatment Works (WwTW).

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Glas Cymru Cyfyngedig

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Mae Dŵr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

We welcome correspondence in Welsh and English

Dŵr Cymru Cyf, a limited company registered in Wales no 2366777. Registered office: Pentwyn Road, Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn Nelson, Treharris, Morgannwg Ganol CF46 6LY.

This site is crossed by a public sewers with their approximate position being marked on the attached Statutory Public Sewer Record. In accordance with the Water Industry Act 1991, Dwr Cymru Welsh Water requires access to its apparatus at all times in order to carry out maintenance and repairs. No part of any building will be permitted within the protection zone of the public sewers measured 3 metres either side of the centreline. Please note, the distance specified for this protection zone is indicative and based on industry standard guidelines. However, the depth of the asset will need to be verified on site which may infer a greater protection zone. For completeness, we recommend the developer refer to their title deeds to confirm if there are any covenants or restrictions associated with the asset(s) crossing the proposed development site.

Accordingly, it is recommended that the developer contact our Plan and Protect team (PlanandProtect@dwrcymru.com) to carry out a survey to verify the location of this asset and establish its relationship to the proposed development. Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

You are also advised that some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect the proposal. In order to assist you may contact Dwr Cymru Welsh Water on 0800 085 3968 to establish the location and status of the apparatus in and around your site. Please be mindful that under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

SURFACE WATER DRAINAGE

As of 7th January 2019, this proposed development is subject to Schedule 3 of the Flood and Water Management Act 2010. The development therefore requires approval of Sustainable Drainage Systems (SuDS) features, in accordance with the 'Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems'. As highlighted in these standards, the developer is required to explore and fully exhaust all surface water drainage options in accordance with a hierarchy preferring infiltration (PL2) and, where infiltration is not possible, disposal to a surface water body (PL3), in liaison with the Lead Local Flood Authority and/or Natural Resources Wales, or surface water sewer or highway drain (PL4) in liaison with the riparian owner and/or Local Highways Authority.

Please note, DCWW is a statutory consultee to the SAB application process and will provide comments to any SuDS proposals by response to SAB consultation. Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note and our Developer Services website at https://developers.dwrcymru.com/en/help-advice/regulation-to-be-aware-of/sustainable-drainage-systems.

FOUL WATER DRAINAGE – SEWERAGE NETWORK

We have considered the impact of foul flows generated by the proposed development and concluded that flows can be accommodated within the public sewerage system. We advise that the flows should be connected to the foul sewer at or downstream of manhole ST00953005 located in Heol y Waun.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account. However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com

Sewerage Treatment

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

Water Supply

The water supply system in the immediate vicinity has insufficient capacity to serve the development and will also cause detriment to existing customers' water supply. A hydraulic modelling assessment is required to establish the scope of any reinforcement works to be completed at the same time as the provision of new water mains to serve the new development under Section 41 and Section 51 of the Water Industry Act (1991).

Information relating to our Hydraulic Modelling Assessment process is available on our website and within our guidance notes. The area planning officer will also be able to provide you within information relating to this process.

The proposed development is crossed by a trunk/distribution watermain, the approximate position being shown on the attached plan. Dwr Cymru Welsh Water as Statutory Undertaker has statutory powers to access our apparatus at all times. I enclose our Conditions for Development near Watermain(s). It may be possible for this watermain to be diverted under Section 185 of the Water Industry Act 1991, the cost of which will be re-charged to the developer. The developer must consult Dwr Cymru Welsh Water before any development commences on site.

I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application. I also attach copies of our water and sewer extract plans for the area, and a copy of our Planning Guidance Note which provides further information on our approach to the planning process, making connections to our systems and ensuring any existing public assets or infrastructure located within new development sites are protected.

Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at **developer.services@dwrcymru.com**

Please quote our reference number in all communications and correspondence.

Yours faithfully,

Matthew Lord
Planning Liaison Manager
Developer Services

glas
Glas Cymru Cyfyngedig

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Mae Dŵr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

We welcome correspondence in Welsh and English

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Rydym yn croesawu gohebiaeth yn y Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn Nelson, Treharris, Morgannwg Ganol CF46 6LY.

<u>Please Note</u> that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.

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Mae Dŵr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

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Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn
Nelson, Treharris, Morgannwg Ganol CF46 6LY.

RHONDDA CYNON TAF COUNTY BOROUGH COUNCIL

Sustainable Drainage Approval Body

Penrhys Village Re-development

Pre-Application Strategy Review Report

January 2025

ANDREW STONE
Head of Flood Risk Management and Strategic Projects
Strategic Projects, Llawr / Floor 2, Llys Cadwyn, Pontypridd, CF37 4TH

STEPHEN WILLIAMS
Director of Highways, Street Care and Transportation Services
Frontline Services, Llawr / Floor 2, Llys Cadwyn, Pontypridd, CF37 4TH

RHONDDA CYNON TAF

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RHONDDA CYNON TAF

DOCUMENT VERIFICATION

Applicant	Hydrock on behalf of Trivallis
Site Name	Penrhys Village Re-development
Document Title	Pre-Application Strategy Review Report
Document Ref	SR – 25 – RCTSAB349-001-PA

Revision Status	FINAL
Date of Issue	January 2025
Prepared by	Liam Swanwick BSc (Hons), MSc
Checked by	Owen Griffiths BSc (Hons), MSc
Approved by	Owen Griffiths BSc (Hons), MSc

This report should only be used in its entirety.

This report is confidential to the Client. Strategic Projects accepts no responsibility to third parties to whom the report, or any part thereof, is made known. Any such party using any information contained within the report do so at their own risk.

RHONDDA CYNON TAF

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CONTENTS

1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

The purpose of the report is to undertake an appraisal of the site and assess the overall strategy of an application compliance with the National Standards. The report will also inform the applicant, where required, what additional information is required for the full application in order for the application to constitute as a validly made application.

1.2 SITE PROPOSAL

The applicant proposes to undertake a full regeneration of Penrhys Village. The design code document suggests that the development will comprise of five phases with each to have sub-phases. Further demolition proposed in 2025. No specific site construction details provided.

The overall proposed development will comprise of residential land uses such as dwelling, driveways, adoptable road etc as well as a variety of other uses such as commercial, tourism, educational, leisure, open space, energy which could include bike trails, play areas, shops, new school, community centre, visitor centre, energy infrastructure etc.

1.3 SUSTAINABLE DRAINAGE PROPOSAL

The submission does not detail out any drainage proposal as such. However, it is stated within the application form that the intention is to drain runoff to the existing SW drainage connections (to be determined as well as extent) with any discharge to a betterment of 30% to the existing regime.

1.4 SITE LOCATION

The land to be developed lies at Penrhys Village (entirety of the village). Postcode of CF43 3RN and approximate easting and northing of 300317E, 194878N.

The village is situated to the north of the B4512 Penrhys Road which links the A4058 Tytyla Road at Ystrad to the west and the A4233 East Road at Tylorstown to the east.

1.5 SUBMITTED DOCUMENTATION

As part of the application, the following documents were submitted:

- Pre-App Application Form
- 30603-HYD-XX-XX-RP-GE-1003-S2_P1 ISSUE
- Yellow Sub Penrhys SI Report
- 30603-HYD-XX-XX-DR-C-0600 - Drainage Survey Scope
- 30603-HYD-XX-XX-RP-C-0001 P02
- 30603-HYD-XX-XX-TN-C-0001 P01 - Site Walkover Note
- 30603-HYD-XX-XX-TN-C-0002 Follow up site investigation
- Location Plan
- Penrhys Design Code (On Screen)
- Penrhys Strategy Summary Report (Interactive)
- TR4592-01-UG
- 21948_A_1to500@A0_(1of9)
- 21948_A_1to500@A0_(2of9)
- 21948_A_1to500@A0_(3of9)
- 21948_A_1to500@A0_(4of9)
- 21948_A_1to500@A0_(5of9)
- 21948_A_1to500@A0_(6of9)
- 21948_A_1to500@A0_(7of9)
- 21948_A_1to500@A0_(8of9)
- 21948_A_1to500@A0_(9of9)

2 SITE APPRAISAL

2.1 SUSTAINABLE DRAINAGE APPLICATION HISTORY

No sustainable drainage application has previously been submitted within the boundary of the development.

2.2 EXISTING SITE USE

The land is currently occupied by the existing Penrhys development which comprises of demolished land, houses, adoptable road, church, public house, school, allotments, commercial buildings (shops) and landscaped areas.

Whilst not formally detailed by Hydrock, the existing surface water scoping report details the following to currently be present on site:

- Housing estate of approximately 300 homes – this was over 900 previously but over the past few decades, demolition of houses has been undertaken.
- Llanfair Uniting Church
- Penrhys Primary School
- Penrhys Children and Family Centre
- Penrhys Cemetery

The site is bounded by fields to the east and west, and forestry to the north. Access to the site is only via the roundabout on Penrhys Road to the south.

2.3 EXISTING SITE DRAINAGE

As noted above, the site currently comprises of a mixture of land uses and as requested, the applicant has commenced considering the existing drainage arrangement on site.

It is noted that there is a significant fall from the top of the site to the bottom with top of site being 350mAOD and the lowest section being approximately 290m AOD, which results in an average gradient of 1 in 8.

As noted above, the land is a variety of mixture uses and therefore there are a variety of surface water drainage systems. It is acknowledged that a number of areas are subject to further survey and investigation work to establish how runoff drains and to where. Walkovers and assessments have been undertaken by Hydrock which are shown on drawing 30603-HYD-XX-XX-DR-C-0600 - Drainage Survey Scope, two walkover summary documents (30603-HYD-XX-XX-TN-C-0001 P01 - Site Walkover Note and 30603-HYD-XX-XX-TN-C-0002 Follow up site investigation) as well as an Existing Drainage Infrastructure Review document (reference: 30603-HYD-XX-XX-RP-C-0001 – P02).

It is worth noting that a significant portion of the DCWW network on site is foul which suggests that the highway and roof drainage likely conveys to a surface water system rather than the DCWW network.

During the walkover of the site, Hydrock identified a number of instances where manholes were close together, which is usually a suggestion of dedicated foul and surface water system (one manhole serving each system). The route and destination of these culverts has not been established, but it is currently assumed by Hydrock that they discharge to the nearby culverts.

Properties – As noted above, there seemingly is a number of separate surface water drainage systems (away from the foul network) and therefore it would have been reasonable to assume drainage from the plots convey to this system. However, a walkover and assessment has identified a number of properties which informally drain to ground with the following noted “Runoff is often informally discharged to ground locally at many of the buildings (e.g. downpipes from roofs outlet onto the ground adjacent). Where this is to hardstanding it is considered to reach the highway drainage collection features via overland runoff”. No direct connection from properties to surface water system on highway was identified, but subject to further investigation and survey work.

Highways - All of the adopted highway drains via gullies with dedicated lines running along each of the roads. Whilst not all roads have been investigated as well as the route and outfall of the lines established, the route of the system seems to convey towards the lower levels of the site (roundabout) or to the culverted watercourses, but no outfall and destination has been established.

It is noted that given the lack of positive connections from properties and the highway, that a soakaway system has not been discounted, albeit it is unlikely given the watercourses in the area and steep topography of the site.

It is noted that a site walkover from the applicant has identified an area of which overland flow from an embankment to the north-east of the site is emanating onto the highway, but being collected by a highway gully.

2.4 Flood Risk Review

Following a review of the Development Advice Map, it was found that the site does not lie within a Tan15 C1 or C2 zone and is in fact within Flood Zone A which is categorise as little or no rusk of fluvial flooding.

The risk of surface water flooding has been investigated utilising Natural Resources Wales' Flood Risk Assessment Wales maps. The results of which have identified that the majority of the site is either at no risk or at low risk to flooding. However, there are localised pockets which are likely depressions or areas where the overland flow route is obstructed. There is one conveyance route which flows through the site which originates from a watercourse situated north of the site boundary (but ultimately drains to culvert inlet 1).

Figure 1. Areas of Medium and High Surface Water Flood Risk at the proposed site, as per NRW Flood Risk Assessment maps.

2.5 Environmental Impact Assessment

The applicant has not stated as to whether the proposed development does require an environmental impact assessment.

Should it be subject to an EiA, the determination period for the full application will be 12 weeks once the application is determined as validly made.

If the proposed development does not require an environmental impact assessment, the determination period for the full application will be 7 weeks once the application is determined as validly made.

2.6 Ordinary Watercourse Consents

Since the Lead Local Flood Authority became responsible for authorising ordinary watercourse consents (OWC) in 2012, no OWC have been authorised within the boundary of the site.

2.7 Dwr Cymru Welsh Water Apparatus

Following a review of the Dwr Cymru Welsh Water (DCWW) GeoWeb, DCWW apparatus was identified within the site boundary comprising of foul, combined and surface water.

The existing development is served by dedicated public foul sewers, all vitrified clay ranging in size from 100mm diameter to 225mm diameter as it is further downstream.

It is noted that there are areas to the north and east shown without foul sewers recorded, and the applicant notes that these may have been removed as part of the demolition of the previous buildings in these areas or at the very least are no longer active if they remain and therefore are not recorded by DCWW.

There is a small number of dedicated surface water sewers recorded within the south west corner of the site to the properties situated between Heol Mair and Heol Dyfed. These are also vitrified clay pipes and 150mm diameter in size. There are no other dedicated public surface water sewers recorded within the boundary of the site.

A vitrified clay combined public sewer conveys flows south west along Heol Pendyrus in the south east of the site, ranging from 150mm diameter to 225mm diameter as it converges with the sewer situated within Penrhys Road (B4512).

2.8 Ordinary Watercourses

A number of unnamed ordinary watercourses lie within the boundary of the site.

This comprises of a number of inlets that convey under the adoptable highway. Inlets are noted at the following locations. For ease, the reference detailed on drawing “drainage survey scope” for each culvert inlet has been replicated in this report.

Culvert inlet 1 – approx. 300102E, 195089N. The LLFA don’t hold any record of this culvert. The route is shown to convey along the highway Heol Pendyrus before conveying under landscaped areas and along footpath/lane adjacent properties with it coming back onto Heol Pendyrus with further survey work to be completed to ascertain route and condition.

Culvert inlet 2 – 300256E, 195131N. The LLFA don’t hold any record of this culvert. The route is shown to convey firstly along the highway Heol Pendyrus and then along Heol-Y-Waun before crossing east of properties and subsequently along footpath/lane to the rear and conveying south of Heol Pendyrus with further survey work to be completed to ascertain route and condition.

Culvert inlet 3 – 300448E, 195260N. Whilst the LLFA hold the record of this inlet, the route is unknown. The drainage scope drawing shows this conveys along the road (Heol Pendyrus) that traverses along the eastern boundary, but route is then unconfirmed and with further survey work to be completed to ascertain route and condition.

All watercourses convey in a southerly direction, but outfalls of each are not currently proven and were not established during a walkover of the site. As such, further investigation and survey work is required to ascertain route and destination.

2.9 Main River

No main river lies within the boundary of the site.

The Afon Rhondda Fach is located to the east of the site and the Afon Rhondda is located to the west of the site. However, both are a considerable distance and much lower level.

2.10 ASSETS

As noted in the ordinary watercourse section, there is one known land drainage asset situated within the boundary of the site which is a culvert inlet in the north-east extent of the site.

In addition to the culverts, the applicant has also scoped out and identified a vast extent of highway drainage. It has been identified a number of lines connect to one of the three culverts identified, however, the diameter of these lines and details of the manholes are not detailed. Also, there are other lines where the destination has not been ascertained and are detailed for further survey work.

3 VALIDITY OF APPLICATION

3.1 REQUIREMENTS FOR A FULL APPLICATION

Paragraph 9 (2) of schedule 3 states that an application must be in any form required by the Approving Body. Within Regulations 'The Sustainable Drainage (Approval and Adoption Procedure) (Wales) Regulations 2018', regulation 3 states that an approving body may refuse to determine an application for approval which is not made in accordance with Paragraph 9(2) of Schedule 3.

The table below summarises the general documentation determined to be the minimum required to constitute a valid application, based on the development proposed. Table A and Table B found within the "Guidance on completing the full application form" has been utilised to determine the required documentation for a validly made application.

It is recommended that the applicant considers Table A and Table B prior to submitting a full application to the SuDS Approval Body (SAB). Supporting documentation required for each of the standards is stated and discussed in chapter 5 "compliance with National Standards" of this report.

Please note that where insufficient detail has been found on a drawing, that documentation has been determined to not be provided.

The SAB application form must be completed in full.

Table 1. General documentation required for the Full Application

Criteria	Information/ documentation	Provided (Y/N)	Required? (Y/N)
A Site Plan	Construction area extent (1:2500 scale)	N	Y
	Extent of Drainage system	N	Y
	Location Plan	N	Y
General documentation	EIA Statement	N	Y
	Drawing Issue Sheet	N	Y

3.2 CONSTRUCTION AREA AND ASSOCIATED FEE

An applicant must pay the correct fee in order for the application to constitute as a valid application. Each full application will be charged by the SAB in accordance with the regulations i.e. the application fee is related to the construction area of the proposed development. A review has been undertaken regarding the construction area and an estimate can be found in the table below.

Table 2. Required Fee based on an estimation of the Construction Area

Criteria	Estimated construction area (m^2)	Required Fee (£)	Comments
Application fee	338,500	4640	Applicant needs to define construction area.

It is of note that the Application fee does not need to be provided to the SAB until the SAB has confirmed the validity of the application. Please visit the below webpage address which states the process of submission and validation for a full application.

Web Link - www.rctcbc.gov.uk/sustainabledrainage

It is of note that the site is to comprise of a number of phases, and therefore the fee above is unlikely to be relevant. A separate application fee is to be required for individual phases, should they be submitted separately.

4 ADOPTION

4.1 REQUIREMENT FOR ADOPTION

The development is in very early stages, and therefore it is difficult to provide comment on the requirement for adoption.

It is acknowledged that the development will comprise of a mixture of many land uses, and therefore providing advice on the requirement for adoption is difficult at this stage.

For clarity, where the SuDS proposed are designed to provide drainage for a single property as defined by Regulation 9 of The Sustainable Drainage (Approval and Adoption Procedure) (Wales) Regulations 2018, **the SAB does not have a mandatory duty to adopt** as per the exemption detailed in paragraph 18 (1) and (2) of Schedule 3 of the Flood and Water Management Act 2010. This could be where the housing association maintains ownership of a number of the properties and drainage serves these or where drainage only serves one plot.

Where the SuDS proposed are designed to provide drainage for more than one property as defined by Regulation 9 of The Sustainable Drainage (Approval and Adoption Procedure) (Wales) Regulations 2018, **the SAB has a mandatory duty to adopt** provided the applicant satisfies the conditions detailed in paragraph 17 (3) of Schedule 3 of the Flood and Water Management Act 2010.

Should Trivallis not maintain ownership of the properties, then drainage that serves more than one plot, irrespective of whether the drainage lies within private curtilage will be subject to the mandatory duty to adopt.

Where drainage serves both properties and the adopted highway, irrespective of whether the housing association maintains ownership of the properties, the drainage will be subject to the mandatory duty to adopt, at the point at which the system drains both.

5 COMPLIANCE WITH NATIONAL STANDARDS

5.1 STANDARD S1 - SURFACE WATER RUNOFF DESTINATION

The submission has not been accompanied by any preliminary layout or proposal, and therefore it is very difficult for the SAB to provide any specific comment at this early stage. Although, a document has been provided which does outline some principles as well as the intention to drain to the surface water systems on the site.

Priority level 1 – As noted above, there is no proposal, and therefore unclear as to whether any water re-use is in fact proposed on the site.

The SAB would require water re-use at full application stage unless the applicant evidence one of the exemption criteria outlined in section G1.4 of the SuDS national standards. For example, no stresses on the DCWW water supply, or evidence that the cost of implementing such system would not considered to be cost effective.

Should the applicant evidence one of the exemption criteria, the SAB would request water butts are proposed as part of the development to maximise compliance with S1, ensuring some level of reuse is provided.

Priority level 2 – As noted above, there is no proposal, and therefore unclear as to whether infiltration is in fact proposed on the site.

The documents and application form imply that the applicant is not proposing to discharge runoff to ground as a primary method for managing runoff with the intention to utilise existing surface water connections.

As the applicant is not proposing to discharge runoff to ground as a method for managing runoff, for a lower priority destination level to be considered at full application the SAB will require the applicant suitably evidences at least one of the exemption criteria outlined in section G1.8 of the SuDS national standards and section 25.2 of the Ciria SuDS manual, which highlights the potential constraints for infiltration systems with respect to infiltration capacity, depth to groundwater, ground stability, groundwater flood risk, and protection of groundwater from contamination.

To evidence of the exemption criteria, a full GI will need to be provided. Details of the requirements to evidence the exemption criteria and constraints are provided below.

Should discharge to ground be proposed, the applicant must consider factor of safety (Table G1.1 of National Standards), proximity of infiltration to existing/proposed structures (paragraph G1.20 of National Standards), minimum depth of 1m unsaturated ground between base of infiltration structure/groundwater level (paragraph G3.32 of the National Standards) and any potential contamination mobilisation due to proposed infiltration.

As part of the submission, a geo-environmental and geo-technical report to support the regeneration has been produced by Yellow Sub Geo and provided (ref: P20217 R1) and also a phase 2 ground investigation report produced by Hydrock (*30603-HYD-XX-XX-RP-GE-1003).* These reports will be duly considered when considering each of the sections.

The phase 2 ground investigation report by Hydrock was produced following a ground investigation that has been conducted by Geo-technical Engineering Limited (GEL) between the 15th April and 10th May 2024. The investigation comprised of the following:

- 7 rotary cored boreholes
- 3 shallow machine dug trial pits (TP101, 102 and 107)
- 20 machine dug trial pits (TP201-220)
- 1 hand dug trial pit (TP106)
- 17 TRL dynamic cone penetrometer probes
- BRE365 testing in 5 trial puts (TP201, TP204, TP212, TP216 and TP219).

Wells for monitoring groundwater were installed in 7 of the boreholes and targeted both the Made ground and Rhondda Member Strata.

<u>Ground conditions identified on site</u>

Site conditions identified either topsoil or ‘general’ made ground at the surface which was underlain by the Rhondda Member bedrock, with no superficial deposits identified.

On the northern portion of the site, made ground was identified of varying depth, but in one trial pit, it was identified to a proven depth of 4.4mbgl. This ground is described as “builders rubble, brick concrete and metal’.

Where made ground was not identified, predominantly in the southern portion of the site, topsoil was encountered at the surface at an average depth of 0.35mbgl, but proven to a depth of 0.6mbgl.

Rhondda Member bedrock was identified to underly the made ground or the topsoil with a depth of 8.10mbgl proven but the actual depth of the layer was not proven. This layer was described as medium strong grey fine to medium Sandstone.

Infiltration capacity and infiltration testing:

As noted above, infiltration testing was completed at five locations, two of which in the made ground and three in the Rhondda Member. Infiltration testing in the made ground either failed (insufficient water losses to record a rate) or three cycles were not able to be completed with 1.0 x 10^{-5} m/s on the second cycle.

Infiltration rates in the Rhondda Member was also highly variable with it ranging between 8.3 x 10^{-5} and 3.3 x 10^{-6} m/s after three cycles, but of note that water intake was too quick in TP219 to identify a rate.

It is acknowledged that a number of constraints/obstructions were identified in a number of the exploratory holes.

The report summarises that the Rhondda Member may be suitable for soakaways and SuDS features. However, it is stated in the investigation report that infiltration features need to be solely in the natural strata. Although, it is noted the geo-chemical testing of the made ground did not identify exceedances of contaminants with the exception of asbestos and PAH's in places.

Please note that should the soakaway testing identify negligible infiltration rates (lower than minimum rate of 1 x 10^{-6}m/s detailed in section 25.2.1 of the Ciria SuDS manual), then the SAB will deem that the exemption criteria has been suitably evidenced. However, should suitable infiltration rates be obtained, the SAB will require one of the other exemption criteria is evidenced.

As noted above, the testing identified rates that were slower than 1 x 10^{-6}m/s with a couple of exceptions. This does imply at this stage that infiltration may not be viable in certain locations. Whilst the SAB acknowledges the above, it is of note that the position of the testing may not be relevant to the drainage design. Whilst the ground conditions seem to be relatively consistent, it is considered the number of infiltration tests conducted is not sufficient for the size of the site. At full application stage, the SAB will require evidence at full application that soakaway testing in accordance with BRE365 has been adequately covered across the site and in particularly in the exact vicinity of any infiltration system. In is considered that more specific GI is completed for each of the phases which is likely to be required from a geo-technical requirement. Testing must reflect the proposal and therefore be within the strata and ideally at the same depth so that it provides sufficient confidence that it is a true reflection of the site.

The SAB require trial pit locations and logs are provided, demonstrating testing was undertaken with a suitable methodology. Should an infiltration test fail, the SAB would expect additional trial pits are excavated to provide sufficient coverage of the site and to demonstrate the findings are reflective of the site as a whole and not just at that specific point.

It's noted as per section 25.2.1 and section 25.3 of the Ciria SuDS manual the soil log is imperative to provide confirmation that the measured infiltration capacity is representative of the wider soil mass, i.e. the Rhondda Member covers the entirety of the site, but only three places have undergone testing of which the infiltration results were variable in nature.

Groundwater contamination:

Made ground has been identified on the northern extent of the site at varying depth, and all SuDS features that allow for infiltration should be constructed within natural strata, and should also not infiltrate or partially infiltrate into any made ground (leaky system), unless it can be evidenced that this will not pose any acceptable risk of groundwater pollution. As noted previously, the made ground contamination testing was variable and only identified exceedances of PAH. Although, the areas under the buildings, boiler house etc have not been tested.

As noted previously, bedrock is underlying the topsoil or the made ground, and this is regarded as a secondary A aquifer which is "comprising of permeable layers that can support local water supplies, and may form an important source of base flow to rivers'.

As such, it is considered that where a leaky system is proposed through the made ground, an assessment for risk to groundwater as a result of the infiltration should be undertaken.

At full application, should the applicant evidence that infiltration would increase the risk of mobilisation of existing contaminants to ground, then as per section 25.2.4 of the Ciria SuDS manual the SAB would deem a lower priority destination level can be considered. However, evidence to justify the risk of contamination via infiltration should include a full GI with evidence of contaminants testing provided across several excavations with sufficient coverage of the site.

Groundwater flood risk and depth to groundwater:

As per section 25.2.2 of the Cira SuDS manual, 1m of unsaturated ground is required beneath the base of an infiltration component/any SuDS feature to ensure the performance of the feature and protecting the system from underlying groundwater.

Should this be evidenced at full application within the GI, and it is deemed unachievable to comply with the 1m separation distance, then the SAB will deem a lower priority destination level can be considered.

Upon review of the GI conducted, it is noted they encountered groundwater at a depth of 2.5mbgl at TP214, but this is the only location at which this was identified. It is considered that the water table is perched at this position, as groundwater was not encountered in any of the boreholes or pits at this depth.

In the monitoring wells, all were found to be dry during the monitoring period (17/05/2024-28/06/2024) with the exception of BH307 (in the southern area of the site) which had a groundwater strike between 2.5 and 6.99mbgl in the Rhondda Member. The report does follow up to state that is expected that the groundwater body is anticipated to be in the Rhondda Member beyond 10mbgl.

It is worth noting that the groundwater monitoring was completed in the spring months, and groundwater is subject to seasonal variation, and as such levels may vary from what identified.

In regard to whether partial infiltration is proposed (leaky system), should the proposal for partial infiltration from a feature result in a non-compliance with the 1m separation distance then the SAB request the systems that compromise the 1m separation distance are impermeably lined.

Overall, it is considered that based on the information supplied, it is likely that there will be 1m separation, whether that be via a leaky system or infiltration system, but of course this is dependent on the depth of the system proposed.

Ground stability:

As per section 25.2.3 of the Ciria SuDS manual, an assessment should be undertaken as to the geotechnical properties of the surrounding soils, to ensure that infiltration will not pose an unacceptable risk of instability/geohazard to the site and/or local area. Should the applicant provide evidence via a geotechnical engineer that infiltration on site may increase the risk of instability to any existing or proposed structures, then the SAB will deem a lower priority destination level can be considered.

Therefore, at full application should further assessment/statement be provided via a geotechnical engineer/engineering geologist that infiltration on site may increase the risk of instability/geohazard to any existing or proposed structures, then the SAB will deem a lower priority destination level can be considered on the basis that infiltration as a method for managing runoff would increase the risk of instability to structures.

The report completed by Yellow Sub Geo considered the mine working in the vicinity of the site and concluded that worked coal seams are at a considerable depth below and are too deep to materially impact the regeneration project. The risks of coal mining are likely to be limited to the south-west of the site. The Ground investigation report from Hydrock discusses mining in its report, and chapter 2.5 states that the site lies within a coal mining report area, but lies outside the coal authorities development high risk area. A report from the Coal Authorities advised there was no known shallow working of the No2 Rhondda and Two Ft Nine coal seams which run 181m and 402m below ground, respectively. This aligns with the summary provided within the Yellow Sub Geo report.

Therefore, at this stage, the applicant has not provided justification in regards to stability to discount infiltration into the Rhondda Member, or alternatively has not adequately assessed the impact of such concentrated or partial infiltration.

Should the features be permeably lined, the SAB requires clarification that partial infiltration on site will not increase the risk of instability to any existing or proposed structures. Should instability risks be identified then the SAB will request all SuDS features within 5m of structures are to be impermeably lined. The SAB notes this will reduce the level of interception offered by the features, however the SAB will deem interception has been provided as far as practically possible should the features need to be lined due to the risk of instability.

The ground investigation report by Hydrock refers to slope stability and states that retaining walls and earthworks will be implemented to re-create the previous flat plateaus, but at this time, no formal slope stability assessment is deemed necessary at this time but is to be reviewed at a later date. Given there is no layout or drainage layout, the SAB is unable to comment in regard to proximity to structures. However, please be aware of proximity of infiltration to existing/proposed structures (paragraph G1.20 of National Standards). Given the steep slopes on site, it is envisaged that retaining structures are likely to be constructed to facilitate the site works. It is requested that any SuDS structures in proximity to this are duly considered in terms of impact of infiltration, and lined should it be found to present stability issues.

With regards to instability, section 25.2.3 of the Ciria SuDS manual states small scale-infiltration (such as proposed for the raingardens) closer than 5m should follow the guidance provided in Susdrain.org. The advice states SuDS features close to buildings should be designed with an impermeable area to base permeable area ratio not exceeding 1:10 and the depth of the stored water should not exceed 300mm.

Partial infiltration:

Should infiltration be discounted and justified in line with the exemption criteria, typically, the SAB request that all features are permeably lined, as it allows for greater losses for interception. However, the proposal for 'leaky' systems should never compromise compliance with the standards or constraints detailed in section 25.2 of the Ciria SuDS manual, complying with all relevant requirements for infiltration systems with respect to depth to groundwater, ground stability, groundwater flood risk, and protection of groundwater from contamination.

Therefore, should the applicant rule out infiltration on the basis that one of the above exemption criteria is met, for example losses to infiltration may increase the risk of instability, contamination, or 1m of unsaturated ground can't be provided beneath the base of an infiltration component, then the SAB would request all SuDS features are impermeably lined.

Please note that given the large extent of site and likely number of SuDS features, it is accepted that leaky systems might be found to be suitable in select areas of the site. Further discussion at detailed design is likely warranted.

Priority level 3 – Discharge at this level has not been stated. Whilst an open waterbody has not been identified by the SAB, the applicant will need to investigate and provide justification in line with the exemption criteria, should this not be proposed and for the design destination to move onto a lower priority level.

Priority level 4 – Whilst no formal design has been supplied with the submission, based on the narrative in the application form and within the Hydrock documents, it would seem that there is an intention to discharge to existing surface water systems which preliminary investigations identify as highway drainage systems or culverted systems (of which the highway may drain to), and therefore would be at priority level 4.

Should the priority levels above be justified adequately (as noted above), then the SAB does not necessarily disagree with the destination. However, the developer will need to establish the drainage arrangement of all areas on the site in terms of collection, conveyance and destination.

As stated previously, there are a number of surface water systems on the site and it will need to be ascertained what flows are entering the system and ensuring that post development, these systems are not impacted negatively. For example, earthworks or development may result in more areas draining to a particular culvert which can be acceptable should the flows be reduced appropriately.

Priority level 5 – There is no current intention to discharge at this priority level.

Table 3. Primary and secondary destination of surface water runoff

Priority Level	Primary destination	Secondary destination	Comments
Priority Level 1	N/A	N/A	
Priority Level 2	N/A	N/A	
Priority Level 3	N/A	N/A	
Priority Level 4	N/A	N/A	
Priority Level 5	N/A	N/A	

It is noted that the applicant intends to potentially utilise an existing connection from the site. However, should a new outfall/connection be required and subsequently proposed, then the applicant will need to obtain the relevant permissions.

*Please note that SAB approval does not provide the right to connect into a culverted watercourse. As per Paragraph G2.3 and G2.4 of the National Standards, the right to connect must be secured from the Landowner who is responsible for the receiving drainage system in which the connection is proposed.

Furthermore, the SAB approval process does not provide consent under Section 23 of the Land Drainage Act 1991 to undertake connection/ outfall works to the ordinary watercourse. This type of consent (Ordinary Watercourse Consent) is regulated by the Lead Local Flood Authority (LLFA). Under this process, the LLFA will review the connection and as to whether the additional flow of water will present an increase in flood risk by reviewing the capacity of the culvert. For more information the applicant is advised to visit RCT's Ordinary Watercourse Consent Webpage which provides Application Guidance, Culverting Policy and contact details to make an application (Section 7)*.

Please note that SAB approval does not provide the right to connect into a drainage system such as a highway drainage system. As per Paragraph G2.3 and G2.4 of the National Standards, the right to connect must be secured from the Landowner who is responsible for the receiving drainage system in which the connection is proposed. It is recommended that the Highways Development Control department are contacted regarding the proposal of runoff to connect into the existing system. Please note the HDC department will be consulted as part of the SAB full application.

It should be noted that SAB approval does not provide the right to connect into Dwr Cymru Welsh Water apparatus. The right to connect must be secured from DCWW via a section 106 agreement. It is recommended that the applicant contacts DCWW prior to the submission of the full application to establish as to whether DCWW would raise any objection to the proposed connection and associated discharge into the DCWW apparatus. Please note the DCWW will be consulted as part of the SAB full application.

In summary, the proposed design **does not include sufficient information to ascertain compliance** with Standard S1.

A likely compliance with Standard S1 can be achieved through the inclusion of the 'further information required' outlined below. However, **compliance is dependent on the quality of the information that is provided** and cannot be guaranteed without appropriate evaluation of the additional documentation.

Further information required

Please see Table 4 which summarises the documentation required to satisfy standard S1.

Whilst a ground investigation has been supplied, further ground investigation including infiltration testing in accordance with BRE365 must be completed and submitted at the full applications stage.

Should infiltration be proposed and given the steep nature of the site, a detailed geotechnical factual and interpretive report will be required at the full application stage that directly considers and assesses the drainage proposal.

Should infiltration be proposed in any of the made ground, it is considered a contaminated land report demonstrating risk of pollution to the underlying groundwater is provided at the full application stage. The GI does not currently consider the impact of concentrated or partial infiltration and its impact to the underlying groundwater.

Table 4. Documentation required to satisfy Standard S1 for the Full Application

Criteria	Information/ documentation	Provided (Y/N)	Required? (Y/N)
Standard S1	Detailed whole Site SuDS Drainage Design Proposals	N	Y
	Geotechnical factual and interpretive report	N	Y
	Permeability testing	N	Y
	Contaminated Land Report	N	Y
	Unstable land report	Y	Y

5.2 STANDARD S2 – SURFACE WATER RUNOFF HYDRAULIC CONTROL

Interception of runoff

As per section 24.8 of the Ciria SuDS manual, compliance with the interception criteria should differentiate between winter and summer, with the first 5mm of rainfall expected to be intercepted during 80% of summer events and 50% of winter events.

The applicant has not provided any drainage layout of the proposal and has provided very little information regarding the proposed design. Therefore, it is difficult to determine whether sufficient interception of runoff will be provided by the proposed design.

To confirm as to whether the interception criteria is met, the contributing areas to each drainage system and size and construction of systems will determine acceptability.

Please see table G2.1 of the Statutory Standards which outlines the interception provided by SuDS features. For further details, it is recommended the design considers the Ciria SuDS Manual C753.

For clarity, interception is only provided where runoff drains to the surface of the features and the features themselves are designed and constructed appropriately.

The steepness of the site and constraints are duly acknowledged by the SAB, and the SAB is amicable to the interception criteria not being fully adhered to (5mm of rainfall does not need to be achieved) providing adequate justification is provided and the applicant seeks to maximise interception i.e. justification provided but no green SuDS or minimal green SuDS that offer interception would not be accepted.

Morphological protection & Flood Risk mitigation of receiving surface water bodies

The proposal does not currently detail the proposed discharge rates from the site given the destination has yet to be established.

The applicant has provided a rough assessment of the existing flows from the site based on 23ha of hardstanding area within the ring road of Heol Pendyrus. “Existing” flows of 572.4l/s and 1428.9l/s has been established for the Q2 and Q100 event, respectively. This has been calculated utilising the modified rational method, but it is noted the supporting information has not been supplied which would be required at full application stage.

Greenfield flows of 218.7l/s and 476.7l/s has been established for the Q2 and Q100 event, respectively. A Wallingford greenfield sheet has been provided showing the rate was calculated based on a greenfield area of 23ha and utilising the IH124 method. Upon review of the input parameters for IH124, the SAB raises no objection to this value. However, the SAB has not been provided any catchment plans to evidence the area and existing destination of the runoff. Furthermore, when the greenfield rate is being calculated, as per section 24.2.2 of the Ciria SuDS manual the applicant will need to ensure only the proposed impermeable area is utilised in the greenfield runoff calculations, or alternatively the remaining landscaped area of the site needs to be included in the hydraulic model (0.4 of landscaped area included as impermeable area). The SAB would request the applicant ensures the total proposed impermeable is utilised in the greenfield runoff calculations.

For areas that are currently greenfield, to ensure morphological damage to the ordinary watercourse is not envisaged and ensure compliance with paragraph G2.23 of the Statutory Standards, the SAB require the applicant mimics the existing greenfield rates. To ensure compliance with section G2.30 of the SuDS national standards in offering sufficient flood risk mitigation, the applicant needs to ensure all runoff up to the Q100+Climate change event discharges off site at the greenfield Q_{BAR}, or 2l/s/ha or mimic volume and provide long term storage, as per paragraph G2.30.

Therefore, should the applicant provide an appropriate greenfield runoff calculation and propose to restrict discharge to the greenfield Q_{BAR} identified in the greenfield calculation, the SAB will deem the applicant is compliant in offering sufficient flood risk mitigation and morphological protection to the receiving waterbody, and would be compliant with G2.23 and G2.30 of the SuDS national standards

As noted in the existing drainage section, the exact drainage collection, conveyance and destination for hardstanding areas on site has not yet been established. Whilst the SAB would seek and prefer for rates to be restricted to greenfield rate to mimic natural flows, it is acknowledged that the applicant states their intention to discharge at a 30% betterment to the existing SW systems.

As previously advised, for the applicant to base the proposed discharge rate on existing brownfield rates and utilise the impermeable area currently on site of 23ha, the existing drainage arrangement and existing catchment plan would need to be clearly shown to evidence the existing area and associated flows to each of the systems as well as proposed rate, and thus evidence a betterment will in fact be provided. The SAB would request that the existing Q1 is found and a 30% betterment applied to this. The SAB will not accept the use of the flows from the Q30 and Q100

event. The existing Q1 rate must be calculated and a 30% betterment applied to this is to be in line with paragraph G2.24 of the Statutory Standards.

Typically, for brownfield sites the SAB request an existing runoff calculation is provided as per section 24.5 of the Ciria SuDS manual.

It's noted from the applicant's submitted information that the extent of the existing drainage system is yet known but is to be established. As such, the SAB request that the applicant provides a hydraulic model of the existing drainage system. Detailing the existing discharge rate for each network on site draining the existing impermeable area that is to be developed and is to drain to the proposed system. This will need to be supported by an existing area plan.

Of note is that it is recognised existing drainage systems are likely to become overwhelmed during the 1:30 and 1:100 rear return periods, and therefore the actual site discharge rate from the site is likely to be increased from overland flow contributions or surcharging. However, as per Ciria these effects should be discounted and the discharge limit should be based solely on the flow rate from the piped system, ensuring a conservative estimate is provided.

As per section 24.5 of the Ciria SuDS manual, peak flows for an existing drainage system can be demonstrated for the low, medium and high storm return period events, producing an accurate representation of the proposed drainage system.

An alternate method for identifying existing flows should only be utilised when the extent of the existing drainage system is unknown, or is not in reasonably working order, however this appears unlikely to be the case in this instance. This method should consist of modelling the total proposed impermeable area as greenfield area response from impermeable soils.

The site is a mixture of both greenfield (including demolished areas) as well as brownfield, and therefore the applicant must evidence the existing flows that would discharge to the existing surface water systems. The SAB would accept a rate that is based on both the greenfield and brownfield rate, providing both have been accurately calculated.

It is was noted in the existing drainage section that roof drainage informally drains with no positive connection. It is believed that unless it can be evidenced the flows will in fact drain to the positive system (i.e. onto hardstanding and then onto the highway) then it shouldn't be considered as existing flows as in reality those flows would not

drain to the system. As such considering the flows could in fact result in increased flows.

It is acknowledged that a significant portion of the site is demolished and has been for a while. The applicant has evidenced the site history in terms of plot occupation and subsequent demolition over time. However, the SAB consider the site in its current form and the associated flows that emanate to the surface water drainage system. The SAB does however acknowledge that demolished area would unlikely reflect greenfield i.e. due to underlying slabs etc, and thus SAB would be open to a value between greenfield and 100% hardstanding. The applicant must assess the conditions and propose a suitable value with adequate justification.

In summary, the agent must ascertain the existing flows to the culvert and utilise this to decipher an appropriate rate.

In addition, the site will be split into phases and the existing drainage arrangements for each of the phases as well as the current and proposed discharge rates will need to be established. It is unlikely to be accepted that storage and restriction to be provided by a later phase as each phase must be compliant with the standards (should they be submitted individually). Individual phase submitted separately will be treated as standalone developments as it results in a risk of a later phase not being submitted and thus increased flows from the site. However, should phases be submitted together, then it can be accepted as it falls under one approval and if a later phase is not built, then the SAB can enforce to ensure that an overall rate is achieved. As such, the applicant must establish the existing drainage arrangements as well as the respective rate and volume for each ‘phase area’ in order for the SAB to establish that the works will not result in increased downstream flood risk as a result of the works.

Flood Protection for the site

At the drainage strategy review stage, hydraulic models are not reviewed. The applicant has not provided any drainage layout of the proposal and has provided very little information in regard to the proposed design.

At the full application stage, the applicant must demonstrate that the drainage system can successfully infiltrate to ground or/and restrict the runoff to an acceptable discharge rate whilst also accommodating the Q100 plus climate change (CC - the SAB requires 40% be implemented for CC) event in line with the principal criteria detailed in paragraph G2.34 of the Statutory Standards. The SAB note all proposed impermeable areas of the site will need to be considered in the hydraulic model.

For clarity, where storage is proposed to be provided by a SuDS feature, the engineering layout or construction detail must provide all relevant details in terms of areas, depth, invert and surface level, slope, material specification etc.

Detailed manhole schedule is required to determine all invert and cover levels align with the calculations.

Surface levels of rain gardens must be provided as well as slope (should it not be flat).

An appropriate allowance of 40% for climate change will need to be incorporated into the proposed hydraulic model.

The applicant has not noted that urban creep will not be incorporated into the model. Should it not be incorporated, adequate justification will be required.

Contributing areas to each node must reflect a contributing area plan showing the areas i.e. roof drainage will likely be split into a variety of catchments and this must be reflected.

At full application stage, a full network model is required, with the supporting information evidencing inputs are appropriate. The network model will need to be accompanied by detailed construction details, an engineering layout, contributing area plan, manhole schedule, and cross section and long section drawings where appropriate. The SAB require the cover and invert levels across the storage features are detailed, and also request the locality, dimensions, and surface and formation gradients for all storage features are provided. The SAB also request the locality of the downpipes is clearly detailed.

A further important consideration is that the drainage proposal should take into account the potential for runoff which might flow onto the site during an extreme event up the Q100 event as per paragraph G2.33 of the Statutory Standards. As such, it is considered the designer should review the proposed levels on site and ensure that the development is resilient to the influx of floodwater and exceedance flows. Furthermore, SuDS features should be designed around this exceedance flow to ensure it can perform as designed without the concern of floodwater entering the system and impacting the hydraulic performance of the proposed SuDS and potentially decreasing the available storage.

Extreme event exceedance management of surface water runoff

The drainage strategy does not consider this element at this early stage. At the full application stage, the applicant must demonstrate via a flow exceedance plan the flow routes of runoff during an exceedance event.

Evaluation of impact of potential failure of a drainage system

The drainage strategy does not consider this element at this early stage. At the full application stage, the applicant must assess the potential failure of the drainage system such as blockage of a flow control and incorporate mechanisms to alleviate the impact of such event.

The SAB will require at full application the applicant proposes an overflow above the max designed water level in system for Q100+40% cc event in any flow control chamber implemented in the design. The level of overflow and mechanism will need to be clearly detailed.

The SAB will also require overflows are proposed in the bioretention areas. The SAB will require the applicant evidences the location of each overflow within the bioretention areas, while also demonstrating the surface gradients of the features, to ensure the overflow is positioned appropriately. Should any surface gradients be proposed for the bioretention areas, then the SAB request the applicant positions the overflow at the low point of the features.

In summary, the proposed design **does not include sufficient information to ascertain compliance** with Standard S2.

A likely compliance with Standard S2 can be achieved through the inclusion of the ‘further information required’ outlined below. However, **compliance is dependent on the quality of the information that is provided** and cannot be guaranteed without appropriate evaluation of the additional documentation.

Further information required

Please see table 5 which summarises the documentation required to satisfy standard S2.

At the full application stage, an engineering layout which includes levels, gradients, locality and storage is required. Furthermore, detailed hydraulic calculations will be required to demonstrate the hydraulic suitability of the proposed drainage system. The

hydraulic calculations will have to demonstrate that the proposed drainage system can accommodate the Q100 plus climate change event, whilst successfully infiltrating to ground/ restricting runoff to the proposed rates. This will need to be accompanied by a contributing area plan that will depict the contributing areas inputted into the hydraulic calculations at each manhole.

Detailed cross sections and construction drawings will be required to demonstrate suitable design.

Table 5. Documentation required to satisfy Standard S2 for the Full Application

Criteria	Information/ documentation	Provided (Y/N)	Required? (Y/N)
Standard S2	Drainage Strategy	N	Y
	Flood Consequence Assessment	N	N
	Greenfield/ pre-development runoff	N	Y
	Hydraulic model/ storage calculations	N	Y
	Schematic Plan	N	Y
	Contributing area plan	N	Y
	Cross section drawings	N	Y
	Longitudinal section coloured drawings	N	Y
	Natural and artificial drainage catchment and sub-catchment plan	N	Y
	General engineering layout coloured drawings	N	Y

5.3 STANDARD S3 – WATER QUALITY

Whilst it is acknowledged that the development will be completed and thus likely submitted in phases, the overall proposed development will comprise of residential land uses such as dwelling, driveways, adoptable road etc as well as a variety of other uses such as commercial, tourism, educational, leisure, open space, energy which could include bike trails, play areas, shops, new school, community centre, visitor centre, energy infrastructure etc (a number of uses also).

At this stage, whilst there is “vision and principles” section with the scoping of the development, each of the land uses as well as extent is not currently established, and therefore, for ease, the table from Ciria which outlines land uses, and their associated pollution is provided below. It is recommended that a SAB pre-application is submitted for each phase with the intended site layout as well as drainage layout in order for the SAB to provide identify each of the land uses and ultimately provide clarity on the associated pollution hazard level, and associated pollutants, as well as the subsequent treatment provided. To be clear, all areas of hardstanding that are subject to use, including solar farms, pedestrian footpaths etc will be required to undergo treatment prior to discharge to either ground or surface waterbody.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.9[2]	0.8[2]	0.9[2]

Notes
1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).
2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

Where a site land use falls outside the defined categories, the indices should be adopted (and agreed with the drainage approving body) or else the more detailed risk assessment method should be adopted.
Where nutrient or bacteria and pathogen removal is important for a particular receiving water, equivalent indices should be developed for these pollutants (if acceptable to the drainage approving body) or the risk assessment method adopted.

Figure 3. Table 26.2 extracted from Ciria SuDS Manual C753

For clarity, it is considered at this stage that the main access road to the site as well as any spine road will be of medium pollution hazard level based on traffic.

The applicant has not provided any drainage layout of the proposal, and has provided very little information in regards to the proposed design. Therefore, the SAB are limited in what can be reviewed. Given the lack of a proposal, the associated treatment requirements from the proposed SuDS will be discussed rather than the treatment provided.

Please note that treatment is only provided by SuDS where the construction is suitable and is in line with the water quality requirements set out in the Ciria SuDS Manual. For example, should a bioretention area be proposed, then it must adhere to the following requirements:

- The area of each raingarden/swale and it's contributing area, to determine if the features are appropriately sized.

- Additionally, for the SAB to determine whether sufficient levels of treatment of runoff are to be provided by the bioretention areas, the SAB require further information as to how runoff will convey to the features. For treatment to be offered, it is required that runoff is conveyed to the features at surface level. While it is assumed this is proposed, it is currently unclear.

- The SAB will also require further information as to the surface gradient of the features. The desirable gradient is either horizontal or as close to horizontal as possible, to ensure flow is evenly distributed across the surface of the feature and for treatment of runoff to be maximised.

- Should any gradient be proposed, the SAB request that check dams are installed along the features to ensure that the full area of the features is utilised for treatment of small events and ensuring that erosion of the surface and subsequent sedimentation is less likely to occur, with flow more evenly distributed across the surface of the feature.

- The SAB will also require the applicant evidences the location of each overflow within the features on plan, to ensure the overflow is positioned appropriately. Should any surface gradients be proposed then the SAB request the applicant positions the overflow at the low point of the feature and incorporates appropriate interception mechanisms so the overflow doesn't constantly take effect, thus bypassing treatment of runoff.

- The SAB will also require a construction detail of the features is provided. In regard to the construction, information is required as to the depth of filter medium, hydraulic conductivity, and depth of the overflows. In regard to the hydraulic conductivity of the filter medium. The SAB require a minimum saturated hydraulic conductivity of 100mm/hr-300mm/hr is proposed to ensure the filter medium has sufficient treatment capacity. The SAB note a minimum depth of 400mm should be provided to ensure suitable design for treatment capacity, while a suitable composition in line with box 18.1 of the Ciria SuDS Manual should also be proposed.

It is acknowledged that permeable paving may be utilised by the applicant to drain private or shared driveways. Should this be the case, the SAB advice the following:

- As per section 20.6 of the Cira SuDS manual, the majority of treatment and pollutant removal from permeable/porous surfacing occurs in the upper surface layers. The design of permeable/porous surfacing should ensure that the surface layer has sufficiently small voids to trap silt within the upper 30mm of the surface, and therefore a jointing material consisting of 2/6.3mm should be utilised to meet this requirement for permeable surfacing, while this requirement is also met by suitably designed porous asphalt, and other forms of permeable surfacing with appropriate design.

- Therefore, should the features consist of suitably designed porous/permeable surfacing, then providing the features don't exceed an impermeable: permeable ratio of 2:1, then the SAB would deem sufficient treatment of runoff would be provided for the parking/driveway areas.

- However, should macro pervious surfacing be proposed, then the SAB will deem sufficient treatment of runoff from the parking areas will not be provided by the design. As the surface itself will not be permeable or porous, and as such there will be minimal treatment benefits for the parking areas via the features, as the runoff will be conveyed immediately to the subbase via the aco-gully connection. The proposed connection will offer some level of treatment, as runoff conveys to the ACO sump unit and passes through the subbase towards the outlet, however the mitigation indices stated will not be offered. The SAB would instead utilise the mitigation indices provided by a filter drain, as indicative indices, however evidence would be required that this arrangement would offer sufficient treatment of runoff for the parking areas should macro-pervious paving be proposed. In this instance should macro-pervious paving be proposed further treatment of runoff would be required elsewhere.

Risk of pollution of groundwater:

As per section 25.2 of the Ciria SuDS manual, where any infiltration is proposed, an assessment is required on the risk of pollution from the mobilisation of existing contaminants, in addition to the risk of pollution to groundwater from polluted surface water runoff.

Given the applicant is proposing to permeably line the systems and allow for partial losses of runoff to ground, the SAB require evidence that the proposal will not increase the risk of mobilisation of existing contaminants to ground. As per the comments in S1, should made ground be present on site, all SuDS features should be constructed within natural strata, and should also not infiltrate or partially infiltrate into any made ground (leaky system), unless it can be evidenced that this will not pose any acceptable risk of groundwater pollution.

In summary, the proposed design **does not include sufficient information to ascertain compliance** with Standard S3.

A likely compliance with Standard S3 can be achieved through the inclusion of the 'further information required' outlined below. However, **compliance is dependent on the quality of the information that is provided** and cannot be guaranteed without appropriate evaluation of the additional documentation.

Further information required

Please see Table 6 which summarises the documentation required to satisfy standard S3.

Table 6. Documentation required to satisfy Standard S3 for the Full Application

Criteria	Information/ documentation	Provided (Y/N)	Required? (Y/N)
Standard S3	Water quality treatment and pollution prevention strategy and Plan	N	Y
	Contaminated Land Report	N	Y

5.4 STANDARD S4 – AMENITY

The applicant has not provided any drainage layout of the proposal and has provided very little information regarding the proposed design. Therefore, the SAB are limited in what can be reviewed. It is acknowledged that the planning documents supplied which scopes out the potential development as well as principles and options does reference green corridors, areas of multi-use as well as biodiversity benefits, and therefore it is being duly considered by the applicant.

It is of note that the design will be split into a number of phases, and whilst it is acknowledged that the preliminary masterplan design does include for green areas (some phases seemingly including above ground green infrastructure), it will be required that individual phases and the associated SuDS designs must include green infrastructure to ensure that all phases meet the Statutory Standards.

In summary, the proposed design **does not include sufficient information to ascertain compliance** with Standard S4.

A likely compliance with Standard S4 can be achieved through the inclusion of the 'further information required' outlined below. However, **compliance is dependent on the quality of the information that is provided** and cannot be guaranteed without appropriate evaluation of the additional documentation.

Further information required

At full application stage the applicant must evidence that sufficient amenity benefit will be provided by the proposed surface water drainage system, in line with the Statutory standards. This must be demonstrated via an amenity plan and landscape layout drawing.

Please see Table 7 which summarises the documentation required to satisfy standard S4.

Table 7. Documentation required to satisfy Standard S4 for the Full Application

Criteria	Information/ documentation	Provided (Y/N)	Required? (Y/N)
Standard S4	Amenity Plan	N	Y
	Landscape Plan	N	Y
	Landscape Layout drawings	N	Y

5.5 STANDARD S5 – BIODIVERSITY

The applicant has not provided any drainage layout of the proposal, and has provided very little information in regards to the proposed design. Therefore, the SAB are limited in what can be reviewed. It is acknowledged that the planning documents supplied which scopes out the development does reference green corridors, areas of multi-use as well as biodiversity benefits, and therefore it is being duly considered by the applicant.

The applicant has not provided proposed SuDS landscaping proposals at this stage and as such this could not be reviewed. This will be required at full application stage and will be reviewed by RCT's ecologists.

It is of note that the design will be split into a number of phases, and whilst it is acknowledged that the preliminary masterplan design does include for green areas (some phases seemingly including above ground green infrastructure), it will be required that individual phases and the associated SuDS designs must include green infrastructure to ensure that all phases meet the Statutory Standards.

In summary, the proposed design **does not include sufficient information to ascertain compliance** with Standard S5.

A likely compliance with Standard S5 can be achieved through the inclusion of the 'further information required' outlined below. However, **compliance is dependent on the quality of the information that is provided** and cannot be guaranteed without appropriate evaluation of the additional documentation.

Further information required

At full application stage the applicant must evidence that sufficient biodiversity benefits will be provided by the proposed surface water drainage system, in line with the Statutory standards. Furthermore, planning arrangements must be detailed to ensure suitable plant species. This must be demonstrated via a biodiversity plan and landscape layout drawing.

Please see table 8 which summarises the documentation required to satisfy standard S5.

Table 8. Documentation required to satisfy Standard S5 for the Full Application

Criteria	Information/ documentation	Provided (Y/N)	Required? (Y/N)
Standard S5	Biodiversity Plan	N	Y
	Landscape Plan	N	Y
	Landscape Layout drawings	N	Y

5.6 Standard S6 – Design of Drainage for Construction, Maintenance and Structural Integrity

At this stage the applicant has provided very little information relative to standard S6, therefore, this standard cannot be properly reviewed by the SAB.

Due to the nature of the development, at full application the SAB will require a construction management plan is provided detailing how the SuDS features will be constructed, ensuring sufficient protection of the features during the construction phase.

Adoption: The SAB require a statement that the proposed dwellings and parking areas will remain under one ownership for the lifetime of the development. Should this be the case, given the proposed access road is to be adopted by RCTCBC Highways, any proposed surface water drainage which drains both the highway & the residential areas will by definition be serving more than one curtilage and thus will require mandatory adoption by the SAB. As such, a list/quantities of the proposed adoptable surface water drainage will be required at full application stage in order for the SAB to calculate the commuted sum.

Alternatively, should the plots be sold individually then any drainage which serves more than one property will be subject to mandatory adoption by the SAB. As such, a list/quantities of the proposed adoptable surface water drainage will be required at full application stage in order for the SAB to calculate the commuted sum.

Given the mandatory duty to adopt for the SAB likely applies, an adoption plan will be required at the full application stage at the point of submission. An adoption plan is a plan that details the Developer's Land edged red, the adoptable SUDS coloured blue, non-adoptable drainage orange and any Easement Strip edged green for ease to pass onto RCTCBC legal department.

It should be noted given the proposed access road is to be adopted by RCTCBC HDC, that adoption will be subject to the proposed access road meeting HDC's design requirements, with works being completed to an adoptable standard. RCTCBC HDC will be consulted at full application stage for comment.

At the full application stage, the applicant must provide a suitable maintenance plan that details appropriate schedules and demonstrates ease of access to all elements of the drainage system. The schedules must be in accordance with the schedules outlined in the Ciria SuDS manual. It's noted the applicant has provided some schedules within a table in the drainage methodology, however these schedules do

not cover all SuDS features and are not in accordance with Ciria Guidance. The schedules must also be detailed within a maintenance plan. To note it is particularly prevalent for a schedule to be provided for the flow control chambers.

Furthermore, the design life of all elements of the drainage system must be considered, and should it be less than the design life of the development, a replacement must be incorporated into the maintenance schedule as per paragraph G6.17 of the Statutory Standards.

The SAB will also request at full application that the applicant provides clarification within the maintenance plan regarding as to who will be responsible for funding the maintenance of the proposed SuDS features. The cost of maintenance will also need to be clearly detailed. The maintenance plan should also clearly detail the design intent, how the SuDS features work and their purpose and potential performance risks.

All elements of the drainage system will require free and easy access. In particular, access will need to be particularly evidenced to the storage, flow control chambers etc. All adoptable drainage will require easement and appropriate forms of access for the relevant plant.

As a fundamental principle of the Statutory Standards, there must be no requirement for pumping and the entirety of the drainage system should drain via gravity.

Although unclear it appears the drainage proposal includes predominantly underground infrastructure, and therefore issues cannot be identified at the surface which is a fundamental principle of the Statutory Standards.

At the full application stage, full construction details will be required of all drainage elements including the flow control chambers. SuDS should be designed in accordance with best practice such as Ciria SuDS Manual and suitable specification of material.

Of particular note is the proposal for permeable surfacing. Given the traffic loads on the car parking area, a suitable depth of sub-base and capping layer should be proposed depending on the Californian Bearing Ratio (CBR).

An important further consideration to the SAB is the amount of runoff that will drain to the permeable parking spaces from the hardstanding area if any. It is recommended that the ratio of impermeable to permeable should not be greater than 2:1 due to the increased risk of clogging. The SAB is currently unable to provide advice regarding

this as the specific area of permeable surfacing and hardstanding that may drain to it has not been provided.

Whilst Dwr Cymru Welsh Water have not been consulted as part of the pre-application, on previous sites, they have stated the following regarding the interaction of permeable systems and their adoptable assets “Service strips within permeable paved areas apply for all adoptable drainage, so any pipe that is conveying flows of more than one property, or a single property carrier pipe that leave the curtilage of a property (lateral)”. It is also noted DCWW will not accept any SuDS structure crossing or overlying their existing or any proposed adoptable infrastructure. It was noted in the desktop review that a number of DCWW foul and combined sewers were present. It is unclear as to whether these will be kept or replaced, and as an advisory, DCWW have requested an easement of 3m either side of the centre line on previous applications. It is recommended that DCWW are contacted for advice prior to the SAB full application.

In summary, the proposed design **does not include sufficient information to ascertain compliance** with Standard S6.

A likely compliance with Standard S6 can be achieved through the inclusion of the ‘further information required’ outlined below. However, **compliance is dependent on the quality of the information that is provided** and cannot be guaranteed without appropriate evaluation of the additional documentation.

Further information required

Please see table 9 which summarises the documentation required to satisfy standard S6.

Full construction details of all drainage will be required including specification of materials in the design to ensure appropriate construction. The associated unit costs of all drainage features and subsequent total construction cost is required in order to calculate the non-performance bond of the Sustainable Drainage System (SuDS), should one be required. Further details are required regarding the construction in terms of management and phasing to ensure a structured approach is utilised.

A Maintenance plan must be provided to ensure the SuDS will be properly maintained and can function across its entire design life. A maintenance plan must include the schedules including activity and frequency, access arrangements for each drainage feature including the flow control chamber and the responsible person to undertake the tasks for each drainage feature. Should the applicant be in any doubt regarding

whether the mandatory duty to adopt applies, then please contact the SAB prior to submitting the full application.

Given the mandatory duty to adopt for the SAB applies, an adoption plan will be required at the full application stage at the point of submission. An adoption plan is a plan that details the Developer's Land edged red, the adoptable SUDS coloured blue, non-adoptable drainage orange and any Easement Strip edged green for ease to pass onto RCTCBC legal department.

Table 9. Documentation required to satisfy Standard S6 for the Full Application

Criteria	Information/ documentation	Provided (Y/N)	Required? (Y/N)
Standard S6	Construction details (including standard details)	N	Y
	Cost of construction (to calculate non-performance bond)	N	Y
	Construction Management Plan	N	Y*
	Construction Phasing Plan	N	Y*
	Information and communications plan	N	Y
	SuDS Maintenance Plan	N	Y
	Specialist drawings	N	Y
	General engineering layout coloured drawings	N	Y
	Adoption Plan	N	Y

Please note the asterisk illustrates documentation that is required but can be conditioned as part of any approval.

6 MEETING MINUTES

6.1 MEETING ATTENDEES

- Liam Swanwick (LS) – SuDS Approval Body
- Joshua Jones (JJ) – SuDS Approval Body
- Meurig Hughes - Stantec
- Chris Dolecki (CD) – Stantec
- Louise Attwood (LA) – Trivallis
- Rachel Leigh (RL) – Trivallis

Meeting held on 14th January 2025.

6.2 SUMMARY OF DISCUSSION

- Introductions held.
- Chris shows master plan map for phase 1.
- Louise question Liam whether he is happy with the approach of doing plan in phases rather all together. Liam confirms it's no problem from a SAB perspective and Trivallis can approach however way they wish, but simply that they cannot start work for any phase without SAB approval. LS stated they would discuss ramifications of splitting phases later in the meeting.
- Meurig questions Liam's whether the application gets a written response which Liam confirms a summary report will be issued and says it's been drafted.
- Meurig says there's been a bit of a change to the drainage strategy showing the differences. Meurig also mentions rerouting culvert.
- Meurig shows the masterplan development and initial layout plan. Meurig mentions it will be quite challenging to get above ground suds.
- Chris questions whether there are any other design requirements for rerouting culvert. Liam confirms he raises no objection to re-routing as long as designs are up to standard and accessible. LS confirmed rerouting would form part of an OWC and not the SAB, and they would consider its suitability.
- Chris mentions there are opportunities to keep culvert open, which is a positive for RCT. LS found this positive and in line with the RCT culvert policy.
- Meurig questions Liam if there are any flooding issues downstream. Liam says there are no known reports of flooding or any issues on site.
- Meurig mentions the site partially being a brownfield and how's there been various demolition. Louise mentions what buildings are still currently at penrhys and the upcoming demolition.

- Meurig questions how Liam would like them to prove brownfield site and flows.
- LS stated they need to assess the existing drainage regime in terms of catchments by establishing area of greenfield area, buildings and their respective positive drainage and demolished areas and subsequently model it as recommended by Ciria.
- Chris says he will do an existing drainage model with current information.
- Meurig questions Liam whether they will need the drainage information now which Liam answers he would like the existing drainage system and regime to be established now and what goes into the system. Sab would require an understanding of the drainage system, what goes into the culvert and what the existing Q1 flow is now to the culvert in order to appropriately assess S2.
- Meurig shows Phase 1 A plan. Goes back to year 2000 to show difference in 20 years to provide evidence on the site being a greenfield/brownfield hybrid.
- Meurig questioned whether you can base the site on historically pre-demolition. LS confirmed this would not be accepted as the SAB must treat it on the existing drainage and existing flows entering the culvert.
- Liam suggests site may be a mixture of greenfield, hardstanding and demolished area, but will need to be duly evidenced by the applicant. A discussion was held on what the SAB would expect from the demolished area in terms of input for the existing flows, and LS noted that whilst the SAB acknowledges this demolished area is unlikely to be acting in the same way as a greenfield site, it would need to be assessed by the applicant in terms of flows emanating and also shown to be going to the culverted network. LS stated this would be discussed with the relevant officer.
- Liam asks for a pdf drawing from both old and new maps which he can incorporate into summary report.
- Meurig mentions bedrock which varies from half meter depth to meter depth and how the infiltration will be limited. As such, swales and bioretention system will likely be lined.
- Meurig question if there's any concerns with the suds system in the site being lined. Liam says suds may need to be lined, although will be on the applicant to assess whether partial infiltration is viable. Liam also mentions this would need to consider structural integrity of any structures. Meurig says there will be assessments to show as to why they will be lined and noted the retaining walls required due to the slope of the site. Liam responds they will take the limitation of the site into account because of steepness of the site and any structures which the SAB would not want to be impacted by infiltration or partial infiltration, but reiterated the onus is on the applicant to explain why they were not able to achieve infiltration.
- Meurig mentions how there will be phased approach to suds. Meurig also questions whether Liam would consider a couple of phases for attenuation or

whether it all must be phase 1 A. Which Liam answers explaining the sab must only treat the red line boundary given for the phase and mentions if the sab was one big application it would be possible. However, a system from a later phase could not be considered by the SAB should only phase 1A be submitted.

- Louise mentions, the lowest level where the access is phase 1 B. Louise mentions temporary groundworks across all master plan map, but is happy to do some enabling works around the parcel if that covers 1A. For example, ponds in southern part if that facilitates 1A. Louise also states they're in process of buying land outside red line boundary, will purchase or relocate their ecology and put the drainage onto that. Eastern side has challenges with landslip, western side risk of wildfire. Mentions diverting drainage system to western side to mitigate fire. Questions Liam whether they need to factor that in and how they could look into it. Liam asks if the intention of phase 1 is for discharge to go directly into culvert then into pond or pond and then culvert. Also, LS responded to the query that enabling works could only be considered if forming part of the application as the SAB can only duly consider what is supplied. Also, the timing of the phases is critical as the enabling works would need to occur at the same or immediately after. In summary, an answer cannot be given at moment. Agreed further discussed will be held going forward.
- Meurig says attenuate culverts themselves will be problematic and also mentions attenuating then discharging into culvert, which Liam says he doesn't expect them to attenuate any flows within the culverted system itself, with attenuation and restrictions purely for the surface water runoff from the development site.
- Louise mentions how NRW recently planted a lot more trees and which has blocked surrounding areas of the culvert and Meurig mentions how culvert has definitely been rerouted prior and how they would have to keep that in mind.
- Chris mentions how run off is finding its way down the track and down road. Chris mentions how in future they could propose an interception to stop flow running off down road. LS questioned whether the source of the water has been established, and it was confirmed it has not. Suggestion to find source.
- Liam questions whether any work will happen to road or will remain as is. Meurig says works will be undertaken. LS requested this is considered as exceedance flows that emanate from outside the site, but conveyance along the highway would not be objected to by the SAB.
- Meurig questions Liam whether he is happy with 100 year storm being stored underground, which Liam stated that he provides no outright objection subject to evidence that it cannot be facilitated above ground, but would prefer above ground infrastructure (fundamental principle of the Statutory Standards) but understand the limitations. Green SuDS in terms of collection and conveyance would need to be fully explored.

- Chris noted that a green corridor is proposed for the site and scope for opening the culvtered watercourse. Liam mentions a masterplan with a green corridor will help SAB justify the acceptance of underground storage for phase 1A. Which Meurig mentions a phasing diagram of the phasing culverts and catchment diagrams to be sent over, and will form part of any future submission.
- Meurig questions Liam whether anything you want to go through. Liam questions if more GI work will be coming as whilst rates were not great for infiltration, it was limited when considering the size of the site. Meurig confirmed further phase specific investigation is underway.

7 FURTHER INFORMATION

7.1 USEFUL WEBPAGES

For further information, it is recommended you visit the below webpages:

RCT SAB Pre-Application Webpage –
https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/SustainableDrainage/PreapplicationAdvice.aspx

RCT SAB Full Application Webpage –
https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/SustainableDrainage/MakeaSustainableDrainageApplication.aspx

RCT Ordinary Watercourse Consent Webpage -
https://www.rctcbc.gov.uk/EN/Business/LicencesandPermits/Otherlicences/OrdinaryWatercourseConsenting.aspx

Natural Resources Wales Environmental Permitting Website -
https://naturalresources.wales/permits-and-permissions/environmental-permits/?lang=en

Welsh Government – Sustainable Drainage Systems on new Developments -
https://gweddill.gov.wales/topics/environmentcountryside/epg/flooding/drainage/?lang=en

Susdrain Website - https://www.susdrain.org/

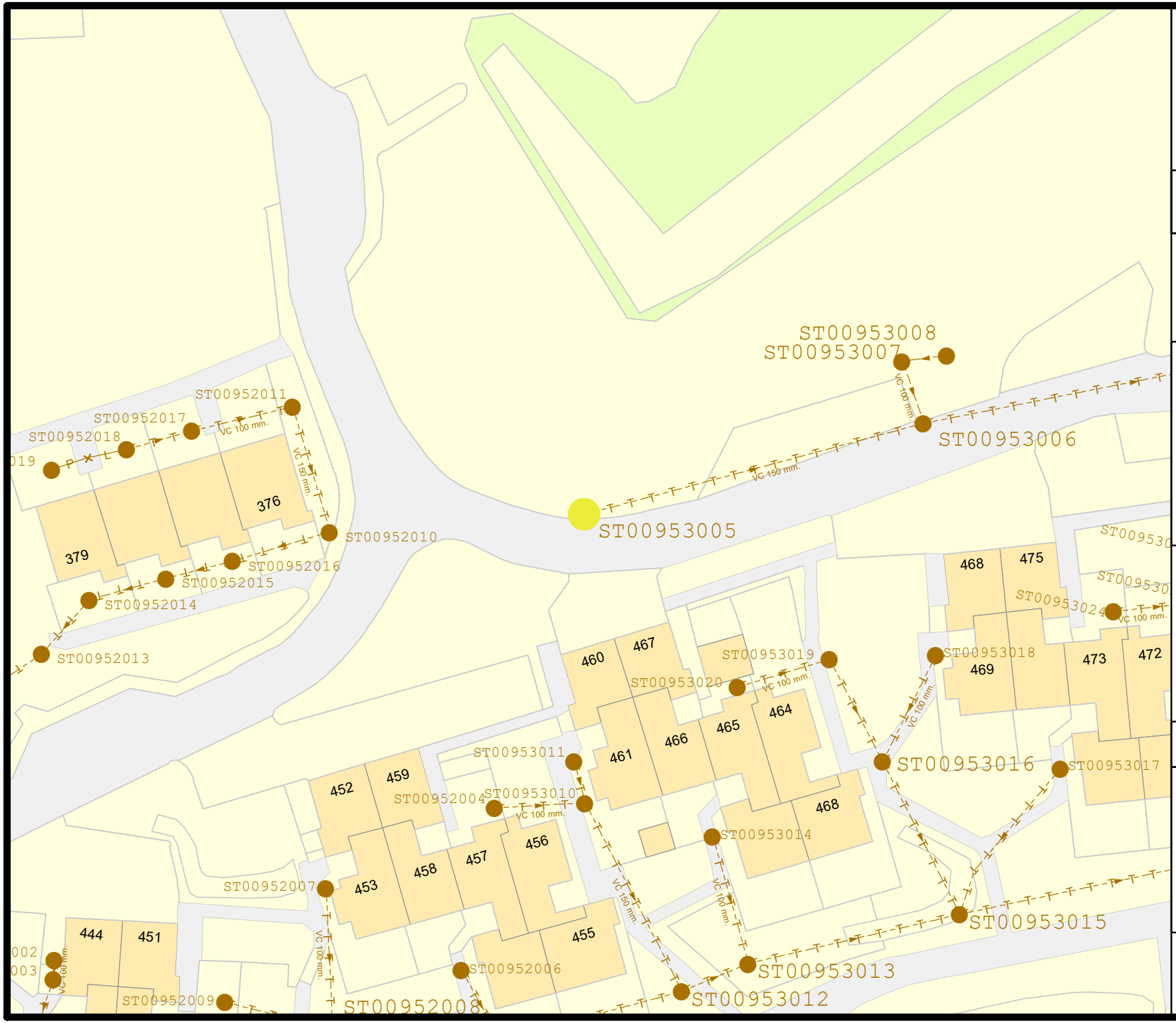
Wallingford Hydrosolutions – http://www.uksuds.com/drainage-calculation-tools/greenfield-runoff-rate- estimation

Ciria Website - https://www.ciria.org/

Dwr Cymru Welsh Water Website - https://www.dwrcymru.com/en/Developer-Services/Pre-Planning.aspx

Please note:

The advice given in this response represents an informal opinion, provided in accordance with the Council's Pre-Application Service. In particular, it is emphasised that while this pre-application advice will be carefully considered in reaching a decision or recommendation on an application, the final decision on any application that you may make can only be taken after we have consulted statutory consultees. It does not therefore prejudice any decision which the SuDS Approval Body may make should an application be submitted.



Dŵr Cymru
Welsh Water

ST00953005

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow
- Special purpose chamber
- Treatment works
- Pumping station
- Outfall
- Lamphole
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.

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

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 scale:	1:500
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PPA0009548

Conditions For Development Near Water Mains

Location: Heol Penyrus, Tylorstown, RCT
Date: 06/08/2025

The development of the site with our water main located as shown on the attached plan will involve certain conditions which must be strictly adhered to.

1. No structure is to be sited within a minimum distance of **as below** from the centre line of the pipe. The pipeline must therefore be located and marked up accurately at an early stage so that the Developer or others understand clearly the limits to which they are confined with respect to the Company's apparatus. Arrangements can be made for Company staff to trace and peg out such water mains on request of the Developer.

   6-inch CI main travelling from location XY 300268, 195115 and XY 299965, 194890, 9.1m easement (4.55m either side of main)

   4-inch CI main travelling from location XY 300292, 195057 and XY 299965, 194890, 8.9m easement (4.45m either side of main)

2. Adequate precautions are to be taken to ensure the protection of the water main during the course of site development.

3. If heavy earthmoving machinery is to be employed, then the routes to be used in moving plant around the site should be clearly indicated. Suitable ramps or other protection will need to be provided to protect the water main from heavy plant.

4. The water main is to be kept free from all temporary buildings, building material and spoil heaps etc.

5. The existing ground cover on the water main should not be increased or decreased.

6. All chambers, covers, marker posts etc. are to be preserved in their present position.

7. Access to the Company's apparatus must be maintained at all times for inspection and maintenance purposes and must not be restricted in any way as a result of the development.

8. No work is to be carried out before this Company has approved the final plans and sections.

These are general conditions only and where appropriate, will be applied in conjunction with specific terms and conditions provided with our quotation and other associated documentation relating to this development.

Dŵr Cymru
Welsh Water

PPA0009548 Sewer plan

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow
- Special purpose chamber
- Treatment works
- Pumping station
- Outfall
- Lamphole
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.

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

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:	300156,194999
Map scale:	1:2275
Printed by:	Stacey Harris
Printed on:	06 Aug 2025

Mynydd Ty'n-tyle

180 mm. HPPE 2020

6 IN. CI 1966)

6IN. CI 1966 ()

6IN. CI 1966)

4IN. CI 1966

4 IN. CI 1966)

4IN. CI 1966

6 IN. SI 1966)

6IN. CI 1966 ()

4 IN. CI 1966)

4IN. CI 1966

4IN. CI 1966

6IN. CI 1966

4 IN. CI 1966)

4IN. CI 1966

150mm. DI 1994

4IN. CI 1966

3 IN. CI 1966)

4IN. CI 1966

4IN. CI 1966 ()

6IN. CI 1966)

6 IN. SI 1966 (BI)

4 IN. CI 1966)

4IN. CI 1966 ()

6 IN. CI 1966)

6IN. CI 1966 ()

6IN. CI 1966 ()

6 IN. CI 1966)

160mm. HPPE 2014

160mm. HPPE 2014

3 IN. CI 1900)

6 IN. CI 1966)

3IN. CI 1900 ()

3IN. CI 1900

3IN. CI 1900 ()

Dŵr Cymru
Welsh Water

PPA0009548 Water plan

N
W E
S

LEGEND

Clean network:

- Sluice valve
- Pressure reducing valve
- Meter
- Bulk meter
- Hydrant (FH)
- Cap end
- Air valve
- Stop tap
- Water Treatment Works
- Water Pumping Station
- Existing main
- Non-operational main
- Raw Water

NB: Water main symbol colour indicates the type.

LIGHT BLUE - Trunk
DARK BLUE - Distribution
YELLOW - Raw Water

Notes:

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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:	300156,194999
Map scale:	1:3275
Printed by:	Stacey Harris
Printed on:	06 Aug 2025

A.6 Appendix F – Existing Drainage Works

OS NORTH

DO NOT SCALE

KEY

- PHASE 1A SITE BOUNDARY

DCWW SEWERS (POSITION CONFIRMED BY BOTH MAPPING AND GPR SURVEY) KEY

- FOUL WATER SEWER
- FOUL WATER CHAMBER
- COMBINED WATER SEWER
- COMBINED WATER CHAMBER
- PRIVATE FOUL WATER SEWER
- PRIVATE FOUL WATER CHAMBER

DCWW SEWERS (POSITION CONFIRMED GPR SURVEY ONLY) KEY

- FOUL WATER SEWER
- FOUL WATER CHAMBER

DCWW SEWERS (POSITION CONFIRMED DCWW MAPPING ONLY) KEY

- FOUL WATER SEWER
- FOUL WATER CHAMBER
- FOUL WATER FITTING
- PRIVATE FOUL WATER SEWER
- PRIVATE FOUL WATER CHAMBER
- FOUL WATER PRIVATE FITTING

SURFACE WATER DRAINAGE KEY (POSITION AND CONNECTIVITY CONFIRMED BY DRAINTECH DYE AND BANG TESTING)

- SURFACE WATER DRAINAGE
- SURFACE WATER CHAMBER

SURFACE WATER DRAINAGE KEY (POSITION CONFIRMED BY GPR)

- SURFACE WATER DRAINAGE
- SURFACE WATER CHAMBER
- SURFACE WATER GULLY
- FOUL WATER DRAINAGE
- FOUL WATER CHAMBER

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT DRAWINGS AND SPECIFICATIONS
2. ALL FIGURED LEVELS ARE IN METRES AND RELATED TO EXISTING SURVEY GRID & DATUM UNLESS NOTED OTHERWISE
3. ALL FIGURED DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE, DIMENSION ARE NOT TO BE SCALED.
4. THE DRAWING SHALL BE USED FOR THE INTENDED PURPOSE ONLY AND THIS DRAWING HAS BEEN BASED ON INFORMATION PROVIDED BY OTHER PARTIES AND STANTEC DO NOT WARRANT THE ACCURACY OF THIS INFORMATION.

REVISIONS

Rev.	Revision Notes	Date	Drawn By	Checked | Approved
P01	Issue For PAC	08/09/25	BM	SP | CD

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CLIENT: TRIVALLIS

PROJECT: PENRHYS

TITLE: EXISTING DRAINAGE - PHASE 1A

STANTEC PROJECT NO.	SCALE @ A1
333700566	1:500

STATUS DESCRIPTION	STATUS
SUITABLE FOR INFORMATION	S2

DRAWING NO.	REVISION
00566-STN-1A-XX-DR-C-0400	P01

Filename: \\A\333700566\01_WIP\DR_Drawing\C\00566-STN-1A-XX-DR-C-0400 - Phase 1A Existing Drainage.dwg

Stantec

Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

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