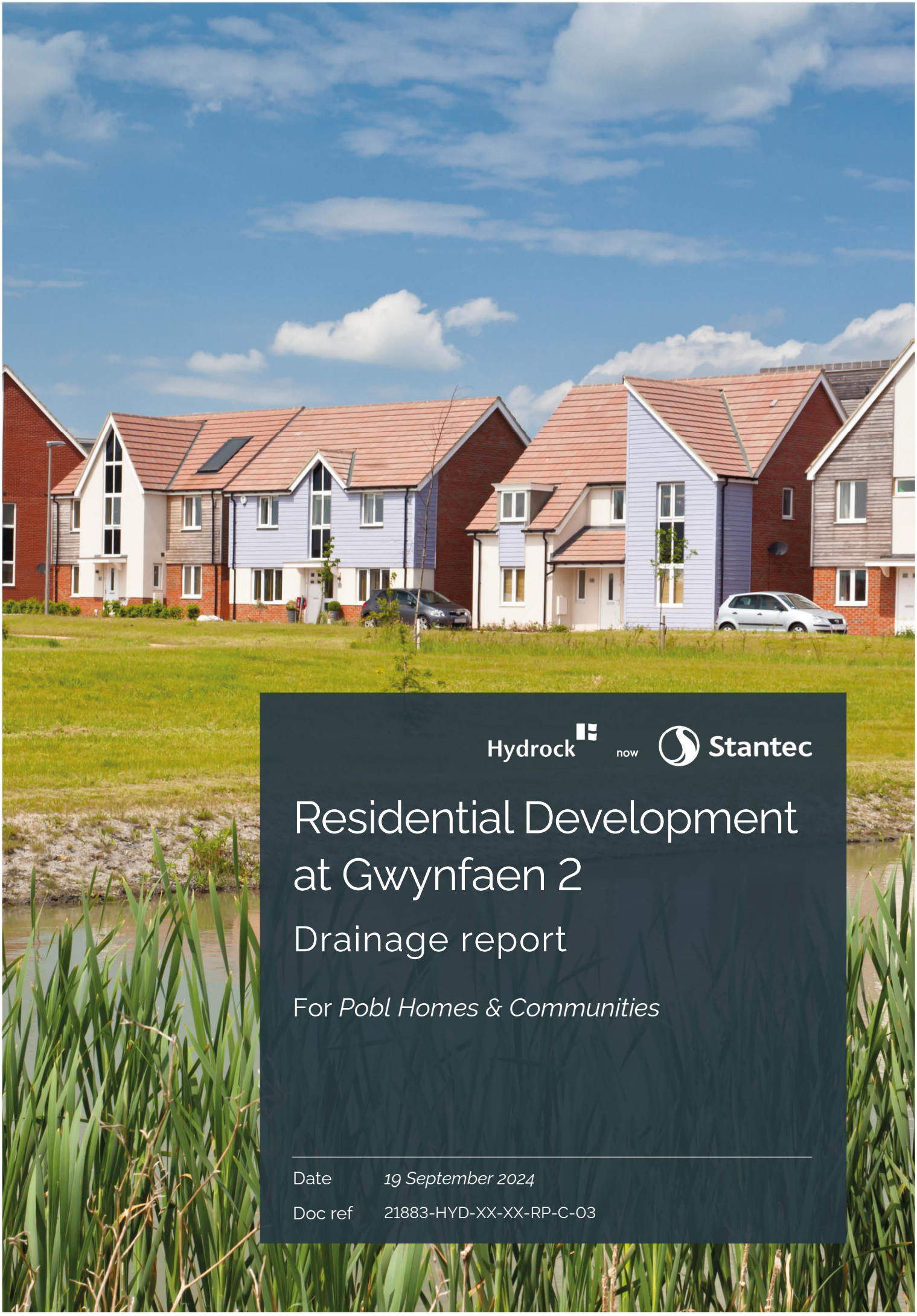

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Residential Development at Gwynfaen 2

Drainage report

For *Pobl Homes & Communities*

Date	*19 September 2024*
Doc ref	21883-HYD-XX-XX-RP-C-03

Document control sheet

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1. Introduction

Hydrock have been commissioned by Pobl Homes & Communities to provide a drainage report and design for the proposed residential development at Gwynfaen Farm, Gorseinon, Swansea.

It is our understanding that the client is seeking to redevelop the current greenfield site which is not allocated within the LDP and is being brought forward as an exception residential development and that this report is required to support the planning application and SAB submissions.

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 to comply 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 pr-application submission to the local authority's SuDS Approval Body (SAB).

The following tasks will be undertaken to complete this report;

- Undertake a desktop investigation of the site's existing foul and surface water drainage arrangements;
- Outline anticipated solutions for foul sewage disposal and surface water disposal. This will include preliminary calculations, in order to determine that the conceptual designs may be agreed with the relevant authorities. In preparing the surface water drainage strategy, we will consider inundation of the floodplain and assess flood levels in the location of attenuation features;
- Determine the area of impermeable surfaces that will be added by the proposed development and estimate the equivalent greenfield and brownfield run-off rates for this area;
- Assess the feasibility of using infiltration as a disposal method, based on soakaway test results or any other available information on ground and site conditions; and
- Estimate the size of storm water storage needed to manage run-off from the site post-development, using drainage design software (Infodrainage);

A number of sources have been used to compile this drainage strategy. Whilst Hydrock 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 Hydrock cannot be held responsible.

2. Existing Site

2.1 Site Location

Figure 2.1 indicates the site location within the red circle, which is located off Min Yr Aber Road to the west of Gwynfaen Phase 1 (currently under construction) in Gorseinon, Swansea, SA4 4YZ (Approximate Grid Reference X-257776, Y-199337; What3Words: pass.clever.decanter). ©OpenStreetMap.

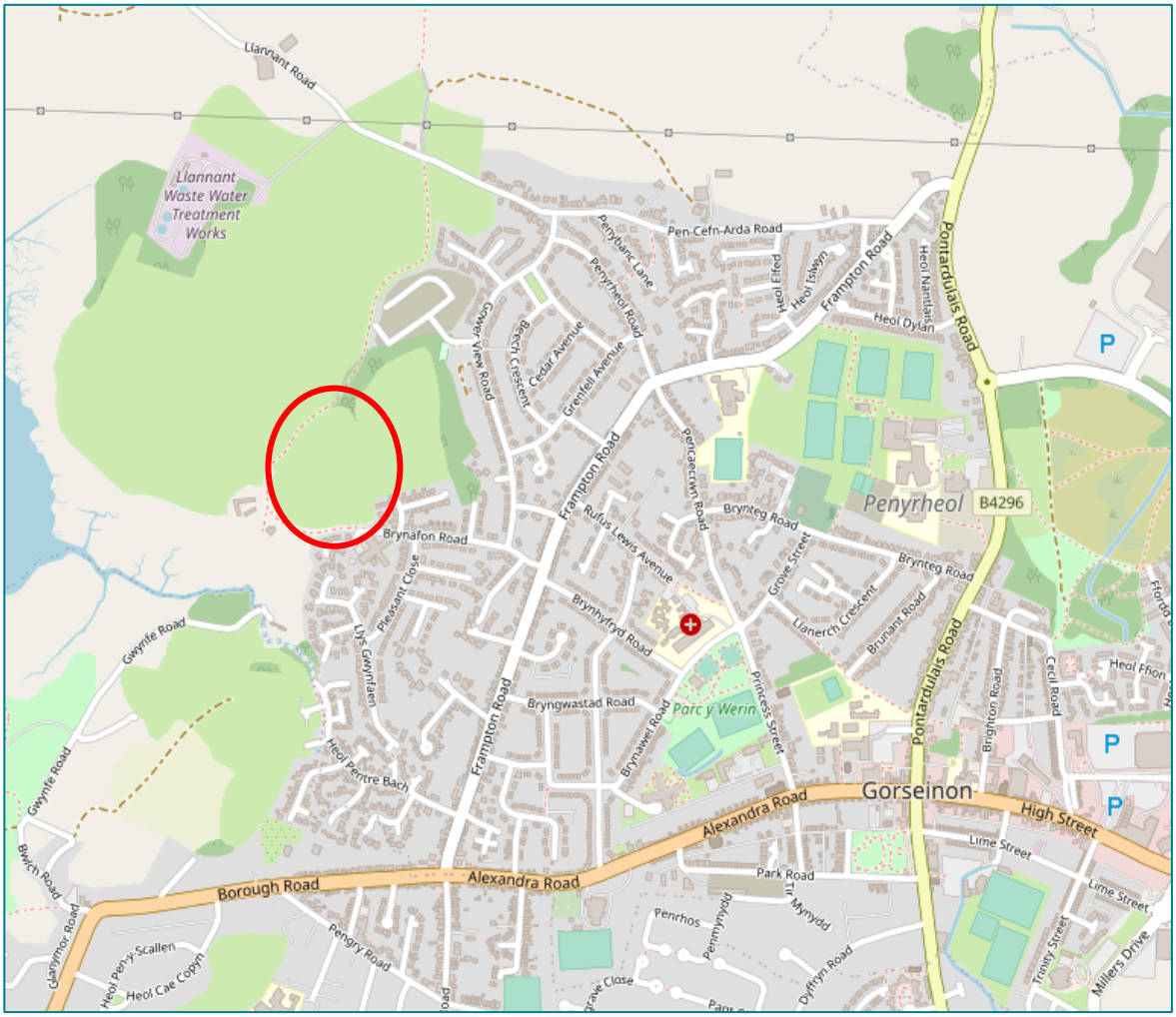


Figure 2.1: Site location plan (ref Open Street Map)

2.2 Site Description

The site is approximately 3.5 hectares in area and is greenfield in nature.

A topographic survey of the site, reproduced in drawing no 21883-HYD-XX-XX-DR-C-0200, was undertaken by Senior Surveys Land Survey Consultants in October 2023. The survey identifies that the site roughly falls from east to west at a gradient of 1 in 10.

The site is bordered by a farm on the northern and western boundaries with existing dwellings to the south and the Gwynfaen phase 1 development to the east. The site has allowance for direct vehicle access via Min Yr Aber Road through Phase 1 of the development.

2.3 Flood risk

From available mapping information, a small portion of the site is subject to low risk of surface water and small watercourse flooding and free from all other types of flooding. Figure 2.2 contains an extract of the National Resources Wales (NRW) flood risk maps with the site boundary shown in green. The map identifies flooding outside the perimeter of the site along the line of the existing streams/ditches. The low risk flooding onsite is believed to be associated with a localised depression channeling overland surface water flow.

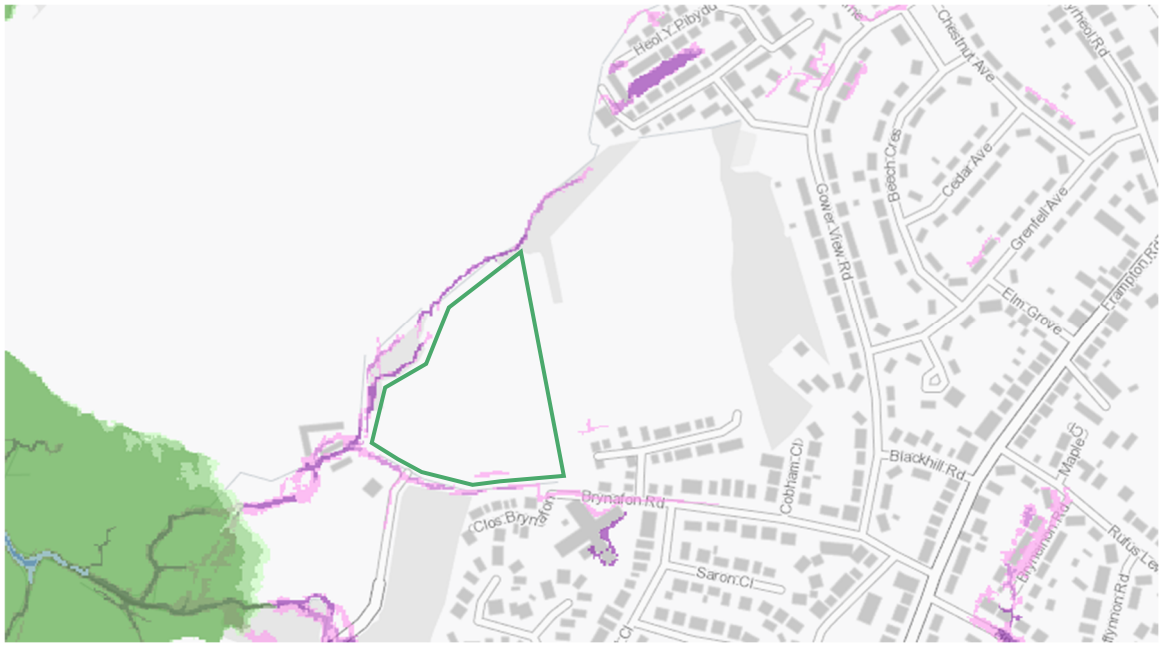


Figure 2.2: Extract of NRW Flood Risk Map (Accessed July 2024)

2.4 Existing Drainage Arrangements

From available mapping information it has been established that the nearest main watercourse is approximately 290m south west of the site, the River Loughor which flows east to west. There is also a minor watercourse located along the northern boundary of the development which flows north east to south west.

Figure 2.3 contains an extract of the Dwr Cymru Welsh Water (DCWW) asset plan for the area with the site boundary shown in green. This identifies number of existing foul, surface water and combined sewers crossing the site.

The primary combined sewer elements are a combined sewer overflow upstream of 3no parallel 1800mm diameter storage pipes, The CSO is connected to the storage pipes via a 1200mm dia concrete sewer and the storage pipes are connected to the downstream network via a 600mm dia concrete pipe. Sections of the overflow from the CSO are identified as 375mm dia with others 450mm dia. This infrastructure will need to remain in place and DCWW have been consulted and have confirmed that the required easements are;

» 3 no. 1800mm combined sewers banked together – the total easement width is approximately 14.850m based on a 5m easement width either side of the centreline of the outer pipes.

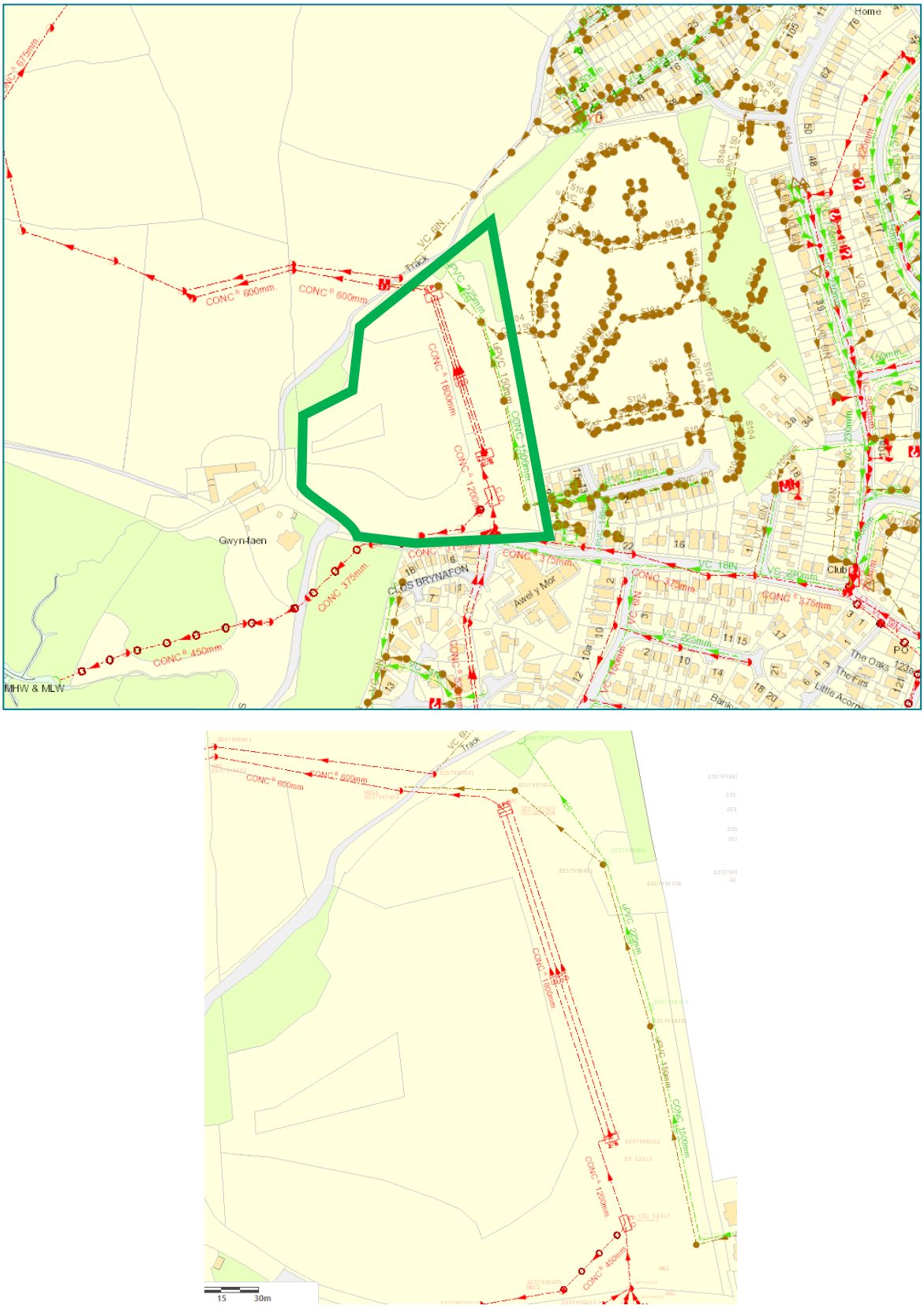


Figure 2.3: Extract of DCWW asset plan (accessed July 2024)

- 1200mm combined sewer linking the CSO to the storage pipes a total easement width of 10m from the centre of the sewer (i.e. 5m either side).
- 600mm combined sewer at the north of the site a total easement width of 6m from the centre of the sewer (i.e. 3m either side).
- 450/375mm storm overflow at the south of the site would require a total easement width of 6m from the centre of the sewer (i.e. 3m either side).

In addition to the DCWW combined sewers there is an existing 150mm foul sewer crossing the site flowing south to north located near the eastern boundary. This initially conveyed flows solely from the Brynafon Road development however a spur has recently been added conveying flows from the Gwynfaen phase 1 development to the east of the site.

A 225mm diameter DCWW surface water sewer is located within the site which flows south to north parallel to the 150mm dia foul sewer. This sewer discharges into the existing watercourse on the northern boundary. This sewer is solely associated with the neighbouring Brynafon Road development. Extracts of the Brynafon Road development drainage layout by Smart Associates is shown in Figure 2.4. Attenuation storage for the Brynafon Road development is located within the proposed development site in the form of an online 1500mm diameter concrete storage pipe, with a restricted discharge rate of 5l/s.

The existing drainage network is reproduced in drawing no 21883-HYD-XX-XX-DR-C-0400.

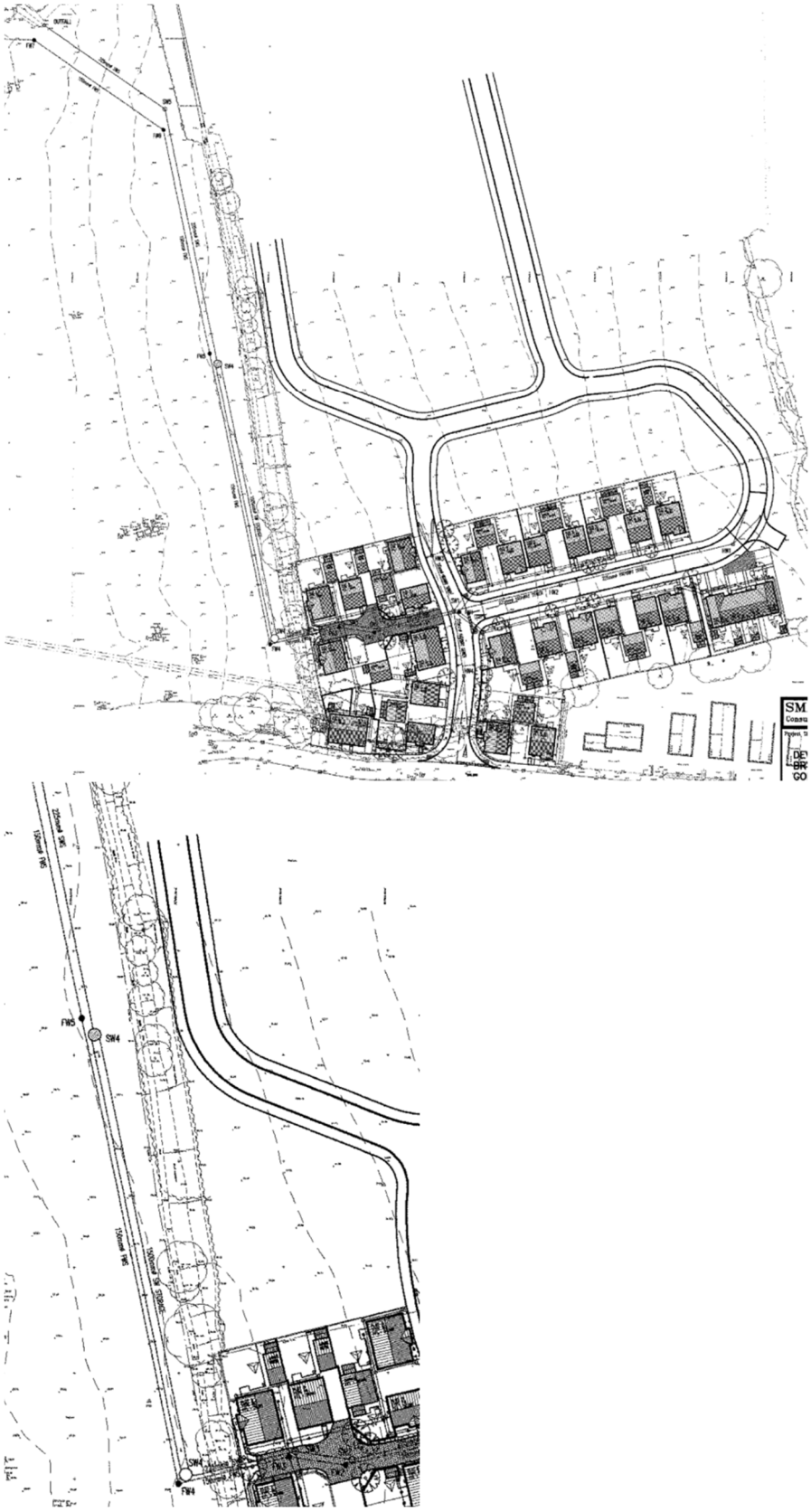


Figure 2.4 Extracts from Smart Associates Drainage Layout for Brynafon Road

2.5 Existing Contributing Areas and Run-Off Rates

The total site area is circa 3.5 ha, Portions of the site will not be captured by active drainage and will continue to drain as existing greenfield. These areas will be discounted from the area used to calculate the global greenfield run-off rates for the site. The effective contributing area of the site is taken as 2.34ha.

The greenfield runoff rate has been calculated using the FEH Statistical Method from H R Wallingford and Table 2.1 summarises the runoff rates for each return period (1, 30 & 100). Calculations detailing the derivation of the values in these tables are available in Appendix A.

Table 2.1: Greenfield Run-off Rates by Return Period

Return Period	Greenfield Run-off Rate (l/s)
1 YRP	28
30 YRP	57
100 YRP	69

Adjacent to the site is the Brynafon Road development, associated with it is an online 1500mm diameter concrete surface water storage pipe. The drainage layout drawing by Smart Associates for the development states the hydrobrake flow control discharges at 5l/s from the storage pipe. The surface water runoff from Brynafon Road is proposed to be re-directed into the Gwynfaen Phase 2 development's new surface water drainage system in order to abandon the existing concrete storage pipe.

The total discharge from the site will therefore be a combination of the greenfield runoff rate and the existing controlled flow rate from Brynafon Road. Table 2.2 summaries the combined runoff rate for each return period (1, 30 & 100)

Table 2.2: Combined Run-off Rates by Return Period

Return Period	Development Greenfield Run-off Rate (l/s)	Brynafon Road Run-off Rate (l/s)	Combined Run-off Rate (l/s)
1 YRP	28	5	33
30 YRP	57	5	62
100 YRP	69	5	74

3. Proposed Development

3.1 Development Proposals

For assessment purposes the development is a proposed 50 unit residential development with associated infrastructure. The units will comprise of 22 flats, 23 houses and 5 bungalows.

3.2 Foul Drainage

The most sustainable method for the disposal of foul water discharge from the proposed development site is via the existing main sewer network which crosses the site. Pre-Planning Advice (PPA) has been attained from DCWW, whom have confirmed that current capacity is not achievable. Reinforcement works are however scheduled for completion by 31st March 2025 at which time there will be available capacity for the development at the Llannant Welsh Water Treatment Works.

The PPA has confirmed the proposed connection point is located outside of the site boundary, in the neighbouring Welsh Assembly Government (WAG) land to the north of the site. The location of the proposed connection point (manhole SS57996402) is shown in Figure 3.1 below.

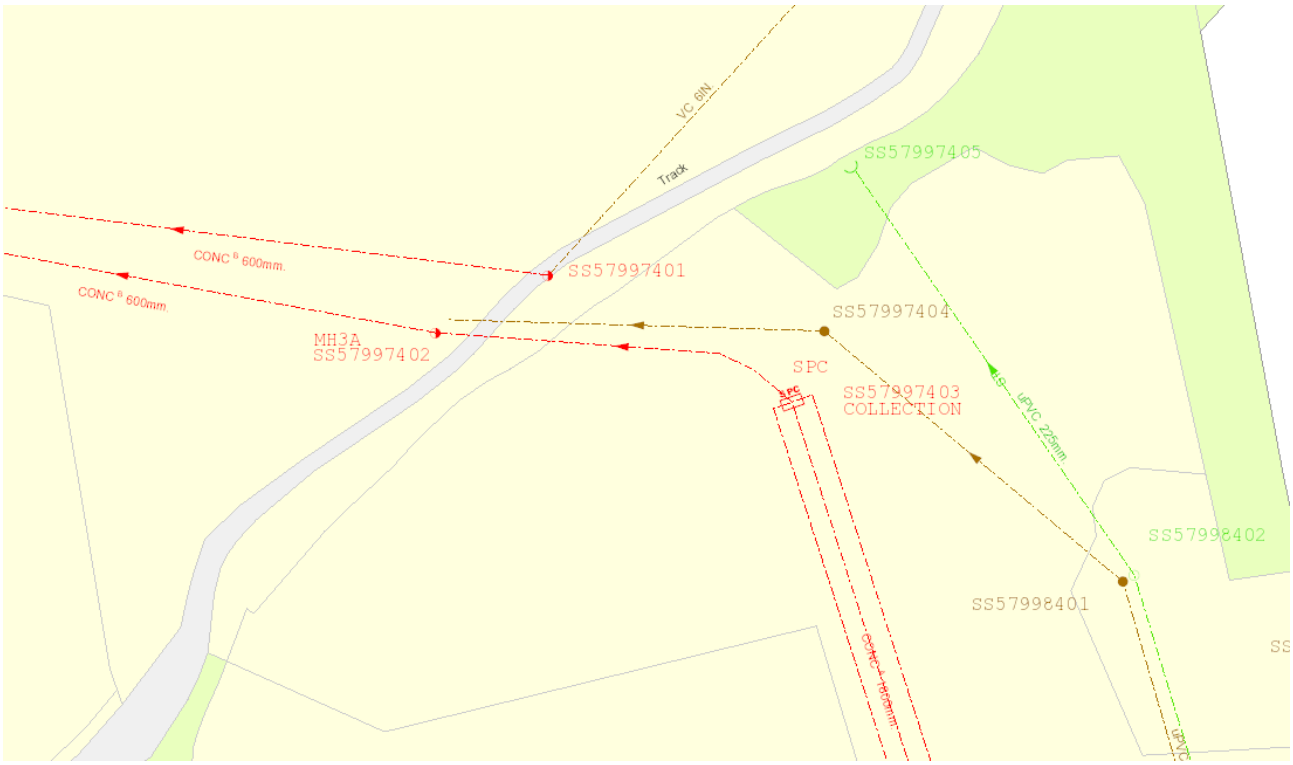


Figure 3.1: Extract of DCWW asset plan showing connection manhole

DCWW records identify manhole SS57996402 as having an invert level of 21.99mAOD. As the site falls east to west a pumping station will be required to ensure the proposed foul from the western areas can discharge to the public sewer. 12no properties will contribute to the pumping station, which will requiring a DCWW type 2 pumping station (typically 6 to 20 dwellings with a incoming peak design flow >0.25l./s < 1.0l/s). The pumping station will be located so that the wet well will be in excess of the minimum allowable 10m clearance from habitable buildings in an area not susceptible to flooding.

All on site sewerage systems will be designed and constructed to comply with Welsh 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

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 statutory "Sustainable Drainage Systems Standards for Wales" (SDSSW) document 2018. The previous sections of this report have established the current drainage arrangements on site and have also determined the current discharge rates for surface water leaving the site.

From 7th January 2019 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 100m^2 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 in order to comply with the SDSSW. S1 is a hierarchy standard with standards S2-S6 being fixed.

3.3.1 S1 - Surface Water Runoff 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. Each of these options are considered below.

3.3.1.1 Collected for Use

The suitability of this option will depend on the proposed water usage of the development, if the development has low grey water demand, as is typical of residential developments the collection of water for reuse would not be economical or feasible, however if the demand for grey water is deemed to be high then rainwater harvesting would be an appropriate solution for parts of the development. The use of rainwater harvesting would need to be used in conjunction with one of the below methods of discharge in order to cater for exceedance flows in extreme rainfall events where the rainfall volume exceeds the volume of surface water storage provided by the rainwater harvesting tanks. As the development is considered to have low demand for grey water 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. 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 however the demand for this will again be low as the planted landscape areas will be accepting surface water runoff from the impermeable areas as part of the design. Based on this storing rain water runoff for reuse is not feasible on this scheme.

3.3.1.2 *Infiltration Methods*

Based on the Cranfield University Soilscapes mapping the subsoils in the area of the site are noted as slowly permeable seasonally wet acid loamy and clayey soils. Based upon infiltration testing undertaken as part of the adjacent Gwynfaen 1 development, infiltration is not anticipated to be a viable means of surface water disposal. The investigations for that site, conducted by Integral Geotechnique concluded: -

"Within trial pit TP01, no groundwater was recorded during the soil infiltration test. Within trial pit TP08, an initial groundwater infiltration was observed however no infiltration was observed for 88 minutes below a depth of 1.9m below existing ground …. No infiltration rate could therefore be calculated at these locations. Within trial pit TP03 an infiltration rate of 6.4x10-6m/s was calculated. However, it should be noted that the soil infiltration rate was calculated by extrapolating the available information following slow infiltration rates."

At the time of writing this report we are awaiting the results of the site investigation. Infiltration testing will need to be carried prior to detail design to confirm the assumption that infiltration is not a viable means of surface water disposal.

Though not being taken into account in the calculations, the proposed rain gardens will be left unlined to utilise any available infiltration that may occur.

3.3.1.3 *Discharge to Surface Water Body*

Sequentially, the next consideration in the hierarchical approach is discharge to a surface water body. The nearest watercourse is located along the northwestern, west and southwestern boundaries of the site. It is therefore proposed to discharge the developments surface water via a new gravity connection into the existing watercourse to the northwestern of the site.

3.3.1.4 *Discharge to Surface Water Sewer*

Based on the above information there is no need to consider discharging into a public surface water sewer system.

3.3.1.5 *Discharge to Combined Sewer*

Based on the above information there is no need to consider discharging into a combined public sewer system.

3.3.2 *S2 - Surface Water Runoff 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 1 in 100-year return period with mitigating proposals developed for the scheme.

3.3.2.1 *Interception of Runoff*

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. 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. Refer to table G2.1 in the SDSSW 2018 document published by Welsh Government for details of interception mechanisms and their assumed compliance with the standards. It is proposed that this scheme will utilise permeable paving, rain gardens and an attenuation basin to provide suitable levels of interception.

Based on unlined bases, the following interception ratios can be deemed to be achieved under the guidance in the SDSSW document

- Bioretention area and rain gardens, 5 times base area;
- Permeable paving, 1 times base area; &
- Detention basin, 5 times base area.

To minimise the total depth of water within the attenuation basin it is proposed to utilise a storage tank beneath the basin. The basin has been sized to accommodate the 1 in 30 yr storm event with excess flows from the 1 in 100yr +40% climate change event then overflowing into the tank beneath. To prevent water infiltrating into the tank for lesser events an impermeable liner is proposed above the tank. The liner will be placed a minimum of 300mm below the base of the attenuation basin to allow wetting of the soil and transpiration to take place to meet interception criteria.

3.3.2.2 Hydraulic Control and Storage

In accordance with statutory guidelines, the development of this site should not increase flood risk elsewhere and as such, all runoff from attenuated 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 and urban creep allowance. It is proposed to discharge surface water runoff from the development via gravity to the watercourse with runoff rates being restricted to the combination of the 1 year greenfield runoff rate from the contributing site area and the 5l/s from the Brynafon Road development as stated in Table 2.2. This equates to a maximum discharge rate of 33 l/s for the development.

Surface water flows from the proposed development will need to be attenuated via a flow control chamber, and on-site storage 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 and urban creep.

Given the proposed site usage overland storage in the form of rain gardens, permeable paving, an attenuation basin and a crated tank are achievable across the site. These features will be both on plot and in public open spaces including adjacent to the public highways across the site.

For the purposes of this report storage has been estimated using InfoDrainage and the paragraph below provides a summary of the features used and storage values.

The maximum discharge rate assumed at 33l/s for all rainfall events up to and including the 100 year return period with 40% allowance for climate change and urban creep. The minimum storage required has been calculated as a volume of 1360m^3. This volume is split between an attenuation basin and cellular storage tanks. The attenuation basin is sized to store the 1 in 30 year storm with maximum storage volume of 777m^3, runoff from any storm greater than a 1 in 30 year return period will be stored in the cellular storage tanks via overflows within the attenuation basin; storage volume within the cellular storage tanks of 583m^3. This storage volume could be reduced by the use of alternative complex controls to satisfy clause G2.30 of the standards.

Liaison and agreement would be needed to be undertaken with the SAB to confirm whether a complex control would be acceptable.

Appendix B contains the InfoDrainage calculations for the development and with drawing no 21883-HYD-XX-XX-DR-C-3000 contains the proposed layout plans with Table 3.1 providing a summary of the preliminary storage volumes across the site in the different SuDS features.

Table 3.1: Development storage summary

SuDS Feature	Approx size	Storage required (m^3)
Attenuation Basin	1666m2 (top of freeboard area) x 0.75m deep (including freeboard)	777
Cellular Storage Tanks	850m2 x 0.75m high	583

*

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 will be designed to convey the overland flows from rainfall events above a 1in100 year return period (plus 40% for climate change and urban creep) to suitable areas of open space, such as 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.

3.3.2.4 *Flood Risks 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, the hydraulic model will be refined 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 Figure 2.1 (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.

1.1.1 S3 - Water Quality

This standard requires treatment of surface water runoff to prevent negative impacts on the receiving water quality and/or 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.

Whilst the development is connecting to an existing stream as best practice 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 would have been 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.

The possible impact of accidental spills will need to be addressed with the most vulnerable areas to a spill or other pollution incident being any car park areas and access roads, therefore the highway areas and parking will be drained into SuDS features, which will provide a level of treatment for pollution.

Planting within the SuDS features should form part of the water quality strategy. SuDS components like rain gardens 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.

1.1.2 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 users. The scheme will be based on 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 rain gardens and attenuation basin.

1.1.3 S5 - Biodiversity

This standard requires that the surface water management system should maximise biodiversity benefits.

The SuDS scheme biodiversity strategy should revolve around the creation of significant and varied habitat to increase 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 should 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 gardens and basin will be the focal habitat for the site and will enhance the site over the current site layout by adding areas of water and damp soils. Exposed areas of rain gardens will attract certain species and shaded areas under adjacent buildings and trees will further enhance the varied ecosystem potential.

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

The surface water drainage system should 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 more than one property, therefore the SAB will be responsible for the maintenance of the off-plot elements of the system to ensure it continues to comply with SuDS standards. In order for the drainage system to be adopted it must be designed and constructed in accordance with the SDSSW document and any conditions of approval stipulated by the SAB.

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 the client's maintenance team, 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. Conclusion

4.1 Foul Drainage

The most sustainable method for the disposal of foul water discharge from the proposed development site is via the existing main sewer network. DCWW PPA has confirmed that current capacity is not achievable. However, reinforcement works are scheduled for completion by 31st March 2025 which will create capacity at the Llannant Welsh Water Treatment Works.

The new development will seek to discharge foul flows from the site to the DCWW public foul sewer system with the PPA identifying a connection location to the north of the site within the adjacent Welsh Government owned field. Due to the existing/proposed levels there will be a requirement for a DCWW type 2 pumping station to accommodate flows from the western portion of the site with a gravity connection from the central and eastern portions.

Subject to agreement from DCWW and a S185 agreement, it is proposed to redirect foul flows from the existing Brynafon Road development through the proposed development s drainage network thereby removing the existing easements from the eastern portion of the site, All works to the existing public sewer system will need to be agreed with DCWW prior to construction.

All on site sewerage systems will be designed and constructed to comply with the Welsh 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.

4.2 Surface Water Drainage

The aim of the surface water drainage strategy is to mimic the natural catchment processes as closely as possible and the proposed system will be designed in accordance with the statutory (SDSSW) document 2018, any local authority's SAB requirements and CIRIA's C753 SuDS Manual as well as meeting the requirements of Building Regulations, Document H.

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 in the statutory (SDSSW) document 2018 published by the Welsh Government. Based on the hierarchy it is proposed to discharge surface water runoff from the development to the watercourse near the northwestern corner of the site. Infiltration has been ignored when sizing drainage elements, Based on information available for the adjacent Gwynfaen 1 development, it is assumed that infiltration will not be a suitable means of discharge of surface water from the site and a gravity connection to the adjacent watercourse is proposed. This assumption will need to be confirmed by the infiltration testing which at the time of writing this report has not been carried out. However small, it is however proposed that the proposed raingardens and permeable paving areas will be unlined to utilise any available infiltration to attempt to reduce the load on the receiving watercourse.

Surface water runoff is to be attenuated from site to 33 l/s. This run-off rate will be maintained for all rainfall events up to and including a 1 in 100yr storm with 40% allowance for climate change and urban creep.

Given the proposed site layout, storage will be provided in the form of rain gardens, permeable paving, a basin and storage tanks. The main storage feature for the site will be the attenuation

basin and tanks which will be located at the low point of the site to the west, with rain gardens/permeable paving being provided on plots providing further storage upstream of the main feature. All drainage features will be developed further at detailed design stage.

To minimise the total depth of water within the attenuation basin it is proposed to utilise a storage tank beneath the basin. The basin has been sized to accommodate the 1 in 30 yr storm event with excess flows from the 1 in 100yr +40% climate change event then overflowing into the tank beneath.

As the scheme is a residential development it has been considered that 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 however other 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.

Amenity and biodiversity benefits to the site will be provided in the form of the rain gardens which will be incorporated throughout the site and also form part of the attenuation storage for the site along with the main attenuation basin. These will maximise the available green infrastructure within the development site which will improve air quality and water quality of the site.

All on site surface water drainage systems will be designed and constructed to comply with the (SDSSW) and building regulations requirements. The detailed design of the scheme will incorporate the philosophies outline in this report regarding standards S1-S6 listed in section 7 of this report.

Appendix A Runoff Rates

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	stephanie parry
Site name:	Gwynfaen Phase 2
Site location:	

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

Site Details

Latitude:	51.67465° N
Longitude:	4.05808° W
Reference:	2811370199
Date:	Jun 18 2024 10:44

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 2.34

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.412
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.08

Hydrological characteristics

	Default	Edited
SAAR (mm):	1298	1279
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

Default Edited

Q_{BAR} (l/s):		31.75
1 in 1 year (l/s):		27.94
1 in 30 years (l/s):		56.52
1 in 100 year (l/s):		69.22
1 in 200 years (l/s):		78.11

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix B InfoDrainage Storage Calculations

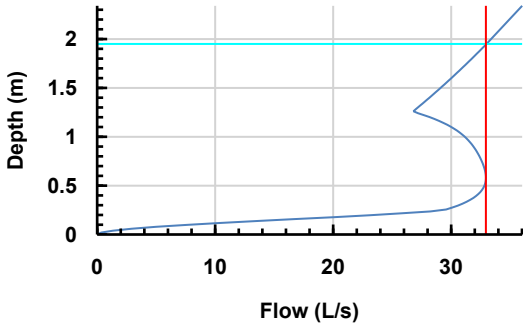
Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Junctions Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

Outlets

Junction	Outlet Name	Outgoing Connection	Outlet Type
Manhole	Outlet	Pipe	Free Discharge
Manhole (1)	Outlet	Pipe (4)	Free Discharge
Manhole (2)	Outlet	Pipe (5)	Free Discharge
Manhole (3)	Outlet	Pipe (1)	Free Discharge
Manhole (4)	Outlet	Pipe (2)	Free Discharge
Manhole (5)	Outlet	Pipe (3)	Free Discharge
Manhole (6)	Outlet	Pipe (6)	Free Discharge
Manhole (7)	Outlet	Pipe (7)	Free Discharge
Manhole (8)	Outlet	Pipe (8)	Free Discharge
Manhole (9)	Outlet	Pipe (9)	Free Discharge
Manhole (10)	Outlet	Pipe (11)	Free Discharge
Manhole (11)	Outlet	Pipe (10)	Free Discharge
Manhole (12)	Outlet	Pipe (12)	Free Discharge
Manhole (13)	Outlet	Pipe (13)	Free Discharge
Manhole (14)	Outlet	Pipe (14)	Free Discharge
Manhole (15)	Outlet	Pipe (16)	Free Discharge
Manhole (16)	Outlet	Pipe (15)	Free Discharge
	Outlet	(None)	Hydro-Brake®

Invert Level (m)	17.075
Design Depth (m)	1.950
Design Flow (L/s)	33.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☑
Unit Reference	SHE-0234-3300-1950-3300

Manhole (17)



Pond

Type : Pond

Dimensions

Exceedance Level (m)	19.175
Depth (m)	0.750
Base Level (m)	18.425
Freeboard (mm)	150
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	5.068
Total Volume (m³)	802.444

Depth (m)	Area (m²)	Volume (m³)
0.000	1145.332	0.000
0.750	1646.696	1041.338

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (56)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (1)

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (16)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (5)

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (59)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (6)

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (60)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (25)

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	Pipe (17)
Outlet Type	Free Discharge

Outlet (1)

Outgoing Connection	Pipe (18)
Outlet Type	Free Discharge

Outlet (2)

Outgoing Connection	Pipe (19)
Outlet Type	Free Discharge

Outlet (3)

Outgoing Connection	Pipe (20)
Outlet Type	Free Discharge

Outlet (4)

Outgoing Connection	Pipe (21)
Outlet Type	Free Discharge

Outlet (5)

Outgoing Connection	Pipe (22)
Outlet Type	Free Discharge

Outlet (6)

Outgoing Connection	Pipe (23)
Outlet Type	Free Discharge

Advanced

Perimeter	Circular
Length (m)	83.744
Friction Scheme	Manning's n
n	0.03

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Stormwater Controls Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

Cellular Storage

Type : Cellular Storage

Dimensions

Exceedance Level (m)	19.175
Depth (m)	0.750
Base Level (m)	17.175
Number of Crates Long	24
Number of Crates Wide	34
Number of Crates High	1
Porosity (%)	95
Crate Length (m)	2
Crate Width (m)	0.5
Crate Height (m)	0.75
Total Volume (m³)	582.650

Inlets

Inlet (1)

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (18)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (19)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (2)

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (20)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (3)

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (21)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (4)

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (22)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (5)

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (23)
Bypass Destination	(None)
Capacity Type	No Restriction

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Connections Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

Name	Length (m)	Connection Type	Slope (1:X)	Manning's n	Colebrook-White Roughness (mm)	Diameter / Base Width (mm)	Upstream Cover Level (m)	Upstream Invert Level (m)
Pipe	27.832	Pipe	15.000		0.6	375	29.349	28.149
Pipe (1)	14.496	Pipe	99.691		0.6	300	27.855	26.655
Pipe (2)	47.165	Pipe	99.927		0.6	300	28.048	26.510
Pipe (3)	22.311	Pipe	100.051		0.6	300	28.170	26.038
Pipe (4)	8.309	Pipe	17.347		0.6	375	28.552	26.294
Pipe (5)	30.063	Pipe	52.557		0.6	375	27.994	25.815
Pipe (6)	12.069	Pipe	80.000		0.6	450	26.593	25.393
Pipe (7)	32.854	Pipe	74.819		0.6	450	26.759	25.243
Pipe (8)	33.665	Pipe	40.496		0.6	450	26.004	24.804
Pipe (9)	51.464	Pipe	100.013		0.6	450	25.173	23.973
Pipe (10)	29.416	Pipe	43.774		0.6	375	25.330	24.130
Pipe (11)	41.289	Pipe	20.368		0.6	450	25.074	23.458
Pipe (12)	27.412	Pipe	15.821		0.6	450	22.631	21.431
Pipe (13)	27.264	Pipe	58.063		0.6	525	20.898	19.698
Pipe (14)	42.493	Pipe	100.072		0.6	525	20.429	19.229
Pipe (15)	19.807	Pipe	25.655		0.6	450	20.776	19.576
Pipe (16)	17.114	Pipe	45.155		0.6	525	20.327	18.804
Pipe (17)	9.178	Pipe	100.000		0.6	450	19.175	18.425
Pipe (18)	5.681	Pipe	3.250		0.6	150	19.175	18.923
Pipe (19)	12.320	Pipe	7.048		0.6	150	19.175	18.923
Pipe (20)	13.734	Pipe	7.857		0.6	150	19.175	18.923
Pipe (21)	7.650	Pipe	4.377		0.6	150	19.175	18.923
Pipe (22)	6.703	Pipe	3.835		0.6	150	19.175	18.923
Pipe (23)	8.139	Pipe	4.656		0.6	150	19.175	18.923

Name	Downstream Cover Level (m)	Downstream Invert Level (m)	Lock
Pipe	28.552	26.294	All
Pipe (1)	28.048	26.510	All
Pipe (2)	28.170	26.038	All
Pipe (3)	27.994	25.815	All
Pipe (4)	27.994	25.815	All
Pipe (5)	26.759	25.243	All
Pipe (6)	26.759	25.243	All
Pipe (7)	26.004	24.804	All
Pipe (8)	25.173	23.973	All
Pipe (9)	25.074	23.458	All
Pipe (10)	25.074	23.458	All
Pipe (11)	22.631	21.431	All
Pipe (12)	20.898	19.698	All
Pipe (13)	20.429	19.229	All
Pipe (14)	20.327	18.804	All
Pipe (15)	20.327	18.804	All
Pipe (16)	19.175	18.425	All
Pipe (17)	19.200	18.333	All
Pipe (18)	19.175	17.175	All
Pipe (19)	19.175	17.175	All
Pipe (20)	19.175	17.175	All
Pipe (21)	19.175	17.175	All
Pipe (22)	19.175	17.175	All
Pipe (23)	19.175	17.175	All

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Inflow Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
Catchment Area	Pond		Time of Concentration	0.165	100	0	100	0.165
Catchment Area (2)	Manhole (6)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (3)	Manhole (7)		Time of Concentration	0.014	100	0	100	0.014
Catchment Area (4)	Manhole (8)		Time of Concentration	0.011	100	0	100	0.011
Catchment Area (5)	Manhole (8)		Time of Concentration	0.010	100	0	100	0.010
Catchment Area (6)	Manhole (9)		Time of Concentration	0.014	100	0	100	0.014
Catchment Area (7)	Manhole (9)		Time of Concentration	0.010	100	0	100	0.010
Catchment Area (8)	Manhole (12)		Time of Concentration	0.022	100	0	100	0.022
Catchment Area (9)	Manhole (11)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (10)	Manhole (12)		Time of Concentration	0.011	100	0	100	0.011
Catchment Area (11)	Manhole (12)		Time of Concentration	0.010	100	0	100	0.010
Catchment Area (12)	Manhole (12)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (13)	Manhole (3)		Time of Concentration	0.022	100	0	100	0.022
Catchment Area (14)	Manhole (5)		Time of Concentration	0.017	100	0	100	0.017
Catchment Area (15)	Manhole (2)		Time of Concentration	0.011	100	0	100	0.011
Catchment Area (16)	Manhole (1)		Time of Concentration	0.022	100	0	100	0.022
Catchment Area (17)	Manhole (16)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (18)	Manhole (16)		Time of Concentration	0.011	100	0	100	0.011
Catchment Area (19)	Manhole (15)		Time of Concentration	0.011	100	0	100	0.011
Catchment Area (20)	Manhole (15)		Time of Concentration	0.011	100	0	100	0.011
Catchment Area (21)	Manhole (14)		Time of Concentration	0.014	100	0	100	0.014
Catchment Area (22)	Manhole (14)		Time of Concentration	0.010	100	0	100	0.010
Catchment Area (23)	Manhole (13)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (24)	Manhole (4)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (25)	Manhole (4)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (26)	Manhole (1)		Time of Concentration	0.006	100	0	100	0.006
Catchment Area (27)	Manhole (1)		Time of Concentration	0.002	100	0	100	0.002
Catchment Area (28)	Manhole (5)		Time of Concentration	0.013	100	0	100	0.013
Catchment Area (29)	Manhole (6)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (30)	Manhole (6)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (31)	Manhole (8)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (32)	Manhole (8)		Time of Concentration	0.005	100	0	100	0.005

Catchment Area (33)	Manhole (8)		Time of Concentration	0.006	100	0	100	0.006
Catchment Area (34)	Manhole (8)		Time of Concentration	0.006	100	0	100	0.006
Catchment Area (35)	Manhole (9)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (36)	Manhole (9)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (37)	Manhole (9)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (38)	Manhole (9)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (39)	Manhole (10)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (40)	Manhole (12)		Time of Concentration	0.006	100	0	100	0.006
Catchment Area (41)	Manhole (13)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (42)	Manhole (14)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (43)	Manhole (14)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (44)	Manhole (15)		Time of Concentration	0.008	100	0	100	0.008
Catchment Area (45)	Manhole (15)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (46)	Manhole (15)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (47)	Manhole (16)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (48)	Manhole (16)		Time of Concentration	0.007	100	0	100	0.007
Catchment Area (49)	Manhole (16)		Time of Concentration	0.006	100	0	100	0.006
Catchment Area (50)	Manhole (16)		Time of Concentration	0.006	100	0	100	0.006
Catchment Area (51)	Manhole (12)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (52)	Manhole (12)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (53)	Manhole (12)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (54)	Manhole (11)		Time of Concentration	0.009	100	0	100	0.009
Catchment Area (55)	Manhole (10)		Time of Concentration	0.005	100	0	100	0.005
Catchment Area (56)	Pond		Time of Concentration	0.523	100	0	100	0.523
Catchment Area (57)	Manhole		Time of Concentration	0.859	66	0	66	0.567
Catchment Area (59)	Pond		Time of Concentration	0.069	100	0	100	0.069
Catchment Area (60)	Pond		Time of Concentration	0.061	100	0	100	0.061
Catchment Area (61)	Manhole (15)		Time of Concentration	0.457	100	0	100	0.457
Catchment Area (63)	Manhole (10)		Time of Concentration	0.374	100	0	100	0.374
TOTAL		**0.0**		**2.969**				**2.677**

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Network Design Criteria Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

Pipe Options

Lock Slope Options	None
Design Options	Minimise Excavation
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Manhole Options

Apply Offset	☐

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Outfall Details Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

Outfalls

Outfall	Outfall Type	Fixed Surcharged Level (m)	Level Curve
Manhole (17)	Free Discharge		

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Title: Rainfall Analysis Criteria	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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	☐

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Junctions Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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

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
Manhole	FEH: 2 years: +0 %: 15 mins: Summer	29.349	28.149	28.268	0.119	109.7	0.042	0.000	108.8	47.734	OK
Manhole (1)	FEH: 2 years: +0 %: 15 mins: Summer	28.552	26.294	26.438	0.144	114.7	0.216	0.000	112.7	50.266	OK
Manhole (2)	FEH: 2 years: +0 %: 15 mins: Summer	27.994	25.815	26.004	0.189	125.6	0.283	0.000	121.6	56.617	OK
Manhole (3)	FEH: 2 years: +0 %: 15 mins: Summer	27.855	26.655	26.695	0.039	4.2	0.059	0.000	4.0	1.813	OK
Manhole (4)	FEH: 2 years: +0 %: 15 mins: Summer	28.048	26.510	26.557	0.047	6.6	0.071	0.000	6.0	2.929	OK
Manhole (5)	FEH: 2 years: +0 %: 15 mins: Summer	28.170	26.038	26.099	0.061	11.8	0.091	0.000	10.8	5.402	OK
Manhole (6)	FEH: 2 years: +0 %: 15 mins: Summer	26.593	25.393	25.437	0.044	3.5	0.065	0.000	2.4	1.518	OK
Manhole (7)	FEH: 2 years: +0 %: 15 mins: Summer	26.759	25.243	25.434	0.191	126.7	0.286	0.000	120.9	59.268	OK
Manhole (8)	FEH: 2 years: +0 %: 15 mins: Summer	26.004	24.804	24.961	0.157	129.4	0.234	0.000	125.1	62.892	OK
Manhole (9)	FEH: 2 years: +0 %: 15 mins: Summer	25.173	23.973	24.185	0.213	133.6	0.318	0.000	126.1	66.510	OK
Manhole (10)	FEH: 2 years: +0 %: 15 mins: Summer	25.074	23.458	23.601	0.143	149.0	0.214	0.000	142.4	76.472	OK
Manhole (11)	FEH: 2 years: +0 %: 15 mins: Summer	25.330	24.130	24.155	0.025	3.1	0.037	0.000	3.0	1.373	OK
Manhole (12)	FEH: 2 years: +0 %: 15 mins: Summer	22.631	21.431	21.564	0.133	156.4	0.199	0.000	152.4	82.524	OK
Manhole (13)	FEH: 2 years: +0 %: 15 mins: Summer	20.898	19.698	19.887	0.189	154.9	0.282	0.000	149.2	83.534	OK
Manhole (14)	FEH: 2 years: +0 %: 15 mins: Summer	20.429	19.229	19.443	0.215	156.2	0.321	0.000	147.2	86.449	OK
Manhole (15)	FEH: 2 years: +0 %: 15 mins: Summer	20.327	18.804	19.006	0.202	183.8	0.302	0.000	175.1	102.433	OK
Manhole (16)	FEH: 2 years: +0 %: 15 mins: Summer	20.776	19.576	19.610	0.033	8.7	0.050	0.000	8.5	3.779	OK
Manhole (17)	FEH: 2 years: +0 %: 240 mins: Summer	19.200	17.075	18.684	1.609	33.8	1.820	0.000	32.0	517.658	OK

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Junctions Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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

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
Manhole	FEH: 30 years: +0 %: 15 mins: Summer	29.349	28.149	28.328	0.179	223.7	0.063	0.000	222.1	97.243	OK
Manhole (1)	FEH: 30 years: +0 %: 15 mins: Summer	28.552	26.294	26.538	0.244	234.1	0.365	0.000	229.4	102.411	OK
Manhole (2)	FEH: 30 years: +0 %: 15 mins: Summer	27.994	25.815	26.136	0.321	249.7	0.480	0.000	242.0	115.375	OK
Manhole (3)	FEH: 30 years: +0 %: 15 mins: Summer	27.855	26.655	26.712	0.057	8.5	0.085	0.000	8.2	3.694	OK
Manhole (4)	FEH: 30 years: +0 %: 15 mins: Summer	28.048	26.510	26.578	0.068	13.5	0.101	0.000	12.6	5.954	OK
Manhole (5)	FEH: 30 years: +0 %: 15 mins: Summer	28.170	26.038	26.147	0.109	24.3	0.163	0.000	15.8	11.026	OK
Manhole (6)	FEH: 30 years: +0 %: 15 mins: Summer	26.593	25.393	25.542	0.149	7.1	0.223	0.000	5.2	3.086	OK
Manhole (7)	FEH: 30 years: +0 %: 15 mins: Summer	26.759	25.243	25.541	0.298	252.7	0.446	0.000	244.9	120.815	OK
Manhole (8)	FEH: 30 years: +0 %: 15 mins: Summer	26.004	24.804	25.051	0.247	262.1	0.369	0.000	255.3	128.254	OK
Manhole (9)	FEH: 30 years: +0 %: 15 mins: Summer	25.173	23.973	24.311	0.338	272.5	0.506	0.000	259.0	135.695	OK
Manhole (10)	FEH: 30 years: +0 %: 15 mins: Summer	25.074	23.458	23.675	0.217	305.8	0.324	0.000	294.8	156.053	OK
Manhole (11)	FEH: 30 years: +0 %: 15 mins: Summer	25.330	24.130	24.164	0.034	6.4	0.052	0.000	6.2	2.789	OK
Manhole (12)	FEH: 30 years: +0 %: 15 mins: Summer	22.631	21.431	21.636	0.206	323.4	0.308	0.000	316.5	168.425	OK
Manhole (13)	FEH: 30 years: +0 %: 15 mins: Summer	20.898	19.698	20.002	0.304	321.4	0.455	0.000	311.0	170.510	OK
Manhole (14)	FEH: 30 years: +0 %: 15 mins: Summer	20.429	19.229	19.573	0.344	325.3	0.515	0.000	309.5	176.568	OK
Manhole (15)	FEH: 30 years: +0 %: 15 mins: Summer	20.327	18.804	19.117	0.313	384.2	0.468	0.000	369.7	209.196	OK
Manhole (16)	FEH: 30 years: +0 %: 15 mins: Summer	20.776	19.576	19.623	0.047	17.6	0.071	0.000	17.4	7.687	OK
Manhole (17)	FEH: 30 years: +0 %: 240 mins: Winter	19.200	17.075	18.911	1.836	59.7	2.077	0.000	32.3	775.066	Flood Risk

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Junctions Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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

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
Manhole	FEH: 100 years: +0 %: 15 mins: Summer	29.349	28.149	28.353	0.204	273.0	0.071	0.000	269.4	118.952	OK
Manhole (1)	FEH: 100 years: +0 %: 15 mins: Winter	28.552	26.294	26.578	0.285	269.2	0.426	0.000	259.8	125.178	OK
Manhole (2)	FEH: 100 years: +0 %: 15 mins: Summer	27.994	25.815	26.356	0.541	298.6	0.809	0.000	277.9	141.871	Surcharged
Manhole (3)	FEH: 100 years: +0 %: 15 mins: Summer	27.855	26.655	26.719	0.064	10.4	0.095	0.000	10.1	4.524	OK
Manhole (4)	FEH: 100 years: +0 %: 15 mins: Summer	28.048	26.510	26.584	0.074	16.5	0.111	0.000	15.8	7.295	OK
Manhole (5)	FEH: 100 years: +0 %: 15 mins: Summer	28.170	26.038	26.265	0.227	56.1	0.340	0.000	10.9	14.222	OK
Manhole (6)	FEH: 100 years: +0 %: 15 mins: Summer	26.593	25.393	25.568	0.175	8.7	0.261	0.000	6.3	3.781	OK
Manhole (7)	FEH: 100 years: +0 %: 15 mins: Summer	26.759	25.243	25.572	0.329	291.0	0.493	0.000	278.6	147.917	OK
Manhole (8)	FEH: 100 years: +0 %: 15 mins: Summer	26.004	24.804	25.077	0.273	299.6	0.409	0.000	294.1	157.015	OK
Manhole (9)	FEH: 100 years: +0 %: 15 mins: Summer	25.173	23.973	24.359	0.387	315.1	0.578	0.000	304.1	166.147	OK
Manhole (10)	FEH: 100 years: +0 %: 15 mins: Summer	25.074	23.458	23.700	0.242	361.3	0.362	0.000	352.0	191.088	OK
Manhole (11)	FEH: 100 years: +0 %: 15 mins: Summer	25.330	24.130	24.168	0.038	7.8	0.057	0.000	7.5	3.415	OK
Manhole (12)	FEH: 100 years: +0 %: 15 mins: Summer	22.631	21.431	21.663	0.232	386.9	0.347	0.000	380.3	206.218	OK
Manhole (13)	FEH: 100 years: +0 %: 15 mins: Summer	20.898	19.698	20.049	0.351	386.3	0.525	0.000	375.9	208.786	OK
Manhole (14)	FEH: 100 years: +0 %: 15 mins: Summer	20.429	19.229	19.628	0.399	393.3	0.597	0.000	376.6	216.225	OK
Manhole (15)	FEH: 100 years: +0 %: 15 mins: Summer	20.327	18.804	19.161	0.357	467.8	0.534	0.000	452.7	256.133	OK
Manhole (16)	FEH: 100 years: +0 %: 15 mins: Summer	20.776	19.576	19.628	0.052	21.5	0.078	0.000	21.2	9.388	OK
Manhole (17)	FEH: 100 years: +0 %: 120 mins: Winter	19.200	17.075	19.149	2.074	150.0	2.977	0.574	32.4	395.116	Flood Risk

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Junctions Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

FEH: 100 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Depth

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
Manhole	FEH: 100 years: +40 %: 15 mins: Summer	29.349	28.149	28.455	0.306	382.3	0.107	0.000	358.1	166.351	OK
Manhole (1)	FEH: 100 years: +40 %: 15 mins: Summer	28.552	26.294	27.469	1.176	378.5	1.759	0.000	379.7	175.409	Surcharged
Manhole (2)	FEH: 100 years: +40 %: 15 mins: Summer	27.994	25.815	26.907	1.092	387.3	1.633	0.000	359.6	199.464	Surcharged
Manhole (3)	FEH: 100 years: +40 %: 15 mins: Summer	27.855	26.655	26.774	0.119	38.4	0.178	0.000	3.8	6.949	OK
Manhole (4)	FEH: 100 years: +40 %: 15 mins: Summer	28.048	26.510	26.893	0.383	42.4	0.574	0.000	9.8	12.664	Surcharged
Manhole (5)	FEH: 100 years: +40 %: 15 mins: Summer	28.170	26.038	26.926	0.888	43.9	1.328	0.000	45.2	22.477	Surcharged
Manhole (6)	FEH: 100 years: +40 %: 15 mins: Summer	26.593	25.393	25.705	0.312	12.1	0.467	0.000	9.1	5.422	OK
Manhole (7)	FEH: 100 years: +40 %: 15 mins: Summer	26.759	25.243	25.705	0.462	375.1	0.692	0.000	360.3	207.289	Surcharged
Manhole (8)	FEH: 100 years: +40 %: 30 mins: Summer	26.004	24.804	25.150	0.346	355.5	0.518	0.000	351.3	310.406	OK
Manhole (9)	FEH: 100 years: +40 %: 15 mins: Summer	25.173	23.973	24.781	0.809	383.3	1.210	0.000	382.6	233.064	Surcharged
Manhole (10)	FEH: 100 years: +40 %: 15 mins: Summer	25.074	23.458	23.743	0.285	462.7	0.427	0.000	444.3	267.932	OK
Manhole (11)	FEH: 100 years: +40 %: 15 mins: Summer	25.330	24.130	24.175	0.045	10.9	0.067	0.000	10.6	4.780	OK
Manhole (12)	FEH: 100 years: +40 %: 15 mins: Summer	22.631	21.431	21.705	0.275	493.2	0.411	0.000	476.1	289.047	OK
Manhole (13)	FEH: 100 years: +40 %: 15 mins: Summer	20.898	19.698	20.132	0.433	484.4	0.648	0.000	468.7	292.720	OK
Manhole (14)	FEH: 100 years: +40 %: 30 mins: Summer	20.429	19.229	19.808	0.580	486.0	0.867	0.000	484.0	428.329	Surcharged
Manhole (15)	FEH: 100 years: +40 %: 60 mins: Summer	20.327	18.804	19.257	0.453	544.7	0.677	0.000	541.6	686.425	OK
Manhole (16)	FEH: 100 years: +40 %: 15 mins: Summer	20.776	19.576	19.637	0.061	30.1	0.092	0.000	29.7	13.143	OK
Manhole (17)	FEH: 100 years: +40 %: 360 mins: Summer	19.200	17.075	19.110	2.035	72.1	2.302	0.000	33.6	1170.347	Flood Risk

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
Pond	FEH: 2 years: +0 %: 240 mins: Summer	18.688	18.688	0.263	0.263	143.0	322.524	0.000	0.000	33.8	517.650	59.807	OK
Cellular Storage	FEH: 2 years: +0 %: 15 mins: Summer	17.175	17.175	0.000	0.000	0.0	0.000	0.000	0.000	0.0	0.000	100.000	OK

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
Pond	FEH: 30 years: +0 %: 240 mins: Winter	18.913	18.913	0.488	0.488	168.2	634.417	0.000	0.000	59.7	774.663	20.939	OK
Cellular Storage	FEH: 30 years: +0 %: 15 mins: Summer	17.175	17.175	0.000	0.000	0.0	0.000	0.000	0.000	0.0	0.000	100.000	OK

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
Pond	FEH: 100 years: +0 %: 240 mins: Summer	18.962	18.962	0.537	0.537	297.6	707.414	0.000	0.000	101.7	929.544	11.843	OK
Cellular Storage	FEH: 100 years: +0 %: 240 mins: Winter	17.360	17.360	0.185	0.185	71.6	143.674	0.000	0.000	0.0	0.000	75.341	OK

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

FEH: 100 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Avg. Depth

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
Pond	FEH: 100 years: +40 %: 120 mins: Summer	19.018	19.018	0.593	0.593	622.1	791.652	0.000	0.000	353.0	867.232	1.345	OK
Cellular Storage	FEH: 100 years: +40 %: 360 mins: Winter	17.924	17.924	0.749	0.749	166.6	581.007	0.000	0.000	0.0	0.000	0.282	OK

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Connections Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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
Pipe	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (1)	Manhole (1)	29.349	28.268	0.132	47.734	3.1	0.21	108.8	OK
Pipe (1)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (3)	Manhole (4)	27.855	26.695	0.043	1.813	0.6	0.04	4.0	OK
Pipe (2)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (4)	Manhole (5)	28.048	26.557	0.054	2.929	0.7	0.05	6.0	OK
Pipe (3)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (5)	Manhole (2)	28.170	26.099	0.125	5.402	0.4	0.1	10.8	OK
Pipe (4)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (1)	Manhole (2)	28.552	26.438	0.167	50.266	2.4	0.23	112.7	OK
Pipe (5)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (2)	Manhole (7)	27.994	26.004	0.190	56.617	2.2	0.44	121.6	OK
Pipe (6)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (6)	Manhole (7)	26.593	25.437	0.118	1.518	0.1	0.01	2.4	OK
Pipe (7)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (7)	Manhole (8)	26.759	25.434	0.174	59.268	2.1	0.32	120.9	OK
Pipe (8)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (8)	Manhole (9)	26.004	24.961	0.185	62.892	2.0	0.25	125.1	OK
Pipe (9)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (9)	Manhole (10)	25.173	24.185	0.178	66.510	2.2	0.39	126.1	OK
Pipe (10)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (11)	Manhole (10)	25.330	24.155	0.084	1.373	0.2	0.01	3.0	OK
Pipe (11)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (10)	Manhole (12)	25.074	23.601	0.138	76.472	3.4	0.2	142.4	OK
Pipe (12)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (12)	Manhole (13)	22.631	21.564	0.161	82.524	3.0	0.19	152.4	OK
Pipe (13)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (13)	Manhole (14)	20.898	19.887	0.202	83.534	1.9	0.23	149.2	OK
Pipe (14)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (14)	Manhole (15)	20.429	19.443	0.208	86.449	1.8	0.3	147.2	OK
Pipe (15)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (16)	Manhole (15)	20.776	19.610	0.118	3.779	0.3	0.01	8.5	OK
Pipe (16)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Manhole (15)	Pond	20.327	19.006	0.151	102.433	3.4	0.24	175.1	OK
Pipe (17)	FEH: 2 years: +0 %: 120 mins: Winter	Pipe	Pond	Manhole (17)	19.175	18.657	0.276	329.672	1.3	0.13	42.3	OK
Pipe (18)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.545	0.000	0.000	0.0	0	0.0	OK

Pipe (19)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.545	0.000	0.000	0.0	0	0.0	OK
Pipe (20)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.545	0.000	0.000	0.0	0	0.0	OK
Pipe (21)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.545	0.000	0.000	0.0	0	0.0	OK
Pipe (22)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.545	0.000	0.000	0.0	0	0.0	OK
Pipe (23)	FEH: 2 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.545	0.000	0.000	0.0	0	0.0	OK

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Connections Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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
Pipe	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole	Manhole (1)	29.349	28.328	0.212	97.243	3.5	0.43	222.1	OK
Pipe (1)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (3)	Manhole (4)	27.855	26.712	0.062	3.694	0.8	0.07	8.2	OK
Pipe (2)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (4)	Manhole (5)	28.048	26.578	0.088	5.954	0.7	0.11	12.6	OK
Pipe (3)	FEH: 30 years: +0 %: 30 mins: Summer	Pipe	Manhole (5)	Manhole (2)	28.170	26.116	0.164	15.388	0.4	0.16	17.8	OK
Pipe (4)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (1)	Manhole (2)	28.552	26.538	0.282	102.411	2.6	0.48	229.4	OK
Pipe (5)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (2)	Manhole (7)	27.994	26.136	0.310	115.375	2.5	0.88	242.0	OK
Pipe (6)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (6)	Manhole (7)	26.593	25.542	0.224	3.086	0.1	0.01	5.2	OK
Pipe (7)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (7)	Manhole (8)	26.759	25.541	0.273	120.815	2.4	0.65	244.9	OK
Pipe (8)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (8)	Manhole (9)	26.004	25.051	0.293	128.254	2.3	0.5	255.3	OK
Pipe (9)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (9)	Manhole (10)	25.173	24.311	0.278	135.695	2.5	0.8	259.0	OK
Pipe (10)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (11)	Manhole (10)	25.330	24.164	0.126	2.789	0.2	0.02	6.2	OK
Pipe (11)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (10)	Manhole (12)	25.074	23.675	0.211	156.053	4.0	0.41	294.8	OK
Pipe (12)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (12)	Manhole (13)	22.631	21.636	0.255	168.425	3.4	0.39	316.5	OK
Pipe (13)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (13)	Manhole (14)	20.898	20.002	0.324	170.510	2.2	0.49	311.0	OK

Pipe (14)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (14)	Manhole (15)	20.429	19.573	0.329	176.568	2.2	0.64	309.5	OK
Pipe (15)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (16)	Manhole (15)	20.776	19.623	0.180	7.687	0.3	0.03	17.4	OK
Pipe (16)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Manhole (15)	Pond	20.327	19.117	0.233	209.196	4.0	0.51	369.7	OK
Pipe (17)	FEH: 30 years: +0 %: 15 mins: Winter	Pipe	Pond	Manhole (17)	19.175	18.673	0.292	36.674	0.6	0.19	59.9	OK
Pipe (18)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.671	0.000	0.000	0.0	0	0.0	OK
Pipe (19)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.671	0.000	0.000	0.0	0	0.0	OK
Pipe (20)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.671	0.000	0.000	0.0	0	0.0	OK
Pipe (21)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.671	0.000	0.000	0.0	0	0.0	OK
Pipe (22)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.671	0.000	0.000	0.0	0	0.0	OK
Pipe (23)	FEH: 30 years: +0 %: 15 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.671	0.000	0.000	0.0	0	0.0	OK

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Connections Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

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
Pipe	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole	Manhole (1)	29.349	28.353	0.236	118.952	3.7	0.52	269.4	OK
Pipe (1)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (3)	Manhole (4)	27.855	26.719	0.069	4.524	0.8	0.09	10.1	OK
Pipe (2)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (4)	Manhole (5)	28.048	26.584	0.151	7.295	0.7	0.14	15.8	OK
Pipe (3)	FEH: 100 years: +0 %: 30 mins: Summer	Pipe	Manhole (5)	Manhole (2)	28.170	26.137	0.199	19.102	0.4	0.2	22.2	OK
Pipe (4)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (1)	Manhole (2)	28.552	26.561	0.375	125.230	2.7	0.61	293.1	OK
Pipe (5)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (2)	Manhole (7)	27.994	26.356	0.375	141.243	2.5	1	277.9	Surcharged
Pipe (6)	FEH: 100 years: +0 %: 15 mins: Winter	Pipe	Manhole (6)	Manhole (7)	26.593	25.566	0.246	3.771	0.1	0.02	8.0	OK
Pipe (7)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (7)	Manhole (8)	26.759	25.572	0.301	147.917	2.5	0.74	278.6	OK
Pipe (8)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (8)	Manhole (9)	26.004	25.077	0.330	157.015	2.4	0.58	294.1	OK
Pipe (9)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (9)	Manhole (10)	25.173	24.359	0.314	166.147	2.6	0.94	304.1	OK
Pipe (10)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (11)	Manhole (10)	25.330	24.168	0.140	3.415	0.2	0.02	7.5	OK
Pipe (11)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (10)	Manhole (12)	25.074	23.700	0.237	191.088	4.1	0.49	352.0	OK
Pipe (12)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (12)	Manhole (13)	22.631	21.663	0.291	206.218	3.5	0.47	380.3	OK
Pipe (13)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (13)	Manhole (14)	20.898	20.049	0.375	208.786	2.3	0.59	375.9	OK

Pipe (14)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (14)	Manhole (15)	20.429	19.628	0.378	216.225	2.3	0.78	376.6	OK
Pipe (15)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (16)	Manhole (15)	20.776	19.628	0.204	9.388	0.3	0.03	21.2	OK
Pipe (16)	FEH: 100 years: +0 %: 15 mins: Summer	Pipe	Manhole (15)	Pond	20.327	19.161	0.268	256.133	4.1	0.63	452.7	OK
Pipe (17)	FEH: 100 years: +0 %: 60 mins: Winter	Pipe	Pond	Manhole (17)	19.175	18.939	0.450	191.201	2.0	0.91	293.0	Surch arged
Pipe (18)	FEH: 100 years: +0 %: 240 mins: Winter	Pipe	Pond	Cellular Storage	19.175	18.962	0.096	29.076	4.8	0.14	14.3	OK
Pipe (19)	FEH: 100 years: +0 %: 240 mins: Winter	Pipe	Pond	Cellular Storage	19.175	18.962	0.096	19.758	3.4	0.15	9.8	OK
Pipe (20)	FEH: 100 years: +0 %: 240 mins: Summer	Pipe	Pond	Cellular Storage	19.175	18.962	0.089	17.433	3.1	0.15	9.3	OK
Pipe (21)	FEH: 100 years: +0 %: 240 mins: Winter	Pipe	Pond	Cellular Storage	19.175	18.962	0.096	25.041	4.2	0.15	12.6	OK
Pipe (22)	FEH: 100 years: +0 %: 240 mins: Winter	Pipe	Pond	Cellular Storage	19.175	18.962	0.096	26.752	4.5	0.15	13.4	OK
Pipe (23)	FEH: 100 years: +0 %: 240 mins: Winter	Pipe	Pond	Cellular Storage	19.175	18.962	0.096	24.279	4.1	0.15	12.2	OK

Residential Development at Gwynfaen 2:	Date: 17/06/2024		
	Designed by: SP	Checked by: ML	Approved By: ML
Report Details: Type: Connections Summary Storm Phase: Phase	Hydrock now Stantec: 13 Wharton Street Cardiff CF10 1GS		

FEH: 100 years: Increase Rainfall (%): +40: 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
Pipe	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole	Manhole (1)	29.349	28.455	0.375	166.351	3.2	0.69	358.1	OK
Pipe (1)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (3)	Manhole (4)	27.855	26.725	0.146	6.384	0.6	0.11	12.5	OK
Pipe (2)	FEH: 100 years: +40 %: 30 mins: Summer	Pipe	Manhole (4)	Manhole (5)	28.048	26.609	0.300	14.431	0.7	0.14	15.8	OK
Pipe (3)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (5)	Manhole (2)	28.170	26.926	0.300	19.212	1.0	0.41	45.2	Surcharged
Pipe (4)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (1)	Manhole (2)	28.552	27.469	0.375	175.409	3.4	0.79	379.7	Surcharged
Pipe (5)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (2)	Manhole (7)	27.994	26.907	0.375	197.842	3.3	1.3	359.6	Surcharged
Pipe (6)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (6)	Manhole (7)	26.593	25.674	0.355	5.295	0.2	0.03	9.8	OK
Pipe (7)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (7)	Manhole (8)	26.759	25.705	0.401	207.164	2.6	0.96	360.3	Surcharged
Pipe (8)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (8)	Manhole (9)	26.004	25.126	0.450	219.832	2.5	0.78	397.6	OK
Pipe (9)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (9)	Manhole (10)	25.173	24.781	0.450	233.064	2.4	1.18	382.6	Surcharged
Pipe (10)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (11)	Manhole (10)	25.330	24.175	0.165	4.780	0.2	0.03	10.6	OK
Pipe (11)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (10)	Manhole (12)	25.074	23.743	0.280	267.932	4.3	0.62	444.3	OK
Pipe (12)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (12)	Manhole (13)	22.631	21.705	0.354	289.047	3.5	0.58	476.1	OK
Pipe (13)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (13)	Manhole (14)	20.898	20.132	0.475	292.720	2.3	0.74	468.7	OK

Pipe (14)	FEH: 100 years: +40 %: 30 mins: Summer	Pipe	Manhole (14)	Manhole (15)	20.429	19.808	0.513	428.329	2.3	1	484.0	Surcharged
Pipe (15)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (16)	Manhole (15)	20.776	19.637	0.246	13.143	0.3	0.05	29.7	OK
Pipe (16)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (15)	Pond	20.327	19.235	0.374	358.960	4.3	0.81	587.5	OK
Pipe (17)	FEH: 100 years: +40 %: 120 mins: Winter	Pipe	Pond	Manhole (17)	19.175	19.010	0.450	403.782	1.2	0.23	74.8	Surcharged
Pipe (18)	FEH: 100 years: +40 %: 120 mins: Summer	Pipe	Pond	Cellular Storage	19.175	19.018	0.150	88.672	6.7	0.61	61.0	OK
Pipe (19)	FEH: 100 years: +40 %: 120 mins: Summer	Pipe	Pond	Cellular Storage	19.175	19.018	0.150	61.367	4.8	0.69	46.7	OK
Pipe (20)	FEH: 100 years: +40 %: 120 mins: Summer	Pipe	Pond	Cellular Storage	19.175	19.018	0.150	58.190	4.6	0.7	44.7	OK
Pipe (21)	FEH: 100 years: +40 %: 120 mins: Summer	Pipe	Pond	Cellular Storage	19.175	19.018	0.150	77.036	5.9	0.65	55.5	OK
Pipe (22)	FEH: 100 years: +40 %: 120 mins: Summer	Pipe	Pond	Cellular Storage	19.175	19.018	0.150	81.984	6.3	0.63	57.9	OK
Pipe (23)	FEH: 100 years: +40 %: 120 mins: Summer	Pipe	Pond	Cellular Storage	19.175	19.018	0.150	74.822	5.8	0.65	54.3	OK