Rockfield Road, Monmouth – Phase 2

FLOOD CONSEQUENCE ASSESSMENT

11438 FCA01 Rv1

Date: 23.06.25

Hallam Land

Document Control Sheet

Document Title	Flood Consequence Assessment
Document Ref	11438 FCA01 Rv1
Project Name	Rockfield Road, Monmouth – Phase 2
Project Number	11438
Client	Hallam Land

Document Status

Rev	Issue Status	Prepared / Date	Checked / Date	Approved / Date
0	Draft	K. Peers 30.05.25	A. Wilkinson 18.04.25	A. Wilkinson 18.04.25
1	Draft	K. Peers 23.06.25	A. Wilkinson 23.06.25	A. Wilkinson 23.06.25

Issue Record

Name / Date & Revision	18.06.25	23.06.25				
Hal Parsons – Hallam Land	0	1				

Executive Summary

Development Summary and Existing Conditions Overview		Section
Development Summary	Planning for 130 dwellings across 2 phases; • Phase 1: 70 units, submitted as an outline planning permission reference DC/2017/00539 granted Feb 2019. Live Reserved Matters application M/2019/02060, and; • Phase 2: 60 units.	1
Existing Land Use	The entire Site is currently undeveloped agricultural land, which is not thought to have been historically subject to any significant built development.	3

Baseline Conditions		Section
Existing Watercourses	There is an existing land drainage channel that flows along the eastern boundary of the Site, while a field drain exists just outside the south-western boundary of the Site, conveying storm water flows from a small catchment in the easternmost part of the Site.	2
Topography	At the northern boundary, levels fall from a high point of approximately 29m AOD to a low point of approximately 24m AOD to the south by Hamilton Way, within the wider development Site.	3
Geology	With reference to the British Geological Survey map, the Site is shown to be underlain by siltstone and mudstone bedrock geology belonging to the Raglan Mudstone Formation, with River Terrace Deposits of sand and gravel across the majority of the Site.	3
Hydrogeology	The underlying bedrock and superficial geology forms a Secondary A Aquifer and is shown to be situated within a 'high and medium-high risk', in terms of groundwater vulnerability	3

Flood Risk			
Mechanisms	Potential	Comment	Section
Coastal & Tidal	N	The Site lies approximately 17.8km north from the nearest tidal watercourse and lies at a minimum of circa 24m above ordnance datum and therefore, has a very low risk of coastal flooding.	4
Fluvial	N	The entire Site lies within Flood Zone 1.	4
Overland Flow (Pluvial)	Y	There are areas of very low risk across the majority of the Site, with a low to high risk of flooding within and adjacent to the drainage channel located along western boundary of the Site.	4
Reservoirs, Canals etc	N	The Site is approximately 1km north from the nearest extent of reservoir flooding.	4
Sewers	N	A Site walk over inspection does not suggest any material problem with sewer flooding.	4
Groundwater	Y	The Site specific ground investigation produced for the scheme finds shallow ground water in the west of the entire Site (Phase 2).	4

Drainage Strategy		**Section**
Surface Water Drainage		
Discharge Method	Surface water will discharge through a conveyance swale and detention SuDS basins before discharging into the drainage channel along the eastern boundary.	7
Pre Development Conditions	The existing runoff rate for the Site is 5.78 l/s for the 1 year storm event and 14.35 l/s for the 100 year storm event.	7
Post Development Conditions	Surface water will be restricted to the Qbar discharge rate of 2.14 l/s/ha, which gives a final Site discharge rate of 6.57 l/s.	7
Foul Drainage		
Discharge Method	It is anticipated that foul water from the scheme shall discharge to Monmouth Wastewater Treatment Works. A Developer Services Hydraulic Modelling Report was completed by Welsh Water in December 2018, which identifies a proposed connection point at manhole SO49136305 located on Levitsfield Close to the south east of the development, connecting via gravity, to an existing 150mm foul sewer.	9

Contents

Figures

Tables

Appendices

1 Introduction

1.1.1.1 Brookbanks is appointed by Hallam Land to complete a Flood Consequence Assessment (FCA) for a proposed residential development at Rockfield Road, Monmouth.

1.1.1.2 The overall development (illustrated in **Appendix A**) is to comprise of:

130 dwellings across 2 phases;

- *Phase 1: 70 units, submitted as an outline planning permission reference DC/2017/00539 granted Feb 2019. Live Reserved Matters application M/2019/02060, and;*
- *Phase 2: 60 units*

This report focuses on the 60 units proposed for Phase 2 of the development.

1.1.1.3 This document forms an FCA, to accord with alterations in local and national planning requirements as well as updates to Natural Resources Wales (NRW) requirements. The objective of the study is to demonstrate the development proposals are acceptable from a flooding risk and drainage perspective.

1.1.1.4 This report summarises the findings of the study and specifically addresses the following issues in the context of the current legislative regime:

- Flood risk,
- Surface water drainage,
- Foul water drainage.

1.2 Planning Application

1.2.0.5 This FCA for Phase 2 has been produced in order to provide information to support a LDP candidate Site submission. As highlighted in the above section, Phase 1 land, which is to the immediate east of Phase 2 land has the benefit of an outline planning permission granted in 2019, now subject to a live Reserved Matters application.

1.2.0.6 This report sets out to illustrate that potential flooding can be managed appropriately and a drainage strategy can be successfully designed and constructed for the proposed development of this Phase 2 scheme.

1.2.0.7 The FCA will then be the utilised for a planning application where detailed design layouts and criteria will be provided at the appropriate time.

2 Site Context

2.1 Location

2.1.0.1 The proposed development lies approximately 1.8km to the north west of the centre of Monmouth. The B4233 Rockfield Road bounds the east of the Site, which links Monmouth to the nearby villages of Rockfield, Maypole, Newcastle and Crossway. A relatively recent residential development lies immediately southwest of the Site. Agricultural fields bound the land to the northeast and northwest.

2.2 Existing Site Drainage

2.2.0.2 There is an existing land drainage channel that flows along the eastern boundary of the Site, adjacent to Rockfield Road. The channel/watercourse follows the route of Rockfield Road, flowing in a south easterly direction, to a confluence with the Watery Lane Stream before flowing into the River Monnow approximately 200m upstream of the Monnow Bridge. In the region of the Site, the Rockfield Road watercourse is a well-defined and maintained channel. Downstream of the Site, lengths of the watercourse are culverted.

2.2.0.3 The residential development to the southeast of the proposed development relies on a drainage strategy that included the construction of a new watercourse/swale through the development, designed to both convey and attenuate storm water before discharge to the Watery Lane Stream. The 'development watercourse' is engineered in nature due to the voluminous, well defined and maintained channel profile routing through the development.

2.2.0.4 The Watery Lane Stream flows approximately 410m south of the Site, through the residential developments. The 'development watercourse' meets with the Watery Lane Stream, approximately 20m west of the junction of Brook Crescent with Watery Lane. As of 2016, an overflow channel has been employed to control the discharge of storm water from the 'development watercourse' to the Watery Lane Stream.

2.2.0.5 A field drain exists just outside the south-western boundary of the Site, conveying storm water flows from a small catchment in the easternmost part of the Site. The drain flows in an southeasterly direction before crossing the aforementioned land and conveying flows through the Rockfield Estate to meet the 'development watercourse'.

2.2.0.6 The closest main river is the River Monnow, which flows approximately 370m north of the Site.

2.2.0.7 The Site location and drainage features are shown indicatively on **Figure 2-1.**

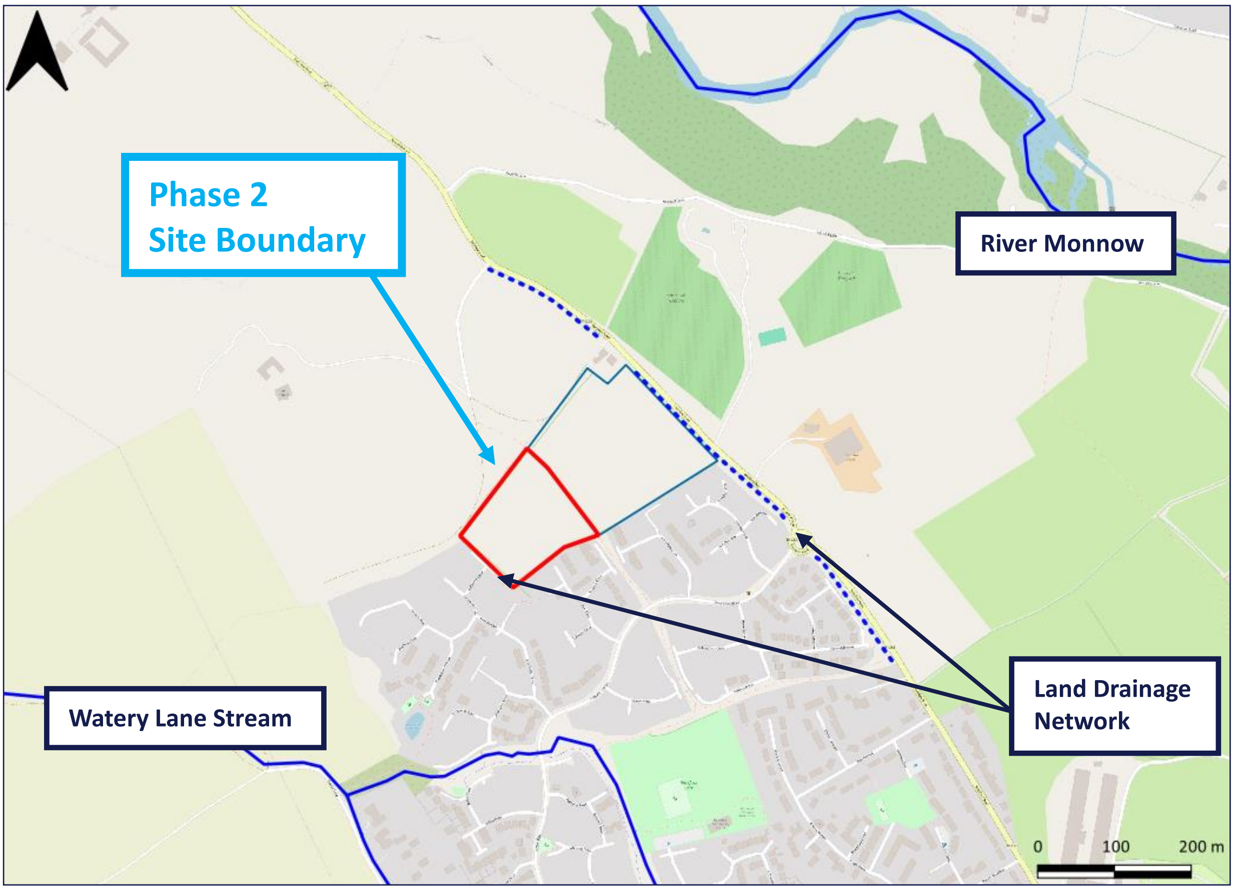


Figure 2-1: Site Location and Existing Drainage

3 Baseline Conditions

3.1 Present Day

3.1.0.1 The entire Site is currently undeveloped agricultural land, which is not thought to have been historically subject to any significant built development.

3.2 Topography

3.2.0.2 The development land is located to the west of the nearby River Monnow, on the western extents of the River Wye Valley. The topography across the entire Site is characterised by a sweeping gradient falling at approximately 1 in 65m in a south easterly direction from Croft-y-Bwla Lodge on the northeast boundary of the development, to a low point at the rear of the properties fronting Hamilton Way along the southwest boundary of the development.

3.2.0.3 At the northern boundary, levels fall from a high point of approximately 29m AOD to a low point of approximately 24m AOD to the south by Hamilton Way, within the wider development Site.

3.3 Geology

3.3.0.4 With reference to the British Geological Survey map, the Site is shown to be underlain by siltstone and mudstone bedrock geology belonging to the Raglan Mudstone Formation, with River Terrace Deposits of sand and gravel across the majority of the Site.

3.3.0.5 The Site Geology is illustrated below on **Figures 3-2 and 3-3**.

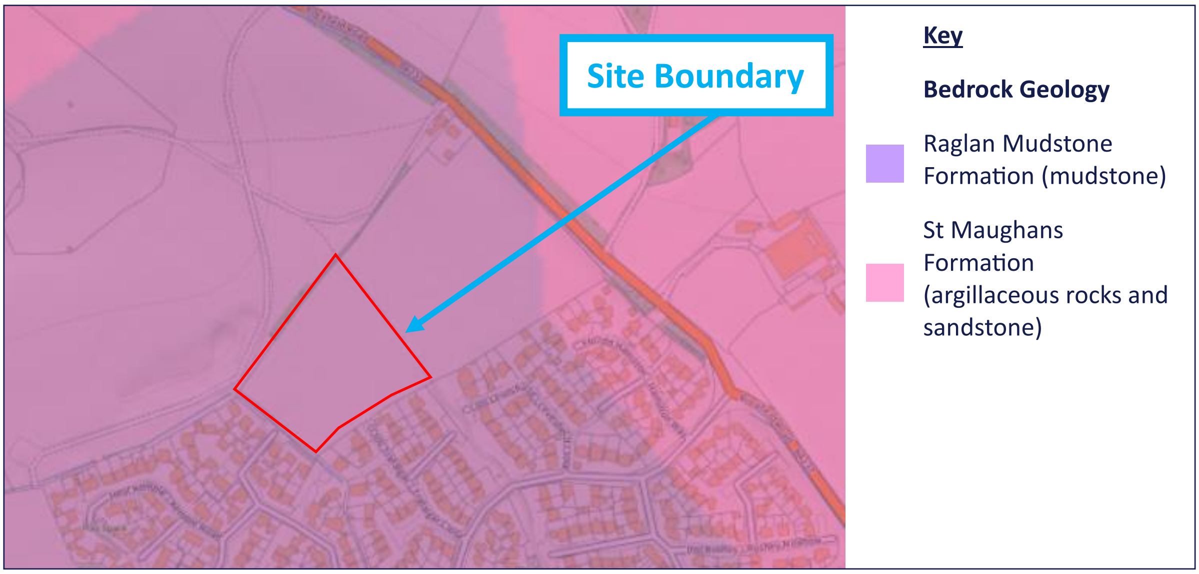


Figure 3-1: BGS Published Bedrock Geology (2025)

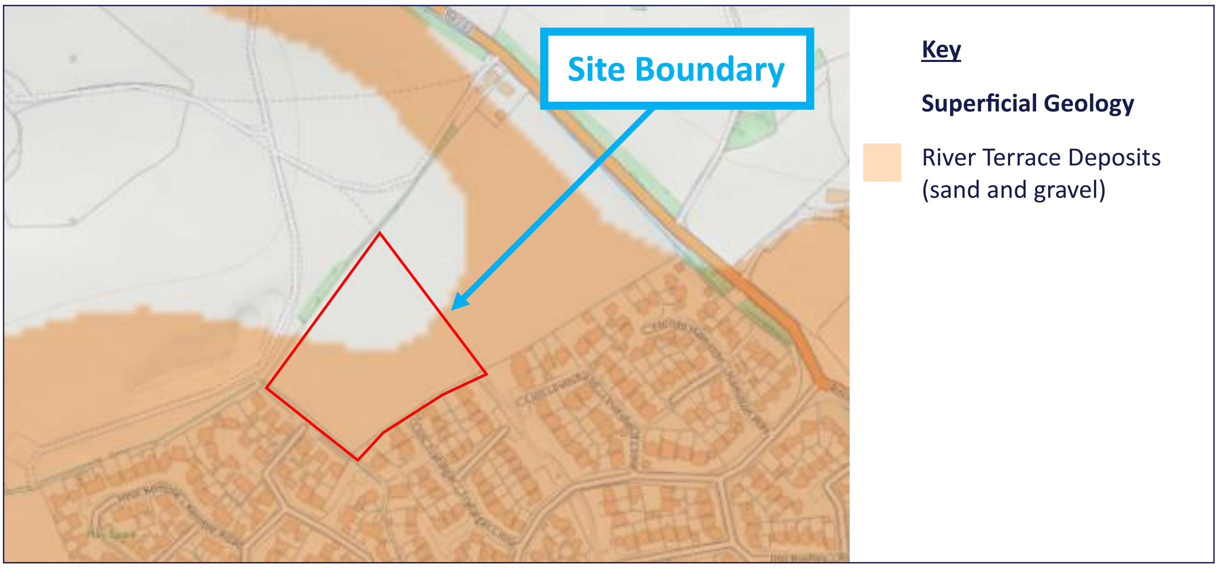


Figure 3-2: BGS Published Superficial Geology (2025)

3.4 Hydrogeology

3.4.1 Aquifers

3.4.1.6 Aquifers form a body of porous rock which can contain or transmit groundwater and are categorised into four types. The type of aquifer is defined by the "geological characteristics, how much groundwater it is possible to extract, and how easily and how much they support river flows and habitats."

3.4.1.7 The underlying bedrock and superficial geology forms a Secondary A Aquifer.

Secondary Aquifers *- These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage.*

Secondary A *- permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.*

3.4.2 Groundwater Vulnerability

3.4.2.8 The vulnerability of groundwater is determined by its risk of pollution. The risk of pollution is determined by the:

- *physical, chemical and biological properties of the underlying soil and rocks*
- *depth and quality of soil*
- *presence of glacial sediment and other materials – known as 'drift'*
- *depth of the unsaturated zone*

3.4.2.9 The NRW Groundwater Vulnerability Zones (GVZ) Mapping summarises the overall risk to groundwater, taking into account groundwater vulnerability, the types of aquifer present (superficial and/or bedrock) and their designation status, as discussed previously.

3.4.2.10 The Site is shown to be situated within a 'high and medium-high risk', in terms of groundwater vulnerability.

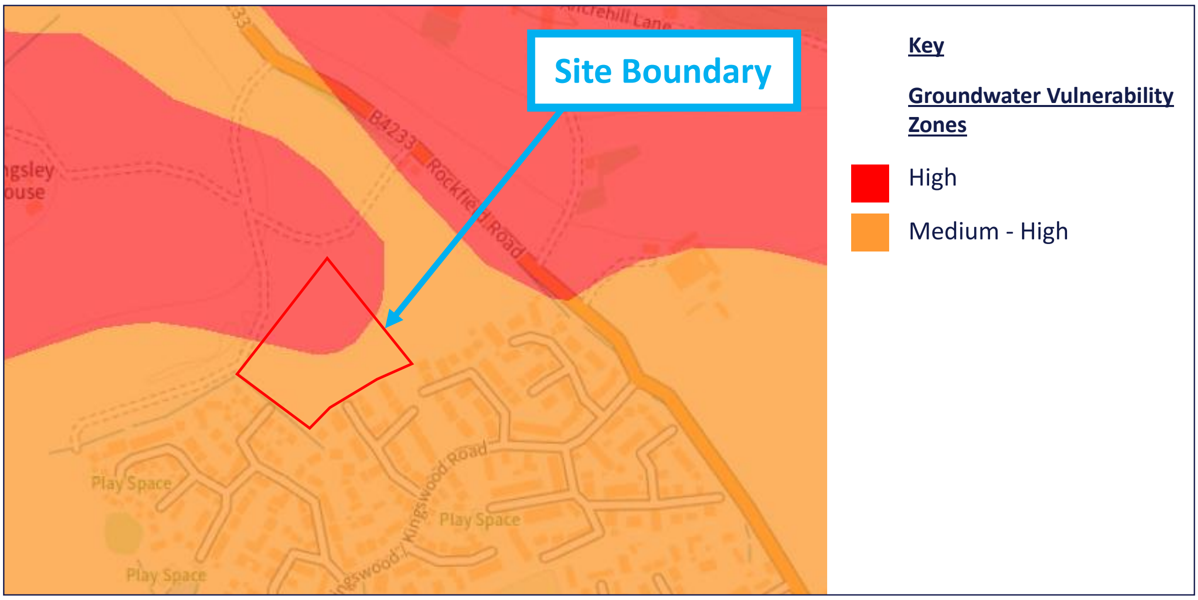


Figure 3-3: Groundwater Vulnerability Map (NWW, Interactive Map Viewer, 2025)

3.5 Source Protection Zone

3.5.2.11 The Site does not lie within a source protection zone, but there is a Zone III – Total Catchment Area located approximately 2km north of the Site.

4 Flood Risk

4.1.1.1 Having completed a Site hydrological desk study, the possible flooding mechanisms at the Site are identified as follows.

4.2 Fluvial Flooding

4.2.0.2 The Flood Map for Planning mapping illustrated on **Figure 4-1** shows that the entire Site lies within Flood Zone 1; being an area with less than 1 in 1000 (0.1%) (plus climate change) chance of flooding in a given year.

Figure 4-1: Flood Map for Planning Wales – Rivers and Seas (May, 2025)

4.3 Pluvial Flooding

4.3.0.3 The Flood Map for Planning mapping on **Figure 4-2** illustrates areas of very low risk across the majority of the Site, with a low to high risk of flooding within and adjacent to the drainage channel located along western boundary of the Site.

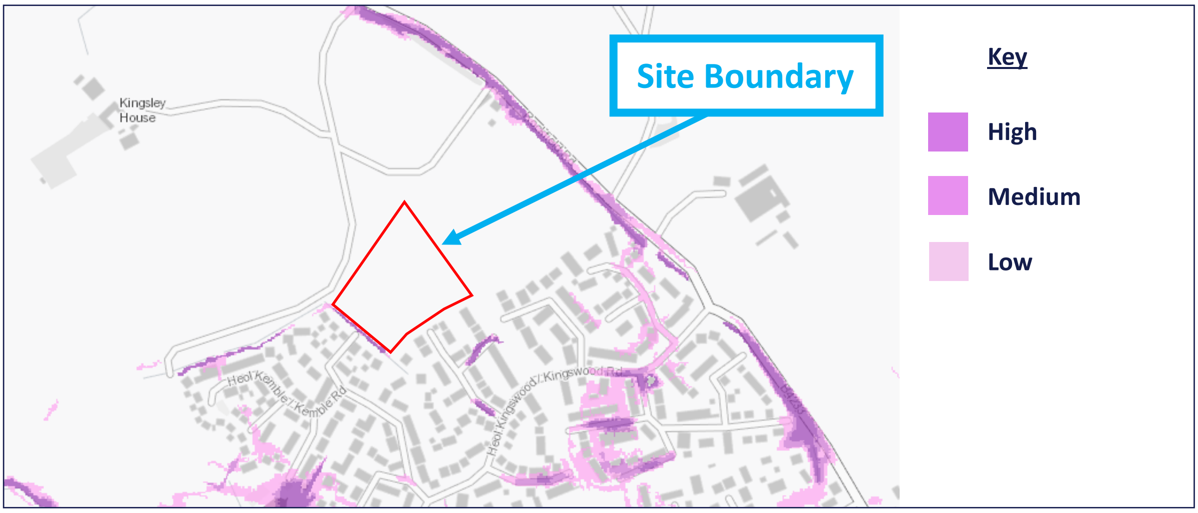


Figure 4-2: Flood Map for Planning Wales – Surface Water and Small Watercourse (May, 2025)

4.3.0.4 Overland flow mechanisms result from the inability of unpaved ground to infiltrate rainfall or due to inadequacies of drainage systems in paved areas to accommodate flow directed to gullies, drainage downpipes or similar. In minor cases, local ponding may occur. In more extreme events, flows accumulate and may be conveyed across land following the topography.

4.4 Coastal Flooding

4.4.0.5 Coastal flooding affects low-lying coastal land which becomes submerged by seawater through high tides, storm surges or rising sea levels.

4.4.0.6 The Site lies approximately 17.8km north from the nearest tidal watercourse and lies at a minimum of circa 24m above ordnance datum and therefore, has a very low risk of coastal flooding.

4.5 Artificial Water Bodies

4.5.0.7 Non-natural or artificial sources of flooding comprise of reservoirs, canals and lakes where water is retained at or above the natural ground level. Artificial water bodies have the potential to cause flooding due to the release of large volumes of water, resulting from a dam, bank or lock failure.

4.5.0.8 The Site is approximately 1km north from the nearest extent of reservoir flooding.

4.6 Sewerage Systems

4.6.0.9 A copy of the Dwr Cymru Welsh Water (DCWW) sewerage network records has been obtained to confirm the presence of adopted foul sewers in the vicinity of the Site.

4.6.0.10 Adopted and unadopted private foul sewers service the Rockfield Estate to the south of the Site. DCWW also confirms that they have adopted foul sewers in Rockfield Road and report no problems in their adjacent network.

4.6.0.11 A Site walk over inspection does not suggest any material problem with sewer flooding. Residents of the southern development anecdotally report of sewer surcharging due to the backwater effects of high water levels in the ‘development watercourse’ during extreme storm events. Welsh Water has been contacted regarding their public sewerage networks and no flooding is reported

4.7 Groundwater

4.7.0.12 Groundwater flooding is characterised by low-lying areas often associated with shallow unconsolidated sedimentary aquifers which overly non-aquifers. These aquifers are reported to be susceptible to flooding, especially during the winter months, due to limited storage capacity.

4.7.0.13 The Site specific ground investigation produced for the scheme finds shallow ground water in the west of the entire Site (Phase 2).

5 Planning Policy

5.1 Planning Policy Wales (PPW)

5.1.0.1 PPW was first published in December 2018, with the latest updated published in July 2024.

5.1.1 Flood Risk

5.1.1.2 Paragraphs 6.6.25 to 6.6.27 of the PPW state that:

Development should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development Site itself. The priority should be to protect the undeveloped or unobstructed floodplain from development and to prevent the cumulative effects of incremental development.

In areas of flood plain currently unobstructed, where water flows in times of flood, built development should be wholly exceptional and limited to essential transport and utilities infrastructure. Such infrastructure should be designed and constructed so as to remain operational even at times of flood, to result in no net loss of floodplain storage, to not impede water flows and to not increase flood risk elsewhere. TAN 15: Development and Flood Risk should be referred to for further policy advice on development and flood risk. It will be important to note that developments located within flood risk areas remain at risk from flooding even if mitigation measures are applied.

Planning authorities should be aware of the risk of surface water flooding, usually caused by heavy rainfall, and ensure developments are designed and planned to minimise potential impacts. Development should not cause additional run-off, which can be achieved by controlling surface water as near to the source as possible by the use of SuDS. Care should be taken in places of shallow groundwater or where flooding is caused by combined surface and groundwater processes. In such situations direct infiltration SuDS may not be appropriate. Consultation with drainage bodies and NRW should be undertaken and relevant evidence and information drawn from Area Statements taken into account.

5.1.2 Sustainable Drainage Systems

5.1.2.3 The approval and adoption of SuDS lies with the SuDS Approving Body (SAB), which is independent of the planning process.

5.1.2.4 All new developments of more than one dwelling or where the area covered by construction work equals or exceeds 100m² require SuDS and therefore, require planning approval from the SAB, along with adoption and management arrangements.

5.2 Technical Advice Notice (TAN) 15

5.2.2.5 Within Wales allocation and planning of development must be considered in the context of Flood Risk using, Planning Policy Wales which is supplemented in terms of flood risk by TAN15: Development, Flooding and Coastal Erosion.

5.2.2.6 First published in July 2004, the latest updates to TAN15 were published in March 2025, with the aim of the providing guidance on the polices set out in the PPW.

5.2.2.7 NRW are responsible for updating the flood map for planning flood zones, while the definitions for these zones are outlined within TAN15 and are as follows:

Flood Zone	Flooding from Rivers	Flooding from the Sea	Flooding from Surface Water and Small Watercourses
Zone 1	Less than 1 in 1000 (0.1%) (plus climate change) chance of flooding in a given year.		
Zone 2	Less than 1 in 100 (1%) but greater than 1 in 1000 (0.1%) chance of flooding in a given year, including climate change.	Less than 1 in 200 (0.5%) but greater than 1 in 1000 (0.1%) chance of flooding in a given year, including climate change.	Less than 1 in 100 (1%) but greater than 1 in 1000 (0.1%) chance of flooding in a given year, including climate change.
Zone 3	A greater than 1 in 100 (1%) chance of flooding in a given year, including climate change.	A greater than 1 in 200 (0.5%) chance of flooding in a given year, including climate change.	A greater than 1 in 100 (1%) chance of flooding in a given year, including climate change.
TAN 15 Defended Zones	Areas where flood risk management infrastructure provides a minimum standard of protection against flooding from rivers of 1:100 (plus climate change and freeboard).	Areas where flood risk management infrastructure provides a minimum standard of protection against flooding from the sea of 1:200 (plus climate change and freeboard).	Not applicable.

Table 5-1: TAN15 Figure 1 - Definition of Flood Map for Planning Flood Zones

5.2.2.8 **Zone 1**: Planning authorities should prioritise all types of development to Zone 1. Any allocation must be fully justified and should support the delivery of the LDP strategy. Greenfield land provides important capacity or space to manage or slow the flow of flood water. Once land becomes developed, it has a reduced ability to store excess water, in particular during floods of a higher magnitude and high intensity rainfall events.

5.2.2.9 **Zone 2**: Allocations may be made for new development and redevelopment of any vulnerability that is necessary to implement the strategy of an LDP, a strategy to regenerate or revitalise existing settlements or to achieve key economic or environmental objectives, provided that a Strategic Flood Consequences Assessment has identified an acceptable level of risk.

5.2.2.10 **Zone 3**: Allocations for highly vulnerable new development must not be made as the risks and consequences of flooding are not considered acceptable for these types of development. Allocations for less vulnerable new development should only be made in exceptional circumstances.

5.3 Local Policy

5.3.3 Monmouthshire County Council Local Development Plan

5.3.3.11 Monmouthshire County Council (MCC) produced a Local Development Plan (LDP) in September 2011, adopted on the 27th February 2014.

5.3.3.12 MCC are currently in the process of preparing a Replacement Local Development Plan for the period 2018 – 2033. The Preferred Strategy was consulted on between 5th December 2022 and 30th January 2023 but is yet to be adopted. Therefore this report reviews the LDP adopted in 2014 to ensure compliance with local policy at the time of writing.

5.3.3.13 Policies relevant to this FCA include:

- Policy S12 - Efficient Resource Use and Flood Risk
- Policy SD3 - Flood Risk Assessment
- Policy SD4 - Sustainable Drainage

Policy S12 - Efficient Resource Use and Flood Risk

All new development must:

- *Demonstrate sustainable and efficient resource use – this will include energy efficiency/ increasing the supply of renewable energy, sustainable construction materials/ techniques, water conservation/ efficiency and waste reduction;*

- *Avoid the siting of inappropriate development in areas at risk of flooding.*

Policy SD3 - Flood Risk

Proposals for highly vulnerable development or emergency services will not be permitted in areas which may be liable to flooding, unless the residential development is for the conversion of upper floors within defined settlement boundaries or the proposal is to extend an established tourism, leisure or educational establishment. Less vulnerable built development will be permitted within defined settlements or on Sites allocated for uses such as employment. Development proposals within a flood plain will be required to demonstrate that:

a) the development is or can be protected by approved engineering works and / or other flood protection measures;

b) such remedial measures would not cause flooding or significantly increase the risk of flooding elsewhere;

c) the development, including any remedial measures, can be sympathetically assimilated into the environment in terms of its siting, scale, design and landscaping;

d) the development does not interfere with the ability of the Environment Agency or other bodies to carry out flood control works or maintenance; and e) the nature conservation interest of the water source corridor is protected and, where practicable, enhanced.

Development resulting in additional surface water run-off and leading to an increased risk of flooding will only be permitted where adequate protection and mitigation measures are included as part of the proposal.

Policy SD4 - Sustainable Drainage

Development proposals will be expected to incorporate water management measures, including Sustainable Urban Drainage Systems (SUDS), to reduce surface water run-off and minimise its contribution to flood risk elsewhere.

6 Surface Water Drainage

6.1.1.1 The Site is currently greenfield, and currently storm water drains to the ground and into the existing ordinary watercourse along the eastern boundary of the Site.

6.2 SuDS Components

6.2.0.2 It is proposed to implement a Sustainable Drainage Systems (SuDS) scheme consistent with local and national policy at the proposed development. The CIRIA SuDS Manual 2015 offers comprehensive guidance on the design of SuDS, and the four pillars of SuDS design are illustrated in **Figure 6-1**.

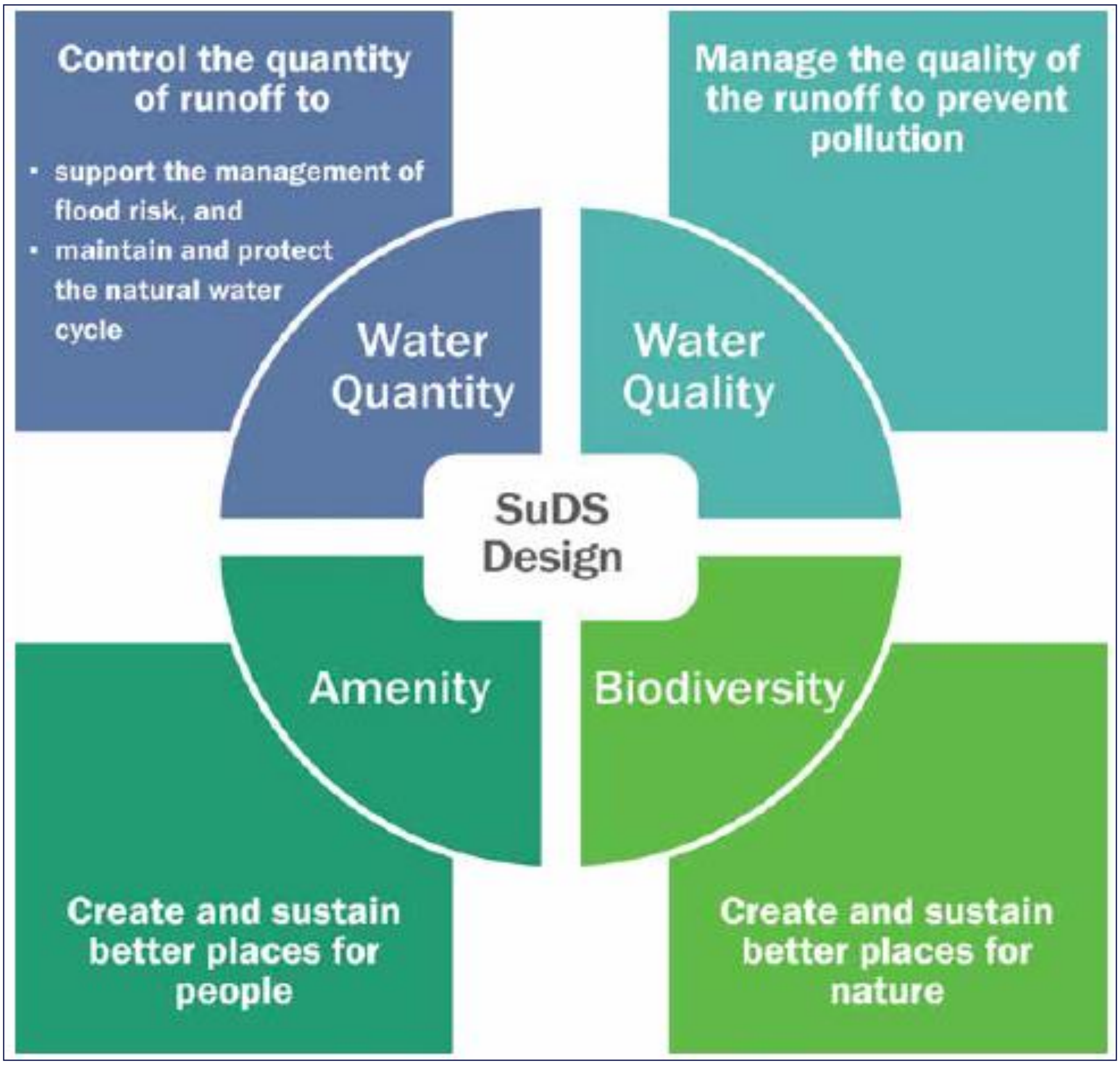


Figure 6-1: Four Pillars of SuDS from SuDS Manual Executive Summary

6.2.0.3 SuDS are about minimising the effect of the built environment on the natural water cycle, and the fundamental purpose of a SuDS solution is to enable a developed Site to handle rainfall and surface water runoff as if it were still a greenfield Site. To achieve this, SuDS will be designed to mimic natural drainage by managing surface water runoff as close to the source and the surface as possible, rather than overwhelming stormwater drains and risking flooding.

6.2.0.4 At the head of the drainage network, across the Site, source control measures will be implemented to reduce the amount of run-off being conveyed directly to piped drainage systems. These can include in-parcel SuDS measures such as those described in **Table 6-1**.

6.2.0.5 Through future consultations with the LLFA at outline planning stage, the nature of source control measures will be developed and implemented and will need to remain flexible, providing each house builder with a 'toolkit' of options to reach an agreed target for discharge reduction and water treatment.

6.2.0.6 **Table 6-1** is an extract of Table C from the CIRIA SuDS Manual C753, which outlines a number of SuDS options available.

Component Types	Description	Collection Mechanism	Design Criteria					
			Water Quantity					
			Peak Runoff Rate	Runoff Volumes		Water Quality	Amenity	Biodiversity
				Small Events	Large Events			
Rainwater Harvesting Systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		●	●		●	
Green Roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	●		●	●	●
Infiltration Systems	Systems that collect and store runoff, allowing it to infiltrate into the ground	P	●	●	●	●	●	●
Proprietary Treatment System	Subsurface structures designed to provide treatment of runoff	P				●		
Filter Strips	Grass strips that promote sedimentation and filtration as runoff is conveyed over the surface	L		●		●	○	○
Filter Drains	Shallow stone filled trenches that provide attenuation, conveyance and treatment of runoff	L	●	○		●	○	○
Swales	Vegetated channels (sometimes planted) used to convey and treat runoff	L	●	●	●	●	●	●
Bioretention Systems	Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils	P	●	●	●	●	●	●

Trees	Trees within soil-filled tree pots, tree planters or structural soils used to collect, store and treat runoff	P	●	●		●	●	●
Pervious Pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	S	●	●	●	●	○	○
Attenuation Storage Tanks	Large, below ground voided spaces used to temporarily store runoff before infiltration, controlled release or use	P	●					
Detention Basins	Vegetated depressions that store and treat runoff	P	●	●		●	●	●
Ponds and Wetlands	Permanent pools of water used to facilitate treatment runoff – runoff can also be stored in an attenuation zone above the pool	P	●			●	●	●

* Key

P - Point, L - Lateral, S – Surface

● Likely Valuable Contribution ○ Some Potential Contribution to Delivery of Design Criterion

Table 6-1: CIRIA Guidance (SuDS Component Delivery of Design Criteria)

6.3 Drainage Hierarchy

6.3.0.7 The following paragraphs in this section outline the proposed drainage strategy to meet national and local design requirements and guidance.

6.3.0.8 Current guidance requires that new developments implement means of surface water control, known as SuDS, to maintain flow rates discharged to the surface water receptor at the pre-development 'baseline conditions' and improve the quality of water discharged from the land.

6.3.0.9 When appraising suitable surface water discharge options for a development Site, the statutory standards for sustainable drainage systems (2018) provides the following search sequence for identification of the most appropriate drainage methodology.

Priority Level 1*: Surface water runoff is collected for use;*

Priority Level 2: *Surface water runoff is infiltrated to ground;*

Priority Level 3*: Surface water runoff is discharged to a surface water body;*

Priority Level 4*: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system;*

Priority Level 5*: Surface water runoff is discharged to a combined sewer.*

6.3.0.10 The search sequence outlined above indicated that the ordinary watercourse along Rockfield Road is the most appropriate receptors for surface water disposal at the Site. Infiltration testing may show that localised infiltration SuDS may be incorporated across the Site, as the scheme progress.

6.4 SuDS Selection

6.4.0.11 The primary aim of this Drainage Strategy is to establish a Site-wide allocation of space to SuDS within the development area. On-plot SuDS (also known as in-parcel SuDS) are sustainable drainage systems located within each parcel of development within the Site. Off-plot SuDS are larger-scale systems typically located within the development area but outside or on the border to development parcel and can be within communal or public open space areas.

6.4.0.12 By integrating on-plot and off-plot SuDS, an effective drainage strategy emerges, maximising benefits across all four pillars of SuDS design. **Table 6-2** outlines which SuDS options are considered suitable for this development.

6.4.0.13 The development of SuDS within the development parcels will be the responsibility of the developer/ builders of the respective development parcel. As the final detailed design of the development is not available at either the Plan making stage or the outline planning application stage, the design of on-plot SuDS will be considered during the detailed planning application stage or as reserved matters associated with an outline planning consent.

Component Types	To be Considered at Outline	To be Considered at Reserved Matters
Rainwater Harvesting Systems		✓
Green Roofs		
Infiltration Systems		✓
Proprietary Treatment System		
Filter Strips		✓
Filter Drains		✓
Swales	✓	✓
Bioretention Systems		
Tree Pits		✓
Pervious Pavements		✓
Attenuation Storage Tanks		
Detention Basins	✓	✓
Ponds and Wetlands		

Table 6-2: Types of SuDS Components to be Considered

6.4.0.14 Proposals have been developed to inform the strategic drainage network across the development. It is proposed that the drainage system for the Site utilises a SuDS system as the primary storm water management scheme.

6.4.0.15 Accordingly, a plan showing the conceptual drainage masterplan for the Site is contained within **Appendix C**.

7 Preliminary Drainage Proposals

7.1.1.1 The common aims of a Primary Drainage System are:

- Provide the benefits of the four pillars of SuDS;
- Reduction in peak discharges to the agreed Site wide run-off rate from the development areas.

7.1.1.2 Preliminary assessment of the requirements for storm drainage have been based on the following criteria as shown in **Table 7 1**.

Criteria	Measure/Rate/Factor
Full Site Area	4.33 ha
Application Site Area (Phase 2)	1.48 ha
Developed Area	1.14 ha
Landscaped Area	0.34 ha
Sewer design return period[1]	1 in 1 year
Sewer flood protection[1]	1 in 30 years
Fluvial / Development flood protection[1]	1 in 100 years
Minimum cover to sewers[1]	1.2 m
Minimum velocity[1]	1.0 m/sec
Pipe ks value[1]	0.6 mm
Allowance for climate change- 1 in 100 year event [15]	40%
Rainfall Method	FEH

Table 7-1: Drainage Criteria and Measure

7.2 SuDS Design Criteria

7.2.0.3 National policy requires that new developments control the peak discharge of storm water from a Site to the baseline, undeveloped, Site conditions.

7.2.0.4 The Greenfield runoff rate estimation tool has been developed by HR Wallingford to facilitate easy calculation of greenfield runoff rates for new developments to assist developers, drainage engineers and those involved in assessing planning applications.

7.2.0.5 Site discharge assessments use the nationally accepted IoH124 (Institute of Hydrology) methodology for small rural catchments.

7.2.0.6 The baseline IoH 124 run-off rates are shown on **Table 7-2**.

1Design and Construction Guidance for Foul and Surface Water Sewers

Event	IoH 124 (4.3ha)	IoH 124 Scaled to 1ha
1 year (l/s)	8.10	1.88
QBAR (l/s)	9.20	2.14
100 year (l/s)	20.10	4.67

Table 7-2: IoH124 Baseline Discharge Rates

7.2.0.7 The calculations for the proposed development areas and runoff rates have been provided in **Table 7-3**.

Catchment	Land Use	Developable Area (ha)	Total Impermeable Area (ha) *
A	Residential	1.97	0.99
B	Residential	1.10	0.67
		3.07	**1.65**

*including 10% urban creep

Table 7-3: Surface water Drainage Calculations

7.3 Outline Surface Water Drainage Strategy

7.3.0.8 The first submitted report for the Site (10410 FRA03 Rv2 in July 2016) was for the entire development area (i.e. Phase 1 & 2), with the drainage design accounting for the entire scheme. The drainage calculations demonstrated that the maximum storm water detention storage required for the Site was 1,117.5m^3 for the critical 1 in 100 (+30%) year event storm, while limiting the peak discharge into the Rockfield Road watercourse at 9.2 l/s (Qbar runoff rate).

7.3.2 Phase 1

7.3.2.9 Since the Phase 1 development was approved for planning in February 2019, with reserved matters submitted in December 2019, and the SAB deadline was January 2020, the proposed SuDS strategy is not subject to SAB approval.

7.3.2.10 The surface water drainage strategy includes a series of surface water sewers to convey storm water via gravity into an attenuation basin located in the south east corner of the Site. It is also proposed to construct cellular storage of up to 1.2m deep underneath the basin to accommodate additional storage due to the increase in climate change allowance since the initial application was submitted.

7.3.2.11 These SuDS features have been designed to accommodate storm water volume from both Phases of development before discharging into the Rockfield Road watercourse.

7.3.3 Phase 2

7.3.3.12 Phase 2 of the development will require SAB approval, but within the development parcel only, as the most sustainable method of disposal of its surface water runoff will be into the Phase 1 system. The Phase 1 scheme has a series of gravity sewers, an attenuation basin and cellular storage and importantly a discharge to a watercourse. It also has the benefit of outline approval.

7.3.3.13 Statutory SuDS guidance (2018) requires rainfall interception in order to mimic greenfield runoff conditions. The guidance states that:

Meeting the Interception criterion is not expected during particularly wet periods when permeable surfaces and subsoils are saturated, so it is more appropriate to set compliance requirements on a probabilistic basis (i.e. Interception should be delivered for a proportion of all events, either per season or on an annual basis). A suggested target is that 80% compliance should be achieved during the summer and 50% in winter.

7.3.3.14 This Site will ensure that interception requirements will be met by incorporating above ground SuDS features such as raingardens, swales and rills. The location and details of these features will be confirmed and designed at a later stage.

7.3.3.15 The development parcel will then connect into the Phase 1 drainage through a surface water sewer located within the road network in the south of the Site.

7.4 SuDS Basin Design

7.4.3.16 Assessments have thereafter been completed to determine the characteristics of proposed SuDS features to be situated within the development. Best practice methods have been employed by performing detention routing calculations for the 1 in 100 years + 40% climate change.

7.4.3.17 The updated summary calculations have been provided in **Appendix D**.

7.4.3.18 Calculations demonstrate that storm water detention storage extending to maximum 1,161.9m^3 will be required to attenuate storm water discharges from the Site during the critical 1 in 100 year event storm + 40% climate change. This will limit the peak discharges to 9.20l/s. **Table 7-4**, summarises the overall detention requirements.

Catchment Area (ha)	Impermeable Area (ha)	Design Run-off (l/s) *	Detention Volume for 1 in 100 + CC Storm Event (m^3)
3.07	1.65	9.20	1,161.9 SuDS Storage: 682 Cellular Storage: 480

Table 7-4: Summary Runoff and Storage Volume

8 SuDS Management

8.1.1.1 The four pillars of SuDS is to treat and clean surface water runoff from urban areas, ensuring the protection of the receiving environment. Diffuse urban pollution, originating from multiple widespread sources, significantly compromises groundwater and receiving water standards required under the EU WFD.

8.2 Water Quantity

8.2.0.2 No long-term storage is currently proposed for surface water within the SuDS design.

8.2.0.3 The suitability of the types of rainwater harvesting systems that can be incorporated within the Site will be investigated further at the detailed design stage.

8.3 Water Quality

8.3.0.4 Impermeable surfaces collect pollutants from a wide variety of sources including cleaning activities, wear from car tyres, vehicle oil and exhaust leaks and general atmospheric deposition (source: CIRIA C609). The implementation of SuDS in development drainage provides a significant benefit in removal of pollutant from development run-off.

8.3.0.5 The SuDS Manual C753 describes a 'Simple Index Approach' for assessing the pollution risk of surface run-off to the receiving environment using indices for likely pollution levels for different land uses and SuDS performance capabilities.

8.3.0.6 CIRIA document C753 Table 26.2, as shown in **Table 8-1** below, indicates the minimum treatment indices appropriate for contributing pollution hazards for different land use classifications. To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index.

Land Use	Pollution Hazard Level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4

Table 8-1: CIRIA 753 Table 26.2 Pollution Hazard Indices

8.3.0.7 For a residential type development, roof water requires a very low treatment of 0.2 for total suspended solids, 0.2 for heavy metals and 0.05 for hydrocarbons, and run-off from low traffic roads such as cul-de-sacs and individual property driveways requires low treatment of 0.5 for total suspended solids, 0.4 for heavy metals and 0.4 for hydrocarbons.

8.3.0.8 To provide the correct level of treatment, an assessment needs to be made of the mitigation provided by each SuDS feature. Table 26.3 of The SuDS Manual CIRIA document C753 shown as **Table 8-2** for discharges to surface waters indicate the treatment mitigation indices provided by each SuDS feature.

Type of SuDS component	Total suspended solids (TSS)	Metals	Hydro-carbons
Swale	0.5	0.6	0.6
Detention basin	0.5	0.5	0.6

Table 8-2: CIRIA 753 Table 26.3 SuDS Mitigation Indices for Discharges to Surface Waters

8.3.0.9 At present, the Site and surrounding area does not benefit from any additional measures of stormwater treatment.

8.3.0.10 Due to the need to provide wider sustainability benefits and view the development at a strategic level, SuDS will be implemented to passively treat run off from the development so as to have a positive impact on the surrounding natural environment.

8.3.0.11 At the outline stage of development, the Site is proposing to employ SuDS features such as swales and detention basins, which are widely accepted to have high pollutant removal efficiency (CIRIA 609). Each feature provides for one stage of treatment to decrease pollutant load within stormwater run-off.

8.4 Amenity

8.4.0.12 The proposed attenuation basin has been designed within the open space around the Site. This allows the basin to be incorporated into the wider landscaping of the area, providing somewhere for planting, play and footpaths.

8.5 Biodiversity

8.5.0.13 The SuDS will provide new habitats for fauna and flora across the Site, as well as enhancing the existing space.

8.5.0.14 The type and location of planting within the SuDS can aid shelter, food, foraging and breeding opportunities for a variety of wildlife. Further details of how SuDS will improve the ecology and BNG is provided within the Ecology report.

8.6 Exceedance Flows

8.6.0.15 Careful regard has to be made in respect of potential exceedance flows, being events that are more extreme than current design criteria. Various national guidance has been published on the matter of exceedance flows and measures that should be incorporated into a development to ensure the safety of occupiers and those using the infrastructure.

8.6.0.16 The principal aim is to direct any exceedance flows away from properties and along defined corridors. At a local level, this may mean water being conveyed along a length of highway, as long as the predicted flow depths and velocities are acceptable. More strategically, the implementation of conveyance corridors is important in avoiding deep and high velocity flows that present a high risk.

8.6.0.17 Many of the measures for dealing with exceedance flows must be dealt with at the detailed design stage. However, the strategic layout can provide the framework of a network that can effectively deal with any future exceedance problems.

8.7 Maintenance

8.7.0.18 The conceptual drainage proposals have been developed in a manner that will allow the Site wide system to be designed to encourage passive treatment of discharged flows and to improve the water quality by removing the low-level silts, oils which could be attributed to track/parking area run off of this nature. Final design will provide for appropriate geometry and planting to maximise this benefit.

8.7.0.19 The storm water management features will be constructed and operational prior to the first use of the Site, derived on a phase-by-phase requirement.

8.7.0.20 It has previously been the case that the functionality of the storm water management system would be ensured by ongoing maintenance, completed by the Local Authority, Drainage Authority, or a private maintenance company as appropriate. Unlike the Phase 1 drainage system where the options are still open, Phase 2 will be automatically adopted by the SAB once it is constructed and then they would continue to maintain it with the likely maintenance regime set out below in **Table 8-3**.

8.7.0.21 It is usual for the following maintenance regime to be implemented:

Frequency	Operation
Post major storm events	Inspection and removal of debris.
Every two months	Grass mowing (growing season) & litter removal.
Annual	Weeding & vegetation maintenance. Minor swale clearance. Sweeping of permeable pavements.
2 years	Tree pruning.
5-10 years	Desilting of channels. Remove silt around inlet and outlet structures.
15-20 years	Major vegetation maintenance and watercourse channel works.

Table 8-3: Framework Maintenance of Detention Systems

8.7.0.22 The conceptual drainage masterplan proposals outlined in this report will be used for final drainage design and detailing. The storm water management system will be constructed and operational in full prior to first use of the relevant phase of development.

9 Foul Drainage

9.1.1.1 A copy of the Welsh Water sewerage network records has been obtained to confirm the presence of adopted foul sewers in the vicinity of the Site. Adopted and unadopted private foul sewers service the Rockfield Estate to the south of the Site, while Welsh Water also confirms that they have adopted foul sewers in Rockfield Road.

9.2 Design Criteria

9.2.0.2 Peak design discharges have been calculated based on the current development criteria as described in Section 2 of this report and for the following:

Domestic peak	=	4,000 litres / dwelling / day (peak)

9.2.0.3 Assessed in accordance with the Design and Construction Guidance for Foul and Surface Water Sewers requirements, the development will have a design peak discharge of approximately 2.77l/s.

9.3 Network Requirements

9.3.0.4 It is anticipated that foul water from the scheme shall discharge to Monmouth Wastewater Treatment Works (WwTW), however this is subject to confirmation from Welsh Water.

9.3.0.5 In 2016 Welsh Water identified potential capacity constraints within their existing network, stating "*it is unlikely that sufficient capacity exist".*

9.3.0.6 A Developer Services Hydraulic Modelling Report (**Appendix E**) was completed by Welsh Water in December 2018, which identifies a proposed connection point at manhole SO49136305 located on Levitsfield Close to the south east of the development, connecting via gravity, to an existing 150mm foul sewer draining to Monmouth Town (**Figure 9-1**).

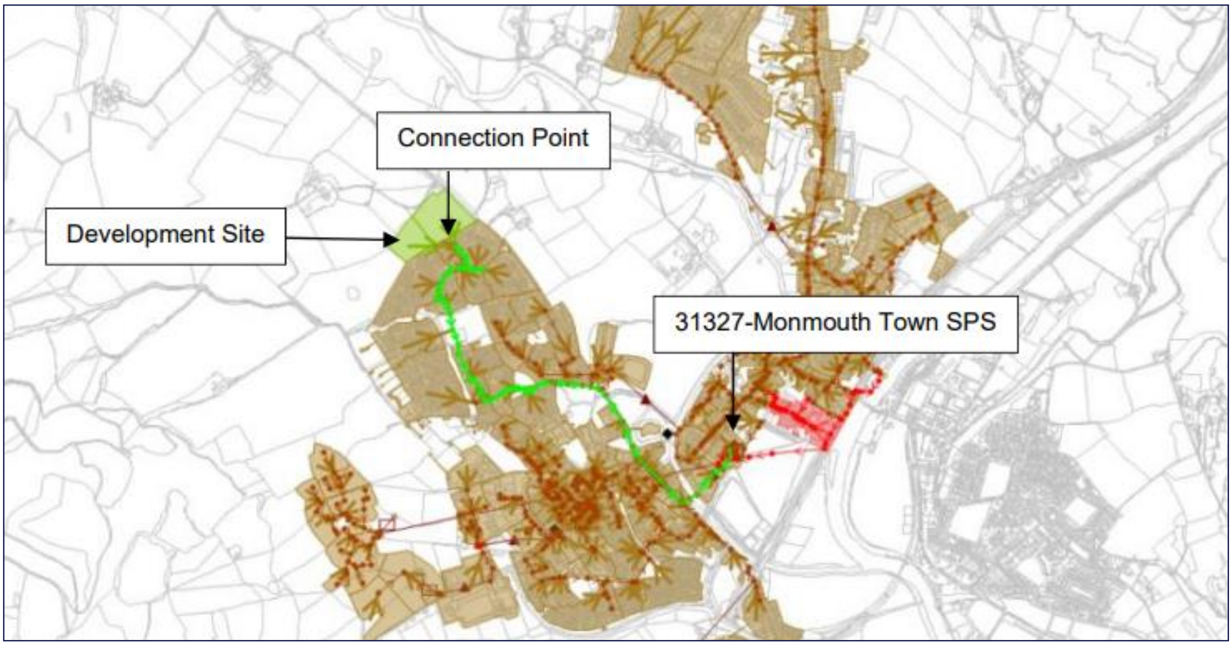


Figure 9-1: Foul Water Connection Point

9.3.0.7 The hydraulic assessment shows that there is anticipated to be 184m^3 of flooding detriment, with the majority of detriment found in two locations, Watery Lane and Wonastow Road.

9.3.0.8 Two solution options to mitigate this flooding have been proposed by DCWW and discussions are currently ongoing.

9.4 Implementation Proposals

9.4.0.9 The proposed drainage network across the Site will be designed to current Welsh Ministers' Standards for new gravity foul sewers and lateral drains, employing a point of connection agreed with DCWW and the system will be offered for the adoption.

9.4.0.10 The Site promoter will assist DCWW with further assessments and support as may be appropriate to ensure that the various statutory obligations are achieved.

10 Summary

10.1.1.1 The objective of the study is to demonstrate the development proposals are acceptable from a flooding risk and drainage viewpoint.

10.1.1.2 This FCA has been produced in order to provide information for an outline planning application.

10.1.1.3 This FCA has identified no prohibitive engineering constraints in developing the Site for the proposed developments.

10.1.1.4 The Site is fully able to comply with the Planning Policy Wales and TAN15 together with associated local policy guidance.

10.1.1.5 The Site lies within Flood Zone 1, a preferable location for residential development. Assessment of other potential flooding mechanisms shows the land to have an overall low probability of flooding from overland flow, sewer and groundwater flooding.

10.1.1.6 This document describes how the Drainage Strategy is fully able to comply with guidance from national, regional and local policy to:

- demonstrate the development proposals are acceptable from a drainage viewpoint complying with these policies, together with non-statutory SuDS standards for the 100 year design lifetime of the development;
- examine the potential quantitative impacts of the development on the risk of surface water flooding both on-Site and within the broader catchment area. It also explores the types of SuDS that could be integrated into the masterplan. SuDS will be considered wherever feasible.
- address the four pillars of SuDS: quantity, quality, amenity, and biodiversity.
- ensure peak discharges from the Site do not exceed that of the baseline conditions.

10.1.1.7 The positive drainage system will incorporate SuDS to attenuate and convey surface water to the respective outfall. Discharges to the watercourse from detention basins will be restricted to Qbar as per the requirements of the Statutory Standards.

10.1.1.8 The SuDS features have been designed to hold the volumes of surface water run-off predicted to flow from the developable areas in the 1 in 100 year plus 40% climate change allowance storm event.

10.1.1.9 A foul Site drainage strategy will be developed that meets with current regulatory requirements by discharging drainage to a sewerage network with capacity to accommodate the flows.

10.1.1.10 Means to discharge foul water drainage will be established that comply with current guidance and requirements of The Welsh Ministers and DCWW.

10.1.1.11 Once development is complete, the network conveying foul flows from the Site will be offered for adoption to DCWW to be maintained as part of their statutory duties.

11 Disclaimer

11.1.1.1 The conclusions and recommendations contained herein are limited to those given the general availability of background information and the planned usage of the Site.

11.1.1.2 Third party information has been used in the preparation of this report, which Brookbanks, by necessity assumes is correct at the time of writing. While all reasonable checks have been made on data sources and the accuracy of data, Brookbanks accepts no liability for same.

11.1.1.3 The benefits of this report are provided solely to Hallam Land for the proposed development at Rockfield Road, Monmouth only.

11.1.1.4 Brookbanks excludes third party rights for the information contained in the report.

12 Glossary of Terms

- **Aquifer** - a body of permeable rock which can contain or transmit groundwater.
- **Flood Risk Vulnerability** - the extent of harm, which can be expected under certain conditions of exposure, susceptibility and resilience.
- **Groundwater Vulnerability Zone** – how easily areas can transmit pollution to groundwater.
- **Hydrogeology** - the branch of geology concerned with water occurring underground or on the surface of the earth.
- **Infiltration** - the flow of water from aboveground into the subsurface.
- **Ordinary Watercourse** - include every river, stream, ditch, drain, cut, dyke, sluice, sewer and passage through which water flows and which does not form part of a main river.
- **Main River (watercourse)**- A large river or stream that is maintained by the Natural Resources Wales, any water course that isn't a main river is an ordinary water course.
- **Primary Drainage System** - a network of lateral drains or swales that carry water to an attenuation basin or SuDS and away from the playing surface.
- **Sustainable Drainage System** – Features designed to manage stormwater locally (as close its source as possible), to mimic natural drainage and encourage its infiltration, attenuation and passive treatment.

Appendix A – Illustrative Parameters Plan

NOTES

KEY

Application site boundary 4.33ha

Built Development

Residential 3.23ha
Up to 130 homes

Proposed point of access
(See submitted access drawing)

Green Infrastructure

Existing Public Footpaths

Existing hedgerows, trees and ditch to be retained

Habitat creation, green space and new planting

Section of hedgerow to be removed to facilitate proposed access.

Detention Basin (SUDS)

Open Space to include children's playing space and community growing area / orchard

Equipped children's play (1 LAP)

Proposed Multi User Path

Existing footpath enhanced for multi user access

fpcr

masterplanning
environmental assessment
landscape design
urban design
ecology
architecture
arboriculture

FPCR Environment and Design Ltd
Lockington Hall
Lockington
Derby DE74 2RH

t: 01509 672772
f: 01509 674565
e: mail@fpcr.co.uk
w: www.fpcr.co.uk

client
Hallam Land Management

project
Land off Rockfield Road, Monmouth

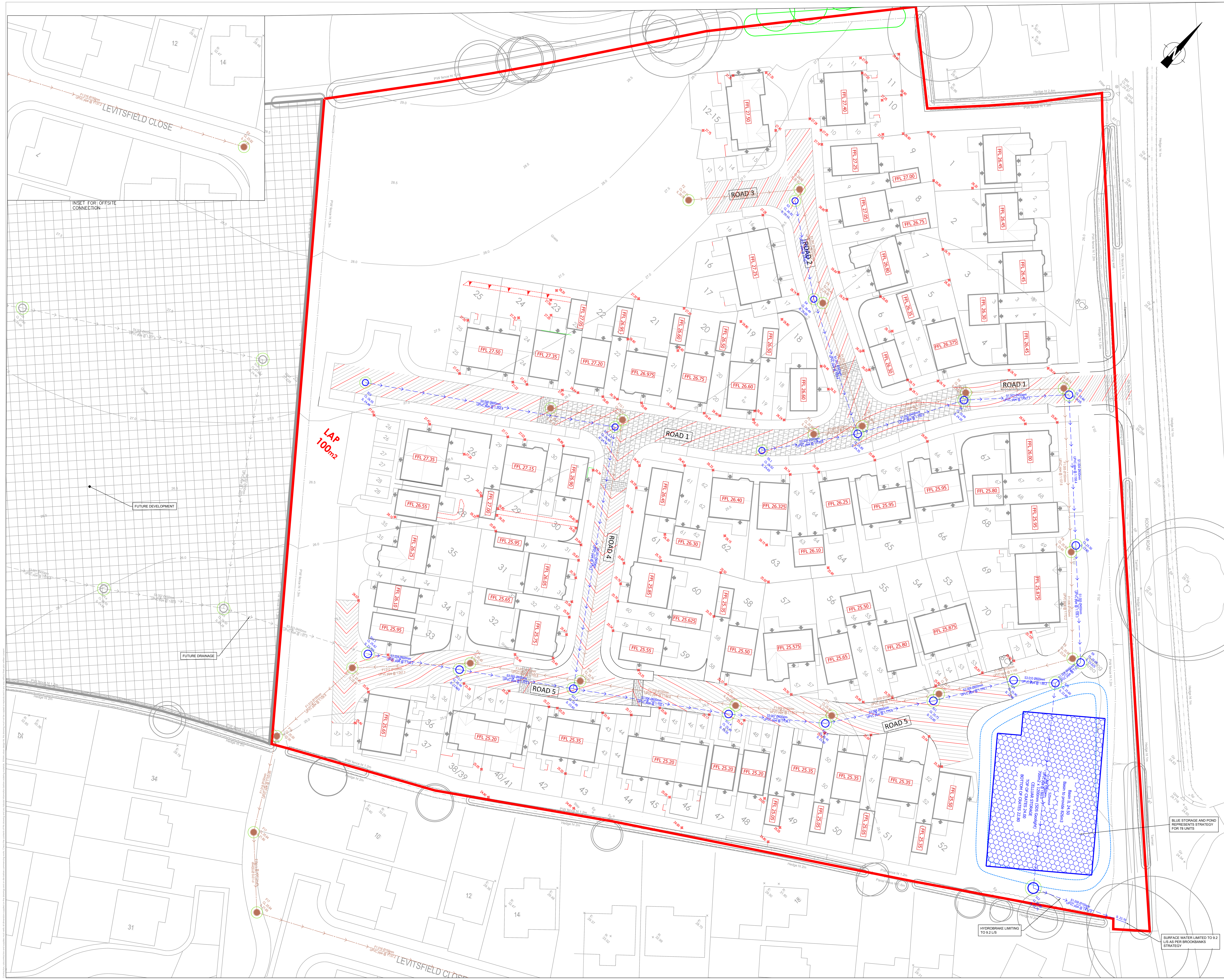
drawing title
FRAMEWORK PLAN

scale	drawn / checked	revision date
1:1250 @ A3	LP/ BC	16.05.2019

drawing number
3381-P-02

rev
J

CAD file: J:\3300\3381\2019 Application\3381-P-02-J Framework Plan.dwg



1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERING AND ARCHITECTS DRAWINGS AND SPECIFICATIONS.
4. THE CONTRACTOR IS TO CHECK & VERIFY ALL SITE DIMENSIONS & LEVELS BEFORE WORKS START ON SITE.
5. POSITIONS OF EXISTING SERVICES ADJACENT TO OR CROSSING PROPOSED EXCAVATIONS ARE TO BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING WORK.
6. ALL EXISTING SERVICES AND DRAINAGE TO BE TRACED AND ASSESSED PRIOR TO SITE CLEARANCE BEING UNDERTAKEN.
7. THE DIVERSION OF ANY PUBLIC SERVICES IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE REQUIREMENTS OF THE RELEVANT AUTHORITY/COMPANY.
8. DRAINAGE DESIGN UNDERTAKEN IN ACCORDANCE WITH SEWERS FOR ADOPTION 7th EDITION.
9. DRAINAGE TO BE CONSTRUCTED IN ACCORDANCE WITH THE BUILDING REGULATIONS PART H, BS-EN 752 AND SEWERS FOR ADOPTION 7TH EDITION.
10. ADOPTABLE FOUL WATER PLOT DRAINAGE TO BE 100mmØ WHEN SERVING UP TO 10 PLOTS & 150mmØ THEREAFTER UNLESS NOTED OTHERWISE.
11. ADOPTABLE SURFACE WATER PLOT DRAINAGE TO BE 150mmØ UNLESS NOTED OTHERWISE.
12. FOUL & SURFACE WATER PLOT CONNECTIONS TO BE CHECKED AGAINST WAINHOMES HOUSETYPE PLANS BEFORE CONSTRUCTION IS UNDERTAKEN.
13. CONTRACTOR TO LOCATE MANHOLE COVERS OUTSIDE OF VEHICLE TRACKS & ORIENTATED SQUARE WITH CARRIAGEWAY.
14. MANHOLE COVERS IN CARRIAGEWAY TO HAVE FACTORY APPLIED SKID RESISTANT COATING APPLIED TO SURFACE.
15. THE DEVELOPER MUST SELF-VET AND CERTIFY THAT THE DESIGN CRITERIA, MATERIAL STANDARDS AND WORKMANSHIP SPECIFICATIONS FOR THE PROPOSED ADOPTABLE SEWERS ARE IN ACCORDANCE WITH THOSE SET OUT IN “SEWERS FOR ADOPTION” 7TH EDITION, THE WELSH MINISTERS STANDARDS AND THE REQUIREMENTS OF DCWW AS THE STATUTORY SEWERAGE UNDERTAKER.
16. A SECTION 106 APPLICATION TO CONNECT MUST BE MADE TO DCWW, THE DEVELOPER SHALL GIVE 21 DAYS' NOTICE PRIOR TO CONNECTION, THE WORKS MAY ONLY BE UNDERTAKEN BY A SSIP ACCREDITED CONTRACTOR.”
17. CONTRACTOR TO VERIFY INVERT LEVELS AT DRAINAGE CONNECTION POINTS. ANY DISCREPANCIES TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
18. GULLIES TO BE LAID 5mm BELOW THE ADJACENT ROAD SURFACE.
19. NO LOOSE CHIPPINGS ARE TO BE USED WITHIN OR NEAR TO THE ADOPTABLE HIGHWAY.
20. FOOTPATH SURFACING TO BE LAID 5mm HIGHER THAN THE ADJACENT KERB.
21. FRONT ACCESS TO ALL PLOTS TO BE AS PER FFL IN ACCORDANCE WITH THE BUILDING REGULATIONS PART M.
22. ALL HIGHWAY DESIGN RECOMMENDATIONS ARE ADVISORY & ARE SUBJECT TO APPROVAL FROM THE HIGHWAYS AUTHORITY.
23. REAR ACCESS TO ALL PLOTS TO BE 150mm BELOW FFL IN ACCORDANCE WITH WAINHOMES' HOUSETYPES.
24. GROUND LEVEL IMMEDIATELY ADJACENT TO PLOT TO BE 150MM BELOW FFL UNLESS STATED OTHERWISE.
25. PROPOSED LEVEL INFORMATION IS PRELIMINARY AND MAY CHANGE AT DETAILED DESIGN STAGE.
26. FINAL FFL'S TO BE +/- 300mm OF CONSTRUCTION LEVELS AND MAY CHANGE AT DETAILED DESIGN.
27. CUT AND FILL VOLUMES HAVE NOT BEEN CONSIDERED ON THE FOLLOWING PROPOSALS AND SHOULD BE UNDERTAKEN AT DETAILED DESIGN STAGE.
28. STEPS TO ACCESS AND IN REAR GARDENS NOT DESIGNED AT THIS STAGE. AN ASSUMPTION SHOULD BE MADE FOR 1 STEP PER 150mm LEVEL DIFFERENCE TO FRONT AND 1 STEP PER 200mm LEVEL DIFFERENCE TO REAR.
29. PRELIMINARY ENGINEERING BASED ON A LIMITED TOPOGRAPHICAL SURVEY. WITH NO SERVICE OR TREE PROTECTION CONSTRAINTS. ENGINEERING TO BE REVIEWED FOLLOWING RECEIPT OF CONSTRAINTS INFORMATION.
30. NO DOORS OR GATES TO OPEN OUT ONTO THE PUBLIC HIGHWAY.
31. CBR VALUES TO BE VERIFIED ON SITE PRIOR TO AGREEING THE THICKNESS OF ANY CAPPING & SUB-BASE USED.
32. DESIGN OF RETAINING STRUCTURES BY OTHERS.
33. THE DEVELOPER MUST COMPLY WITH NRSWA 1991, FOR TRAFFIC MANAGEMENT & FOR ANY ROAD WORKS WITHIN THE HIGHWAY.
34. THIS DRAWING IS YET TO RECEIVE TECHNICAL APPROVAL FROM THE LOCAL HIGHWAY AND DRAINAGE AUTHORITIES AND IS SUBJECT TO CHANGE FOLLOWING DETAILED DISCUSSION
35. CUT AND FILL VOLUMES HAVE NOT BEEN CONSIDERED ON THE FOLLOWING PROPOSALS AND SHOULD BE UNDERTAKEN AT DETAILED DESIGN STAGE
36. STEPS TO ACCESS AND IN REAR GARDENS NOT DESIGNED AT THIS STAGE. AN ASSUMPTION SHOULD BE MADE FOR 1 STEP PER 150mm LEVEL DIFFERENCE TO FRONT AND 1 STEP PER 200mm LEVEL DIFFERENCE TO REAR.
37. PRELIMINARY ENGINEERING BASED ON A LIMITED TOPOGRAPHICAL SURVEY. WITH NO SERVICE OR TREE PROTECTION CONSTRAINTS. ENGINEERING TO BE REVIEWED FOLLOWING RECEIPT OF CONSTRAINTS INFORMATION.

LEGEND

EXTERNAL WORKS

FFL 100.00 FINISHED FLOOR LEVEL

100.00 SPOT LEVEL

MAJOR HIGHWAY CONTOUR 0.1M

MINOR HIGHWAY CONTOUR 0.02M

EMBANKMENT

DRAINAGE

ADOPTABLE SURFACE WATER SEWER

ADOPTABLE FOUL WATER SEWER

SURFACE WATER ATTENUATION

MISCELLANEOUS

SITE BOUNDARY

Rev	Details	Drawn	Checked	Date
F	DRAINAGE UPDATED	AAV	LF	29.06.24
E	ENGINEERING AMENDED.DRAINAGE RUN REMOVED.	LF	LF	04.03.21
D	ENGINEERING AMENDED TO SUIT LAYOUT	ADW	LF	22.01.21
C	DRAWING TITLE AMENDED	KM	LF	13.12.19
B	ENGINEERING AMENDED TO SUIT LAYOUT	ADW	LF	03.12.19
A	ENGINEERING AMENDED TO SUIT LAYOUT	ADW	LF	27.11.19
–	FOR PLANNING	ADW	LF	21.11.19

thinkurban
Architecture & Civil Engineering

Quest House
St Mellons Business Park
Fortran Road
Cardiff
CF3 0EY

T: 02922 520 219

Client:
Hallam Land Management Ltd

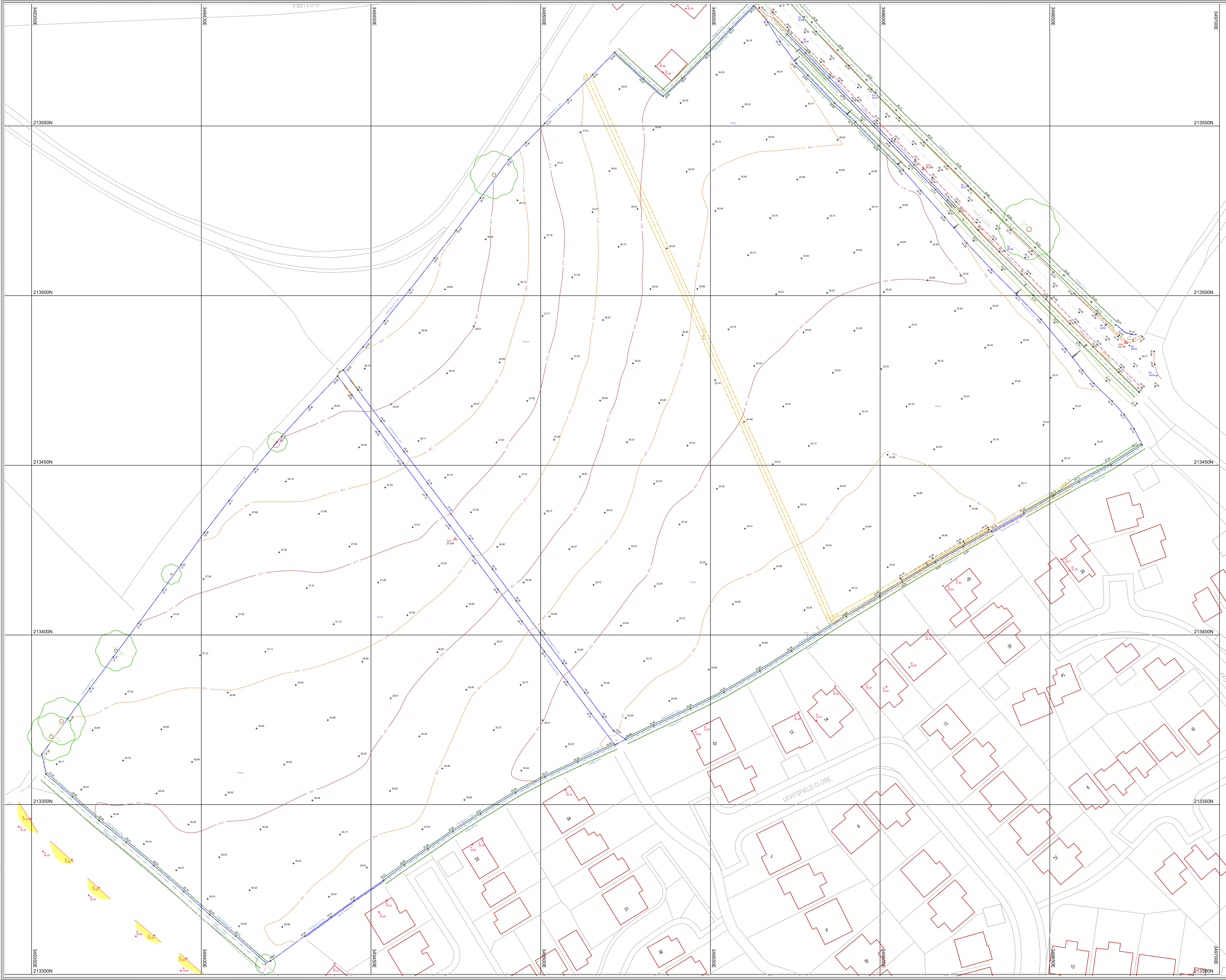
Project:
Rockfield Road
Monmouth

Drawing:
General Arrangement

Scale: 1:250	Sheet Size: A0	
Drawn: ADW	Checked: LF	Date: 22/11/2019
Drawing Number: 190624_TWC_GA_001	Revision: F	

Figure file path & name : Z:\Projects\04-Taylor Wimpey Homes\Cardiff-TWC\190624 - Monmouth\Monmouth Phase 1 - 70 plots\4. ENGINEERING\1 - Drawings\GA - General Arrangement\ 190624-TWC-GA-001 E General Arrangement.dwg
User and Plot Date : aav_6 : 29:6:2024 - 1:6 pm

Appendix B – Topographic Survey



N

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
GH1	349474.781	213428.257	27.235
GH2	349612.753	213537.339	25.259
GH3	349564.030	213587.726	26.206
GH4	349672.468	213486.139	24.716

OS Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

OS Buildings *Surveyed Buildings*

This survey has been orientated to the Ordnance Survey (O.S) National Grid OSGB36(15) via Global Navigational Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN15GB & OSGM15GB transformation models.

The survey has been correlated to this point and a further one or more OSGB36 (15) points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Legend:

Rev	Date	Description	Drawn	Q. Ref

greenhatch group

Topographical Surveys
Site Engineering
Utility / CCTV Surveys
Measured Building Surveys
3D Laser Scanning
Revit & BIM Models

Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044 Fax (01332) 830055
admin@greenhatch-group.co.uk
www.greenhatch-group.co.uk

St Albans
Unit B, The Courtyard
Alban Park
St Albans
Hertfordshire
AL4 0LA
t. (01727) 854481

Newcastle
24 Riverside Studios
Amethyst Road
Newcastle Bus. Park
Newcastle-U-Tyne
NE4 7YL
t. (01912) 736391

London
27, Cornwall Terrace Mews
Regents Park
London
NW1 5LL
t. (02072) 241806

CLIENT

Brookbanks Consulting Ltd

PROJECT

Rockfield Road Monmouth

TITLE

Topograpical Survey

SCALE	DATE
A1@ 1: 500	15.11.17
DRAWN	QUALITY REF
TC	GH1922

Level datum	See notes
Grid orientation	See notes
Job number	28655

Drawing No.	Rev.
28655_T	0

Comments

This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

Appendix C- Surface Water Drainage Strategy

Original Drawing Size A1

NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless otherwise stated.
3. Brookbanks Consulting Ltd has prepared this drawing for the sole use of the client. The drawing may not be relied upon by any other party without the express agreement of the client and Brookbanks Consulting Ltd. Where any data supplied by the client or from other sources has been used, it has been assumed that the information is correct. No responsibility can be accepted by Brookbanks Consulting Ltd for inaccuracies in the data supplied by any other party. The drawing has been produced based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.
4. No part of this drawing may be copied or duplicated without the express permission of Brookbanks Consulting Ltd.
5. Preliminary drawing for outline planning and is intended to inform for outline planning only. Strictly not for construction purposes.
6. All levels currently shown are indicative and are subject to change.
7. Connection points have been determined based on the contour and OS information. Confirmation of these levels to be obtained at detailed design stage.
8. A full finished floor levels assessment across all parcels has yet to be undertaken. Final heights will be calculated at detailed design stage.
9. Exceedance overland flow routes for mitigation to be provided at later design stages.
10. All SuDS features will have their own flow control device.
11. Location of surface water sewers are indicative and will follow the road layout.
12. Location and geometry of basins are subject to amendments following detailed design and required subsequent agreements being made with the approving authorities.
13. Drawing to be read in conjunction with Flood Consequence Assessment.

KEY:

- Red Line Boundary
- Catchment Boundary
- Proposed SuDS Basins and Maintenance Strip
- Illustrative Conveyance Swale
- Existing Drainage Network
- Illustrative Surface Water Connection into Phase 1
- Outfall Location

-	First Issue	KM	AW	AW	11.06.25

BROOKBANKS

6150 Knights Court, Solihull Parkway, Birmingham, B37 7WY
T +44 (0)203 958 5400 E mail@brookbanks.com
W brookbanks.com

Hallam Land Management

Rockfield Road, Monmouth

Illustrative Surface Water Drainage Strategy

Status		Status Date
Information		JUNE 2025
Drawn	**Checked**	**Date**
KP	AW	11.06.25
Scale	**Number**	**Rev**
1:1000	11438-DR-01	-

0 20 40 60 80 100
METRES

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR COMMENCE SITE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT HIS OWN RISK.

Appendix D – Surface Water Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	18.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.316	Preferred Cover Depth (m)	0.600
CV	0.840	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Pond A	1.650	5.00	25.500		45.849	58.306	2.700
1			23.700	1200	64.919	58.302	1.000

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)	Design Flow (l/s)
1.000	Pond A	1	20.000	0.600	22.800	22.700	0.100	200.0	150	5.47	42.2	9.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.707	12.5	9.2	2.550	0.850	1.650	0.0	96	0.772

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Pond A	45.849	58.306	25.500	2.700		0	1.000	22.800	150
1	64.919	58.302	23.700	1.000	1200	1	1.000	22.700	150

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
Rainfall Events	Singular	Skip Steady State	x
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	18.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.316	Starting Level (m)	
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.850	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node Pond A Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	22.800	Product Number	CTL-SHE-0120-9200-2400-9200
Design Depth (m)	2.400	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	9.2	Min Node Diameter (mm)	1500

Node Pond A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	22.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	400.0	0.0	1.201	1.0	0.0	1.700	780.0	0.0
1.200	400.0	0.0	1.699	1.0	0.0	2.700	1140.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 15 minute summer	400.470	113.319	100 year +40% CC 360 minute summer	56.786	14.613
100 year +40% CC 15 minute winter	281.031	113.319	100 year +40% CC 360 minute winter	36.912	14.613
100 year +40% CC 30 minute summer	274.105	77.562	100 year +40% CC 480 minute summer	44.728	11.820
100 year +40% CC 30 minute winter	192.354	77.562	100 year +40% CC 480 minute winter	29.716	11.820
100 year +40% CC 60 minute summer	192.272	50.812	100 year +40% CC 600 minute summer	36.624	10.017
100 year +40% CC 60 minute winter	127.741	50.812	100 year +40% CC 600 minute winter	25.024	10.017
100 year +40% CC 120 minute summer	121.766	32.179	100 year +40% CC 720 minute summer	32.630	8.745
100 year +40% CC 120 minute winter	80.898	32.179	100 year +40% CC 720 minute winter	21.930	8.745
100 year +40% CC 180 minute summer	94.281	24.262	100 year +40% CC 960 minute summer	26.776	7.051
100 year +40% CC 180 minute winter	61.285	24.262	100 year +40% CC 960 minute winter	17.737	7.051
100 year +40% CC 240 minute summer	74.559	19.704	100 year +40% CC 1440 minute summer	19.377	5.193
100 year +40% CC 240 minute winter	49.536	19.704	100 year +40% CC 1440 minute winter	13.022	5.193

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 96.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Pond A	915	25.217	2.417	69.1	1161.9720	0.0000	FLOOD RISK
15 minute summer	1	1	22.700	0.000	8.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
960 minute winter	Pond A	Hydro-Brake®	1	9.2	557.5

Appendix E- Developer Services Hydraulic Modelling Report

Dŵr Cymru
Welsh Water

Developer Services Hydraulic Modelling Report

099 – SE265 - Rockfield Road

30988 – A Monmouth WwTW

Prepared By	Date	Approved	Date	Rev	Section(s)	Comments
K. Adams	07/09/2018	T. Boichot		1.0	1-8	Draft for comment
K. Adams	11/09/2018	T. Boichot	11/09/2018	2.0	1-8	Draft for comment
K. Adams	30/10/2018	T. Boichot	31/10/2018	3.0	1-8	Draft for comment
K. Adams	06/12/2018	T. Boichot	07/12/2018	4.0	1-8	Final report

Dŵr Cymru
Welsh Water

Contents

Figures

Tables

Appendices

Appendix A – Drawings & Plans
Appendix B – HMA Sign Off Form
Appendix C – Verification Plots & Comparative Analysis
Appendix D – Hydraulic Assessment Results & Long Sections
Appendix E – Formula A Calculation Spreadsheet
Appendix F – Kick Off Meeting Agenda

Executive Summary

- A development has been proposed to the west of Rockfield Road, Monmouth, within the Monmouth WwTW catchment. A total of 130 dwellings are proposed.

- The proposed development has been assessed using one connection point at manhole SO49136305 on Levitsfield Close to the south east of the development.

- The model has been updated with survey data undertaken as part of this HMA to improve the understanding of key manholes in the network and improve the model representation of Monmouth Town SPS. Monmouth Town SPS has also been updated using construction drawings of the new arrangement which aims to mitigate detriment from the Wonastow Road development.

- As part of this HMA two flow monitors and a depth monitor were installed in the network to undertake a verification review of the model. A satisfactory level of verification was achieved.

- The hydraulic assessment shows that there is anticipated to be 184m^3 of flooding detriment as a result of the new development. This was primarily observed in two locations, Watery Lane and Wonastow Road. This was considered an unacceptable level of detriment and solutions have been developed in order to mitigate this.

- Solution development has identified two solutions (with multiple iterations) to resolve the predicted detriment (see table 0):

Solution	Description	Cost
1	Bifurcation and upsizing pumps to 100l/s and additional storage at Monmouth Town SPS.	£980,000
2	Transfer to Rockfield Road SPS and throttle flow at Monmouth Town SPS.	£1,030,000

Table 0 – Solution summary.

Due to extensive buildability issues associated with solution 1, the preferred Solution is 2 - the transfer of development flows to Rockfield Road SPS and throttle flow at Monmouth Town SPS.

1 Introduction

1.1 Appointment

In March 2018 Atkins were appointed by Dŵr Cymru Welsh Water (DCWW) to undertake a Hydraulic Model Assessment (HMA) relating to an application for a new development consisting of 130 dwellings in a greenfield location to the north east of Over Monnow and west of Rockfield Road (B4233), Monmouth. Monmouth WwTW serves this catchment and the new development.

DCWW has advised that the existing public sewerage system is unlikely to have sufficient capacity to accommodate the additional flows generated by the development, without causing detriment to the level of service the system offers. A HMA has been undertaken to:

- Establish whether a point of adequacy exists within the system;
- Quantify the effects that the development would have on the existing combined sewer network performance, and;
- Identify notional solutions to resolve any potential detriment and consider further recommendations.

This report presents the findings of the HMA for the proposed Rockfield Road development.

1.2 Development Site

- Size – 4.3ha – see Figure 1.
- Location – the new development is proposed to the north east of Over Monnow. The access point to the development is off Rockfield Road.
- Topography – the development will not require a pumped connection. There is a gravity sewerage system between the connection point and the terminal pumping station - Monmouth Town Sewage Pumping Station (SPS), see Figure 2.
- Previous/ Current Usage – Greenfield.
- Proposed Usage – Residential.
- Connection Type – a connection point has been proposed at manhole SO49136305. This is located within Levitsfield Close, see Figure 1.
- Phasing – the land parcel adjacent to Rockfield Road, including an access road into the development, will be developed first and this has received planning approval; this will include 70 residential dwellings. There will be a second phase included, pending planning approval, to the west of this in the next few years and this will feature 60 residential dwellings. Both phases are anticipated to connect in at the same connection point. This report will assess the detriment impact of both phases of the development.

1.3 Background Information

The proposed development is located within the Monmouth WwTW catchment, reference 30988-A.

The Monmouth hydraulic model has been previously used for a HMA in the catchment to review the impact of the Wonastow Road development (2014) and for the Monmouth Sustainable Drainage Plan (SDP) (2015). The model was verified as part of the previous HMA against three flow monitors and two depth monitors. The verification included good coverage in the vicinity of the development, and around the Monmouth Town SPS. Overall a reasonable level of verification was achieved, however, there were concerns raised as part of the Wonastow Road HMA output, particularly:

- The survey at Monmouth Town SPS was incomplete, as recorded by a SPS survey contractor in the Monmouth Town SPS Full report (27th March 2014), and various alternative sources of information were used to model the SPS. The report also showed that very poor data was recorded at Monmouth Town SPS, and as such, confidence in verification at this location is limited.

- The model was verified to best match flows recorded at flow monitors FM02, FM03 and FM04 during the largest storm (event 1). Therefore, model performance during less intense storms may be less accurate.

- Wonastow Brook is thought to interact with the sewer network. However, this has not been included in the summer model as an infiltration response was not seen in verification, and also as the interaction with the Wonastow Brook is not fully know and has not been included in earlier studies.

The Wonastow development was partially populated at the time of this HMA with sewage being tankered for treatment (at Nash WwTW) during weekdays and discharged to the network at weekends. Upgrades to the storm storage capacity of Monmouth Town SPS are, at the time of writing, under construction, but for the purposes of hydraulic assessment they have been considered complete (i.e. upgrades have been incorporated into the model used during hydraulic assessments). The new storage tank and connection between the foul and storm wet well have been modelled with a storm return pump.

As part of this HMA, manhole, connectivity and flow surveys were undertaken in the catchment to increase confidence in the model predictions in areas likely to be affected by the development site. A flow survey comprising of two flow monitors and one depth monitor was undertaken between 17/04/2018 and 18/06/2018. The hydraulic model was then updated accordingly. For further details refer to Section 3.

2 Land Usage

The proposed development consists of 130 residential dwellings on one site, to be constructed in two phases. A master plan was provided for Phase 1, estimates for housing type and size for Phase 2 of construction were not available. For the purposes of the HMA, it is assumed to be of high occupancy housing with an occupancy rate of 2.5 persons per property, which is the standard approach agreed with DCWW for HMAs. Table 1 provides the calculated number of residents per phase.

Land Use surfaces for the development have been defined as per the DCWW MBV Specification.

Domestic Populations				
Phase	Type	Number of Units	Bedrooms (per House Type)	Number of Residents
1 (Initial)	**Housing**	70	N/A	175
2 (Full)	**Housing**	60	N/A	150
			Total	325

Table 1 - Proposed Domestic Development Contribution – Phase 1 (Initial) & Phase 2 (Total).

2.1 Proposed Connection Details

The following connection point has been proposed by DCWW as stated in 078 – Rockfield Road, Monmouth HMA Brief:

Connection Point 1: Manhole SO49136305 on Levitsfield Close to the south east of the development, connecting to an existing 150mm foul sewer draining to Monmouth Town SPS.

Based on the development details provided / desk top assessment, flows will gravitate from the development to the connection point.

The location of the planned development can be seen in Figure 1. A catchment overview plan showing the location of the development in relation to Monmouth Town SPS is highlighted in Figure 2.

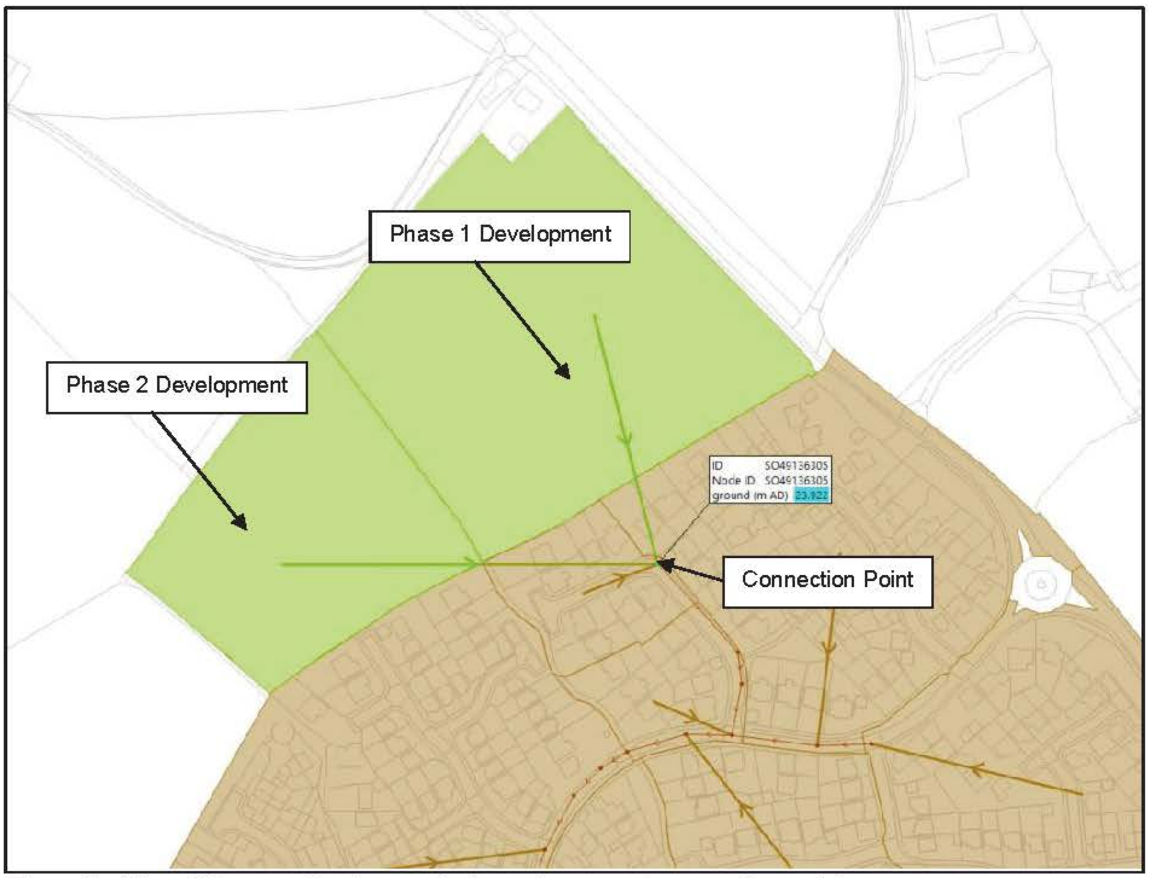


Figure 1 - Plan of the new development site and proposed connection points.

Dŵr Cymru
Welsh Water

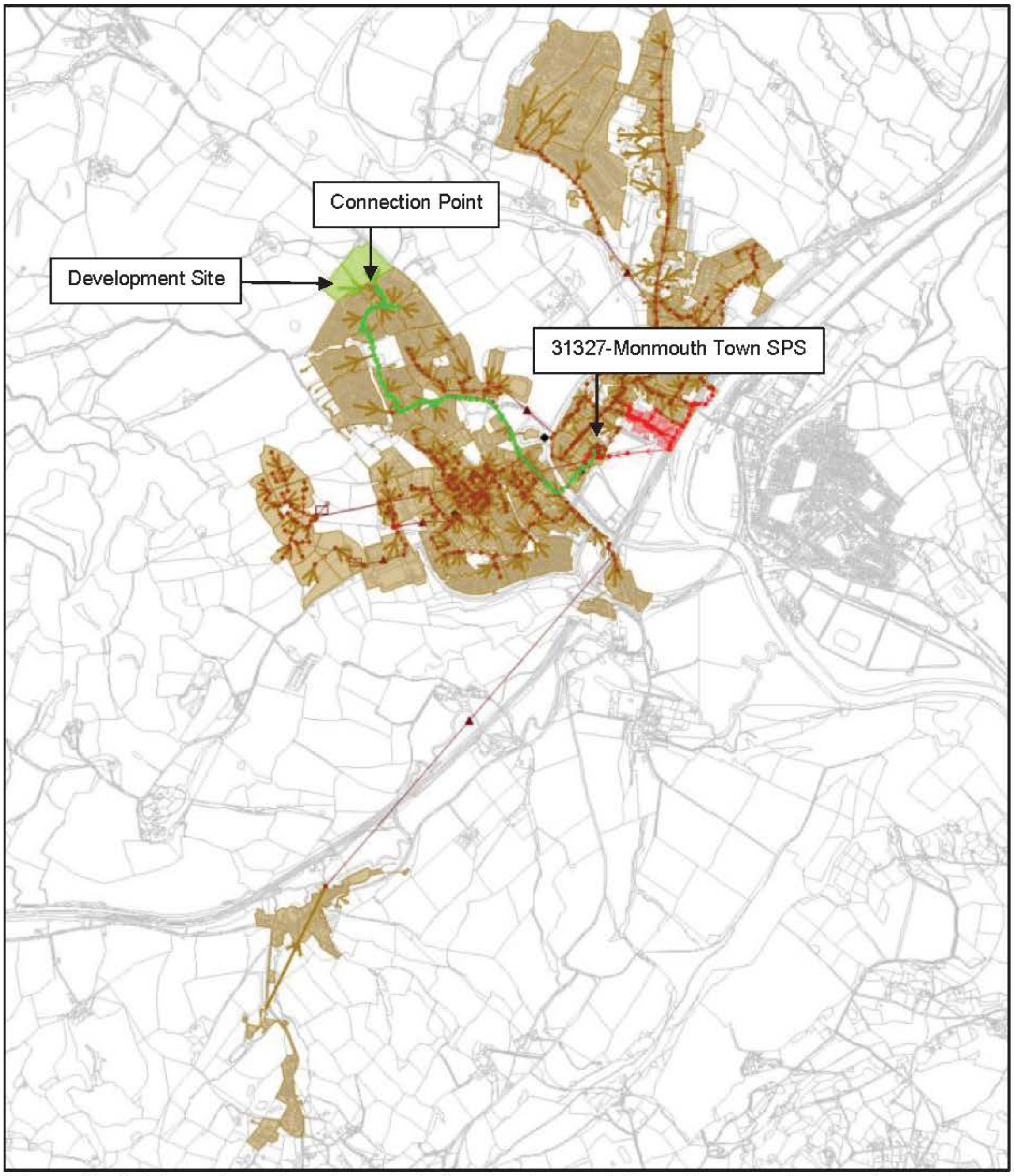


Figure 2 - Catchment overview plan – including development site and proposed connection point.

3 Developed System Modelling

3.1 Model Build / Enhancement

The model database "Wonastow.iwm" was used for the study; this was created for a HMA looking at the Wonastow Road development in AMP5 and as part of the Monmouth SDP.

A review of the model indicated that the robustness of this HMA would benefit from targeted model improvements upstream of Monmouth Town SPS. Therefore, surveys were proposed to improve the network model. In addition to the surveys, further data was collected to assist the model build/enhancement from the following sources:

- Existing DCWW Geographical Information Systems (GIS);
- Historical connectivity survey data;
- DCWW telemetry data;
- Flow survey data;
- Manhole survey;
- Connectivity survey;
- As -designed asset data (Monmouth Town SPS Upgrades).

The following sections detail the infill data used to build / enhance the hydraulic model and the other model build activities undertaken to ensure the model was suitable to undertake the HMA.

3.1.1 STC25 Manhole Survey

As part of this study a manhole survey consisting of three manholes was commissioned to supplement the existing DCWW GIS data. Manhole survey cards for all three of the proposed locations were returned by the survey contractor; SO49136305 (connection point (CP) 1), SO4919805 (U/S of FM02), SO49135106 (D/S of CP1), see Figure 3.

The local connectivity from CP1 to Manhole (MH) SO49136209 has been modelled as part of this HMA using the survey data from MH SO49136305 and DCWW GIS Asset data supplemented with hydraulic model inference where required, Figure 4. Subsequent subcatchment redefinition was carried out.

This survey data was identified with the InfoWorks flag "SA" and notes included within the model.

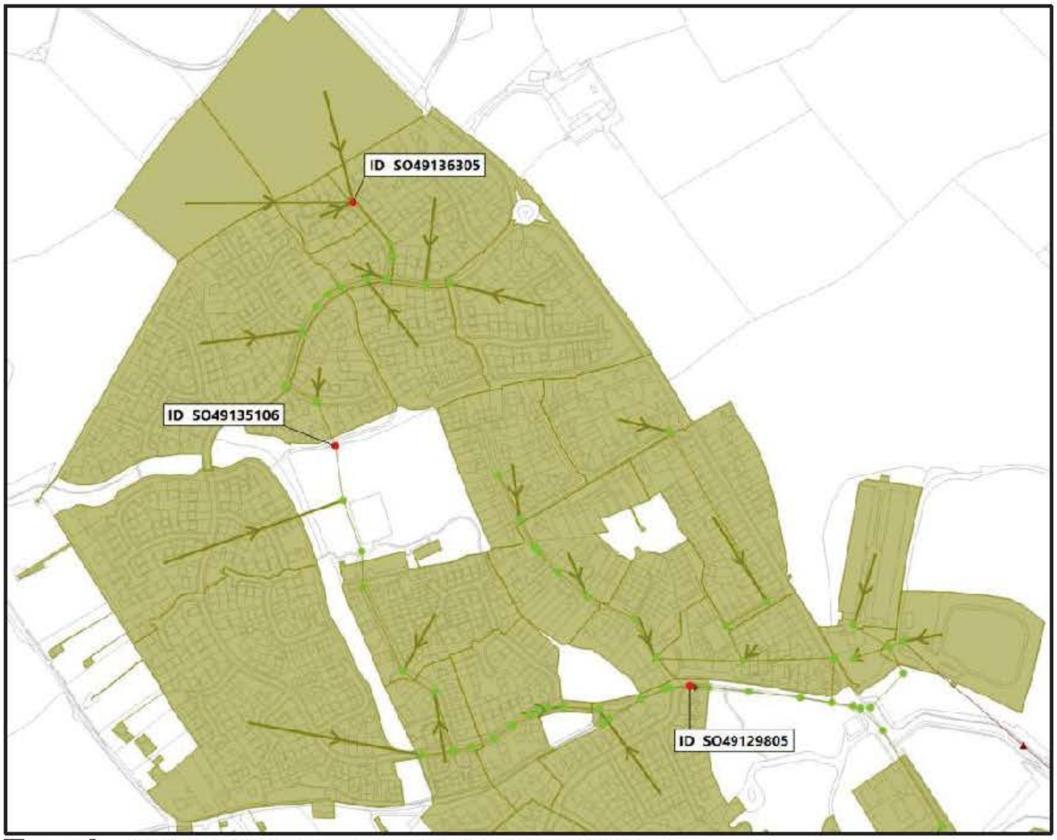


Figure 3 – Location of surveyed manholes in the network.

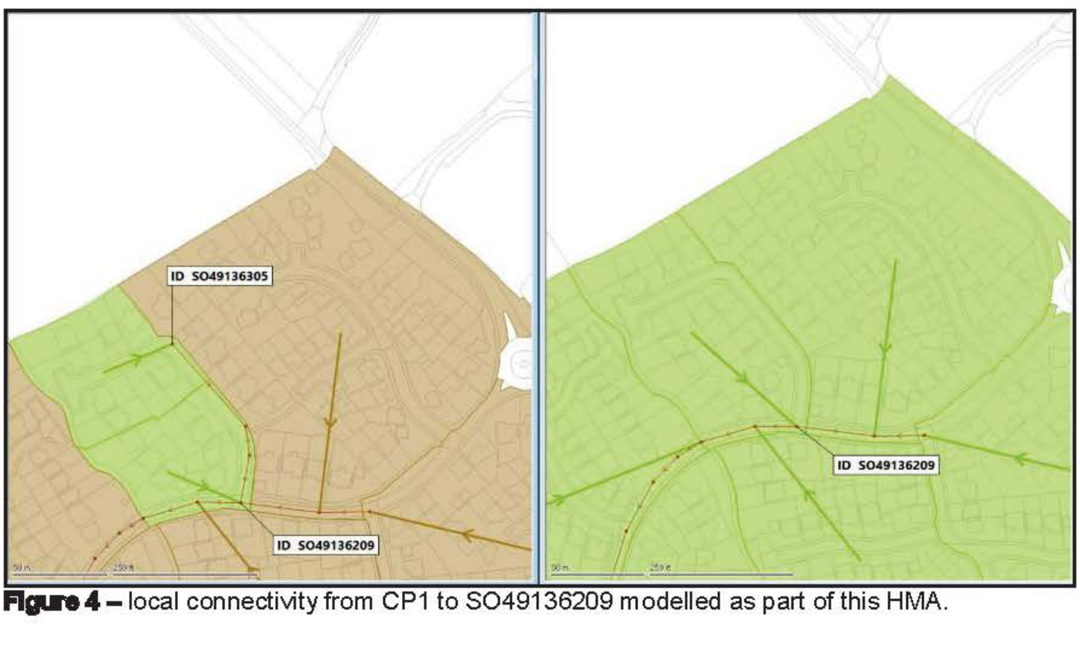


Figure 4 – local connectivity from CP1 to SO49136209 modelled as part of this HMA.

3.1.2 Connectivity Survey

Two connectivity surveys were undertaken as part of this HMA.

A connectivity survey was undertaken to inform the understanding of connecting pipework into Monmouth Town SPS, noted as having low confidence from the previous HMA. Historical connectivity plans, created as part of the Monmouth Town SPS upgrades were provided by the survey contractor, see Figure 5. To address uncertainty related to the connectivity of MH SO50126571, MH SO50126501 and to improve confidence in the invert levels of the sewer network in this area, an additional connectivity and depth measurement survey was conducted, see Figure 6. The modelled network representation has been improved to reflect this.

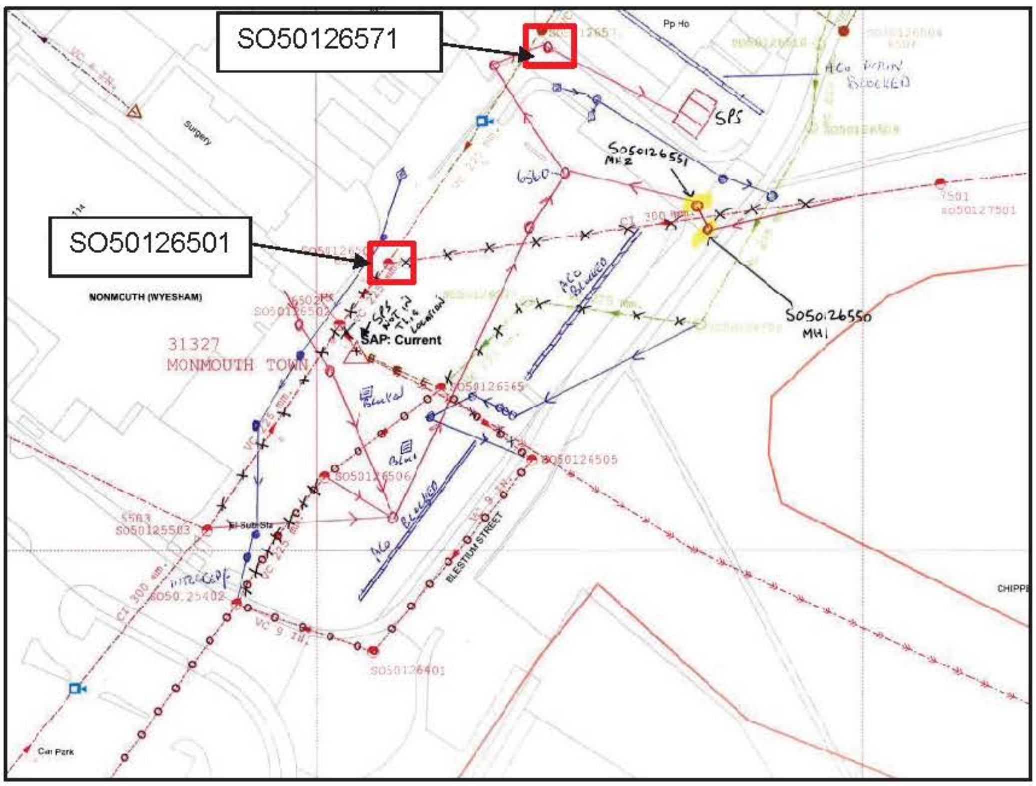


Figure 5 – Historical connectivity survey upstream of Monmouth Town SPS. Plan provided by contractor.

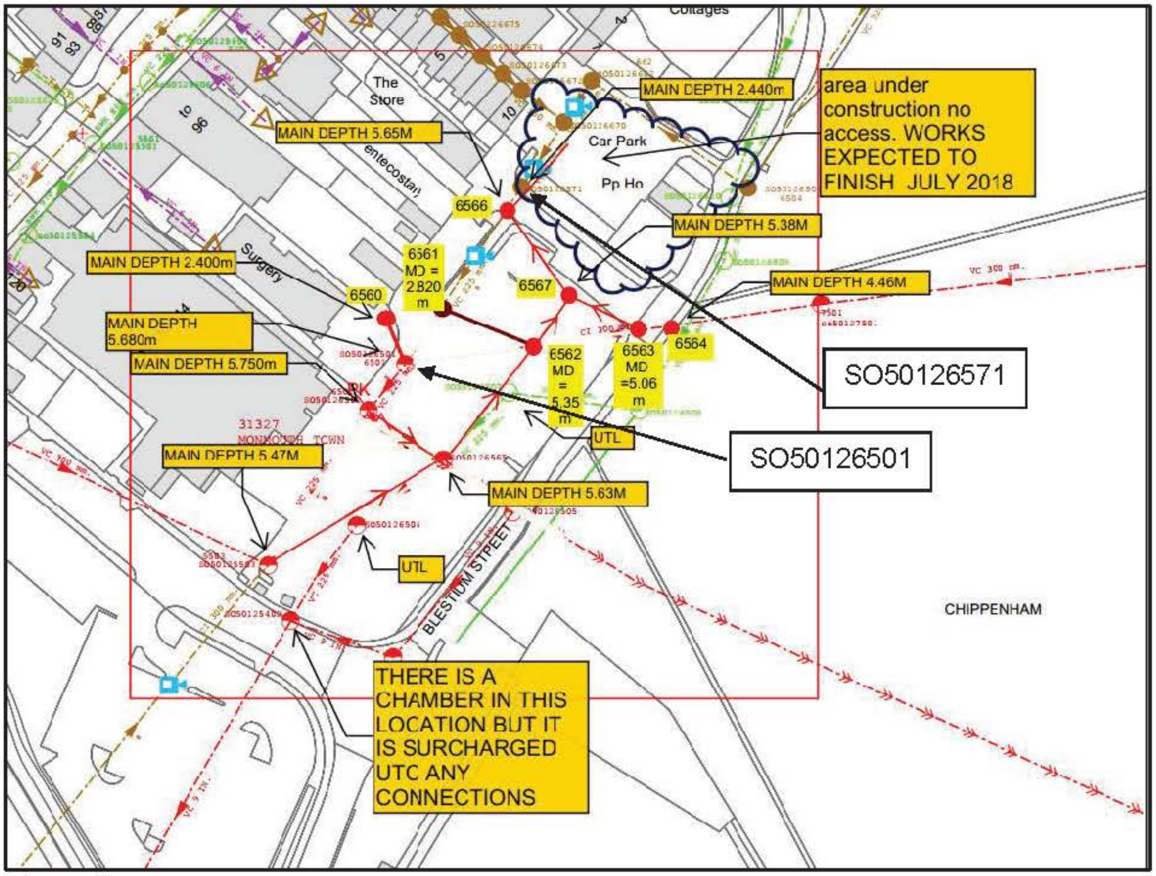


Figure 6 – New connectivity survey of U/S Monmouth Town SPS, plan provided by the survey contractor.

A connectivity survey was also undertaken at the Rockfield Road / Watery Ln (Lon Dyfriog) junction to confirm the existence of a network bifurcation downstream of the development connection point. The survey confirmed that SO50121808.1 does not connect into MH SO50121807. The survey confirms the development flows will not pass towards Rockfield Road SPS. The network has been modelled to reflect the results of the survey (See

Figure **7**).

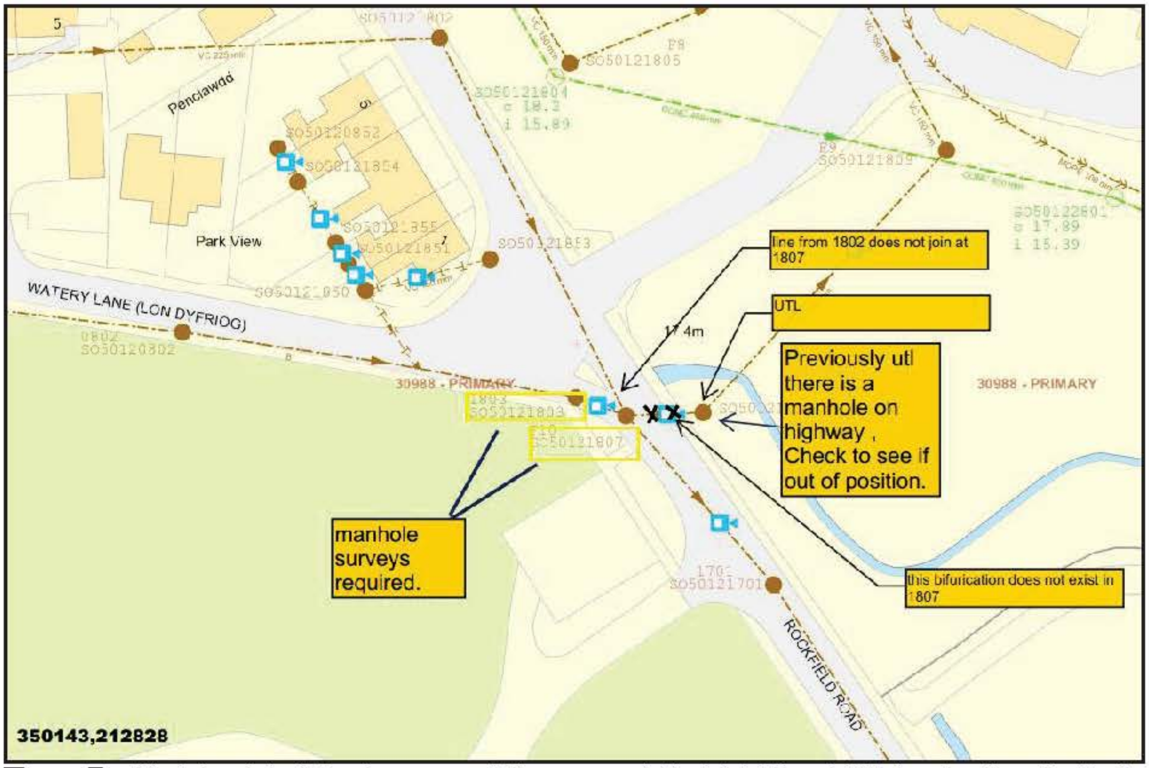


Figure 7 – Model update following connectivity survey at Rockfield Road / Watery Ln (Lon Dyfriog). This plan has been provided by the survey contractor.

This survey data was identified with the InfoWorks flag “SA” and detailed notes included within the model.

3.2 Summary of Model Build / Enhancement Activities

The model enhancement activities undertaken for this HMA include:

- Updated manhole data based on survey data.
- Upsized pipework based on survey data from MH SO50121803 to MH SO49129805.
- Updated connectivity downstream of FM002. Confirmation that bifurcation at MH SO50121808 is not present, based on connectivity survey.
- Improved model representation of the network in the Waitrose car park in to Monmouth Town SPS based on connectivity survey.
- Modelling of the Wonastow Road HMA option currently under construction. Inclusion of a rising main from storage node dev_pump 1 to MH SO50126564. Modelled pumps rates are based on estimated values.
- Updated Monmouth Town SPS with new arrangement. Additional storage, storm return pump with RTC with assumed on off levels, and storm pump rates provided by the designer.
- Improved modelling of Rockfield Road SPS based on observations from site.

3.3 Verification Review

A short-term flow survey was undertaken, comprising of two Flow Monitors (FM), one depth monitor (DM) and three Rain Gauges (RG) located within the Monmouth WwTW catchment to support a verification review. The flow survey began on 16-04-2018 and was terminated on 18-06-2018, a total duration of 63 days. The installation details can be seen in Table 2.

Flow/Depth Monitor	Manhole Ref.	Model Conduit Ref.	Size (mm)	Date Installed	Date Removed
FM1	SO50123404	SO50123403J.1	225	16-04-2018	18-06-2018
FM2	SO49129805	SO49129805.1	300	16-04-2018	18-06-2018
DM1		Monmouth Town SPS_Storm_Wet_Well	N/A	23-04-2018	06-06-2018
DM001A		Monmouth Town SPS_Wet_Well	N/A	06-06-2018	18-06-2018

Table 2 – Flow & Depth Monitor Location Detail.

The flow survey was undertaken during a period of unusually dry weather, it was the driest June since 1925 (Met Office), and as such the data which has been collected is considered to be atypical.

FM2 was installed to monitor the local branch sewer which would receive flows from the development. FM1 and DM1 were installed to provide a review of the current network conditions further downstream in the catchment. The position of DM1 was originally located in the storm well. This monitor was relocated into the foul well in week 7 of the survey period and renamed DM001A. The location of the installed monitors and raingauges can be seen in

Figure **8**.

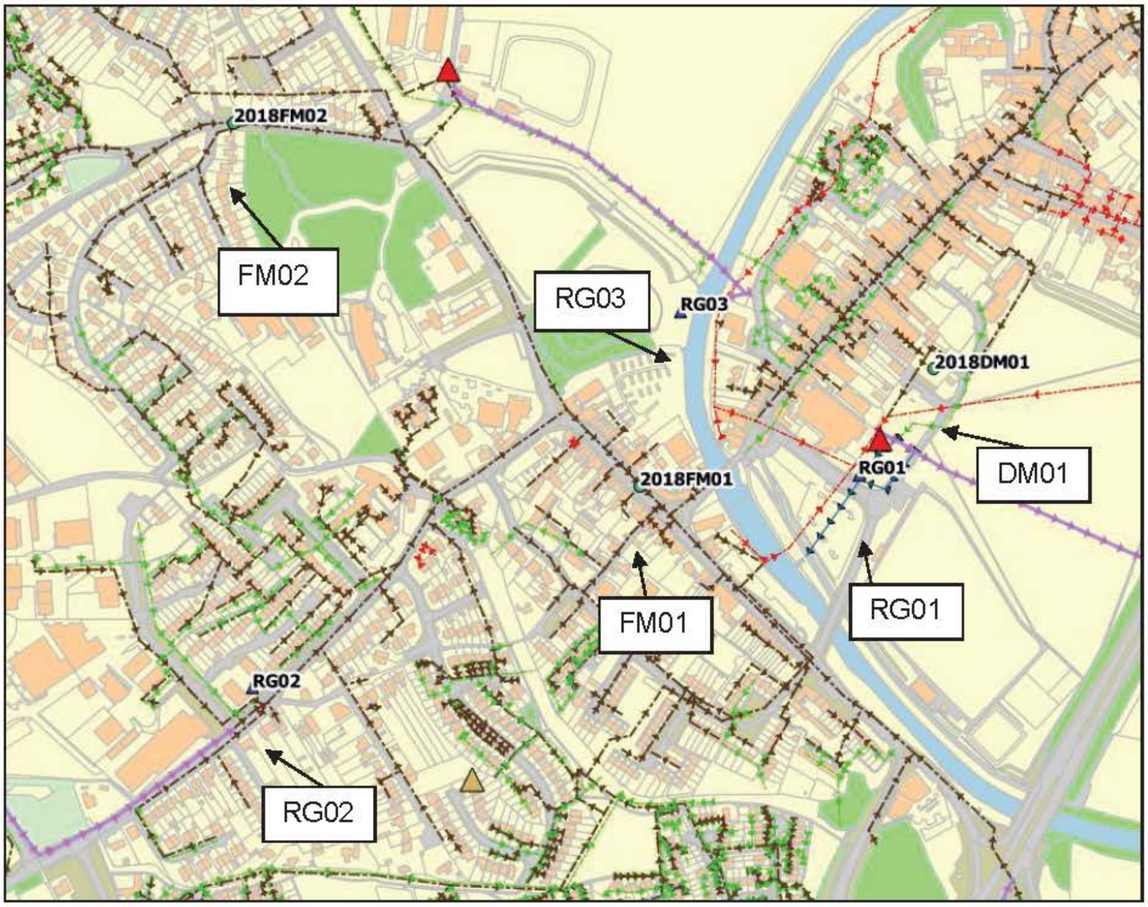


Figure 8 - Flow and Depth Monitor Location Plan.

The model was run for the full period of the flow survey to assess performance across all storm events observed throughout the survey.

The resulting model predictions of flow, depth and velocity were compared to those observed during the flow survey. The flow survey was conducted using a small number of monitors, and as such, significant catchment changes based on the observed data at individual monitors have not been carried out. Where localised differences were found between predicted and observed data, justifiable amendments to the model have been made, especially where previously interpolated levels had been used.

The model was initially run with an inflow file, Inflow Group-Wonastow>Inflow, received in the AMP5 model. This was assumed to have been created to replicate infiltration from the Wonastow Brook over a 2-day period at manholes SO5123501 and SO50121416. Sensitivity testing was undertaken to assess the impact of including this file in the full period scenario, and it was found to have no significant impact on the verification. In addition, as this file was not cited in the Wonastow Road HMA report, the inflow file will be omitted from the detriment assessment.

3.4 Dry Weather Flow Verification Review

As previously mentioned above, the conditions during this flow survey were atypically dry, although there were some short rainfall events across the nine-week period. The flow survey data gathered for the purposes of this HMA has been used to validate the previous verification as part of the Wonastow Road HMA. The data received from the flow survey indicated a significant drop in baseflow levels, as expected during the dry atypical conditions. The full period graphs can be seen in Appendix C.

FM1

The initial model over predicted flow and velocity. Base flow of 3.72 l/s was removed from subcatchments upstream of the monitor. The outcome of this baseflow removal was a better correlation between the observed and predicted flows. No further changes could be justified to replicate the observed flow and velocities, as the flow survey was taken during a period of particular dry weather.

A reasonable level of DWF verification was achieved at this location.

FM2

The initial model overpredicted depths. The model was underpredicting velocities and flow. Based on the survey at MH SO50121803, which surveyed the incoming pipe at 300mm, the sewer from MH SO50121803 to MH 18448483 was upsized from a 150mm diameter to 300mm – see Figure 9. The outcome was a better match on flows and velocities as the flow was no longer restricted by the 150mm pipe.

Overall a reasonable level of DWF verification was achieved at this location.

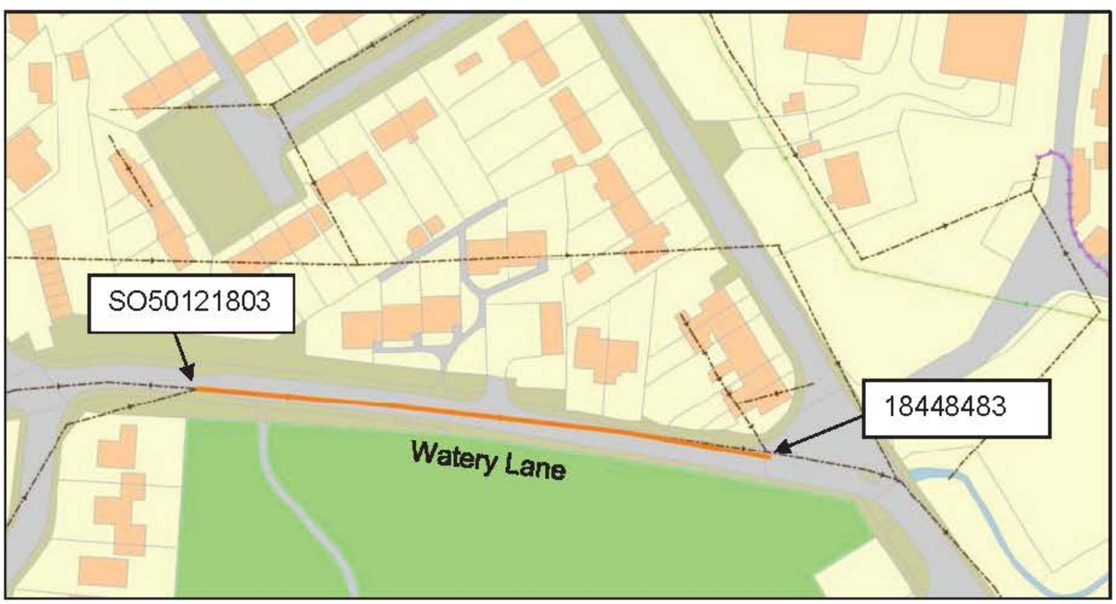


Figure 9 - Pipe upsizing from manhole SO50121803 to 18448483 to 300mm.

DM1

The monitor was located in the storm wet well between 23-04-18 to the 06-06-18 (DM1) and then was moved to the foul wet well between 06-06-18 to 18-06-2018 (DM1A) to capture additional data on depths at the SPS. The depth monitor, is overpredicting depths in the storm wet well and underpredicting in the foul wet well.

A SPS survey was undertaken in AMP5, and given the low number of FMs there is considered to be insufficient evidence to update the on / off levels within the SPS.

3.5 Storm Event Verification Review

The rainfall events captured in the nine-week flow survey period were considered suitable to assess monitor performance against the full survey period, and were compliant with the CIWEM 2017 rainfall specification as confirmed with DCWW. A verification review of these storm events has been undertaken. During these low intensity storm events the spatial variability of the rainfall across the three rain gauges in relatively close proximity was high. Sensitivity testing was carried out, adjusting the rainfall profiles for each monitor and assessing the impact on verification – the testing confirmed that in the catchment the variability of rainfall was high and not all raingauges received the same amounts of rainfall during events.

FM1

The model is overpredicting flow during storm events, but as the peak depths achieved are good, it is deemed appropriate for use in the subsequent detriment assessment.

FM2

A good level of verification was achieved. Therefore, no additional changes were required in order to improve the level of storm verification at this location.

DM1

The model underpredicts peak depths for the duration of the flow survey. However, there is a good correlation between the timings of the observed and predicted peaks. The model is not predicting a sufficient volume at this location, even considering the preceding atypical dry weather conditions. A cross check was performed against telemetry to establish if the modelled pass forward flow at the SPS required adjusting, but the peak telemetry flow (102l/s) appeared to correlate with the observed data. Without further survey work, it is not feasible to confirm if the storm pumps pass forward the modelled rate, which is based on a survey undertaken in AMP5.

There were no significant rainfall events while the monitor was installed in the foul wet well.

3.6 Verification Summary

During the verification review it was found that the monitors show a satisfactory correlation between the observed and predicted flows suggesting that the model was reasonably well verified for the Wonastow Road assessment.

Due to the dry conditions experienced during the flow survey and the small number of monitors, it is not considered appropriate to make significant changes to the model based on this data, and overwrite the previous model changes which were based on a wider survey scope and undertaken during a period of more typical flows.

The verification review has shown that the model conditions are considered acceptable for assessing the impact of the proposed Rockfield Road development on the existing combined network. Verification graphs are presented in Appendix C.

The summer and winter version of the base and development model, with and without the baseflow, has been run and the worst-case detriment scenario taken forward for optioneering.

3.7 Modelling Uncertainties

There are a number of catchment changes which are pertinent to the modelling work of this HMA. These include:

- There are currently ongoing works at the Monmouth Town SPS, where the storage capacity of the SPS is to be increased and a change to the spill/return mechanism implemented.
- The Wonastow Road development (which was modelled during the AMP5 HMA) has been partially constructed. Flows are currently being tankered directly to treatment during weekdays and to the network during weekends.

Both of these issues will impact the results of the short-term flow survey verification. This development (and the associated network mitigations) have been included in the detriment assessment base model, as this will provide a better representation of the future scenario.

3.8 Model Assumptions & Limitations

A number of assumptions have been made during the model build and verification, these include:

- Interaction between the sewer network and the Wonastow Brook has not been modelled as the impacts of the brook were not visible during the period of the flow survey and would require further investigation which is beyond the scope of this HMA.
- Monmouth Town SPS has been modelled with available information as of August 2018. Where possible updated pump rates and levels have been included in the model. However, the drawing and information provided was incomplete. Where necessary, existing levels and previously surveyed pump rates have been retained.
- Very low infiltration was observed during the flow survey. For the baseline model, previous levels of infiltration have been included. It may be feasible to replicate the variation in infiltration using the Ground Infiltration Module. However, this was considered beyond the scope of this

HMA. Should this approach be adopted, care should be taken to ensure that initial conditions for summer and winter events are suitably defined and adhered to.

4 Development System Analysis

4.1 Dry Weather Flow

The Dry Weather Flow (DWF) for the residential properties has been calculated as below for the initial phase (Table 3) and the total development (Table 4).

The developer has not provided information relating to the dwelling type, therefore a multiplier of 2.5 persons per dwelling has been used to generate a value for population.

Parameter	Value	Comment
Population - P	175	70 properties with population as outlined in Table 1
Per Capita Return to Sewer Flow Rate – G	180 l//hd/day	The wastewater profile used for the HMA has a per capita return to sewer flow of 180 l/hd/day. This figure is a standard design figure adopted by DCWW for new developments.
Infiltration	0.037 l/s	10% DWF (PG) assumed
Total DWF Calculations		
P * G	0.365 l/s	Population multiplied by the per capita return to sewer flow rate.
Total DWF	**0.401 l/s**	
DWF Peak Hydraulic Assessment Multiplier	**1 and 2**	DWF Peaking factor for CSO (1) and flooding (2) level of performance investigation.

Table 3 – HMA - DWF Parameters – Phase 1 (Initial)

Parameter	Value	Comment
Population - P	325	130 properties with population as outlined in Table 1.
Per Capita Return to Sewer Flow Rate – G	180 l//hd/day	The wastewater profile used for the HMA has a per capita return to sewer flow of 180 l/hd/day. This figure is a standard design figure adopted by DCWW for new developments.
Infiltration	0.068 l/s	10% DWF (PG) assumed
Total DWF Calculations		
P * G	0.68 l/s	Population multiplied by the per capita return to sewer flow rate.

Total DWF	**0.745 l/s**	
DWF Peak Hydraulic Assessment Multiplier	**1 and 2**	DWF Peaking factor for CSO (1) and flooding (2) level of performance investigation.

Table 4 – HMA - DWF Parameters – Phase 1 and 2 (Total).

4.2 Surface Water Run-off

The developer has been advised that surface water runoff is to be separated from foul flows and it will not be discharged into the existing foul/combined system. The scope of this HMA is limited to the impact on the existing combined system, hence surface water systems within the separated areas have not been considered.

Whilst the surface water network of the proposed development has not been modelled, a nominal allowance of 2% of the total contributing area has been allocated to represent possible future misconnections between the foul and storm systems and the impact of urban creep. This has been applied to each of the road and roof runoff surfaces within the foul sub-catchment.

A detailed layout plan has not been provided for both phases of development, therefore a percentage of the total site area, based on a medium housing (60% of the total subcatchment area) density has been adopted. An even distribution between the road (2%) and roof (2%) contributing area has been applied and this impermeable area has been represented as 100% fixed run off.

The calculation has been tabulated in Table 5.

Phase	Total Impermeable Area (ha)	Total Road Area (ha)	2% Road Area (ha)	Total Roof Area (ha)	2% Roof Area (ha)
1	1.676	0.838	0.017	0.838	0.017
2	0.900	0.450	0.009	0.450	0.009
Total			0.026		0.026

Table 5 - Development Impermeable Areas – Phase 1 (Initial) and Phase 2 Total.

5 Existing / Developed Comparison

5.1 Hydraulic Assessment

Design storms based on a 30 year return period were used to determine the potential flood volumes in the existing and development scenarios.

Winter and summer design storms with durations of 15, 30, 60, 90, 120, 240, 360, 480, 720, 960, 1440 minutes were applied to the existing and full development model. These durations were run for summer and winter events and the winter events were found to be the 'worst case' scenario. The greatest flood detriment volumes were observed during the 1440 minute winter storm duration but the greatest number of flooding manholes were observed during a 30 minute winter storm. This highlights that model predicted flood volumes and number of flooding manholes vary with the duration of the event and therefore all storm durations have been assessed to highlight the worst case scenario.

Existing flooding is predicted at a number of locations downstream of the development connection point (MH SO49136305). The flooding is primarily caused by flows backing up from Monmouth Town SPS, and also by localised hydraulic incapacities, and both are exacerbated by the development flows. The flooding detriment between the baseline and the full development model has been reported in Table 6 where detriment is greater than $1m^3$.

5.1.1 Flood Detriment Full Development - Connection Point 1

This scenario assesses the impact of the development connecting to SO49136305 for the full development of 130 units.

Manhole ID	Critical Duration (min)	Flood Volume (m^3)		Flooding Detriment	
		Existing	Developed	Absolute (m^3)	Percentage (%)
18448483	1440	19.9	30.7	10.8	54.3
SO49129207	480	314.2	315.6	1.4	0.4
SO49129807	1440	3.7	11.6	7.9	213.5
SO49129808	960	3.9	10.4	6.5	0.0
SO50120305	1440	472.2	476.6	4.4	0.9
SO50120802	1440	21.7	33.3	11.6	53.5
SO50120803	1440	24.8	37.6	12.8	51.6
SO50121306	1440	1596.4	1673.9	77.5	4.9
SO50121401	1440	242.5	244.7	2.2	0.9
SO50121403	1440	500	524.4	24.4	4.9
SO50121803	960	2.6	7.2	4.6	0.0
SO50121807	480	1.1	3.4	2.3	0.0
SO50122501	240	31.3	33.7	2.4	7.7
SO50122601	480	72	73.7	1.7	2.4
SO50136601	60	187.4	188.4	1	0.5
SO51131002	90	62.1	63.4	1.3	0.0

SO51131011	90	88.1	93.9	5.8	6.6
SO51131012	90	60.1	63.1	3	5.0
SO51131039	90	34.8	36.7	1.9	5.5

Table 6 – Hydraulic Assessment Results – Full Development.

The total detriment which is seen across the Monmouth Catchment is 184m^3, the majority of which manifests at two key locations:

Wonastow Road

The largest amount of flooding detriment is predicted to occur at this location, where flooding has been recorded historically. There are two contributing factors to the root cause of flooding. Firstly, there is an incapacity in the network underneath the River Monnow. Secondly, Monmouth Town SPS is overwhelmed during a 30 year return period storm which causes flow to back up to Wonastow Road and causes significant flooding – see Figure 10 and Figure 11.

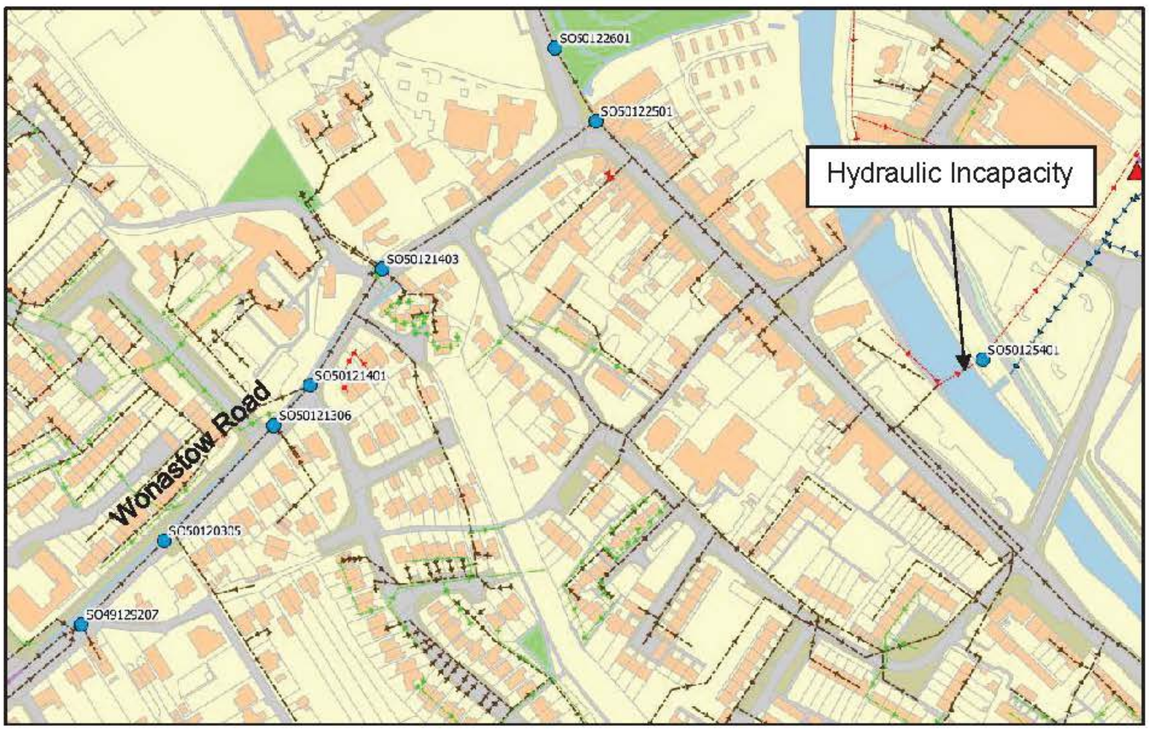


Figure 10 - Extent of flooding detriment at Wonastow Road.

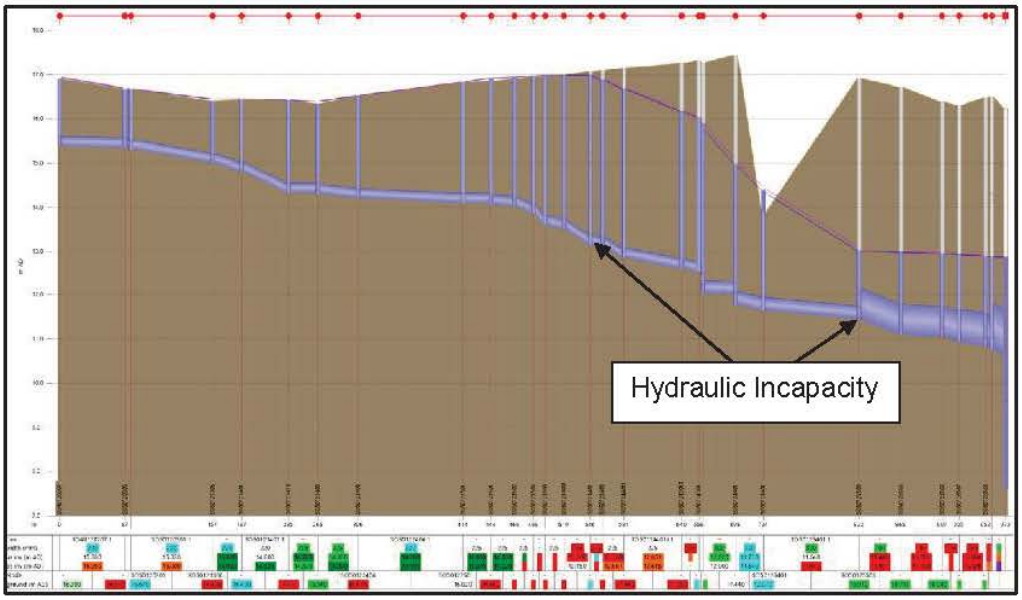


Figure 11 - Long section from River Monnow Crossing to Wonastow Road

Watery Lane

The second location of flooding is at Watery Lane to the north of Wonastow Road with the root cause being identical to that mentioned above. The location of flooding can be seen in Figure 12 and a long section showing the hydraulic incapacity can be seen in Figure 13.

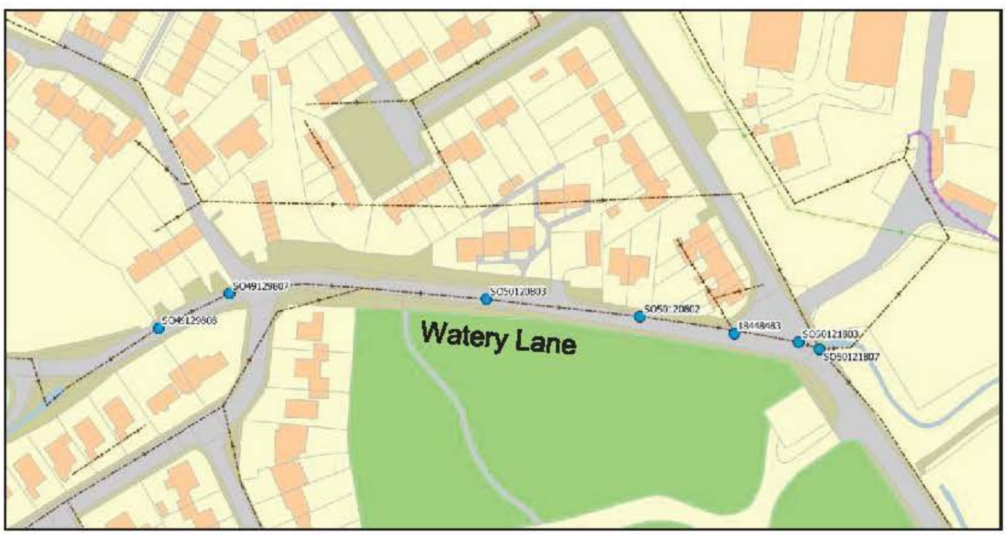


Figure 12 - Flood detriment locations at Watery Lane.

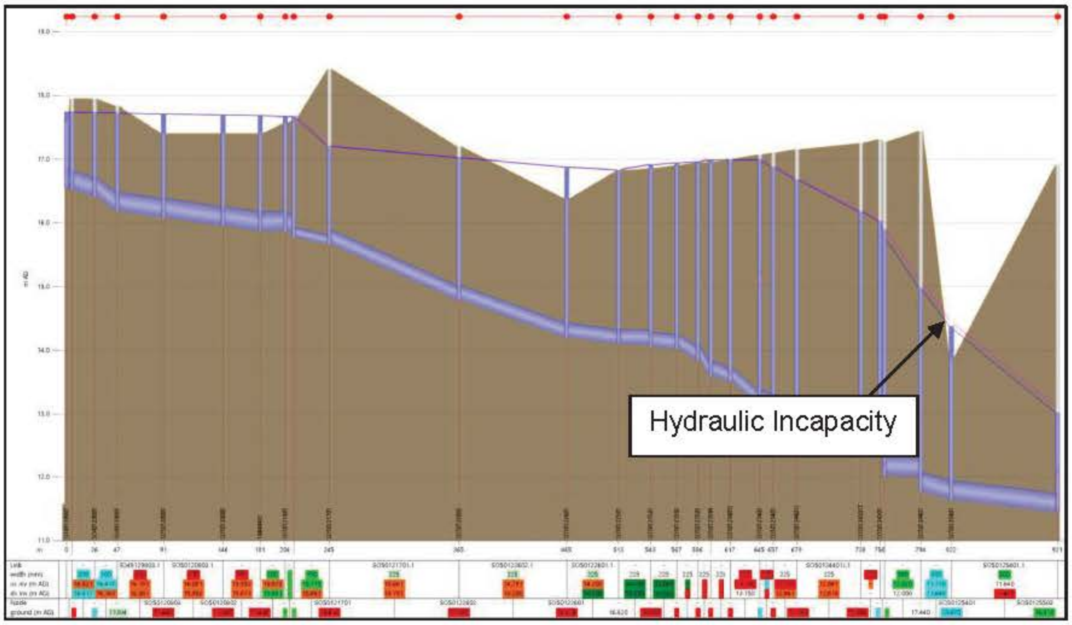


Figure 13 - Long Section from river crossing to Watery Lane.

There are a handful of flood detriment locations found to the west of the catchment (

Figure 14) where flood volumes are <5m^3. The root cause of this flooding cluster is surcharging from Monmouth Town SPS, the long section is captured in Figure 15.

Figure 14 – Flood Locations to west of Monmouth Town SPS.

Figure 15 – Long section of flooding cluster SO51131039- SO51131011.

5.2 Spill Assessment

Spill volume analysis of the overflow(s) was carried out using a rainfall dataset covering a typical year. This dataset was copied from the AMP5 SDP model database. The spill assessment has been conducted on the storm pumps at Monmouth Town SPS using the 12/24/24 block counting method

A summary of the analysis is shown in Table 7.

Asset Name	Spill Frequency							
	Existing		Developed		Spill Difference	Frequency	Spill Volume Difference	
	Spills (No.)	Total Spill Vol. (m^3)	Spills (No.)	Total Spill Vol. (m^3)	Absolute (No.)	Percentage (%)	Absolute (m^3)	Percentage (%)
Monmouth Town SPS	64	29,463	67	30,475	3	4	1,012	3

Table 7 – Spill Assessment – Base model comparison with full development.

Table 7 shows an increase of 1,012m^3 in spill volume between the baseline and the future model including the new development. The new development increases spill volumes.

5.3 Formula 'A' Assessment

The value of Formula 'A' has been determined at Monmouth Town SPS which is impacted on by the development. The Formula 'A' flow is a measure of the continuation flow required at a SPS prior to spill occurring.

The calculated Formula 'A' figures are presented in Table 8.

Asset	Model	Pass Forward Flow (l/s)	Formula A (l/s)	DWF (l/s)	Passes Formula A
Monmouth Town SPS	Existing	96	141.5	53.4	No
	Full Development	96	143.6	54.2	No

Table 8 – Formula 'A' Assessment – Monmouth Town SPS.

The model has been assessed to ensure that the SPS meets the requirement to pass forward Formula 'A' flows and that this requirement is not unduly affected by the addition of the development.

5.4 SPS Assessment

The impact of development flows has also been assessed at Monmouth Town SPS in relation to operational performance including number of pump starts, pump runtimes and pump volumes. The assessment also determines the impact on emergency storage requirements.

The consented emergency storage requirement is for 6 hours of storage at DWF.

Storage calculations are presented in Table 9.

Rockfield Road SPS has not been included in this assessment as without the implementation of a solution the SPS will not be impacted by the development flows.

	3DWF	**Storage Requirement (2hrs @ 3DWF)**
Existing	132.8 l/s	1,153m^3
Developed	134.9 l/s	1,170m^3

Table 9 – Monmouth Town SPS Assessment Emergency Storage – Total Development.

The emergency storage requirement for the existing situation is 1,153m^3, rising to 1,170m^3 with the inclusion of the development. This is an increase in storage requirements of 17m^3.

Pump performance results are presented in Table 10 for DWF conditions.

SPS Name	**Existing**		**Developed**		**Run Time Difference**		**Run Volume Difference**	
	Run Time (minutes)	Run Volume (m^3)	Run Time (minutes)	Run Volume (m^3)	Absolute (minutes)	Percentage (%)	Absolute (m^3)	Percentage (%)
Monmouth Town SPS	2,875	12,725	2,870	13,098	-5	0.1	373	3

Table 10 – SPS Assessment – Runtime & Volume – Total Development.

The development does not have a material impact on the run time as the foul pumps are already operational throughout the simulation during DWF conditions. The new development does have an impact on the volume passed forward at the works as anticipated with the increase in upstream population.

In accordance with Sewers for Adoption, all pumping stations should operate with a maximum of 15 starts per hour. Table 11 gives the maximum number of dry weather starts per hour for all pumps, during a DWF design scenario.

The assessment compares the predicted number of starts per hour for the existing system with the number for the developed system.

Monmouth Town SPS		
	Baseline	**New Development**
Monmouth Town SPS	3	3

Table 11 – SPS Assessment – Number of Pump Starts – Full Development.

The new development has no impact on the number of pump starts per hour.

Dŵr Cymru
Welsh Water

5.5 Flows Arriving at Monmouth WwTW

Using the annual time series 'typical year', it was calculated that 577,488m^3 of flow arrives at Monmouth WwTW. With the new development, this figure increases to 587,096m^3. This corresponds to an increase of 9,607m^3 or 2%.

5.6 Network Performance Assessment Summary

- The new development site is causing 184m^3 of flooding detriment across the catchment and solutions should be developed to mitigate this. The flooding is found in places where there have been flooding incidents recorded historically, primarily in Wonastow Road and Watery Lane.

- The spill frequency at Monmouth Town SPS increases by 3%. Options to reduce this will be considered as part of the solution development.

- The pass forward flow at Monmouth Town SPS has been assessed during the baseline and the full development scenario. The key issue in this catchment is that Monmouth Town SPS is not able to manage the additional incoming flows during long duration storm events, and as a consequence causes surcharge in the network in upstream locations.

Dŵr Cymru
Welsh Water

6 Solution Development

The hydraulic assessment indicates that the addition of development flows results in detriment with regards to network performance. Therefore, solutions have been investigated to offset this detriment. Solutions have only been developed for the full development and not Phase 1.

The notional solutions described in the following sections show conceptual arrangements only and are presented to illustrate the adequacy of the solutions in terms of gross parameters (e.g. pipe capacities); their inclusion does not infer buildability and they are not to be considered as detailed design proposals.

6.1 Notional Solutions

A list of notional solutions was developed and a high-level review was undertaken to determine those that were feasible for a more detailed assessment (Table 12). The high-level review has been undertaken using a winter M30-240 minute storm which was the critical duration for the catchment.

Solution type	**Description**	**Comment on feasibility**	**Proposed solutions to take forward**
Bifurcation / Transfer and flow throttle	New connection point to direct flow from MH SO50121807 to Rockfield SPS and throttle flow at Monmouth Town SPS. **(preferred)**	Medium feasibility. The solution could be combined with proposals to accommodate flows from development site "Land East of Rockfield".	Yes
Bifurcation / Transfer	New connection point to direct flow from MH SO50121807 to Rockfield SPS.	Medium feasibility, low cost solution. The solution could be combined with proposals to accommodate flows from development site "Land East of Rockfield".	Yes
Storage	Storage at DG5 location	Low feasibility due to the built-up nature of the surrounding area and cost of tank (411m^3) (with pump emptying and RTC) to mitigate flooding. Operational staff are unlikely to accept increased OPEX requirements.	No
Storage	Storage D/S of detriment	Low feasibility due to built-up nature of the surrounding area and approximate cost of tank (974m^3) with return pump to mitigate all detriment. There are also issues regarding the access and maintenance of this solution.	No

Rainscape	Identify areas for removal of impermeable area	Not feasible due to catchment flooding concerns and inability to infiltrate.	No
Conveyance	New RM to Monmouth Town SPS	Low feasibility and solution does not resolve detriment with current capacity upsizing works at Monmouth Town SPS. High cost solution thus not progressed at this time as other solutions deemed more suitable.	No
Conveyance	New RM to Rockfield Road SPS	Medium feasibility, more analysis required to assess the impact on Rockfield Road SPS and ensure adequate capacity, e.g. SPS survey.	No
Bifurcation / Transfer	New pipe constructed under the River Monnow	This solution increases flooding significantly at MH SO50125401. Further refinement has been tested, but even with further upsizing (at additional cost) cannot address increase in detriment at MH SO50125401.	No
Upsize	Pipe upsize under River Monnow	Upsizing 182m of 300mm diameter sewer between SO50124301T and SO50125503 to 700mm diameter Upsizing 33m from 150mm to 300mm at SO50121807.1 Increase storm pump capacity to 110 l/s. 50m3 storage to offset increased CSO spills.	No

Table 12 – Notional Solutions.

Following the initial high-level appraisal, two main solutions were taken forward for more detailed assessment. These were initially developed using a M30-240 storm and then tested against a full suite of design storms with varying return periods and durations.

6.2 Solution 1 – Transfer flows to Rockfield Road SPS and increase pump rate at Monmouth Town SPS.

This solution comprises:

- Bifurcation at manhole SO50121807.
- 85m of new 300mm diameter pipe between this point and Rockfield Road SPS.
- Upsize 33m of sewer from 150mm to 300mm at SO50121807.1.
- 401m^3 storage at Rockfield Road PS.
- Increase in the capacity of the storm pumps at Monmouth Town SPS from 90l/s to 100l/s.
- 30m^3 storage at Monmouth Town SPS to offset spill increase (this would also offset the requirement for 17m^3 of additional emergency storage). The location of this storage will be decided at detailed design.

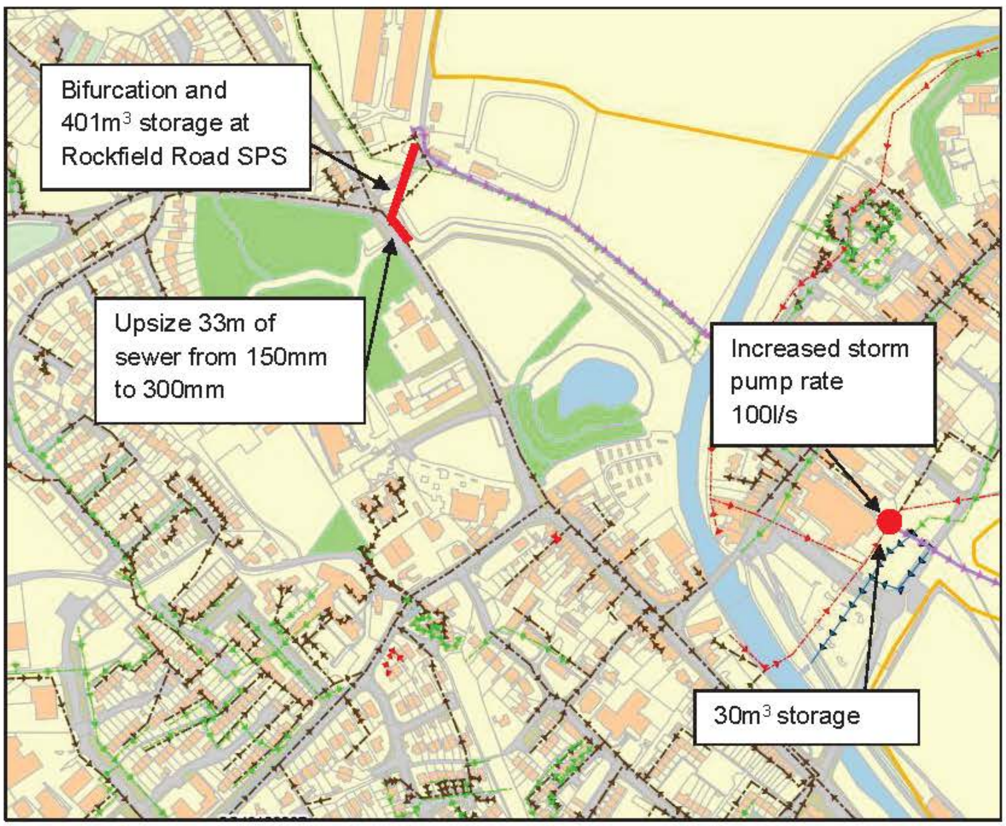


Figure 16 – Solution 1.

The initial scenario used to determine the height of the upstream invert of the new bifurcation sewer looking at DWF found that pipe SO50121807.1 was causing a restriction and causing DWF to be directed over the bifurcation (see Figure 17). In the model, this pipe has a diameter of 150mm yet the pipe diameters upstream and downstream are 300mm and 225mm respectively. The pipe diameter has been flagged as surveyed which provides a level of confidence that it is correct however, if this is found to be incorrect and the diameter found to be 225mm or larger, then this would not need to be implemented. For the purposes of this solution the pipe was upsized to 300mm. This is to be investigated at detailed design stage.

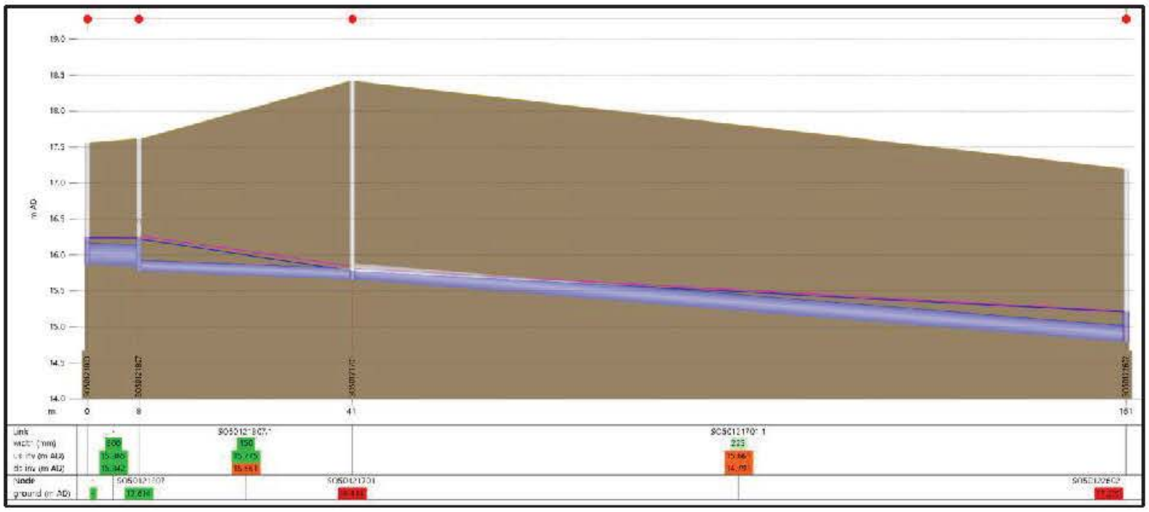


Figure 17 - SO50121807.1 restriction during DWF.

There is minor flood detriment predicted as a result of the Solution as shown in Table 13.

Model Node ID	Critical Duration (min)	Flood Volume (m^3)		Flooding Detriment	
		Existing	Solution 1	Absolute (m^3)	Percentage (%)
SO49129207	480	314.2	316.2	2	0.6

Table 13 - Flooding detriment summary for solution 1.

6.3 Solution 2 - Transfer flows to Rockfield Road SPS and throttle flow at Monmouth Town SPS.

This solution includes:

- Bifurcation at manhole SO50121807.
- 85m of new 300mm diameter pipe between this point and Rockfield Road SPS.
- Upsize from 150mm to 300mm at SO50121807.1.
- 401m^3 storage at Rockfield Road SPS.
- An orifice with a limiting discharge of 96l/s and overflow weir at Monmouth Town SPS to utilise network storage upstream of Monmouth Town SPS, to offset CSO spill increases,
- 23m of 1200mm storage sewer in the Council Car Park to the west of Monmouth Town SPS to offset detriment at MH SO50125401. This is online storage, parallel to the main sewer line with a high-level bifurcation. This provides 26m^3 of storage.
- An increase of 17m^3 of storage to satisfy the emergency storage requirement at Monmouth Town SPS.

It should be noted that this solution will increase the volume of flow passed forward to Monmouth WwTW for treatment (but not the peak flow), but it has been successful at minimising detriment.

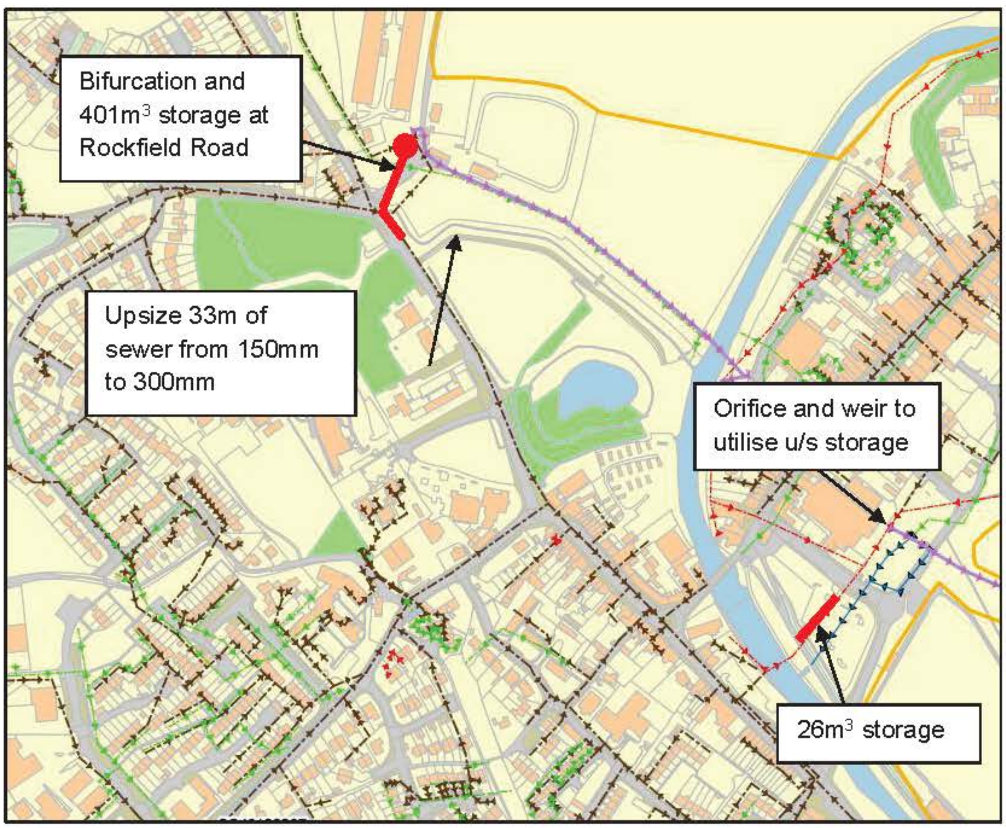


Figure 18 – Solution 2

There is minor flood detriment predicted as a result of the Solution as shown in Table 14.

Model Node ID	Critical Duration (min)	Flood Volume (m^3)		Flooding Detriment	
		Existing	Solution 1	Absolute (m^3)	Percentage (%)
SO49129207	120	179.6	180.6	1	0.6
SO51131039	60	30.7	31.9	1.2	3.9

Table 14 - Flooding detriment summary solution 2.

6.3.1 Spill Assessment

A high-level spill assessment has been completed using the TSR rainfall files, see Table 15. The solutions and sub solutions detailed above have been run with this TSR rainfall and were found to increase the spill volume at Monmouth Town SPS in solution 1 and 3 but not solution 2.

Simulation	Spill Volume Per Annum (m^3)	Spill Frequency Per Annum	Spill Duration Per Annum (hrs)	Total volume increase per spill event compared to baseline (m^3)	Total % increase in spill volume	Storage volume required (m^3)
Baseline	29,463	64	346	-		-
Full Development	30,475	67	361	1,012	3.4	25
Option 1 – Transfer flows to Rockfield Road SPS	30,251	66	352	788	2.6	30
Option 2 - Transfer flows to Rockfield Road SPS and throttle flow	13,148	28	82	0	0	0

Table 15 - Baseline, full development and option spill summary.

Additional storage is required at Monmouth Town SPS for solutions 1 to mitigate the increase in spill volume. Due to buildability issues associated with constructing the storage at Monmouth Town SPS, it is not deemed feasible to include this at the SPS, and an alternative, the option of utilising existing network storage via an orifice and high level overflow at the inlet to Monmouth Town SPS is preferred.

6.4 Solution Summary

The preferred solution is Solution 2 – Transfer of flows to Rockfield SPS and throttle flow, as it requires minimal disruption to the network.

7 Solution Costs

The solution costs provided are based on the DCWW Solution Target Pricing Tool (STPT). This cost model predicts costs based on final costs of completed schemes. These are intended to be high level cost estimates and are for option comparison only and these can be seen in Table 16. The indicative costs do not include the cost of land purchase. It is recommended that a detailed cost estimate is undertaken during the detailed design phase.

Solution	Description	Cost
1	Bifurcation and upsizing pumps to 100l/s and additional storage at Monmouth Town SPS.	£980,000
2	Transfer to Rockfield Road SPS and throttle flow at Monmouth Town SPS.	£1,030,000

Table 16 - Solution summary.

The 17m^3 of emergency storage requirement detailed in the SPS assessment in Table 9, Section 5.4 have been included in each of the solution costings. This can be achieved through the provision of storage at Monmouth Town SPS (not deemed to be acceptable by operations), or through construction of an orifice and overflow immediately upstream of Monmouth Town SPS (preferred) to utilise upstream network storage. It is not considered feasible to construct this storage in the nearby Council Car Park as there is insufficient head to accurately take off the required flow without requiring significant storage volumes.

8 Conclusions & Recommendations

This development has 130 dwellings planned for construction to the west of Rockfield Road, and located to the north of the town of Monmouth. The proposed development has been assessed as connecting to MH SO49136305 on Levitsfield Close, south east of the development (an existing 150mm foul sewer draining to Monmouth Town SPS).

The hydraulic model for the catchment has been updated to support this assessment with:

- MH survey data
- Connectivity survey data
- Ongoing works in the catchment
- Representation of Monmouth Town SPS to reflect the new arrangement. Additional storage, storm return pump with RTC with assumed on off levels, and storm pump rates provided by the designer.

As part of this HMA two flow monitors and a depth monitor were installed in the network in order to undertake a verification review of the catchment. During the verification review it was found that the monitors show a satisfactory correlation between the observed and predicted flows suggesting that the model is fit for the purpose for undertaking this HMA.

Due to the atypical conditions experienced, conditions during the flow survey and the small number of monitors, it would not be appropriate to make significant changes to the model based on this data, and overwrite the previous model changes based on data which is a more typical representation of flows in the catchment.

The following assumptions/limitations have been applied to this HMA:

- The Wonastow Brook Interaction has not been modelled as the impacts of the brook were not observed during the flow survey period, and require further investigation which is beyond the scope of this HMA.
- Monmouth Town SPS has been modelled with available information as of August 2018. Where possible updated pump rates and levels have been included in the model. However, the drawing and information provided was incomplete. Where necessary, existing levels and historic surveyed pump rates have been retained.
- All information relating to Rockfield Road SPS is currently flagged as assumed data and therefore confidence is limited with respect to the performance of this asset. This should be considered further at the detail design stage.
- Very low infiltration was observed during the flow survey. For the baseline model, previous levels of infiltration have been included. It may be feasible to replicate the variation in infiltration using the Ground Infiltration Module. However, this was considered beyond the scope of this HMA. Should this approach be adopted, care should be taken to ensure that initial conditions for summer and winter events are suitably defined and adhered to.

The hydraulic assessment was undertaken on the following scenarios:

- Scenario 1 – Baseline – Connection Point 1
- Scenario 2 – Total Development – Connection Point 1

The hydraulic assessment shows that there is anticipated to be 184m^3 of flooding detriment, with the majority of detriment found in two locations, Watery Lane and Wonastow Road. This was considered an unacceptable level of detriment and solutions have been developed in order to mitigate this.

- Solution development has identified three solutions to resolve the predicted detriment. The solutions are:

Solution	Description	Cost
1	Bifurcation and upsizing pumps to 100l/s and additional storage at Monmouth Town SPS.	£980,000
2	Transfer to Rockfield Road SPS and throttle flow at Monmouth Town SPS.	£1,030,000

Table 17 - Solution and costing summary.

The preferred solution in this HMA is Solution 2 - the transfer of development flows to Rockfield Road SPS with additional storage, as this is a minimal detriment solution and considered more deliverable in terms of buildability

Dŵr Cymru
Welsh Water

Appendix A – Drawings & Plans

KEY

- Development Parcels & Building Line
- Streets
- Existing Retained Vegetation
- Habitat Creation, Landscaping & Open Space
- Equipped Play Facilities
- Detention Basin
- Public Footpath

N

J:\3300\3381\2016 Application\LANDS\Plans\3381-P-08-B Indicative Masterplan.indd

Hallam Land Management
Land off Rockfield Road
Monmouth

INDICATIVE MASTERPLAN

1:1250@A3
21 July 2016 CRD / BC
3381-P-08 B

fpcr

masterplanning ▪
environmental assessment ▪
landscape design ▪
urban design ▪
ecology ▪
architecture ▪
arboriculture ▪

FPCR Environment and Design Ltd
Lockington Hall
Lockington
Derby DE74 2RH

t: 01509 672772
f: 01509 674565
e: mail@fpcr.co.uk
w: www.fpcr.co.uk

Legend

- Site Boundary
- Feature Space
- Keynote Building
- Key Views
- Gateway Frontage
- Proposed Feature Trees ar
- Existing Trees/Hedgerows

Fig.36: Key Views and Features

Dŵr Cymru
Welsh Water

Appendix B – HMA Sign Off Form

Dŵr Cymru Welsh Water

DCWW HMA Sign Off Form

Rockfield Road HMA

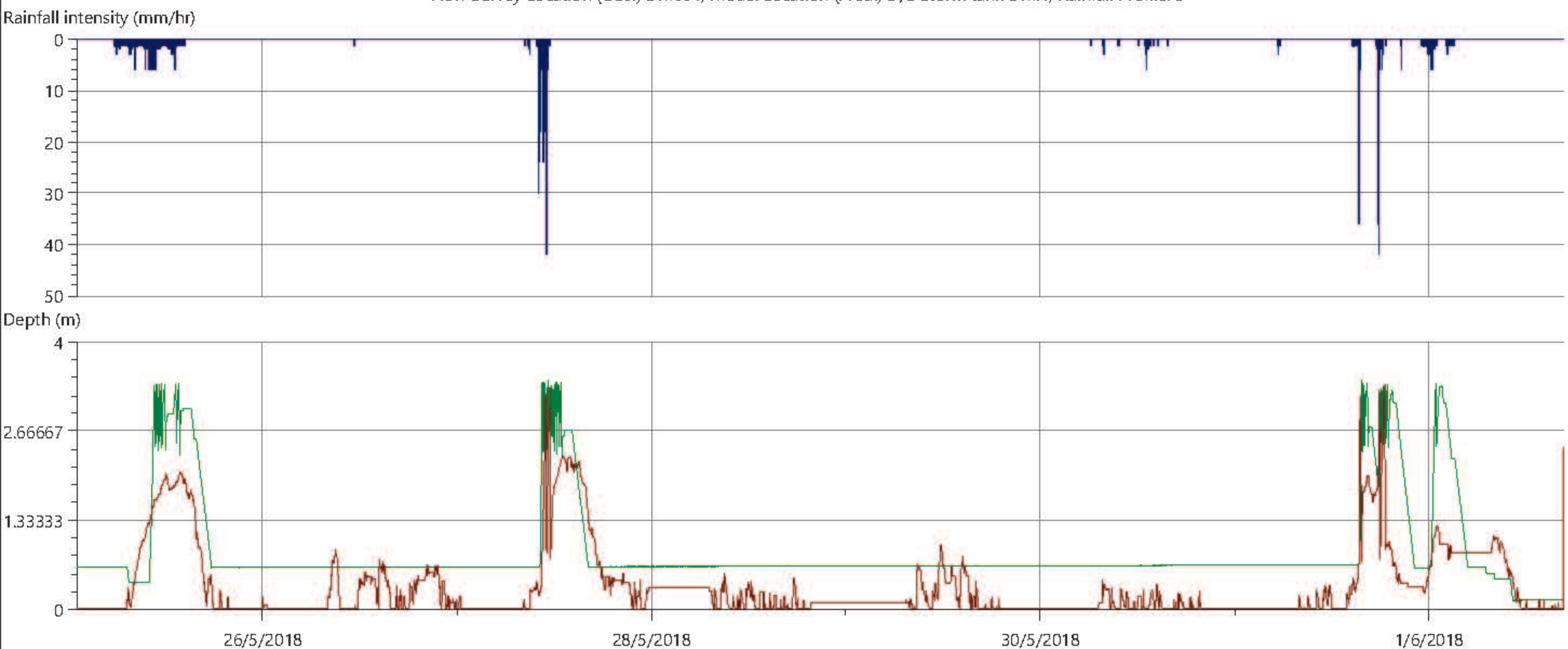
Stage No.	Process & Gateways	Hyperlink	Sign Off	Date	Revised Date
Stage 1	Developer Kick-off Meeting	Section 2.1 - Stage 1	Rhys Tucker	26/02/2018	26/02/2018
	Gateway 1				
Stage 2	Model Build/Enhancement & Verification	Section 2.2 - Stage 2		11/06/2018	03/08/2018
	Gateway 2				
Stage 3	Development Modelling	Section 2.3 - Stage 3		18/06/2018	10/08/2018
	Gateway 3				
Stage 4	Hydraulic Assessment	Section 2.4 - Stage 4		09/07/2018	17/08/2018
	Gateway 4				
Stage 5	Solution Development	Section 2.5 - Stage 5		23/07/2018	29/08/2018
Stage 6	Outline Solution Costs	Section 2.6 - Stage 6		23/07/2018	31/08/2018
Stage 7	Reporting	Section 2.7 - Stage 7		13/08/2018	07/09/2018
Stage 8	Study Close Out	Section 2.8 - Stage 8		24/08/2018	07/12/2018
	Gateway 5				

Appendix C – Verification Plots & Comparative Analysis

Dŵr Cymru
Welsh Water

Appendix D – Hydraulic Assessment Results & Long Sections

Observed / Predicted Report Produced by JEFF5888 (30/07/2018 13:17:50) Page 1 of 4
Flow survey: >Rockfield Road Monmouth>Flow Survey Data>Calibrated Flow Survey Data (19/07/2018 15:06:16)
Sim: >Rockfield Road Monmouth>Simulation Group>Rockfield Road V01 (v32) [2018 HMA FS][Full] v2 RS!>V01: Scenario 3 Calibrated Flow Survey Data (30/07/2018 10:30:41)
Flow Survey Location (Obs.) DM001, Model Location (Pred.) D/S Storm tank DM.1, Rainfall Profile: 3

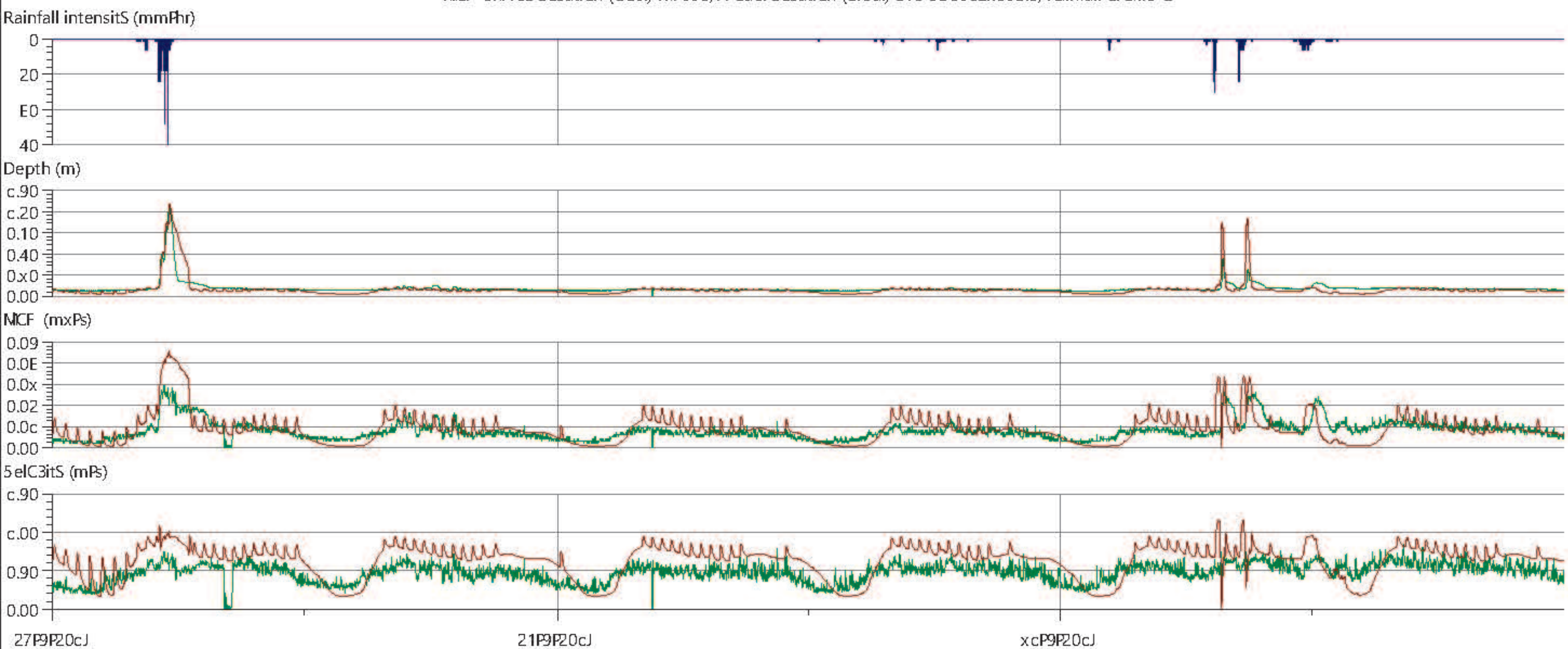


	Rainfall			Depth	
	Depth (mm)	Peak (mm/hr)	Average (mm/hr)	Min (m)	Max (m)
Rain	53.720	42.000	0.293		
Observed				0.137	3.429
... Calibrated Flow Survey Data				0.010	3.344

Observed / Predicted Report (Custom graph) - 2018 HMA Flow Survey v2

Powered by InfoWorks®

Observed Puredi3ted RepCrt urCdw3ed bS 8 MM9JJJ (x0P07P20cJ cx:ε2:90) ua/ e x Cf E
MCF swrveS>6 RC3yfield RCad A CnmCwth6 MCF owrveS Data6 Galibrated MCF owrveS Data (c1P07P20cJ c9:94:ε4)
oim>6 RC3yfield RCad A CnmCwth6 oimwlatiCn VrCwp6 RC3yfield RCad 50c (vx2) [20cJ HA k Mo][MNl] v2 Ro!6 50c>o3enariC x Galibrated MCF owrveS Data (x0P07P20cJ c0:x0:Ec)
MCF owrveS LC3atiCn (Obs.) MA 00c, A Cdel LC3atiCn (ured.) DPo oO90c2x90E.c, Rainfall urCfile>2

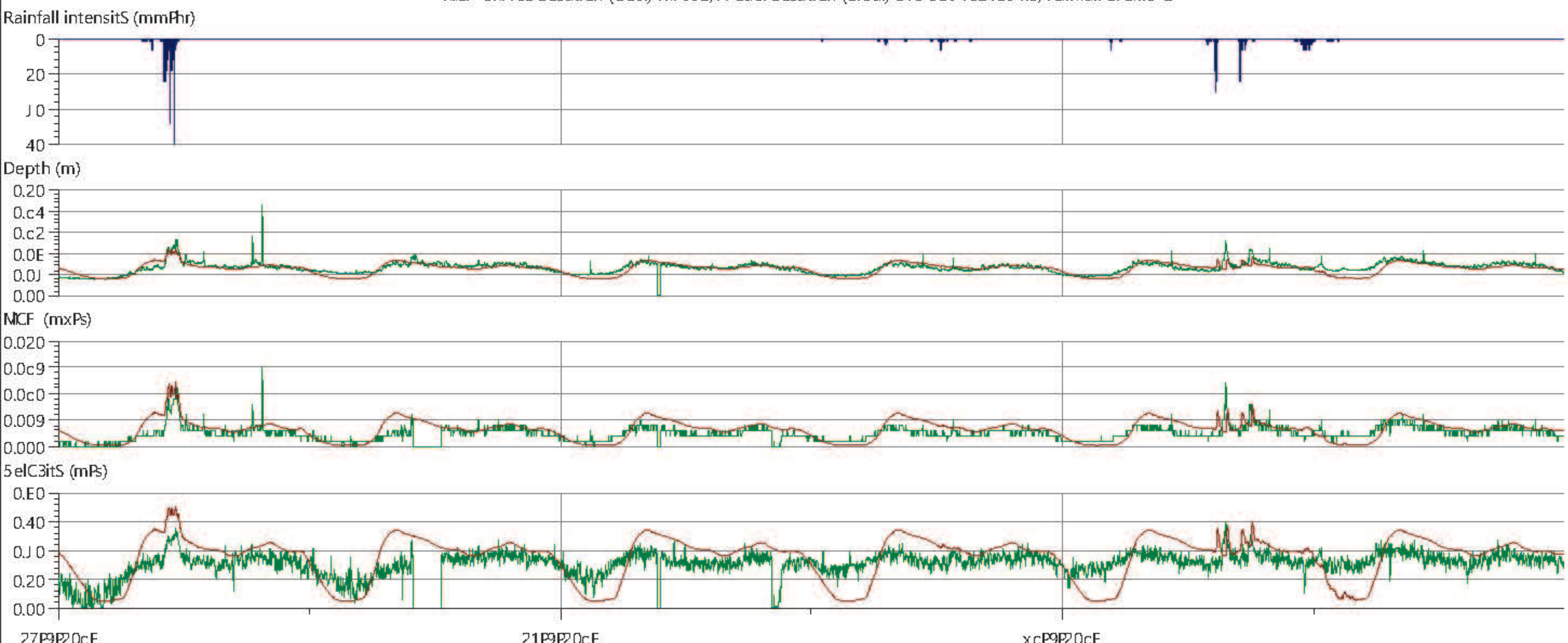


	Rainfall			Depth		MCF			5elC3itS	
	Depth (mm)	ueay (mmPhr)	kvera/ e (mmPhr)	A in (m)	A ag (m)	A in (mxPs)	A ag (mxPs)	5Clwme (mx)	A in (mPs)	A ag (mPs)
Rain	x7.x20	40.000	0.291							
Observed				0.000	c.2J1	0.000	0.021	x142.2x2	0.000	0.JE0
...ICF owrveS Data				0.027	c.x09	0.000	0.0E9	ExJ2.2J7	0.002	c.c9E

Observed / Predicted Report (Custom graph) - 2018 HMA Flow Survey v2

Powered by InfoWorks®

Observed Puredi3ted RepCrt urCdw3ed bS 8 MM9EEE (x0P07P20cE cx:c2:90) ua/ e J Cf J
MCF swrveS>6 RC3yfield RCad A CnmCwth6 MCF owrveS Data6 Galibrated MCF owrveS Data (c1P07P20cE c9:94:c4)
oim>6 RC3yfield RCad A CnmCwth6 oimwlatiCn VrCwp6 RC3yfield RCad 50c (vx2) [20cE HA k Mb][MNl] v2 Ro!6 50c>o3enariC x Galibrated MCF owrveS Data (x0P07P20cE c0:x0:Jc)
MCF owrveS LC3atiCn (Obs.) MA 002, A Cdel LC3atiCn (ured.) DPb oOJ 1c21E04.c, Rainfall urCfile>2



	Rainfall			Depth		MCF			5elC3itS	
	Depth (mm)	ueay (mmPhr)	kvera/ e (mmPhr)	A in (m)	A ag (m)	A in (mxPs)	A ag (mxPs)	5Clwme (mx)	A in (mPs)	A ag (mPs)
Rain	x7.x20	40.000	0.291							
Observed				0.000	0.c7c	0.000	0.0c9	c2J 1.7E1	0.000	0.910
...ICF owrveS Data				0.0x2	0.0EE	0.000	0.0c2	c42x.0E4	0.09J	0.709

Observed / Predicted Report (Custom graph) - 2018 HMA Flow Survey v2

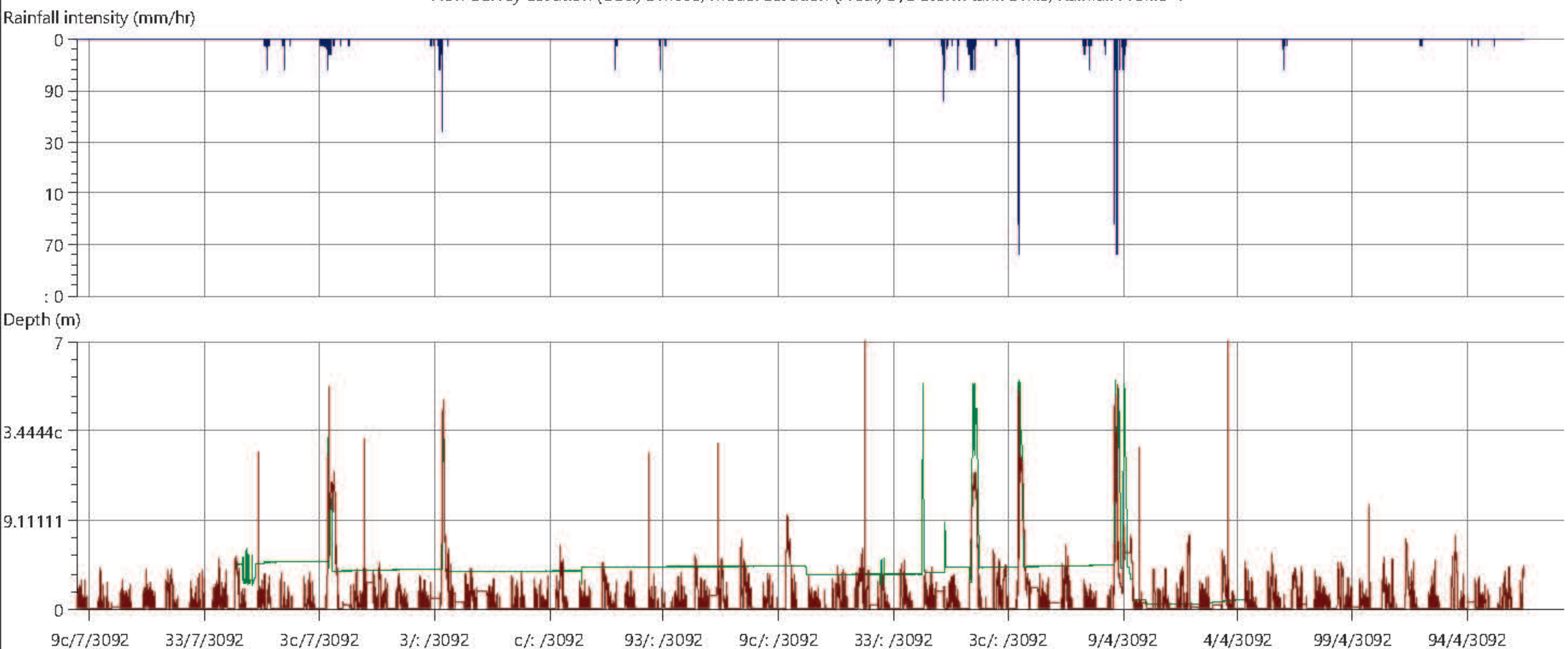
Powered by InfoWorks®

Observed / PrediJted Report ProduJed by E8FF: 222 (10/0c/3092 91:94:7c) Page 9 of 7

Flow survey>6 RoJkfield Road Monmouth6 Flow Survey Data6 Calibrated Flow Survey Data (95/0c/3092 9: :94:94)

Sim>6 RoJkfield Road Monmouth6 Simulation Group6 RoJkfield Road V09 (v13) [3092 HMA FS] [Full] v3 RS!6 V09>SJenario 1 Calibrated Flow Survey Data (10/0c/3092 90:10:79)

Flow Survey LoJation (Obs.) DM009, Model LoJation (Pred.) D/S Storm tank DM.9, Rainfall Profile>1

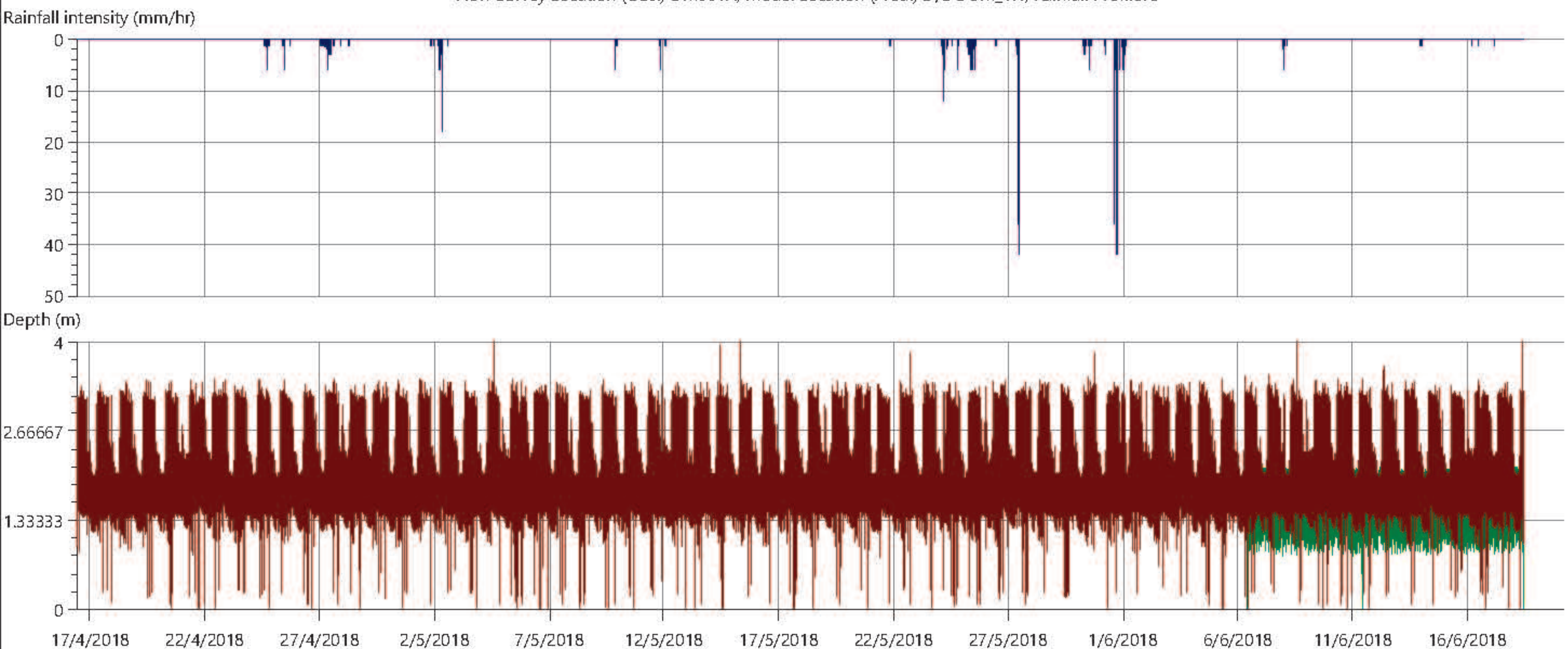


	Rainfall			Depth	
	Depth (mm)	Peak (mm/hr)	Average (mm/hr)	Min (m)	Max (m)
Rain	53.720	73.000	0.049		
Observed				0.000	1.735
... Calibrated Flow Survey Data				0.090	99.40c

Observed / Predicted Report (Custom graph) - 2018 HMA Flow Survey v2

Powered by InfoWorks®

Observed / Predicted Report Produced by JEFF5888 (30/07/2018 13:06:47) Page 2 of 4
Flow survey: >Rockfield Road Monmouth>Flow Survey Data>Calibrated Flow Survey Data (19/07/2018 15:06:16)
Sim: >Rockfield Road Monmouth>Simulation Group>Rockfield Road V01 (v32) [2018 HMA FS][Full] v2 RS!>V01: Scenario 3 Calibrated Flow Survey Data (30/07/2018 10:30:41)
Flow Survey Location (Obs.) DM001A, Model Location (Pred.) D/S DUM_1.4, Rainfall Profile: 3

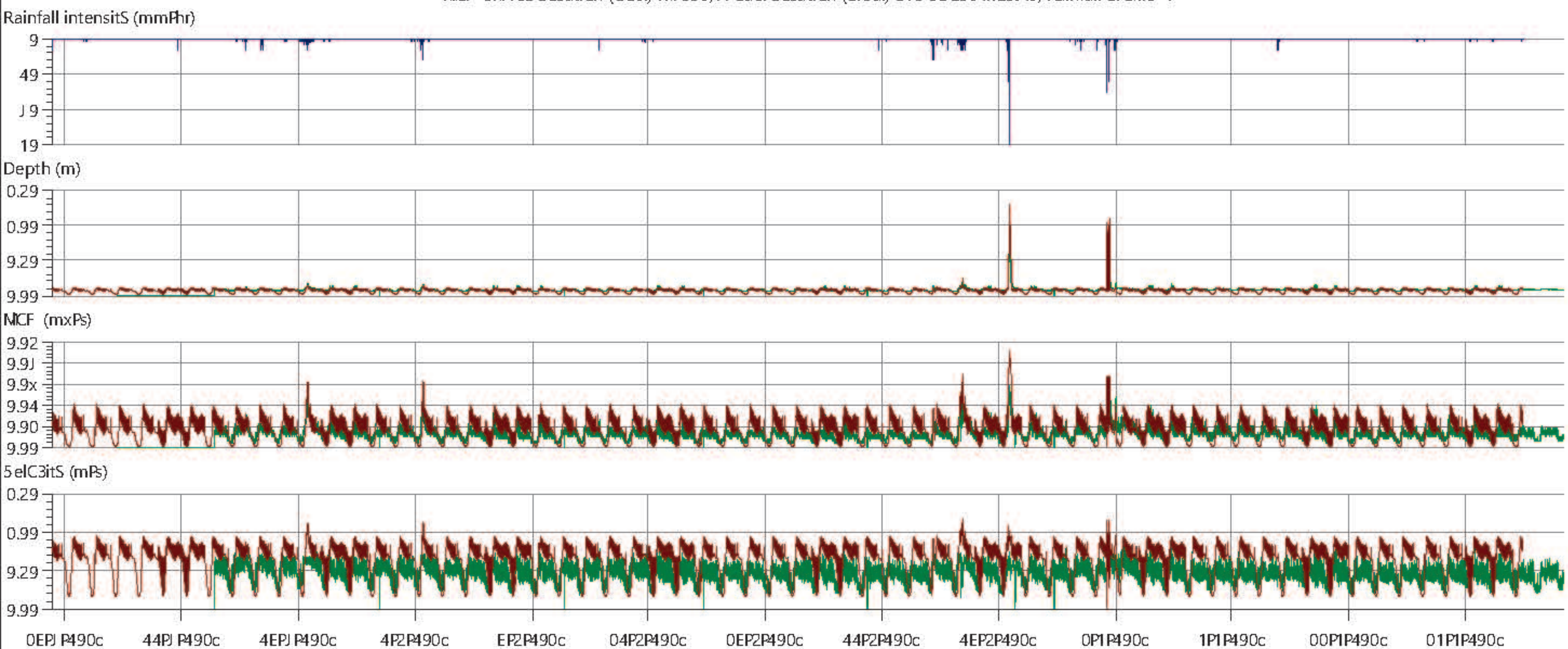


	Rainfall			Depth	
	Depth (mm)	Peak (mm/hr)	Average (mm/hr)	Min (m)	Max (m)
Rain	92.480	42.000	0.061		
Observed				0.000	2.201
... Calibrated Flow Survey Data				0.010	5.435

Observed / Predicted Report (Custom graph) - 2018 HMA Flow Survey v2

Powered by InfoWorks®

Observed Puredi3ted RepCrt urCdw3ed bS 8 MMZccc (x9P9EP490c 0x:04:29) ua/ e x Cf J
MCF swrveS>6 RC3yfield RCad A CnmCwth6 MCF owrveS Data6 Galibrated MCF owrveS Data (07P9EP490c 02:91:01)
oim>6 RC3yfield RCad A CnmCwth6 oimwlatiCn VrCwp6 RC3yfield RCad 5 90 (vx4) [490c HA k Mb] [MMI] v4 Ro!6 5 90>o3enariC x Galibrated MCF owrveS Data (x9P9EP490c 09:x9:J0)
MCF owrveS LC3atiCn (Obs.) MA 990, A Cdel LC3atiCn (ured.) DPo oO2904x29J.0, Rainfall urCfile>4

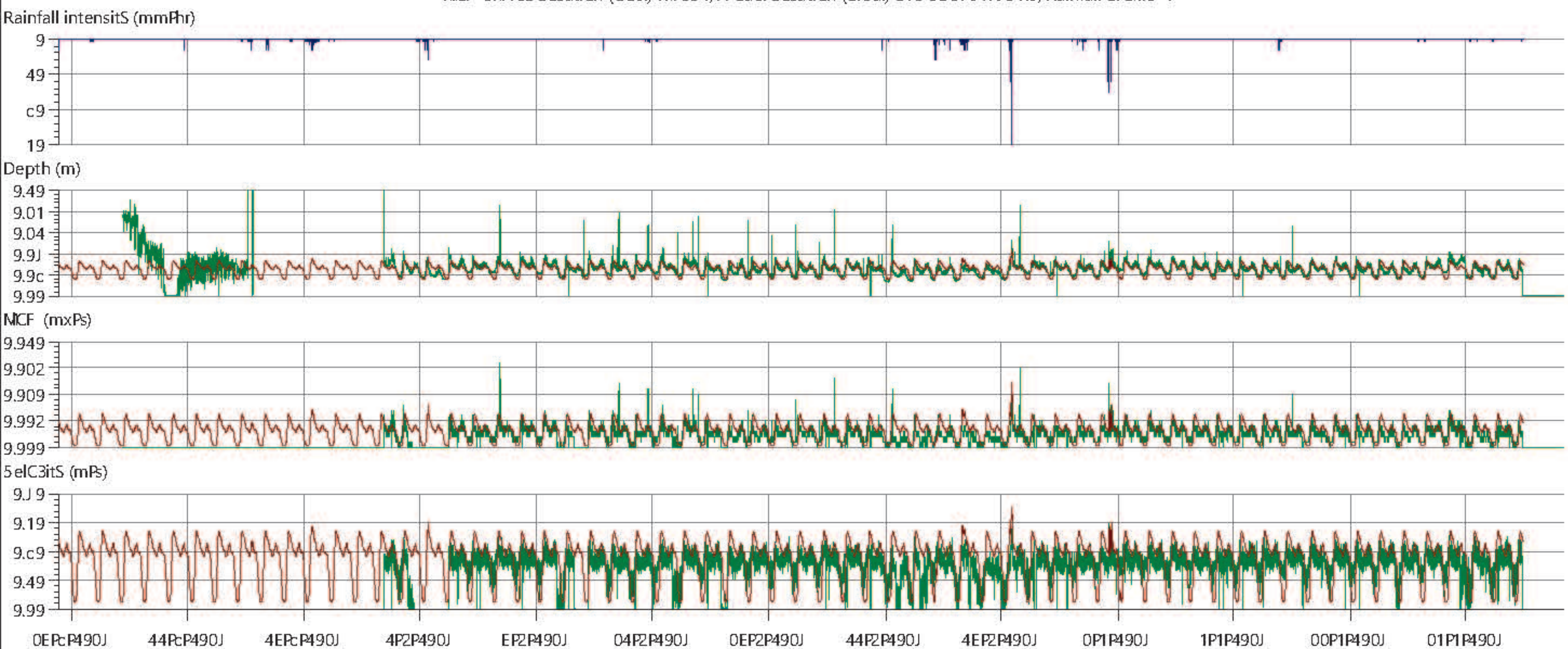


	Rainfall			Depth		MCF			5elC3itS	
	Depth (mm)	ueay (mmPhr)	kvera/e (mmPhr)	A in (m)	A ag (m)	A in (mxPs)	A ag (mxPs)	5Clwme (mx)	A in (mPs)	A ag (mPs)
Rain	72.049	19.999	9.91x							
Observed				9.999	0.4c7	9.999	9.947	x09x1.149	9.999	9.cJ 9
...ICF owrveS Data				9.94E	0.x92	9.999	9.9J 2	J 4001.72J	9.994	0.021

Observed / Predicted Report (Custom graph) - 2018 HMA Flow Survey v2

Powered by InfoWorks®

Observed Puredi3ted RepCrt urCdw8ed bS 8 MM2J J J (x9P9EP490J 0x:94:29) ua/ e c Cf c
MCF swrveS>6 RC3yfield RCad A CnmCwth6 MCF owrveS Data6 Galibrated MCF owrveS Data (07P9EP490J 02:91:01)
oim>6 RC3yfield RCad A CnmCwth6 oimwlatiCn VrCwp6 RC3yfield RCad 590 (vx4) [490J HA k Mb][MMl] v4 Ro!6 590>o3enariC x Galibrated MCF owrveS Data (x9P9EP490J 09:x9:x0)
MCF owrveS LC3atiCn (Obs.) MA 994, A Cdel LC3atiCn (ured.) DPo oOc7047J91.0, Rainfall urCfile>4



	Rainfall			Depth		MCF			5elC3itS	
	Depth (mm)	ueay (mmPhr)	kvera/e (mmPhr)	A in (m)	A ag (m)	A in (mxPs)	A ag (mxPs)	5Clwme (mx)	A in (mPs)	A ag (mPs)
Rain	72.049	19.999	9.91x							
Observed				9.999	9J 7x	9.999	9.901	7cJ E.749	9.999	9.279
...ICF owrveS Data				9.9x4	9.9J J	9.999	9.904	011cE.141	9.92c	9.E92

Observed / Predicted Report (Custom graph) - 2018 HMA Flow Survey v2

Powered by InfoWorks®

Dŵr Cymru
Welsh Water

Appendix E – Formula A Calculation Spreadsheet

The following table is based on the guidance given in the UID Methodology Guidance for Formula A calculations. The table calculates Formula A based on the following formula (m3/d):
Formula A = (PcG+1.360Pc) + I+3E + (3PsG)

CSO name	CSO Ref	WAG Profile	DOMESTIC G (l/hd/d)	P (nr)	Pc (nr) combined	Ps (nr) foul	PG (l/s)	PcG (l/s)	PsG (l/s)
Monmouth Town PS	31915	1	180	9166	427.5	8738.5	19.10	0.89	18.21
		2	180	2825	325	2500	5.89	0.68	5.21
		3	180	1410	0	1410	2.94	0.00	2.94
		4	135	30	0	30	0.05	0.00	0.05
				0	0	0	0.00	0.00	0.00
				0	0	0	0.00	0.00	0.00
				0	0	0	0.00	0.00	0.00
				0	0	0	0.00	0.00	0.00
				0	0	0	0.00	0.00	0.00
				0	0	0	0.00	0.00	0.00
		Total		13431	752.5	12679	27.965625	1.5677	26.358

BASEFLOW I (l/s)	TRADE Profile	TRADE E (l/s)
13.75	1	0.00
	2	0.00
	3	0.00
	4	1.06
	5	4.12
	6	0.00
	7	7.23
	8	0.00
	9	0.00
	10	0.00
13.75		12.41

CRITICAL PARAMETERS DWF (l/s)	3 x DWF (l/s)	FORM 'A' (l/s)	Pass Forward at First Spill (l/s)	Minimum Pass Forward During Spill (l/s)	CSO Passes Formula A?
32.9	71.1	76.0			
5.9	17.7	21.4			
2.9	8.8	8.8			
1.1	3.3	3.3			
4.1	12.4	12.4			
0.0	0.0	0.0			
7.2	21.7	21.7			
0.0	0.0	0.0			
0.0	0.0	0.0			
0.0	0.0	0.0			
54.2	134.9	143.6		100	NO

Emergency/Storage Required	
ltrs	1169977.5
m3 storage	1170

Head Office Address
6150 Knights Court,
Solihull Parkway,
Birmingham Business Park,
Birmingham.
B37 7WY

T +44(0)121 329 4330
brookbanks.com