

Project:	Lower Berse Farm, Ruthin Road, Wrexham	Scheme No:	13840
Subject:	Foul Drainage Phosphate Assessment	Revision:	01
Client:	Redrow Homes Ltd	Date:	05/11/2024
Doc Ref:	13840-Foul Drainage Technical Note-01		
Author:	Aled Williams BSc (Hons) MCIWEM C.WEM		
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Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM		

Introduction

Waterco has been commissioned to undertake a Technical Note to provide information on foul drainage in relation to the proposed residential led development at land south of Ruthin Road, Wrexham, LL11 3BW.

An outline planning application is being submitted for residential development in the region of 1,450 dwellings together with associated roads, open spaces, community facilities and a site for a primary school.

This Technical Note is required in response to the Planning & Environment Decisions Wales (PEDW) letter dated 22/10/2024 (reference CAS-03789-W3C7T6).

The proposed development will discharge foul flows to the public sewer system. The PEDW letter, included as Appendix A, requests the following information for developments which connect to the public sewer system within a riverine Special Conservation Area (SAC):

‘Where the development involves connecting to public wastewater treatment works:

- a) Confirmation as to whether the environmental permit for the associated wastewater treatment works has been reviewed against revised conservation objectives for water quality; and*
- b) Confirmation as to whether there is capacity in place to accommodate the additional wastewater in compliance with revised permit limits; and*
- c) Confirmation the sewer network and associated WwTW is operating in compliance with the permit conditions and has the hydraulic capacity for new connections without leading to an increase in the environmental impact of storm overflows; and*
- d) Confirmation of how foul drainage will be managed; and*
- e) Scale plans showing the location of the nearest public sewer and proposed connection point; and*
- f) Where relevant, evidence that an application has been made to the sewerage undertaker for connection to a public sewer, and a copy of their formal response confirming either:*
 - i. there is capacity to treat additional wastewater and nutrients from the proposed development (in combination with other planned development) within the existing discharge permit limits; or*
 - ii. the necessary treatment capacity to remain within revised environmental permit limits will be delivered within the agreed Asset Management Plan (AMP) and that when implemented the treatment capacity will ensure that additional waste water generated in consequence of proposed development will remain within revised permit limits and*

- iii. *that the sewer network and associated WwTW is currently operating in compliance with permit conditions (or will be prior to any new connection being made) and has the hydraulic capacity to accommodate additional wastewater without contributing to an increase in frequency or duration of storm overflows.'*

Foul Drainage Assessment

Wastewater Treatment Works Environmental Permit

It is proposed to discharge foul flows from the development to the Dwr Cymru Welsh Water (DCWW) public sewer network. The sewer network ultimately discharges to DCWW's Five Fords Wastewater Treatment Works (WwTW). The outfall of treated effluent from the Five Fords WwTW is made to the River Clywedog which is a tributary of the River Dee. The River Dee, located approximately 4.5km east of the Five Fords WwTW and 9.2km south-east of the site, is a designated Special Area of Conservation.

A revised environmental permit for Five Fords Wastewater Treatment Works, setting out phosphate limits, was issued by NRW on 28th July 2023.

Correspondence from DCWW dated 13th October 2023, included as Appendix B, states that *'there is suitable capacity in Five Fords WwTW to accommodate this development's foul flows as well as maintain compliance with both the existing and the proposed phosphorus consent limit'*. The Five Fords WwTW can therefore accommodate foul flows from the proposed development whilst maintaining compliance with the phosphorus limit prescribed by the NRW environmental permit.

Wastewater Treatment Works Capacity

Correspondence from DCWW dated 13th October 2023 and 12th April 2024, included as Appendix B, confirms that there is sufficient capacity in the Five Fords WwTW to accommodate the development foul flows.

A Hydraulic Modelling Assessment (HMA) has been undertaken by DCWW to establish the impact of development foul flows on the public sewer system and WwTW. Where detriment is estimated, the HMA sets out mitigation solutions. The HMA is included as Appendix C.

The HMA concludes that whilst there is capacity at the WwTW, foul flows from the proposed development would cause detriment to spill frequency at the WwTW combined sewer overflow (CSO). However, and as detailed in the DCWW email dated 12th April 2024, DCWW are intending on delivering a capital scheme in AMP9 (2025-2030) at Five Fords WwTW to provide additional headroom at the works to mitigate any impact that development in the area, including the Lower Berse Farm site, would have on CSO spill frequency. DCWW will implement a 'grampian' style condition to the planning permission which prevents occupation of the proposed dwellings until the WwTW upgrades are complete.

It can therefore be concluded that there is capacity at the WwTW and that additional headroom will be provided at the WwTW to mitigate any increase in CSO spill frequency prior to occupation of the proposed dwellings.

Sewer Network Capacity & Foul Drainage Management

The DCWW HMA concludes that without mitigation, the proposed development would cause detriment to the public sewer network. Prior to first occupation of the proposed dwellings, upgrades to the sewer network will be

made to mitigate any detriment. The mitigation is set out in the HMA (Appendix C). The preferred mitigation solution is 'Solution 2' which involves:

- 360.6m of new 300mm diameter sewer connecting to public combined manhole SJ32491401.
- Upsizing of 2no. pipes downstream of the connection point. This involves upsizing pipe diameter from 225mm to 450mm diameter over a total length of 105.5m. 3no. manholes downstream of the connection point will need upsizing to accommodate the upsized pipes.

A plan showing the proposed connection point to the public sewer is included as Appendix D.

Foul drainage from the majority of the site will discharge to the public sewer network by gravity. It is anticipated that 2no. foul pumping stations will be required to facilitate a sewer connection for approximately 15% - 20% of the proposed properties.

The proposed foul drainage system, including the foul pumping stations, will be adopted by DCWW through a S104 agreement.

Conclusion

This Technical Note confirms that the receiving Wastewater Treatment Works has capacity to accommodate foul flows from the proposed development whilst maintaining compliance with the phosphorus limit prescribed by the NRW environmental permit.

Developer funded upgrades to the public sewer network will ensure that there is no detriment to the public sewer system as a result of the proposed development.

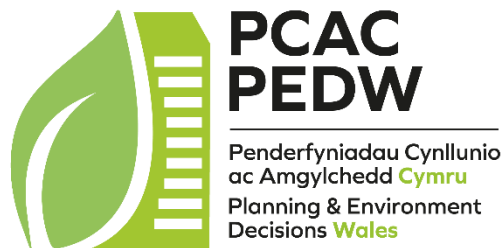
DCWW are intending on delivering a capital scheme in AMP9 (2025-2030) at Five Fords Wastewater Treatment Works to provide additional headroom at the works to mitigate any impact that the development would have on CSO spill frequency.

Sewer upgrades and Wastewater Treatment Works upgrades will be completed prior to first occupation of the proposed dwellings.

Appendix A – PEDW Correspondence

Adeilad y Goron
Parc Cathays
Caerdydd CF10 3NQ

Crown Buildings
Cathays Park
Cardiff CF10 3NQ



Ffôn / tel: 0300 060 4400

Ein Cyf / Our Ref: CAS-03789-W3C7T6

Ebost / email: PEDW.casework@gov.wales

Dyddiad / Date: 22/10/2024

Annwyl / Dear Matthew Gilbert on behalf of Redrow Homes and Wrexham County Borough Council Planning Department,

Subject: Non-determination appeal at Land at Lower Berse Farm, Ruthin Road, Wrexham, L11 3BW

Following the publication by Natural Resource Wales (NRW) of the results of the compliance assessment of Welsh Riverine SACs against Phosphorus targets (<https://naturalresources.wales/evidence-and-data/research-and-reports/water-reports/compliance-assessment-of-welsh-river-sacs-against-phosphorus-targets/?lang=en>), Planning and Environment Decisions (PEDW), has identified the development subject of this appeal as potentially capable of increasing the levels of nutrients (phosphorus and ammonia) discharged into the catchment of a riverine SAC.

Therefore, the appointed Inspector, acting as Competent Authority under the terms of the Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations), will require additional information to carry out a Habitats Regulations Assessment (HRA) screening process to determine whether the proposed development is likely to have a significant effect on the site's qualifying features.

In accordance with the latest advice from NRW (<https://naturalresources.wales/guidance-and-advice/business-sectors/planning-and-development/our-role-in-planning-and-development/advice-to-planning-authorities-for-planning-applications-affecting-phosphorus-sensitive-river-special-areas-of-conservation/?lang=en>), the Local Planning Authority and the appellant are required to provide to PEDW, no later than two weeks from the date of this letter, **i.e. by 05 November 2024**, the following information:

1. Information that will allow the development to be screened out as not likely to have a significant effect on a river SAC in relation to nutrient inputs as there is unlikely to be a source of additional nutrients or pathway for impacts:
 - a) Evidence that the development would not increase the volume and concentration of nutrients in wastewater; or
 - b) Evidence that the development would improve existing water quality discharges by reducing the nutrient concentration of wastewater without increasing volume, or by

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decreasing the volume of wastewater produced without increasing the concentration of nutrients; or

- c) Evidence that the development is intended to provide services, facilities, commercial sites, or places of employment (e.g., community buildings, schools etc.) for a local population already served by residential connections to existing public or private sewers discharging within the SAC river catchment.
- d) Confirmation that the development would provide a private sewage treatment system discharging domestic wastewater to ground, built to the relevant British Standard (BS 6297:2007+A1:2008: <https://knowledge.bsigroup.com/products/code-of-practice-for-the-design-and-installation-of-drainage-fields-for-use-in-wastewater-treatment/standard>) and that **all** of the following criteria are met:
 - i. the maximum daily discharge rate is less than 2 cubic metres (m³); and
 - ii. the drainage field is located more than 40 m from any surface water feature such as a river, stream, ditch or drain and
 - iii. it is located more than 50 m from a SAC boundary, **and**
 - iv. the discharge to ground is at least 50 m from any other discharge to ground.

For developments which do not clearly meet the above criteria, they cannot be screened out of HRA, and the Inspector would have to undertake an Appropriate Assessment if they were minded to allow the proposal. To inform an Appropriate Assessment the following information will be required.

- 2. Where the development involves connecting to public wastewater treatment works:
 - a) Confirmation as to whether the environmental permit for the associated wastewater treatment works has been reviewed against revised conservation objectives for water quality; and
 - b) Confirmation as to whether there is capacity in place to accommodate the additional wastewater in compliance with revised permit limits; and
 - c) Confirmation the sewer network and associated WwTW is operating in compliance with the permit conditions and has the hydraulic capacity for new connections without leading to an increase in the environmental impact of storm overflows; and
 - d) Confirmation of how foul drainage will be managed; and
 - e) Scale plans showing the location of the nearest public sewer and proposed connection point; and
 - f) Where relevant, evidence that an application has been made to the sewerage undertaker for connection to a public sewer, and a copy of their formal response confirming either:
 - i. there is capacity to treat additional wastewater and nutrients from the proposed development (in combination with other planned development) within the existing discharge permit limits; **or**
 - ii. the necessary treatment capacity to remain within revised environmental permit limits will be delivered within the agreed Asset Management Plan (AMP) and that when implemented the treatment capacity will ensure that additional waste

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water generated in consequence of proposed development will remain within revised permit limits and

- iii. that the sewer network and associated WwTW is currently operating in compliance with permit conditions (or will be prior to any new connection being made) and has the hydraulic capacity to accommodate additional wastewater without contributing to an increase in frequency or duration of storm overflows.
3. Where a private sewage treatment system is proposed within a sewerage area you must demonstrate how the development accords with [Welsh Government Circular 008/2018](#) (planning requirement in respect of the use of private sewerage in new development, incorporating septic tanks and small sewage treatment plants), [Planning Policy Wales](#), and where relevant NRW's advice '[Private sewage treatment in an area with a public sewer](#)'.

It must be clearly demonstrated that connection to public sewerage is not possible by:

- i. Feasibility testing - information regarding the connection constraint associated with the environmental performance of the wastewater treatment works, and / or
- ii. The capacity of the SAC catchment to receive increased nutrient discharges and still meet water quality targets.

If a private treatment plant is adequately justified, the following needs to be taken into account:

- iii. There should only be a small discharge around less than 2 m³ per day, via a suitable drainage field, built in accordance with guidance.
- iv. If larger discharges, the proposal will be subject to an Appropriate Assessment.

4. If an Appropriate Assessment is required, the following information would be required to be submitted to us:

- a) Confirmation of how foul wastewater will be managed; and
- b) Clear scale plans showing the location of the proposed private sewage treatment system and discharge location; and
- c) **Where a private sewage treatment system is proposed within a sewerage area:** A statement regarding how the development accords with [Welsh Government Circular 008/2018](#) (planning requirement in respect of the use of private sewerage in new development, incorporating septic tanks and small sewage treatment plants), [Planning Policy Wales](#), and where relevant NRW's advice '[Private sewage treatment in an area with a public sewer](#)'; or
- d) **For all other private sewage treatment systems:** evidence that Circular 008/2018 has been followed; and

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- e) Where discharges to ground are proposed, developers should provide the results of infiltration testing with calculations to demonstrate that the drainage field size and design is appropriate for the volume of discharge proposed and follows the relevant British Standard; and
 - f) Applicants should also provide, where available, copies of any Natural Resources Wales environmental permit or registered exemptions to discharge to ground or to a watercourse.
5. Where the development proposes measures to avoid or mitigate potential phosphorus impacts, for each measure the applicant is required to provide details on:
- a) how the measure would avoid or reduce adverse effects on the SAC (considering the predicted duration of the effects);
 - b) demonstrate how the measure(s) would achieve nutrient neutrality;
 - c) how the measure will be secured and implemented, and by whom;
 - d) how the measure will be maintained and who will be responsible for maintenance; and
 - e) How the measure will be monitored to ensure it is effective.
6. Where phosphorus reduction technologies are proposed for a private system, information is required to provide certainty that the system can be installed and operated effectively in accordance with manufacturers specifications for the lifetime of the development. Supporting information should include:
- test performance certification issued by a recognised body demonstrating the effluent phosphorus standards that can be achieved by the proposed treatment system.
 - a method statement detailing how the sewage treatment plant and phosphorus reduction technology will be operated and maintained.

This information is in addition to the manufacturer's specifications, design information and drainage plans.

Please note that there are other factors covered in NRW's advice that may be relevant to this case. It is the responsibility of the appellant or the Local Planning Authority to provide evidence relevant to the HRA process to support their case.

If you are satisfied that all of the information listed above is included in your appeal submission, please signpost us to where the relevant information can be found.

As noted above, please respond no later than 05 November 2024.

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We welcome correspondence in Welsh. Correspondence received in Welsh will be answered in Welsh and corresponding in Welsh will not involve any delay.

Yn gywir / Yours sincerely

Tanya Leck

Tanya Leck
Swyddog Cynllunio | Planning Officer

Rydym yn croesawu gohebiaeth Gymraeg. Cewch ateb Cymraeg i bob gohebiaeth
Gymraeg ac ni fydd gohebu yn Gymraeg yn arwain at oedi.

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Appendix B – DCWW Correspondence

Aled Williams

From: Rhys Evans <Rhys.Evans3@dwrcymru.com>
Sent: 12 April 2024 10:22
To: Joe Hobbs
Cc: Paul Murray; Aled Williams; Owain George; Miriam Wasik-Evans; Millie Jeffery; Simon Downing; Sion Jones
Subject: RE: 2074_W_Lower Berse Farm, Ruthin Road, Wrexham HMA
Attachments: 2074W - Lower Berse Farm HMA Report Addendum.pdf
Categories: Info

Caution: This is an external email and may be malicious. Please take care when clicking links or opening attachments.

Hi Joe,

Further to the below, see attached finalised report detailing the conclusions of the modelling work and solutions. Solution 2 we believe is the most suitable and is expected to be the most cost effective. I should caveat that costs are subject to change however at detailed design stage.

As detailed in previous correspondence we are intending on delivering a capital scheme in AMP8 (2025-30) at Five Fords Wastewater Treatment Works to address our own environmental challenges as well as provide headroom at the Works to receive the anticipated level of development in the area, including your site at Berse Farm. The element of reinforcement work at the WwTW identified as part of the original HMA would therefore not be required once our capital scheme has been delivered. We are content that a 'grampian' style condition would be suitable in this regard alongside controlling connection points and the delivery of a solution identified in the attached report.

We are happy to meet with you to walk through, discuss delivery options and answer any questions you may have.

Thanks,



Rhys Evans

Planning Liaison Manager | Developer Services
Dŵr Cymru Welsh Water



W: dwrcymru.com



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T: 0800 917 2652 | E: 34588 | M: 07769286691



A: PO Box 3146, Cardiff, CF30 0EH



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From: Rhys Evans
Sent: Thursday, March 28, 2024 3:02 PM
To: Joe Hobbs <joe.hobbs@redrow.co.uk>
Cc: Paul Murray <paul.murray@redrow.co.uk>; Aled Williams <Aled.Williams@waterco.co.uk>; Owain George <Owain.George@dwrcymru.com>; Miriam Wasik-Evans <Miriam.Wasik-Evans@dwrcymru.com>; Millie Jeffery

<millie.jeffery@redrow.co.uk>; Simon Downing <simon.downing@redrow.co.uk>; Sion Jones <Sion.Jones@dwrcymru.com>

Subject: RE: 2074_W_Lower Berse Farm, Ruthin Road, Wrexham HMA

Hi Joe,

The HMA report is in the process of being finalised and expect to be in a position to share next week.

By way of update however I can confirm that the following three solutions have been identified alongside high-level costs.

Solution	Description	Estimated Cost
Solution 1- New connection point and surface water removal	- Laying of 360m of new 300mm diameter pipe and connection to manhole SJ32491406. - Removal of 2.559 Ha of Impermeable Area.	£2,463,876
Solution 2- New connection point and network reinforcement works	- Laying of 360m of new 300mm diameter pipe and connection to manhole SJ32491406. - Upsize 105.5m of the sewerage network from 225mm to 450mm	£698,901
Solution 3 - Online storage bifurcation	- Connection to manhole SJ32490701. - Two 1700 mm pipes to provide online bifurcation storage. - A weir upstream of the storage. - An orifice and flap valve downstream of the storage to limit flows back into the pipes.	£1,208,874

Report to follow with the detail and happy to meet with you to discuss the delivery options.

Thanks,



Rhys Evans

Planning Liaison Manager | Developer Services
Dŵr Cymru Welsh Water



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Aled Williams

From: Sion Jones <Sion.Jones@dwrcymru.com>
Sent: 13 October 2023 15:44
To: Wilks Daly, Aidan; Aled Williams; Simon Downing; Paul Murray; Joe Hobbs
Cc: Miriam Wasik-Evans; Matthew Humphreys; Owain George; Rhys Evans; Ellaway, James
Subject: RE: 2074_W_Lower Berse Farm, Ruthin Road, Wrexham HMA

=====
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=====

Hi Aidan,

Thanks for your e-mail and we would be happy to discuss the phosphates matter as part of our meeting on Monday. For awareness, you referred to recent DCWW correspondences and I would advise that our consultation response to the current planning application for Lower Berse Farm, Ruthin Road, has confirmed there is suitable capacity in Five Fords WWTW to accommodate this development's foul flows as well as maintain compliance with both the existing and the proposed phosphorus consent limit. Hope this information is of assistance and we'll speak further on Monday.

Regards,

Siôn



Siôn Jones

Lead Development Control Officer | Developer Services
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From: Wilks Daly, Aidan <Aidan.WilksDaly@wsp.com>
Sent: Friday, October 13, 2023 1:59 PM
To: Sion Jones <Sion.Jones@dwrcymru.com>; aled.williams@waterco.co.uk; simon.downing@redrow.co.uk; Paul Murray <paul.murray@redrow.co.uk>; Joe Hobbs <joe.hobbs@redrow.co.uk>
Cc: Miriam Wasik-Evans <Miriam.Wasik-Evans@dwrcymru.com>; Matthew Humphreys <Matthew.Humphreys@dwrcymru.com>; Owain George <Owain.George@dwrcymru.com>; Rhys Evans <Rhys.Evans3@dwrcymru.com>; Ellaway, James <James.Ellaway@wsp.com>
Subject: RE: 2074_W_Lower Berse Farm, Ruthin Road, Wrexham HMA

***** External Mail *****

Hi Sion,

I have been asked by Redrow to join the call on Monday, as I have been part of the team at WSP supporting Redrow to meet Nutrient Neutrality requirements, and we are hoping that in addition to discussing the HMA, we could briefly touch about upon nutrient neutrality to get the opinion of DCWW.

Subject to a satisfactory HMA, we are keen to understand the DCWW opinion on the connection to Five Fords WWTW from a nutrient neutrality perspective. We understand that the existing phosphorus consent limit at Five Fords WWTW of 1mg/l requires tightening to 0.7mg/l by 31st March 2030 and that this tightening of the limit will generate headroom in Dee Catchment in terms of phosphorous levels.

We are also aware of a letter from DCWW that outlined that Five Fords WWTW has the capacity to treat the foul flows from the planning application development sites currently being held in abeyance by WCBC, whilst maintaining compliance with both the existing and the proposed phosphorus consent limit and want to understand if this applies to the proposed development at Ruthin Rd.

So, if it would be possible to discuss these matters on Monday's call that would be much appreciated

Kind Regards,

Aidan



Aidan Wilks Daly

Consultant Hydrologist – Sustainable Water Management
MSc (Distinction) BSc (Hons) MCIWEM

Upcoming Leave: Monday the 30th of October until Tuesday the 14th of November

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-----Original Appointment-----

From: Sion Jones <Sion.Jones@dwrcymru.com>

Sent: 13 October 2023 10:14

To: aled.williams@waterco.co.uk; Wilks Daly, Aidan; simon.downing@redrow.co.uk; Paul Murray; Joe Hobbs

Cc: Miriam Wasik-Evans; Matthew Humphreys; Owain George; Rhys Evans

Subject: 2074_W_Lower Berse Farm, Ruthin Road, Wrexham HMA

When: 16 October 2023 15:00-16:00 (UTC+00:00) Dublin, Edinburgh, Lisbon, London.

Where: Microsoft Teams Meeting

Hi,

Further to recent discussions with Waterco, I've put this slot in the diary on Monday (16th) at 3pm to discuss the ongoing HMA for your development of 1500 units and school at Lower Berse Farm, Ruthin Road, Wrexham (Ref: 2074_W).

This follows on from our meetings in February and March and subsequent correspondences in April in which we received your latter instruction to proceed with the modelling at the same proposed connection point. We have recently received a copy of the draft report and are currently awaiting verification of the solution cost prior to final issue. We'd like to take this opportunity to discuss the output from the HMA report including the detriment analysis and proposed solution which comprises part surface water removal and part network engineered reinforcements albeit will entail a considerable undertaking. Discussions are still ongoing with our modelling and wastewater assets team but, while we await the finalised version of the HMA report, it would be useful to have this meeting to discuss beforehand.

Please refer to the Teams link below.

Regards,

Siôn.

Microsoft Teams meeting

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Appendix C – HMA

Developer Services Hydraulic Modelling Report

CLE10801 Lower Berse Farm, Ruthin Road, Wrexham – Hydraulic Modelling Assessment

Prepared By	Date	Approved By	Date	Rev	Section(s)	Comments
Charlotte Landry-Jennings	21/06/2022	Stefan Partridge	21/06/202	1	1-4	Draft
Charlotte Landry-Jennings	23/08/2022	Stefan Partridge	23/08/202	2	1-5	Draft
Charlotte Landry-Jennings	19/09/23	Owen Carey	19/09/23	3	All	Draft
Rebecca Fernandes	26/02/24	Owen Carey	15/03/24	4	All	Draft
Rebecca Fernandes	08/04/24	Owen Carey	08/04/24	5	All	Final

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Executive Summary

Dŵr Cymru Welsh Water (DCWW) has appointed RPS to undertake a Hydraulic Modelling Assessment (HMA) for a proposed development of 1500 residential units to be located on Lower Berse Farm, Ruthin Road, within the Five Fords (Wrexham) Wastewater Treatment Works (WwTW) catchment.

The development has been assessed using the connection point SJ32490701. This is a manhole located on the south-east corner of the development. 1400 units will flow via gravity to the connection point. The remaining 100 units will be served by two pumping stations, pumping to the aforementioned connection point.

A previous HMA study for the development indicated significant detriment. A new assessment was commissioned to account for updates to the HMA specification around the calculation of development flows and to revise the scope of options to resolve the detriment, reflecting the changed specification. The model from the previous HMA has been used as the base model for this HMA study. Prior to this hydraulic modelling assessment, the model underwent several upgrades.

The detriment assessment revealed that the addition of the Lower Berse Farm development to the model caused a total of 89.5 m³ of flooding detriment at two nodes. SJ32490701, the planned connection point, flooded by 48.6 m³ and SJ35482802, downstream where a large area of network from the north connects in, flooded by 40.9 m³. No CSO detriment was assessed due to the scope of this HMA study. The new development causes an increase in DWF at the WwTW of 9.5 l/s.

Three solutions have been identified to resolve the predicted detriment. The three solutions proposed are:

- Solution 1: Connect to SJ32491406 and 2.559 ha of IA removal. Estimated cost of £2,465,000.
 - Solution 2: Connect to SJ32491406. Estimated cost of £700,000.
 - Solution 3: Online storage bifurcation. Estimated cost of £1,210,000.
-

1 Development System Analysis

1.1 Dry Weather Flow

The DWF for the residential properties has been calculated for the total development, shown in Table 1.

Parameter	Value	Comment
Population - P	4354.2	1500 properties.
Per Capita Return to Sewer Flow Rate – G	150 l/hd/day	The wastewater profile used for the HMA has a per capita return to sewer flow of 150 l/hd/day. This figure is a standard design figure adopted by DCWW for new developments.
Infiltration - I	0.872 l/s	10 % DWF (PG) assumed
Trade Flow – E (Primary School)	1.167 l/s	420-place school at 80 l/pupil/day allocation. 8-hour educational profile used. Value is average over 8 school day.
Total DWF Calculations		
P * G	7.559 l/s	Population multiplied by the per capita return to sewer flow rate.
Total DWF	9.599 l/s	PG + I + E
DWF Peak Hydraulic Assessment Multiplier	1 and 2	DWF Peaking factor for CSO (1) and flooding (2) level of performance investigation.

Table 1. HMA - DWF Parameters – single phase

1.2 Surface Water Run-off

Based on new specification creep will no longer be included as part of the development when undertaking an HMA. Following a review of Creep within DCWW's DWMP programme, industry guidance and available evidence, it was decided that there is insufficient evidence in Wales (all studies have been confined to England and Scotland). Therefore, there has been no 2% allowance for creep undertaken in this assessment.

2 Existing / Developed Comparison

2.1 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. These were run on a version of the upgraded model set to a 'Clean' operational state. This entails the removal of all blockages, and all sediment and related pipe roughness increases.

Winter and summer design storms with durations of 15, 30, 60, 90, 120, 240, 360, 480, 720, 960 and 1440 minutes were run in the existing and developed models.

2.1.1 Scenario 1 – Phase 1 (Total) - Connection Point SJ32490701

For the new development, the model predicted flooding detriment of greater than 1 m³ occurred in 2 manholes downstream of the development, one at the connection point (SJ32490701) and one downstream where a large area of network from the north connects in (SJ35482802). Table 2 highlights the detriment on the downstream trunk sewer to the WwTW with the addition of the 1500 units of the new development.

Model Node ID	Manhole ID	Critical Duration (min)	Flood Volume (m ³)		Flooding Detriment	
			Existing	Developed	Absolute (m ³)	Percentage (%)
SJ32490701	SJ32490701	360 (summer)	0	48.6	48.6	-
SJ35482802	SJ35482802	1440 (winter)	0	40.9	40.9	-

Table 2. Hydraulic Assessment Results – Scenario 1 Single Phase.

2.2 DWF Assessment

In the new development model, the DWF is 385.04 l/s, compared to 375.54 l/s in the existing model, shown in Table 3. Therefore, the addition of the new development has increased the DWF at the WwTW by 9.5 l/s.

Model	DWF l/s
Existing	375.54
New Development	385.04
Absolute Difference	+ 9.5

Table 3. DWF Assessment - New Development

2.3 Formula 'A' Assessment

Formula 'A' flow is a measure of the continuation flow required at a CSO prior to spill occurring. Formula A is passed if pass forward flow (PFF) exceeds Formula A. The current PFF at Five Fords (Wrexham) Works CSO is based on the consent dated 2003. The Formula A values are reported in Table 4.

Model	Pass Forward Flow (l/s)	Formula A (l/s)	DWF (l/s)	Passes Formula A
Existing	808	1867.79	375.54	No
Total development	808	1895.45	385.04	No

Table 4. Formula 'A' Assessment – Five Fords (Wrexham) Works CSO

2.4 SPS Assessment

There are no pumping stations downstream of the development site and therefore the SPS assessment is not required.

2.5 Flows Arriving at Five Fords WwTW

Using the 'typical year' simulation, it has been calculated that 9,654,723 m³ of flow arrives at Five Fords WwTW. With the new development, this figure increases to 9,925,903 m³. This corresponds to an increase of 271,180 m³ or 2.7 %.

2.6 Changes From the Previous Assessment

The updated development flows have resulted in slight changes to the detriment compared to that which was predicted in the previous assessment. The key difference is in the flooding detriment, which while significantly less based on the new assessment, now appears at two locations rather than only at the connection point. This is believed to be due to the significant reduction in total flows during wet weather. The local capacity is not as overwhelmed as under the previous specification so the rate of flooding from the connection point is reduced, leading to more flow being retained in the network and impacting downstream. The new spec also results in small reductions in the detriment experienced at the WwTW.

2.7 Network Performance Assessment Summary

- The hydraulic assessment shows that the connection point of the development, SJ32490701 will flood because of the addition of 1500 properties, with 48.6 m³ of flooding predicted.
 - One other manhole downstream, SJ35482802, is predicted to flood by 40.9 m³ as a result of the new development.
 - There is no predicted flooding at the nearby downstream DFL properties.
 - The addition of the new development increases the DWF at the WwTW by 9.5 l/s.
 - The WwTW CSOs fails Formula A in both the current (pre-developed) and post-development scenarios.
 - The development is predicted to increase flows to the WwTW by 271,180 m³ or 2.7 % in a typical year simulation.
-

3 Solution Development

The hydraulic assessment indicates that the addition of development flows causes detriment with regards to network performance. Therefore, solutions have been investigated to resolve this detriment caused by the development flows. Solutions have been derived for the total development.

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.

3.1 Discounted Solutions

Three solutions have been excluded from consideration as initial testing indicates they will not resolve the required detriment.

3.1.1 Lateral online storage tanks

This solution seeks to address the full development connecting to SJ32490701. The solution proposes a downstream flow control with an upsizing of the pipe downstream of the connection point and 2140 m³ of lateral online storage (Figure 1). This increases the online storage capacity of the trunk sewer to attempt to eliminate flooding detriment caused by the development.

The solution elements are as follows:

- Upsizing of SJ32490701.1. This should be done in multiple sections to accommodate ground levels. The first section is upsized from 380 mm diameter to 2000 mm diameter for 84.6 m, second to 1800 mm for 4 m and third to 1600 mm for 19 m.
- The total length to be upsized is 107.6 m.
- 5 x 160 m long 2000 mm diameter pipes. These fill up sequentially as flow backs up from the downstream network and drain down via gravity. These are in farmer's fields that will be part of the development.
- Downstream of these pipes is a flow control device, restricting pass forward flow to 16 l/s. This rate has been chosen to replicate the flows that passed through this part of the network before the insertion of the development, and thus will inhibit the opportunity for detriment.

Despite over 2000 m³ of storage, 3.7 m³ of flooding remains at the connection point in a M30-360 storm.

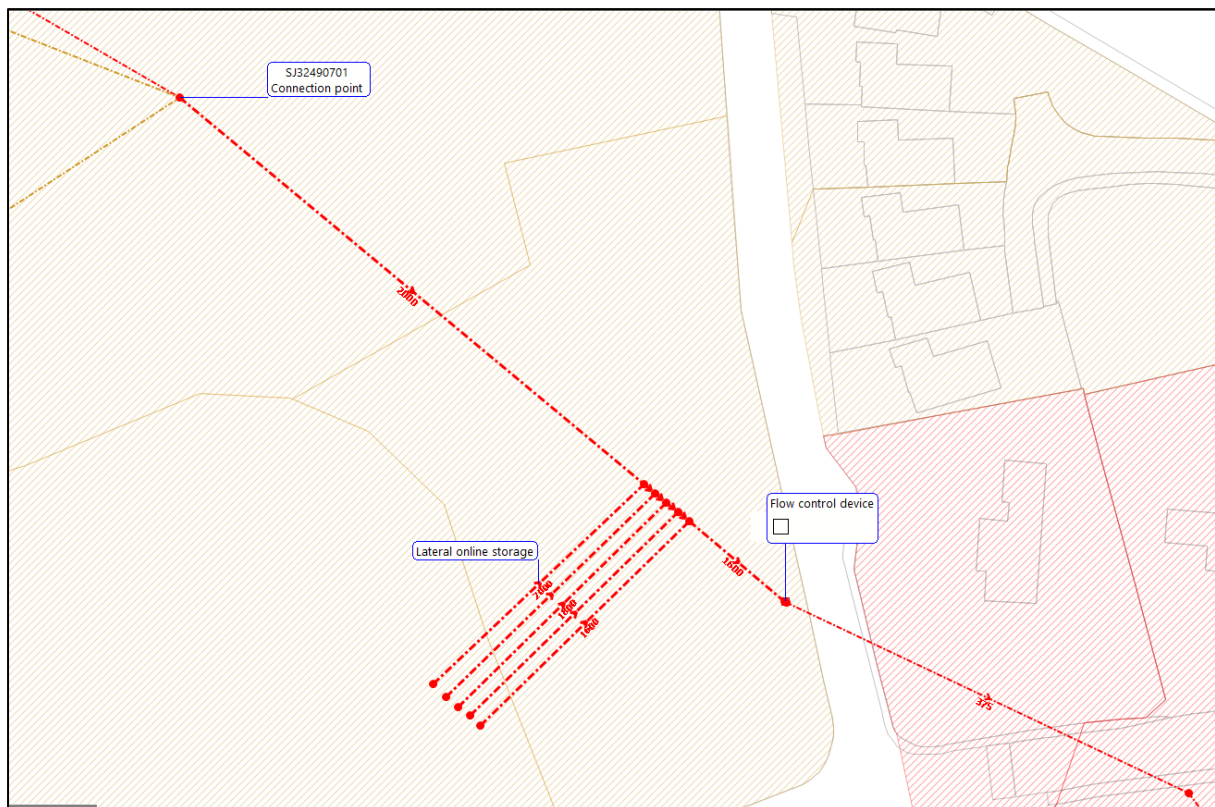


Figure 1. Discounted solution for lateral online storage

3.1.2 Trunk sewer pipe upsize.

This solution seeks to address the full development connecting to SJ32490701. The solution proposes a pipe relay and upsize immediately downstream of the connection point and a pipe relay and restriction ahead of the existing residential area to act as a flow control (Figure 2). This will hold flows in the online storage pipes and limit the pass forward flow to pre-development levels to prevent additional spills at the treatment works.

The solution elements are as follows:

- 131.2 m of new 2000 mm diameter pipes immediately downstream of the connection point.
- Abandon manhole SJ32490601 and associated downstream pipe in their current form.
- Build a new manhole on the junction of Homestead Lane and Bersham Road and new 225 mm diameter pipe from new manhole to SJ32491601. This pipe restriction will function as a flow control so that pass forward flows do not exceed pre-development levels.

The trunk sewer lies around 2 m below ground level in this section of the network. This restricts the ability to upsize the pipe further than 2 m and thus limits the ability to provide online storage directly on the trunk sewer. This option holds the storm flows in this area causes extensive flooding. 6087 m³ of flooding remains at the connection point in a M30-1440 storm.

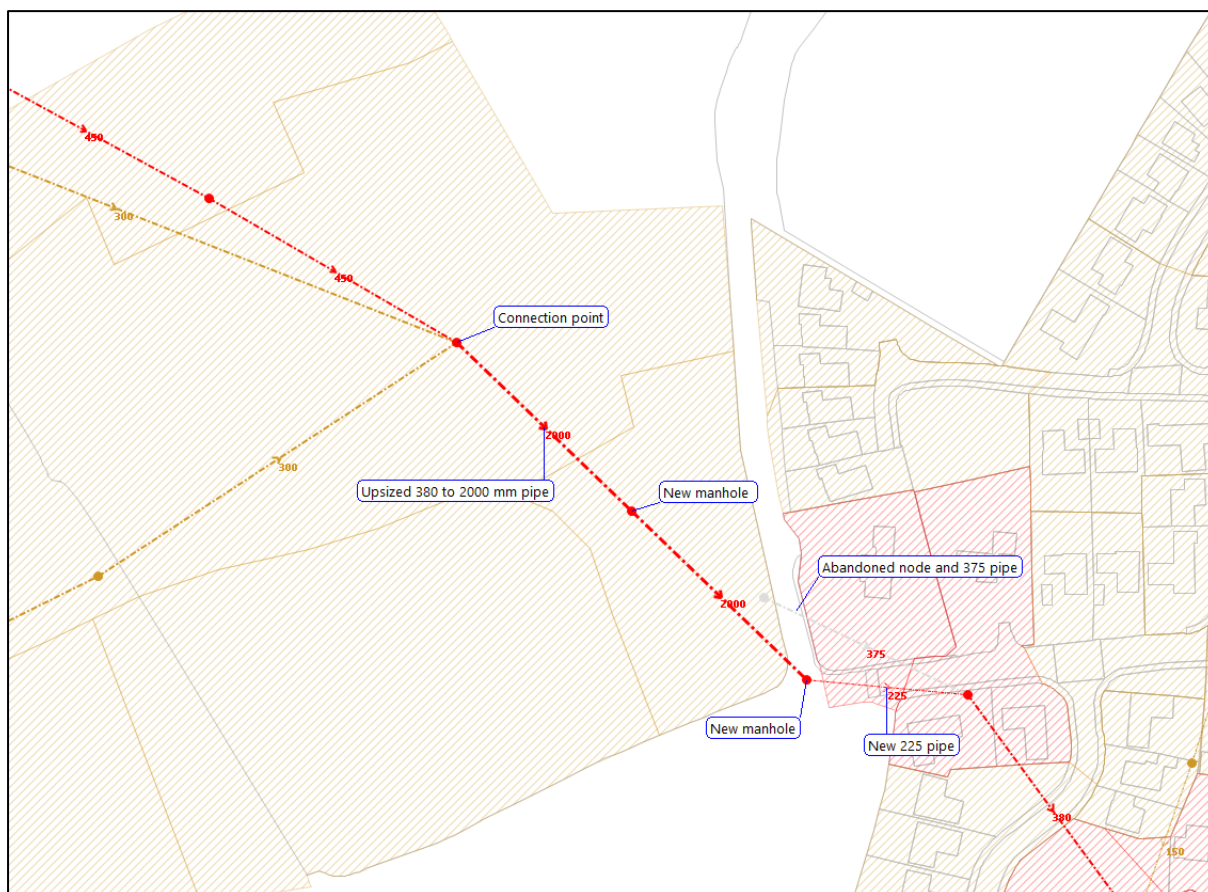


Figure 2. Discounted solution for online storage

3.1.3 Pump whole development upstream (to SJ31504201)

This solution seeks to address the full development connecting to SJ31504201 (not the original connection point of SJ32490701). The solution proposes the construction of a new pumping station that would send 100 % of the development flows to SJ31504201, upstream of the originally proposed connection point (Figure 3). This manhole is chosen as a new, upstream connection point as it was surveyed as part of this investigation so there is greater confidence in the invert levels the pump would connect into. This makes use of the capacity of the trunk sewer before the known restrictions at SJ32490701.1 and SJ32490601.1 which are caused by pipe diameter restrictions.

The solution elements are as follows:

- New pumping station within the development, with a pump rate of 21 l/s.
- A 0.7 km long rising main (approximately) connecting the development directly to SJ31504201.

This solution does not resolve the detriment at the original connection point SJ32490701 and so has not been taken any further. 32.1 m³ of flooding remains at SJ32490701 in a M30-240 storm. In addition, flooding is predicted at two nodes downstream of the new development (SJ35482802 and SJ35482904) where a large area of network from the north connects in. 49.8 m³ of flooding is predicted at SJ35482802 in a M30-30 storm and 10 m³ of flooding is predicted at SJ35482904 in a M30-15 storm.

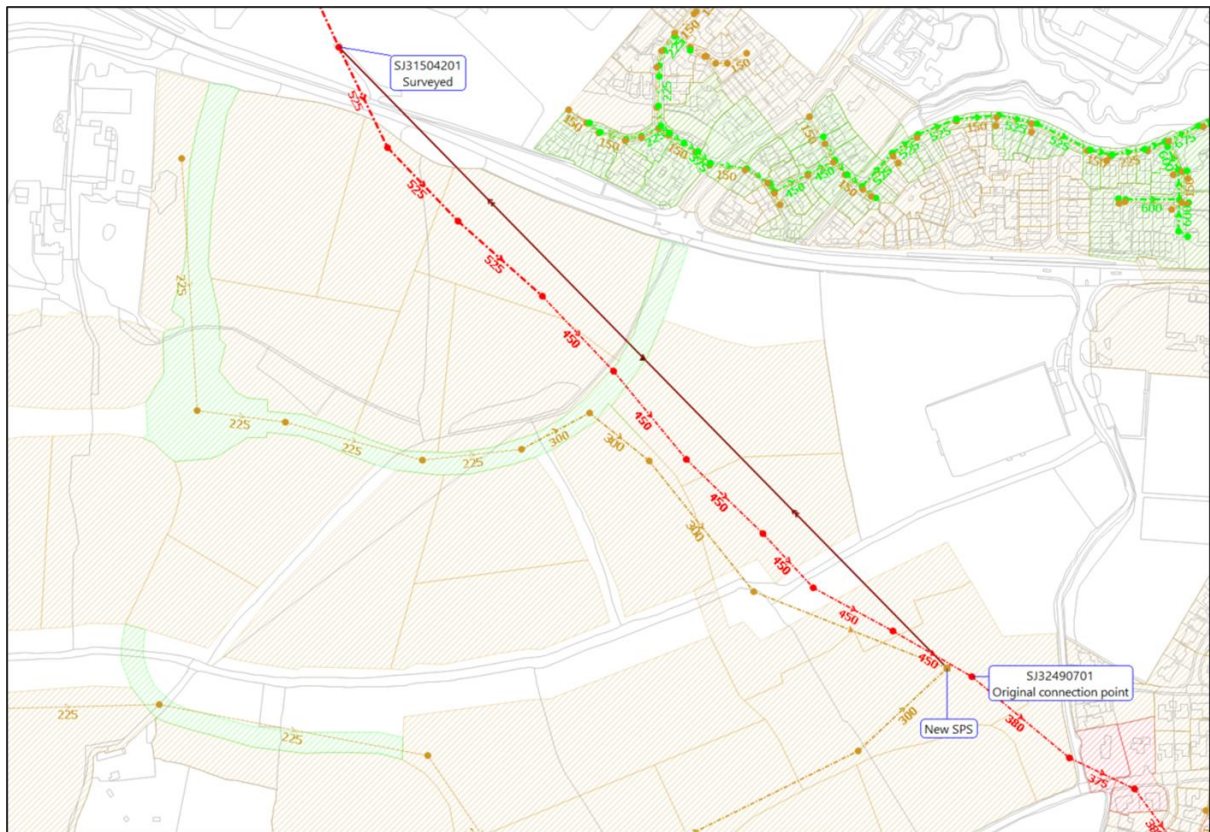


Figure 3. Discounted solution for a new SPS

3.2 Solution 1- Connect to SJ32491406 and IA removal.

3.2.1 Description

This solution addresses the full development to a connection point further downstream than initially proposed. The solution proposes the laying of a new length of sewer to connect the development to a manhole (SJ32491406) along a footpath, west of Foxwood Drive (Figure 5). Providing this alternative route means that none of the development flows are passed through the original connection point (SJ32490701) and this eliminates detriment experienced at this manhole. Two pipes west of Foxwood Drive will also need to be upsized from 225 mm to 375 mm diameter to avoid flooding detriment at the new connection point. This new length of sewer alone does not solve the flooding detriment; therefore, it is proposed that 2.559 ha of roof and road impermeable area is removed from subcatchments where IA surveys have been undertaken.

The solution elements are as follows:

- 360.6 m of new 225 mm diameter pipes running parallel to the trunk sewer near the original connection point, crossing the B5099 (Bersham Road), parallel to the footpath to the south, and connecting to manhole SJ32491401 before the footpath crosses the River Clywedog. Six new manholes to accommodate route around existing housing.
 - Upsize of two pipes after the new connection point, along the footpath and into Foxwood Drive. Upsize from 225 mm to 375 mm diameter. These have a total length of 105.5 m. Upsize and rebenching of 3 manholes to accommodate upsized pipes (SJ32491401 new volume of 2.88 m³, SJ32491406 new volume of 0.38 m³, SJ32492401 new volume of 2.54 m³).
 - 2.559 ha of roof and road impermeable area removed from 81 subcatchments. These areas have been taken from subcatchments which have been surveyed as part of Lower Berse Farm HMA and Gatewen Road HMA.
 - 0.415 ha of impermeable area to be removed from Gatewen Road area (roof and road). Costed assuming rain gardens are 10% of total area removed.
 - 0.192 ha of impermeable area to be removed from Bersham Road area (roof and road). Costed assuming rain gardens are 10% of total area removed.
 - 0.287 ha of impermeable area to be removed from Rockwood Road area (roof and road). Costed assuming rain gardens are 10% of total area removed.
 - 0.065 ha of impermeable area to be removed from Maes Eithen area (roof and road). Costed assuming rain gardens are 10% of total area removed.
 - 1.6 ha of impermeable area to be removed from Victoria Road area (roof and road). Costed assuming rain gardens are 10% of total area removed.
-

3.2.2 Notional Design Solution

There is model predicted flooding at SJ32490701 (the connection point) which is as a direct result of the development.

This solution proposes sending the flows south via new network, shown in Figure 4, consisting of 360.6 m of 225 mm diameter pipes. The original connection point is no longer used and SJ32491401 becomes the new connection point. With the addition of this length of network and the upsizing of two pipes from 225 mm to 375 mm (Figure 5), there is sufficient capacity in the system to accept the additional flows from the development without causing flooding detriment. The pipes required for conveying flows to the new connection point provide additional capacity in the network to alleviate flooding detriment and as such, form part of the solution cost.

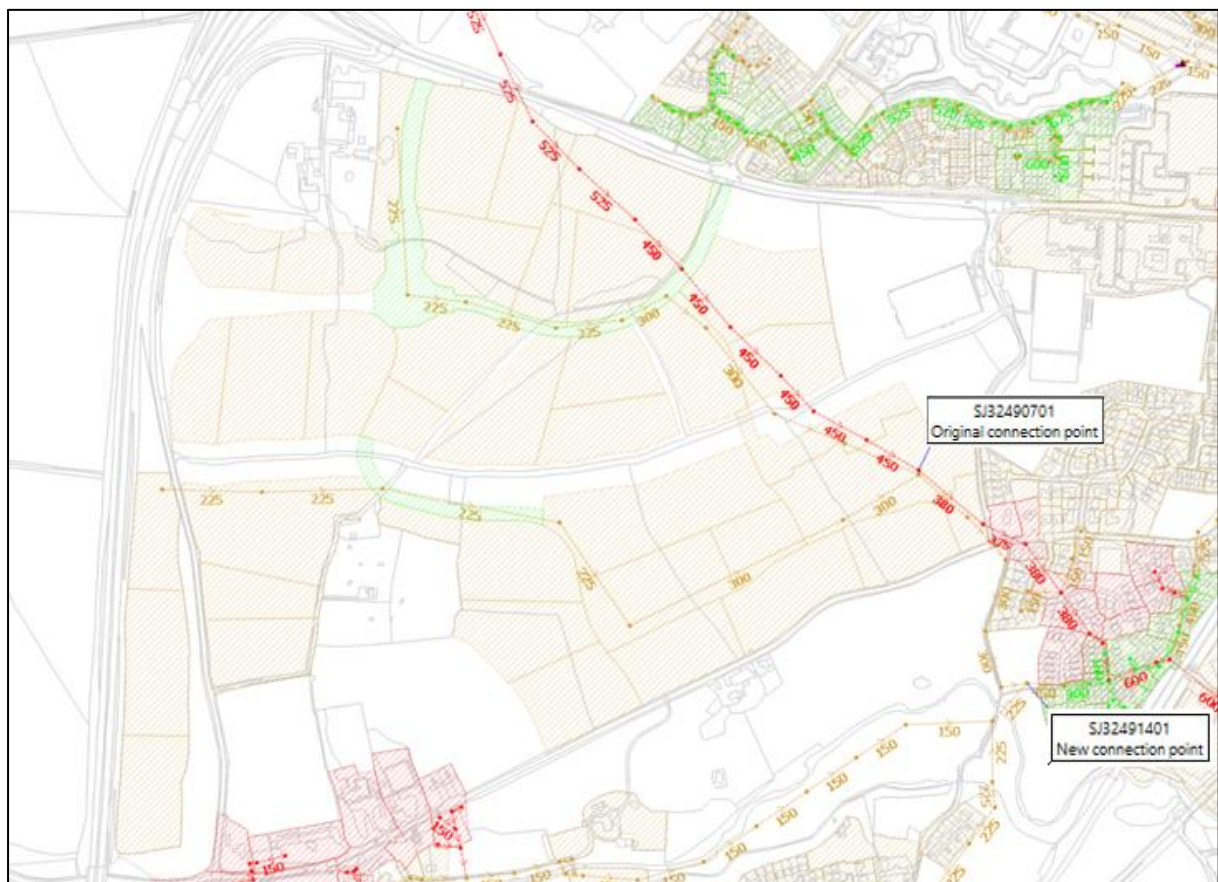


Figure 4. Location of new connection point

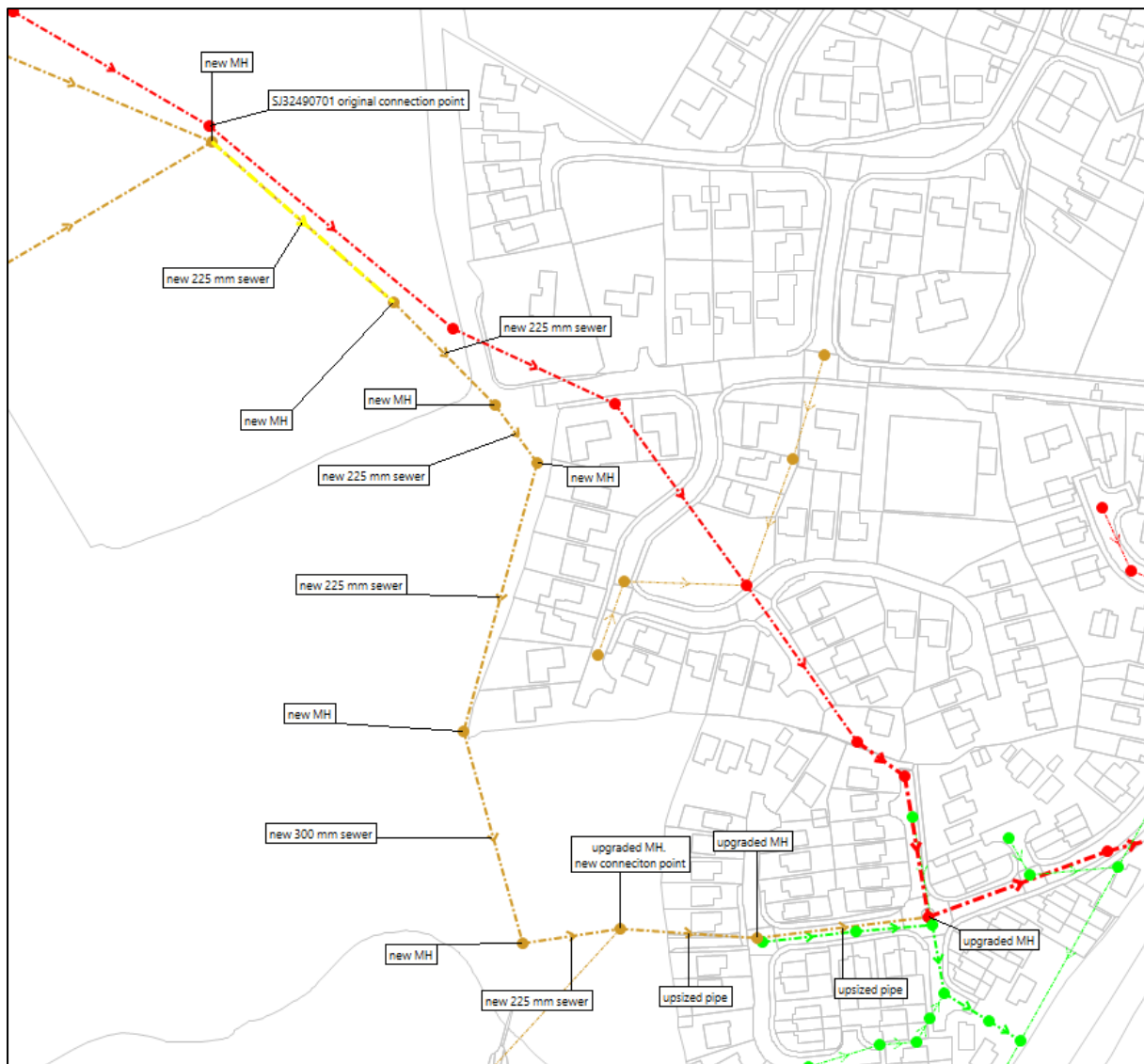


Figure 5. Location of new network, connecting to SJ32491401

This new length of sewer alone does not solve the flooding detriment and further interventions were necessary. Therefore, 2.559 ha of IA has been removed from 81 subcatchments, shown in Figure 6. This removes a significant amount of contributing area from the system and reduces the amount of flow being passed forward to the treatment works CSOs. Because of the extent of removal required, the subcatchments selected were dispersed across the catchment. Only subcatchments which had surveyed IA were selected as the rest of the model has poor model flagging for its contributing area.

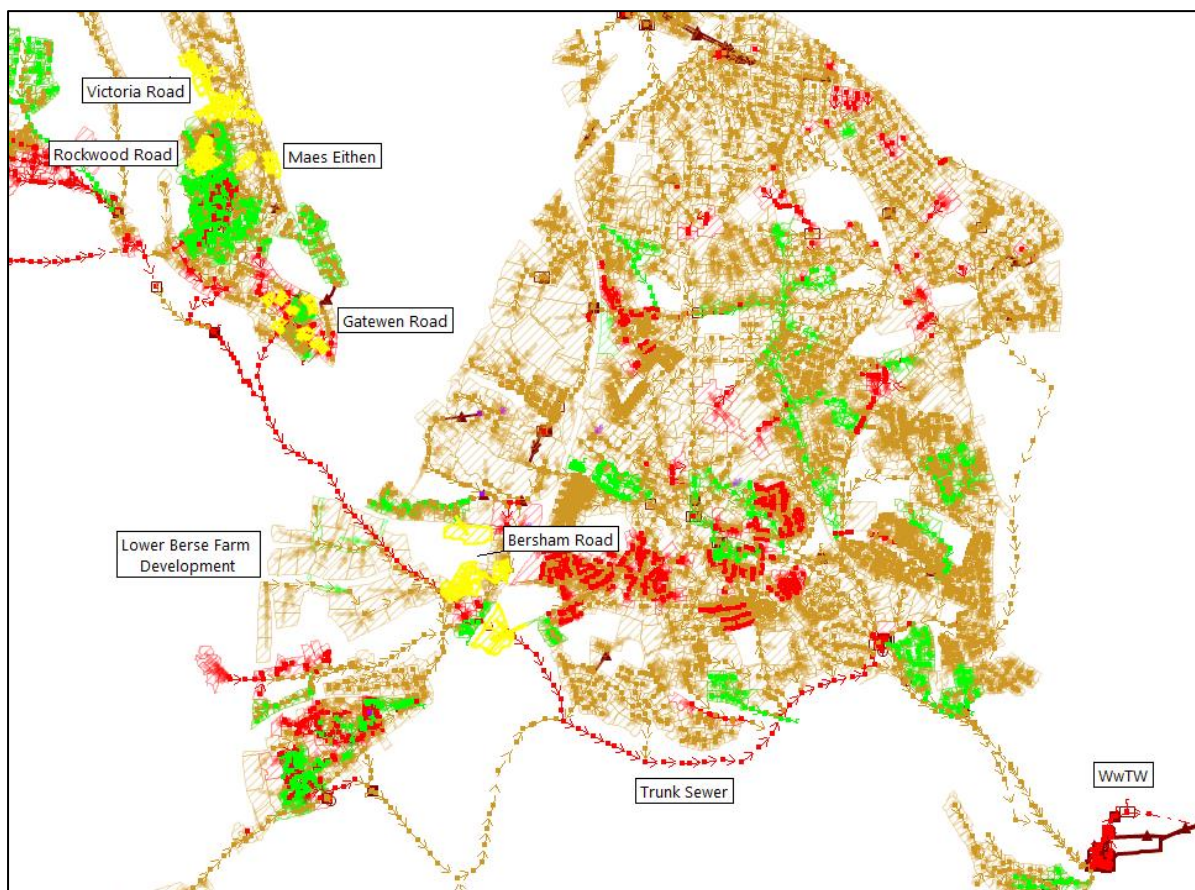


Figure 6. Total coverage of 2.559 ha of IA removal from Gatewen Road, Bersham Road, Maes Eithen, Rockwood Road and Victoria Road.

3.2.3 Solution Assessment

No increase in flooding volume is predicted in the assessment area after the implementation of the above solution, and with the construction of the full development.

Model Node ID	Manhole ID	Critical Duration (min)	Flood Volume (m ³)			Flooding Detriment	
			Existing	Developed	Solution	Absolute (m ³)	Percentage (%)
SJ32490701	SJ32490701	360 (summer)	0	48.6	0	0	-
SJ35482802	SJ35482802	1440 (winter)	0	40.9	0	0	-

Table 5. Hydraulic Assessment Results – Solution 1.

3.2.4 Option Considerations

This solution does not resolve the CSO spill detriment at the WwTW downstream as a result of the development. Although the addition of the development causes CSO spill detriment, this solution does not make this detriment any worse. No further investigation has been undertaken due to the scope of this assessment.

The path modelled to the new southern connection point (SJ32491406) will need further detailed design to assess the feasibility of build. The new connection point has not been surveyed. Access to the farmer's fields south of Bersham Road would need to be granted to lay the new pipes there. If this option is taken forward, detailed investigation of local contributing area may be preferable and reduce cost of implementation – disconnecting the network in more concentrated areas is more efficient than doing it at multiple locations.

3.3 Solution 2- Connect to SJ32491406

3.3.1 Description

This solution addresses the full development to a connection point further downstream than initially proposed. The solution proposes the laying of a new length of sewer to connect the development to a manhole (SJ32491406) along a footpath, west of Foxwood Drive shown in Figure 7. Providing this alternative route means that none of the development flows are passed through the original connection point (SJ32490701) and this eliminates detriment experienced at this manhole. Two pipes west of Foxwood Drive need to be upsized from 225 mm to 450 mm diameter to avoid flooding detriment at the new connection point.

The solution elements are as follows:

- 360.6 m of new 300 mm diameter pipes running parallel to the trunk sewer near the original connection point, crossing the B5099 (Bersham Road), parallel to the footpath to the south, and connecting to manhole SJ32491401 before the footpath crosses the River Clywedog. Six new manholes to accommodate route around existing housing.
- Upsize of two pipes after the new connection point, along the footpath and into Foxwood Drive. Upsize from 225 mm to 450 mm diameter. These have a total length of 105.5 m. Upsize and rebenching of 3 manholes to accommodate upsized pipes (SJ32491401 new volume of 3.28 m³, SJ32491406 new volume of 0.52 m³, SJ32492401 new volume of 2.54 m³).

3.3.2 Notional Design Solution

There is model predicted flooding at SJ32490701 (the connection point) which is as a direct result of the development.

This solution proposes sending the flows south via new network, shown in Figure 4, consisting of 360.6 m of 300 mm diameter pipes. The original connection point is no longer used and SJ32491401 becomes the new connection point. With the addition of this length of network and the upsizing of two pipes from 225 mm to 450 mm (Figure 8), there is sufficient capacity in the system to accept the additional flows from the development without causing flooding detriment. The pipes required for conveying flows to the new connection point provide additional capacity in the network to alleviate flooding detriment and as such, form part of the solution cost.

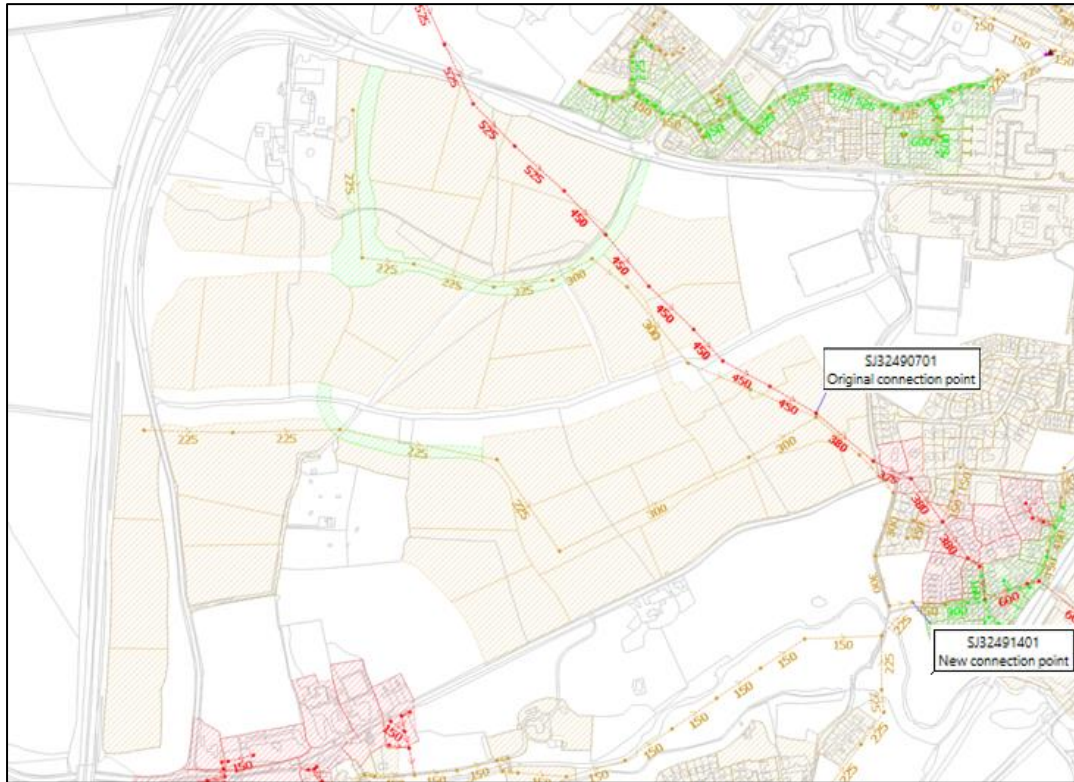


Figure 7. Location of new connection point

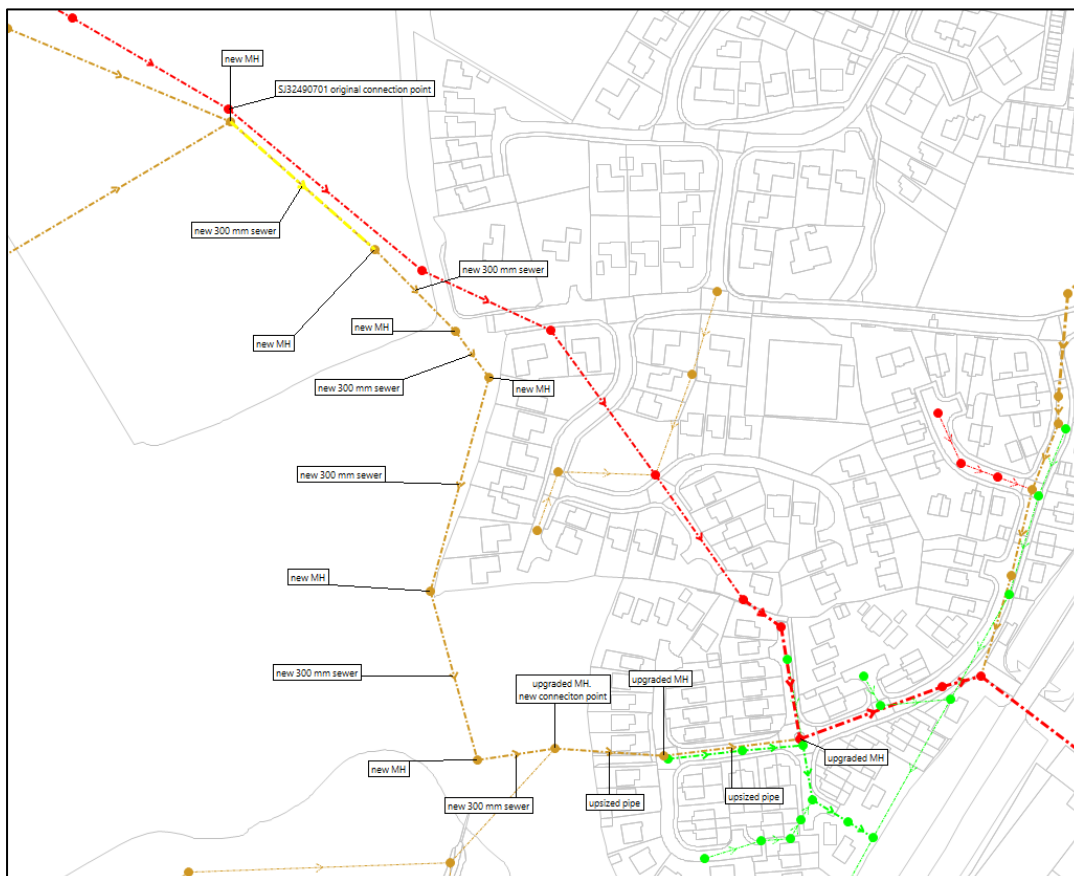


Figure 8. Location of new network, connecting to SJ32491401

3.3.3 Solution Assessment

No increase in flooding volume is predicted in the assessment area after the implementation of the above solution, and with the construction of the full development.

Model Node ID	Manhole ID	Critical Duration (min)	Flood Volume (m ³)			Flooding Detriment	
			Existing	Developed	Solution	Absolute (m ³)	Percentage (%)
SJ32490701	SJ32490701	360 (summer)	0	48.6	0	0	-
SJ35482802	SJ35482802	1440 (winter)	0	40.9	0	0	-

Table 6. Hydraulic Assessment Results – Solution 2.

3.3.4 Option Considerations

This solution does not resolve the CSO spill detriment at the WwTW downstream as a result of the development. Although the addition of the development increases the CSO spill detriment, this solution does not make this detriment any worse. No further investigation has been undertaken due to the scope of this assessment.

The path modelled to the new southern connection point (SJ32491406) will need further detailed design to assess the feasibility of build. The new connection point has not been surveyed. Access to the farmer's fields south of Bersham Road would need to be granted to lay the new pipes there. If this option is taken forward, detailed investigation of local contributing area may be preferable and reduce cost of implementation – disconnecting the network in more concentrated areas is more efficient than doing it at multiple locations.

3.4 Solution 3- Online storage bifurcation

3.4.1 Description

This solution seeks to address the full development connecting to SJ32490701. The solution proposes laying of two new pipes as a bifurcation to SJ32490701.1 highlighted in Figure 9. The aim is for the bifurcation to be used in the event of higher flows and for the existing network to be utilised during normal flow conditions. Flows enter the bifurcation via a high-level weir that flows into two new parallel 1700 mm diameter pipes. Flow is controlled by an orifice and flap valve at the downstream end with a maximum flow of 15 l/s. The flap valve ensures flows are retained within the bifurcation when the network downstream is surcharged.

The solution elements are as follows:

- 2 x ~100 m of new 1700 mm diameter pipes acting as a bifurcation via high level weir from the connection point.
- Orifice and flap valve that connect the two pipes back into SJ32490601. This restricts the flow to 15 l/s so that the storage is utilised, and flows can be returned to the system in DWF events.

3.4.2 Notional Design Solution

There is model predicted flooding at SJ32490701 (the connection point) which is as a direct result of the development.

This solution proposes adding two 1700 mm pipes from the connection point (SJ32490701) to function as online bifurcation storage. A weir into the bifurcation is set at 0.115 m above the soffit of the incoming pipe. This works to take flows in storm events and store them in the set of 1700 mm pipes. The weir is set at the lowest possible level without DWF passing through the bifurcation. An orifice after the bifurcation is set at the highest possible rate before passing too much flow downstream, to limit flows back into the set of pipes which would otherwise cause flooding. A flap valve downstream of the orifice is input to eliminate the possibility of flows backing up into the set of pipes. This is illustrated in Figure 9.

With the addition of two 1700 mm pipes, a weir, orifice and flap valve, there is sufficient capacity in the system to accept the additional flows from the development without causing flooding detriment.

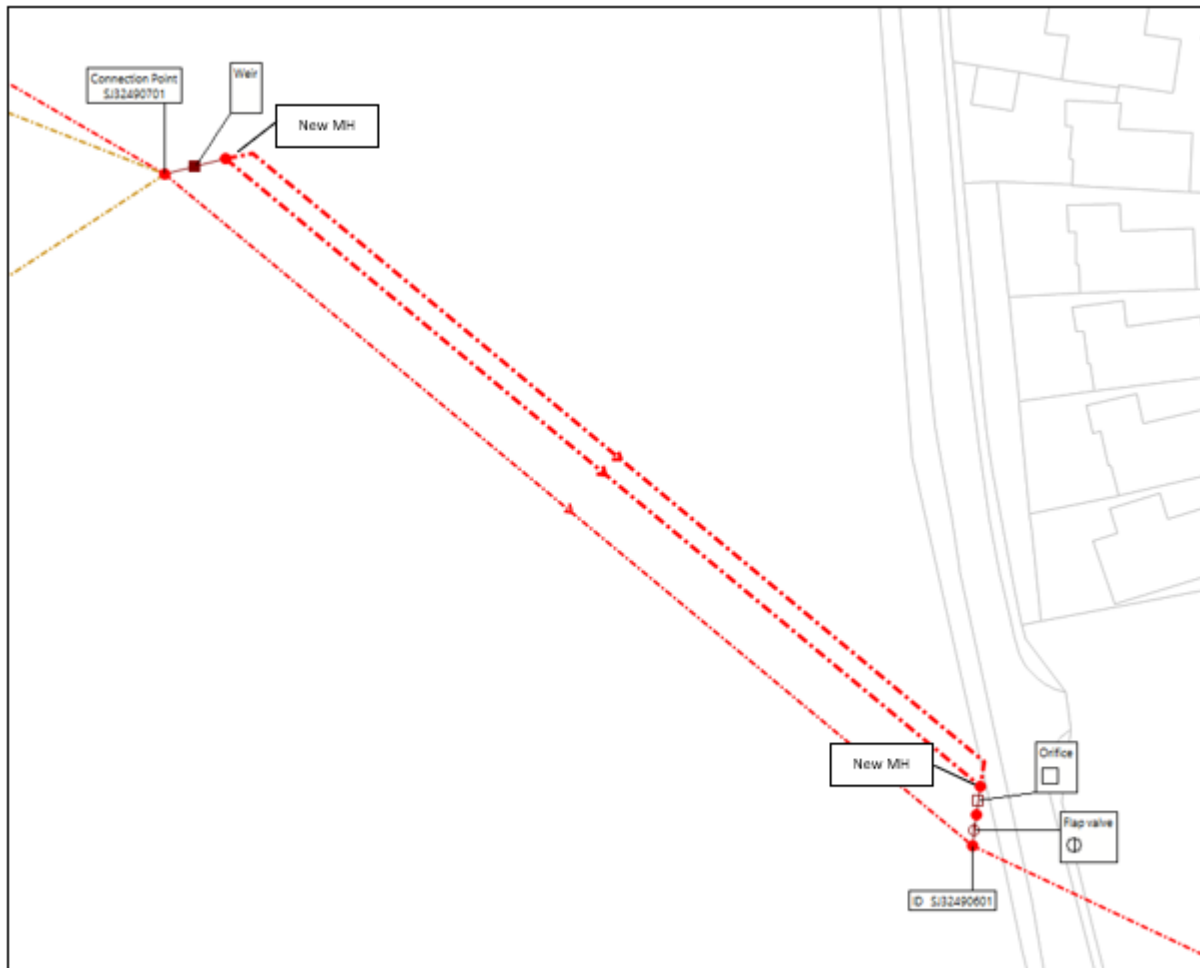


Figure 9. Online storage bifurcation

3.4.3 Solution Assessment

No increase in flooding volume is predicted in the assessment area after the implementation of the above solution, and with the construction of the full development.

Model Node ID	Manhole ID	Critical Duration (min)	Flood Volume (m ³)			Flooding Detriment	
			Existing	Developed	solution	Absolute (m ³)	Percentage (%)
SJ32490701	SJ32490701	360 (summer)	0	48.6	0	0	-
SJ35482802	SJ35482802	1440 (winter)	0	40.9	0	0	-

Table 7. Hydraulic Assessment Results – Solution 3.

3.4.4 Option Considerations

This solution does not resolve the CSO spill detriment at the WwTW downstream as a result of the development. Although the addition of the development increases the CSO spill detriment, this solution does not make this detriment any worse. No further investigation has been undertaken due to the scope of this assessment.

This simulation results indicate that there is sufficient pipe capacity in the existing pipes upstream and downstream of the location where the storage is applied.

It is assumed that there will be no issues acquiring the land needed to build the online bifurcation storage. The cost of this solution does not include the cost of purchasing land required for the construction of this storage.

3.5 Solution Summary

- Solution 1 provides a hybrid grey and green solution. The grey part consists of creating a new connection point further downstream with the addition of six new pipes and manholes and the upsizing of two pipes. The green part consists of the removal of 2.559 ha of impermeable area from 81 subcatchments throughout the network to resolve the flooding detriment.
 - Solution 2 provides a fully grey solution. It consists of creating a new connection point further downstream with the addition of six new pipes and manholes and the upsizing of two pipes.
 - Solution 3 provides a fully grey solution. This consists of laying two new pipes as online bifurcation storage with the addition of a weir, orifice, and flap valve to resolve the flooding detriment.
-

4 Solution Costs

The solution costs provided are based on the AMP 7 Year 4 DCWW Cost and Carbon Estimating Tool (CCET). This cost model predicts costs based on final costs of completed scheme. This is intended to be a high-level cost estimate. It is recommended that a detailed cost estimate is undertaken during the detailed design phase.

Solution	Description	Costs
Solution 1- New connection point and IA removal	Laying of 360 m of new 225 mm diameter pipes including 6 new manholes to accommodate route around existing housing. Connect into existing network at new proposed connection point, downstream of original one. Upsize of 106 m of sewer from 225 mm to 375 mm, including upsize and rebenching of 3 manholes to accommodate upsized pipes (SJ32491401 new volume of 2.88 m3, SJ32491406 new volume of 0.38 m3, SJ32492401 new volume of 2.54 m3). Removal of 2.559 of IA across 5 areas	£2,465,000
Solution 2- New connection point	Laying of 360 m of new 300 mm diameter pipes including 6 new manholes to accommodate route around existing housing. Connect into existing network at new proposed connection point, downstream of original one. Upsize of 106 m of sewer from 225 mm to 450 mm, including upsize and rebenching of 3 manholes to accommodate upsized pipes (SJ32491401 new volume of 3.28 m3, SJ32491406 new volume of 0.52 m3, SJ32492401 new volume of 2.54 m3).	£700,000
Solution 3- Online storage bifurcation	Addition of two 1700 mm pipes to provide online bifurcation storage. A weir upstream of the storage. An orifice and flap valve downstream of the storage to limit flows back into the pipes.	£1,210,000

Table 8. Solution Costs

The costing assumes that solutions would be developed in-house. Furthermore, it is assumed that new sewer construction will be undertaken through open cut techniques. More cost-effective techniques may be possible but have not been costed.

Solution 1 assumes the 360 m of new 275mm diameter pipes will be laid through grassland. Six new manholes will be constructed to support the new network. Two pipes will be upsized from 225 mm to 375 mm. The cost of pipe upsize assumes urban normal depths with three associated manhole enhancements. This solution assumes that the impermeable area removal is undertaken through the creation of bioretention or raingardens. This is a first pass estimate of how much the removal would cost but it should be considered that with detailed investigation and design, there would be a mixture of SUDs features and connecting to existing network. The amount of area removed in this solution demonstrates the quantity required to remove detriment rather than those locations being the actual focus of intervention. Detailed costing has therefore not been undertaken and an assumption of five separate areas of removal was costed as a best estimate. The raingardens have been costed, as per DCWW guidance, through 0.1 ha of raingarden per 1 ha of IA removal.

Solution 2 assumes the 360 m of new 300 mm diameter pipes will be laid through grassland. Six new manholes will be constructed to support the new network. Two pipes will be upsized from 225 mm to 450 mm. The cost of pipe upsize assumes urban normal depths with three associated manhole enhancements.

5 Conclusion & Recommendations

- The proposed development is south of Ruthin Road, Wrexham. This is located to the east of the Wrexham city centre.
 - The size of the development is approximately 53 ha. The developer aims to build the development of 1500 units in one phase.
 - 1400 of the units will drain via gravity and the remaining 100 will drain via two pumping stations.
 - The proposed development has been assessed using an existing connection point of SJ32490701, in the southeast corner of the site.
 - The model used in this study is the AMP7 DWMP 2020 base model, which was last verified in 2014 but has had model upgrades conducted during other HMAs.
 - The hydraulic assessment indicates that there is no flooding detriment around the two DFL properties downstream. There is a total of 48.6 m³ of flooding detriment at the connection point. One other manhole downstream (SJ35482802) is predicted to flood by 40.9 m³ as a result of the new development.
 - Three solutions were discounted as they do not resolve the flooding detriment.
 - Solution 1 consists of a new section of network, connecting the development further downstream and in doing so, avoiding the known pipe restriction location that was causing the flooding detriment. The solution also consists of the removal of 2.559 ha of impermeable area from 81 subcatchments throughout the network to resolve the flooding detriment. This solution is estimated to cost £2,465,000. This solution is a first pass approximation as the exact methods and location of impermeable area removal will have to be reviewed at detailed design.
 - Solution 2 consists of a new section of network, connecting the development further downstream and in doing so, avoiding the known pipe restriction location that was causing the flooding detriment. This solution is estimated to cost £700,000.
 - Solution 3 consists of laying two new pipes as online bifurcation storage to resolve the flooding detriment. This solution is estimated to cost £1,210,000.
-

6 List of Abbreviations

DWF – Dry Weather Flow

WwTW – Wastewater Treatment Works

HMA – Hydraulic Modelling Assessment

CSO – Combined Sewer Overflow

DWMP – Drainage and Wastewater Management Plan

PFF – Pass Forward Flow

DFL – Definitive Flooding List

IAS – Impermeable Area Survey

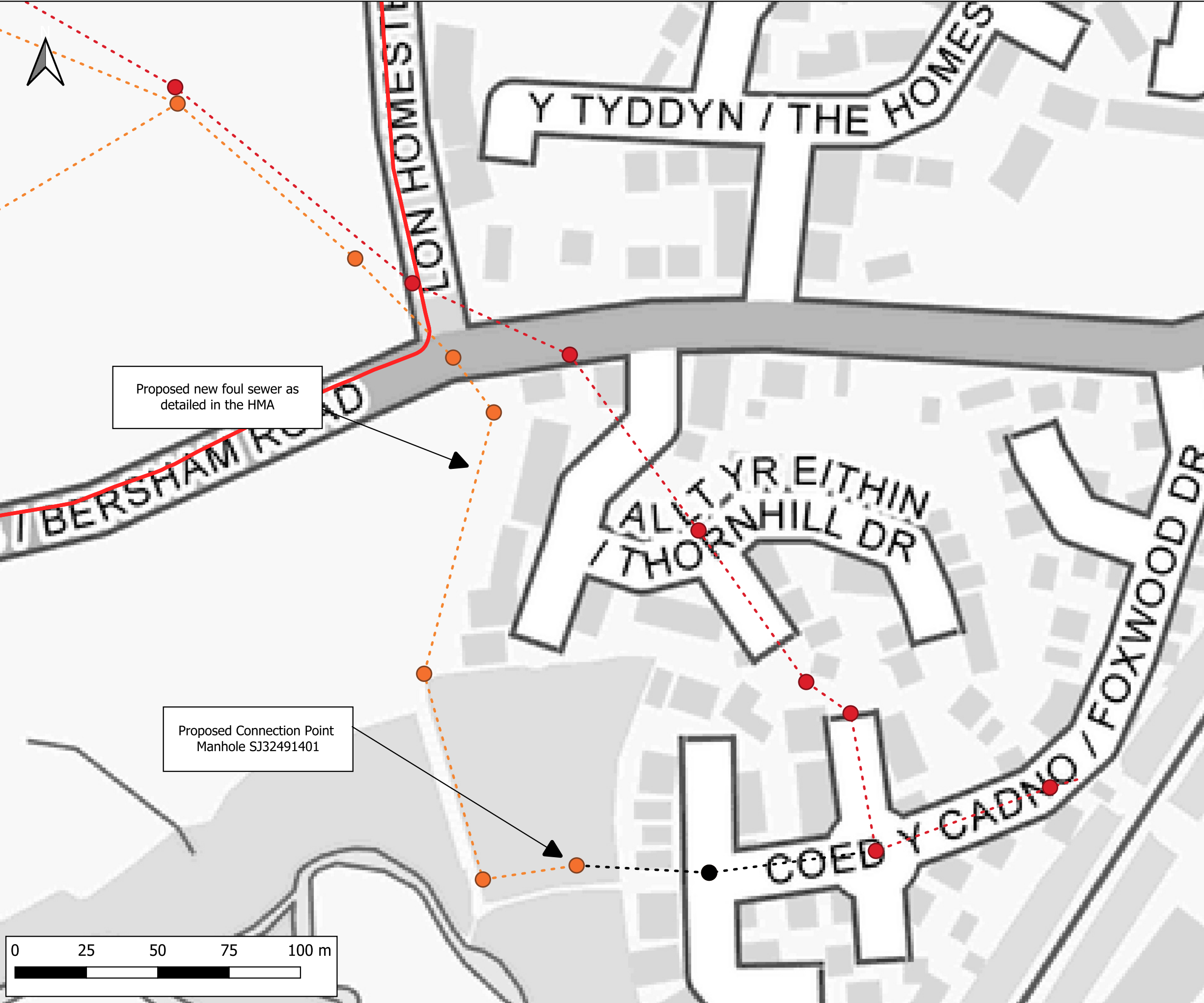
CCET - Cost and Carbon Estimating Tool

SPS – Sewerage Pumping Station

SUDS - Sustainable Drainage Systems

DCWW - Dŵr Cymru Welsh Water

Appendix D – Foul Connection Plan



Notes:

1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Existing Public Combined Sewer
- Proposed Foul Sewer
- Existing Foul Sewer
- Existing Manhole
- Proposed Manhole
- Existing Foul Manhole

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sham
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Rhosyllen
A525
Erddig

CLIENT:

REDROW

waterco
www.waterco.co.uk

SCHEME:

Ruthin Road, Wrexham

PLOT TITLE:

Proposed Foul Connection Point Plan

PLOT STATUS:		DATE:	
FINAL		04-11-2024	

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
AM	AW	MW	1:1300

PLOT NAME:	REVISION:
13840_Proposed_Foul_Connection_Point	-