Gillingham SSA
Foul Drainage Strategy

A055606

Welbeck Strategic Land, C G Fry & Son Ltd and Taylor Wimpey

May 2017

Prepared on behalf of WYG Engineering Limited

Geneva Building, Lakeview Drive, Sherwood Business Park, Annesley, Nottingham, NG15 0ED
Tel: +44 (0)1623 684 550 Fax: +44 (0)1623 684 551
Email: nottingham@wyg.com Website: www.**wyg**.com

WYG Engineering Limited. Registered in England & Wales Number: 01959704
Registered Office: Arndale Court, Otley Road, Headingley, Leeds, LS6 2UJ

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1.0 Scope

As part of the scoping exercise for the development, North Dorset District Council(NDDC) has indicated that the Environmental Statement should include a foul drainage strategy. This report has therefore been produced to address the requirements of NDDC in respect of the foul drainage strategy.

The scope of the foul drainage strategy will consider the following points;

- Development proposals and phasing arrangements for the site
- Points of connection to the public foul sewer
- Gravity or pumped discharges
- Schematic proposals with design flows for critical sewer routes and adoption requirements
- Trigger points for capacity improvements
- Off-site requisition arrangements/capacity improvements

2.0 Introduction

This report presents the proposed high level foul drainage strategy for the development of up to 1,800 new dwellings, the construction of a new primary school, an extension to an existing primary school and a local centre on land to the south of Gillingham, Dorset.

A Pre-Planning Enquiry has been undertaken with Wessex Water, and the response provided, together with subsequent correspondence forms the basis of the foul drainage strategy.

A variety of topographical survey drawings, covering the different areas of the site have been reviewed together with LiDAR level data covering any areas not included within the more detailed surveys. This data has been used to assess suitable routes for critical foul sewer runs and to establish where pumping of flows may be required.

The foul flows entering the critical foul sewers at various locations has been estimated using the development masterplan (Illustrative master plan drawing number 220701/U/SK/IMP/001 produced by Terence O'Rourke). Reference has also been made to the Terence O' Rourke Ltd South Consortium density plan, which provides further details of the density of dwellings within residential areas of the site.

The proposed phasing of the development has also been considered, and reference has therefore been made to the Phasing plan produced by Terence O'Rourke.

For further details and location of the different parcels of land please refer to Chapter 3 of the Environmental Statement.

3.0 Existing Public Foul Sewers

Wessex Water foul sewerage assets are shown on asset location plans included within Appendix A and are described below:-

3.1 Park Farm

A 300mm diameter public foul water sewer (FWS) runs across the site. The sewer enters the east site boundary adjacent Fern Brook and flows west across the site. The sewer leaves the west site boundary at Fern Brook Lane.

A 150mm diameter foul water sewer runs across the site from the south east and connects to the 300mm public foul sewer. The 150mm foul sewer run commences to the south east of Kingsmead Business Park and receives flow from the Park Farm pumping station via a 100mm diameter rising main. The sewer flows in a north easterly direction before turning north west at the east corner of Kingsmead Business Park. The sewer runs just inside the site boundary before turning north, at a location at the north western corner of the proposed primary school, and then connects to the 300mm public sewer on site.

3.2 Ham Farm & Newhouse Farm

There are no public foul sewers shown within either the Ham Farm or Newhouse Farm site boundaries.

3.3 Lodden Lakes

A 300mm diameter public foul sewer runs across the north of the site from east to west. The sewer flows south, to the east of the River Lodden before turning south west (approximately adjacent the play area to rear of Wren Place) to cross the River Lodden. The sewer enters the north boundary of the site (adjacent The Meadows) and flows to the south west. The sewer then changes direction to flow north west at a point located at the north east corner of Lodden Lakes site. The sewer then leaves the west boundary of the site.

Additionally, there is an existing 225mm diameter public foul sewer located to the north of the site. The sewer flows south between the River Lodden and the rear of the existing

residential properties on Addison Close. The sewer connects to the 300mm sewer described in the paragraph above just outside the site boundary.

A 150mm foul sewer is also shown flowing in a south easterly direction within The Meadows. This sewer discharges to the 300mm foul sewer which crosses the site and again the point of connection is location just north of the Site boundary.

4.0 Wessex Water Correspondence

A Pre-Planning Enquiry was made to Wessex Water (WW) in February 2013 to request local capacity details and a connection strategy in respect of foul water drainage services for the development. In response to this enquiry, WW confirmed that the existing foul sewerage network in the site vicinity does not have sufficient capacity to receive the foul flows generated by the development and off-site sewerage network reinforcement would be required.

More recently, in October 2015, further correspondence has been undertaken with WW to refresh the enquiry. Details of the current proposed scheme were provided to WW and a more refined scope of off-site network reinforcement works was requested.

In a letter dated 2nd December 2015, WW provided an update; a copy of this correspondence is provided in Appendix B. A summary of the key points is outlined below.

The southern part of Gillingham drains via a 300mm foul sewer which crosses the site in two locations. The 300mm foul sewer outfalls to Brickyard Lane Foul Pumping Station downstream of the site which pumps flows directly to Common Mead Lane Sewerage Treatment Works. Existing foul sewers between the site and Brickyard Lane Sewerage Pumping Station are reported to be laid at depths of up to 8m below ground level.

The proposed developments will double the size of the catchment discharging to the Brickyard Lane Sewerage Pumping Station and therefore significant new infrastructure will be required. In addition, an Environment Agency permit review will be required in respect of the operation of the Brickyard Lane Pumping Station.

WW has initially proposed two possible schemes to provide the necessary capacity within its network to serve the development. These schemes are outlined below and are shown indicatively within Figures 2 and 3.

4.1 Option 1 – Business Plan 2012 Option

The first option is based on a scheme which was identified as part of the WW Business Plan in 2012. The scheme of off-site reinforcement works is outlined as follows: -

- Replacement of 150 m length of existing 300mm diameter sewer with 2 x 1 m box culvert with a hydroslide to restrict pass forward flow (location annotated A on Figure 1 below);

- Replacement of 240 m length of existing 300mm diameter sewer with 375mm diameter sewer (location annotated B on Figure 1 below);
- Construction of 800 m length of new 1600mm diameter sewer connected to existing network with a new bifurcation manhole (location annotated C on Figure 1 below);
- Works to provide additional capacity at the Brickyard Sewerage Pumping Station (SPS) located to the north west of the site (location D on Figure 1 below).

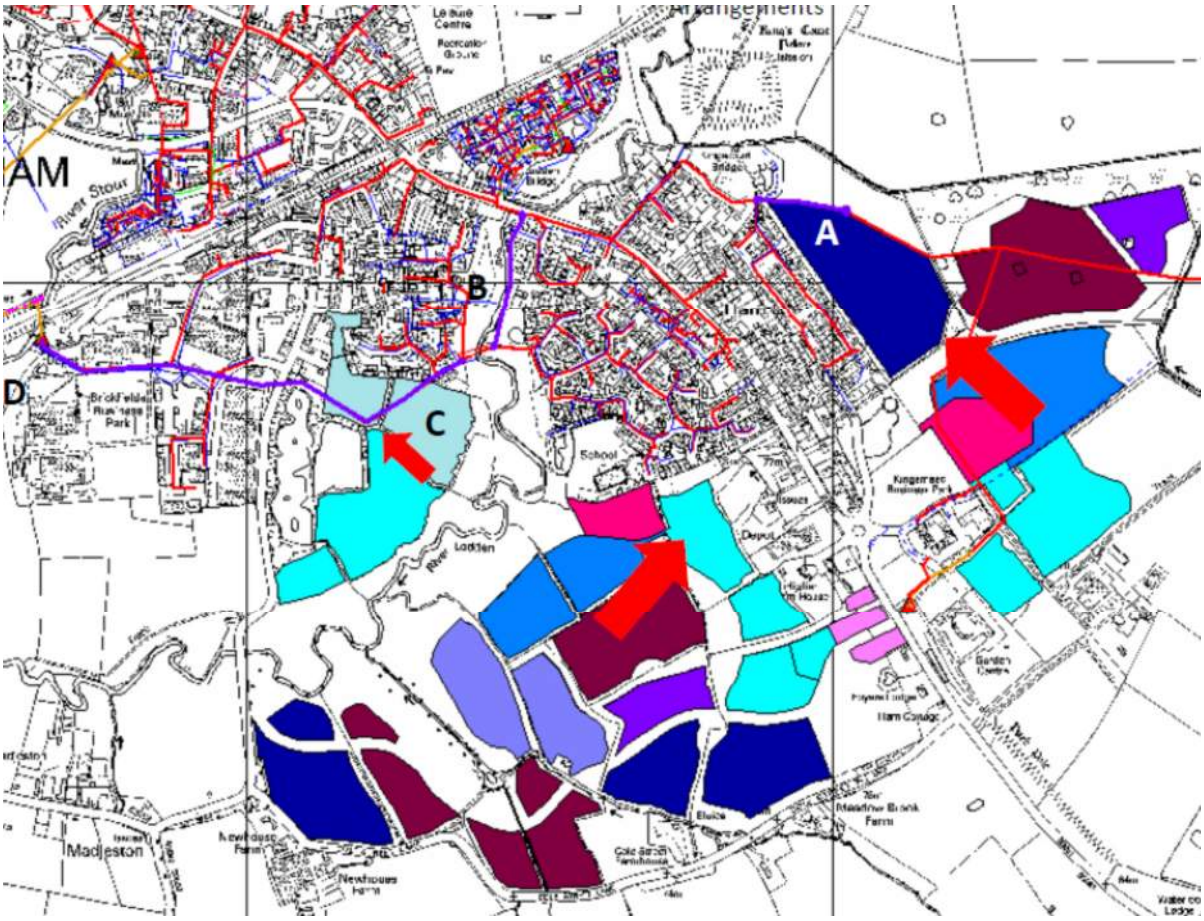


Figure 1 – Off-site Sewerage Upgrades – Option 1 (Business Plan 2012 Option)

In respect of the on-site foul drainage networks, a foul pumping station will potentially be required on the Ham Farm site to discharge foul flows to the existing foul sewerage network.

4.2 Option 2 – New Sewerage Pumping Station Option

A second option is outlined within the latest WW correspondence which involves a new sewerage pumping station constructed on site to serve only the Gillingham Southern

Extension development. New infrastructure work involved in this alternative scheme is shown in Figure 2 on the following page, and is outlined as follows.

- Laying approximately 1km of new 225/300mm sewer (2-3m deep) within the river corridor to the north of the Site. This off-site sewer will convey foul flows from the Park Farm Site (600 new properties assumed) through open land to the Lodden Lakes Site.
- Construction of a 300mm oversize foul sewer through the Lodden Lakes Site.
- Construction of a new sewerage pumping station to the south west of the Lodden Lakes site and outside of the flood plain. The new pumping station would require 288m^3 of storage and is initially estimated to require a depth of 9m.
- A new 250mm diameter rising main laid from the new pumping station and discharging directly to the existing Brickyard Lane pumping station.
- The construction of a new wet well at the existing Brickyard Lane Sewerage Pumping Station with approximately 300m^3 of storage.
- The existing pumps at Brickyard Lane Sewerage Pumping Station will need to be upgraded to discharge at 85 l/s and approximately 400m of new 400mm diameter rising main will be required between the existing pumping station and the sewerage treatment works.

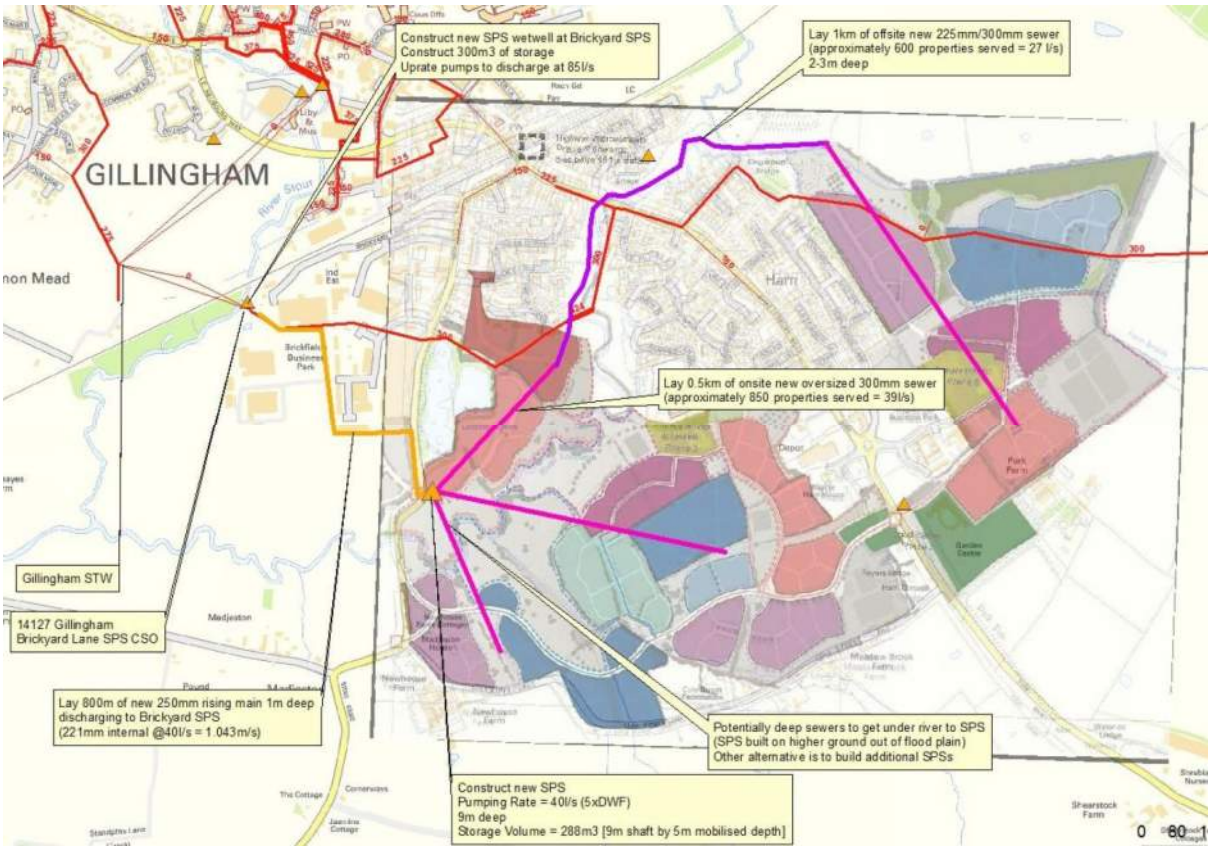


Figure 2 – Off-site Sewerage Upgrades – Option 2 (New Sewerage Pumping Station Option)

The options for off-site sewer improvements set out by Wessex Water have been considered as part of the foul drainage strategy. The two options put forward by Wessex Water involve 3 potential connection points as follows;

- A potential connection to the existing foul 300mm foul sewer in the north of the Park Farm site (subject to network reinforcement);
- A potential connection to the deep 300mm foul sewer flowing through the Lodden Lakes site (subject to network reinforcement);
- And / or, a new pumped connection directly to the existing Brickyard Lane foul pumping station (subject to network reinforcement).

A proposed on-site foul drainage network is considered in the following section.

5.0 Outline Foul Drainage Strategy

The proposed foul drainage strategy for the development is shown on drawings A055606-001 and 002 included within Appendix C. The network is indicative only and provides a strategy for the entire site. It is important to note that the indicative network outlined represents only the strategic level sewers. Additional foul sewer branches will be required to serve side streets and cul-de-sacs. Further to this, additional manholes may be required to suit detailed site layout plans and fully comply with the requirements of Sewers for Adoption 7th Edition.

The topography of the site favours a foul drainage strategy with two catchments. The eastern catchment, draining the Park Farm site, flows in a northerly direction following the slope of the ground towards the existing 300mm foul sewer and Fern Brook in the north. The eastern catchment could potentially connect to either the upgraded existing 300mm sewer (Wessex Water option 1 scheme) or the new off-site outfall sewer following the River corridor as described within the Wessex Water option 2 scheme.

The proposed phasing of the scheme involves commencing construction from several locations across the site concurrently. This is likely to result in high up front capital costs as it will be necessary to put a large portion of the strategic foul sewers in place at the beginning of the build programme. The phasing does, however, provide an opportunity to avoid off-site works within third party land. Whilst the connection points for the eastern catchment suggested by Wessex Water remain viable (and may be preferred depending on construction programmes) an alternative connection method involving pumping flows to the western catchment is shown on the drainage strategy plan.

The western catchment (Ham Farm, Newhouse Farm and Lodden Lakes) generally slope down toward the River Lodden which flows through the middle of the western catchment. It is proposed to drain the western catchment to a new pumping station located just outside of the Flood Risk Zone 3 area on the northern side of the River Lodden (south west corner of the Lodden Lakes site).

As described above the strategy involves two pumping stations for foul flows to be pumped to the Brickyard Lane pumping station to the north west of the site and ultimately to Common Mead Lane Sewerage Treatment Works.

5.1 Park Farm Pumping Station

The majority of the Park Farm site will drain to the proposed pumping station in the north east corner of the site as the site generally slopes from south to north towards the watercourse. Flows will be pumped from the pumping station to the southern boundary of the site where they will discharge to a gravity sewer. The gravity sewer will flow south west off-site, past the existing garden centre and enter the Ham Farm site at the eastern boundary.

5.2 Existing Garden Centre Pumping Station

Flows from the existing garden centre are currently pumped a relatively small distance to the existing foul sewer within the Park Farm site. It is proposed that foul flows from the garden centre would be connected to the proposed new gravity foul sewer and it may be possible to abandon the existing pumping station serving the garden centre (subject to existing levels).

5.3 Lodden Lakes Pumping Station

The Lodden Lakes pumping station will be positioned to the south west of the Lodden Lakes site and will receive flows from the north via a foul sewer serving the Lodden Lakes development and from the south via a foul sewer serving Ham Farm and Newhouse Farm together with the pumped flows from Park Farm. The foul sewer that connects to the pumping station from the south will need to pass under the River Lodden before connecting to the pumping station.

5.4 Foul Flows

The proposed foul drainage network has been modelled within the Network module of the software package MicroDrainage. The outputs from the analysis are included within Appendix D. Foul flows from the site are generated from the residential dwellings together with a new primary school, an extension to an existing primary school and a local centre. The peak foul flow rates from these areas were calculated as follows:

- Residential dwellings – 4000 l/dwelling/day for 1800 dwellings
- Schools (x2) – 90 l/s/person for 420 pupils based on an 8 hour day and a peak flow factor of 6
- Local Centre – 3 l/m^2 for 7000m^2 based on a 12 hour day and a peak flow factor of 6

The approximate quantum of dwellings within each residential parcel has been calculated from the Terence O' Rourke Ltd South Consortium density plan.

The MicroDrainage analysis has been carried out through two separate models. The first model is for the eastern catchment (Park Farm) and provides an approximate indication of the cover levels and invert levels for the proposed foul sewers together with an indication of the foul flow and pipe sizes required. The network receives flows from a total of 626 residential dwellings and a new primary school. The proposed network requires pipes ranging from 150 – 225mm in diameter and is located at depths ranging from 1.35 to approximately 6m below ground at the deepest point.

The second model is for the gravity foul sewers that originate from the western catchment (Ham Farm, Newhouse Farm and Lodden Lakes sites) and discharge to the proposed pumping station located south west of Lodden Lakes. This network also receives flow from the 626 dwellings and new primary school located within the eastern catchment. The model shows that the network requires pipe sizes ranging from 150 – 375mm in diameter and is approximately 5.5m below ground at its deepest point.

5.5 Storage at Pumping Stations

Sewers for Adoption states that to ensure that sewage flooding does not occur at, or upstream of, the pumping station during plant or power failure, additional storage should be provided. As a minimum, the storage should equate to 160 litres/dwelling, and for commercial or industrial developments 1 hour of peak design flow. Therefore, the storage for the two proposed pumping stations is as follows:

Park Farm pumping station

626 dwellings x 160 litres = 100m^3

7.9 l/s from new primary school x 60 x 60 = 28.5m^3

Total storage required = 128.5m^3

Lodden Lakes pumping station

1800 dwellings x 160 litres = 288m^3

15.8 l/s from new school and school extension x 60 x 60 = 57m^3

2.9 l/s from local centre x 60 x 60 = 10.5m^3

Total storage required = 355.5m^3

5.6 Off-site works

In line with the second option outlined by Wessex Water, off-site works will be required for the new pumping station to discharge to the existing Brickyard Lane pumping station. Although the proposed drainage strategy varies from the option 2 strategy provided by WW (proposed off-site sewer from eastern catchment replaced by proposed onsite sewers) both strategies utilise a pumping station to the south of the Lodden Lakes site that receives flow from the entire development. Therefore, the off-site works that were required by WW are valid for the proposed strategy and are as follows:

- A new 250mm diameter rising main laid from the new pumping station and discharging directly to the existing Brickyard Lane pumping station.
- The construction of a new wet well at the existing Brickyard Lane Sewerage Pumping Station with approximately 300m^3 of storage.
- The existing pumps at Brickyard Lane Sewerage Pumping Station will need to be upgraded to discharge at 85 l/s and approximately 400m of new 400mm diameter rising main will be required between the existing pumping station and the sewerage treatment works.
- The proposed strategy also requires off-site works within the highway between the south west boundary of the Park Farm site and the eastern boundary of the Ham Farm site.

5.7 Phasing

In order to construct the development based on the phasing arrangement indicated on the Terence O'Rourke Ltd South Consortium density plan, included within Appendix E, the entire foul sewer network including both pumping stations will be required to be installed for phase 2 of the development. This is due to the fact that most of the early phases of the development are located relatively close to Shaftesbury Road which is approximately the furthest point from the two proposed pumping stations.

6.0 Conclusions

The proposed development includes the construction of up to 1,800 new dwellings, a new primary school, an extension to an existing primary school and a local centre on land to the south of Gillingham, Dorset.

The proposed foul drainage strategy requires the use of two new foul pumping stations. The majority of the Park Farm site will drain to the proposed pumping station in the north east corner of the site as the site generally slopes from south to north towards the watercourse. Flows will be pumped from the pumping station to the southern boundary of the site where they will discharge to a gravity sewer.

The Lodden Lakes pumping station will be positioned to the south west of the Lodden Lakes site and will receive flows from the north via a foul sewer serving the Lodden Lakes development and from the south via a foul sewer serving Ham and Newhouse Farm together with the pumped flows from Park Farm.

The strategic network will require sewers ranging from 150 - 375mm in diameter and will be less than 6m below ground level at its deepest point.

Off-site works will be required to connect the proposed Lodden Lakes pumping station to the existing Brickyard Lane and ultimately to the Common Mead Lane Sewerage Treatment Works.

Based on the proposed phasing arrangement, the entire strategic foul network will need to be installed for construction of phase 2 of the development.

A strategic foul drainage strategy has been provided for the proposed development. The network is indicative only and provides a strategy for the entire site.

7.0 Appendices

Appendix A – Wessex Water Sewer Record Plans

Appendix B – Wessex Water correspondence

Appendix C – Foul Drainage Strategy Plans A055606-001 and A055606-002

Appendix D – MicroDrainage Network Details

Appendix E – Terence O' Rourke Density Plan and Phasing Plan

Appendix A

Wessex Water Sewer Record Plans

Wessex Water
Claverton Down Bath BA2 7WW Telephone 01225 526000
www.wessexwater.co.uk

Our Ref: N 167689

Your Ref:

Atkins Global
FAO Mr Tanveer Ahmed Tajir
The Hub
500 Park Avenue
Aztec West
Almondsbury, Bristol, BS32 4RZ

16 November 2015

Dear Sir

Ref: Site East & West of Shaftesbury Road, Gillingham

Thank you for your enquiry concerning the above. Please note that the following information does not constitute an approval to alter/divert/buildover or connect to any Wessex Water apparatus.

- A plan showing Wessex Water's public services is enclosed. The details are diagramatical only and their accuracy cannot be guaranteed.

Waste

- There are existing public sewers available on site/within the vicinity. There may also be private sewers for which we hold no records.
- The public sewers may be affected by your proposals and the exact position of these services should be located by careful inspection/survey before any works commence. Normally, no new building or similar works will be allowed within a minimum of 3.0m of these services.

On 1st October 2011 Wessex Water became responsible for the ownership and maintenance of thousands of kilometres of formerly private sewers and lateral drains (section 105a sewers). Many of these additional pipe lines run at the rear or side of domestic properties in addition to the existing public sewers shown on our record plans.

They will commonly be affected by extension proposals and either not shown on the public sewer record plans or their indicated position will be approximate only. It is important to undertake a full survey of the site and surrounding land to determine the local drainage arrangements and to contact us at an early stage if you suspect that a section 105a sewer may be affected. More information about this can be found via our website www.wessexwater.co.uk.

Continue-

Wessex Water
Claverton Down Bath BA2 7WW Telephone 01225 526000
www.wessexwater.co.uk

Supply

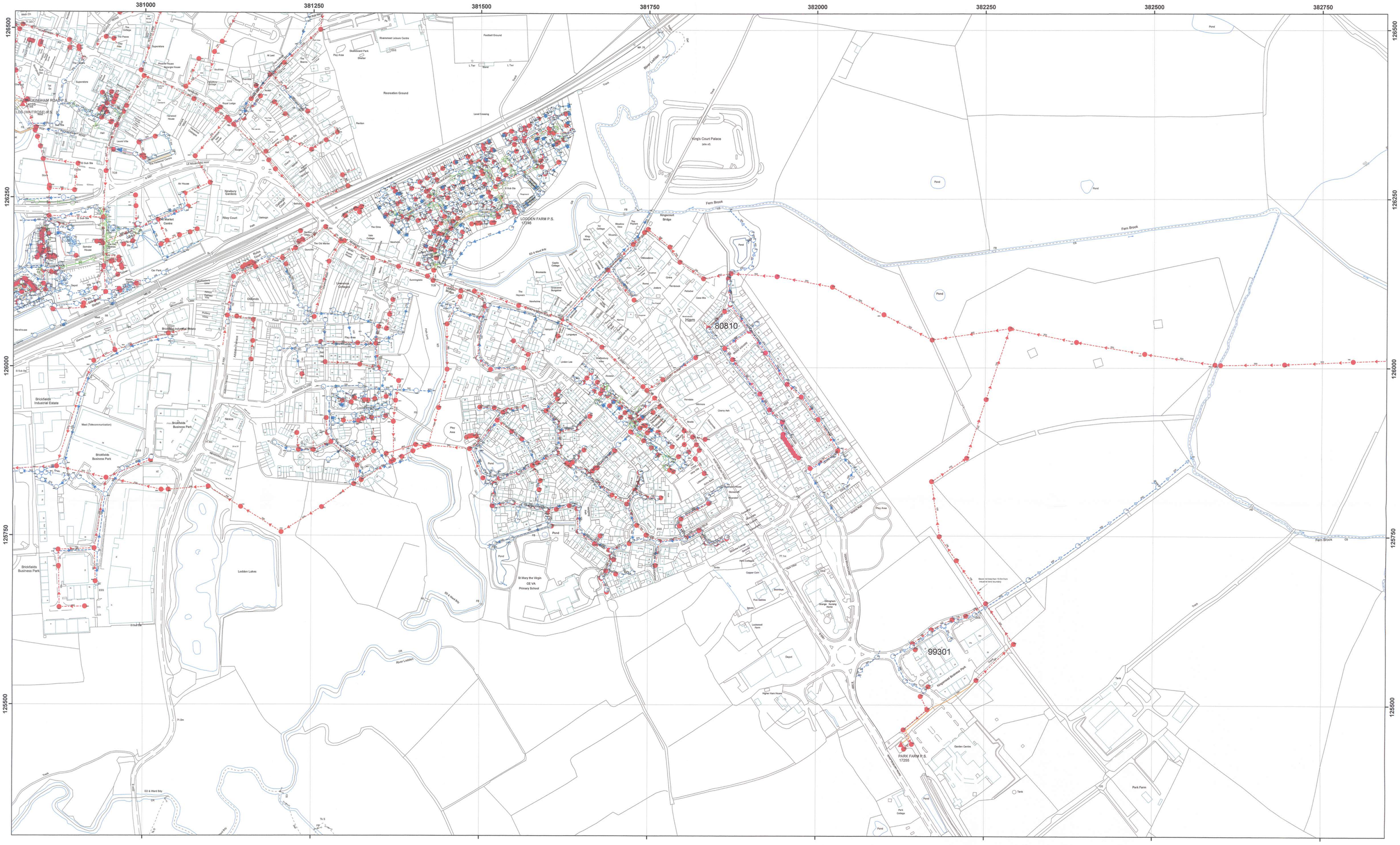
- There are public water mains available on site/within the vicinity. There may also be private water mains for which we hold no records.
- The public water mains may be affected by your proposals and the exact position of these services should be located by careful inspection/survey before any works commence. Normally, no new building or similar works will be allowed within a minimum of 3.0m of these services.

Yours faithfully

M. McDermott

Asset Searches Team
Tel: 01225 526422
e-mail: asset.enquiries@wessexwater.co.uk

a YTL company



Location: East/West Shaftsbury Road, Gillingham

Drawing Number: 1 of 1

Scale: 1:2500

Date Printed: 16/11/2015

WASTE NETWORK LEGEND

Colours generally indicate the use of the sewer/drain.

e.g. Red Foul
Dark Blue Surface
Magenta Combined/Dual Use
Light Green Highway Drain
Mid Green Overflow

Styles of line are shown on the key in sample/typical colours

BOUNDARIES

- Section 104 Site

STRUCTURES

- Manhole - Foul
- Manhole - Surface
- Manhole - Combined
- Outfall
- Inlet
- Lamphole
- Bifurcation - Foul
- Bifurcation - Surface
- Bifurcation - Combined
- Combined Sewage Overflow
- Pumping Station - Surface
- Pumping Station - Foul/Combined
- Gully
- Vent Column
- Rodding Eye
- Catchpit
- Flushing Chamber
- Soakaway
- Non Return Valve
- Air Valve
- Washout
- Hatch Box
- Other

PUBLIC SEWERS

- Foul Sewer
- Surface Water Sewer
- Combined Sewer
- Rising Main
- Syphon
- Overflow
- Use Unknown

OTHER STRUCTURES

- Attenuation Tank
- Storage Tank
- Chamber
- Tunnel
- Interceptor

NON-PUBLIC SEWERS & PIPELINES

- Private Sewer/Drain
- Highway Drain
- Culverted Watercourse
- Abandoned Sewer
- Status Unknown
- Section 104 - Foul
- Section 104 - Surface
- Section 104 - Combined
- Private Rising Main
- Effluent Disposal Main

Information in this plan is provided for identification purposes only. No warranty as to accuracy is given or implied. The precise route of pipe work may not exactly match that shown. Wessex Water does not accept liability for inaccuracies.
Sewers and lateral drains adopted by Wessex Water under the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011 are to be plotted over time and may not yet be shown.
In carrying out any works, you accept liability for the cost of any repairs to Wessex Water apparatus damaged as a result of your works. You are advised to commence excavations using hand tools only.
Mechanical digging equipment should not be used until pipe work has been precisely located.
If you are considering any form of building works and pipe work is shown within the boundary of your property or a property to be purchased (or very close by) a surveyor should plot its exact position prior to commencing works or purchase. Building over or near Wessex Water's apparatus is not normally permitted.

Appendix B

Wessex Water correspondence

lee.aldridge

From: Gillian Sanders [Gillian.Sanders@wessexwater.co.uk]
Sent: 15 February 2013 09:03
To: lee.aldridge
Subject: WW Resp Sewerage Improvements: Enquiry - Gillingham, Dorset Network Modelling arrangements

Lee,

Thank you for your email.

New development totals as described below in South Gillingham of circa 1800 dwellings, a school and 6.5ha employment land will generate significant foul flows in the Brickyard Lane catchment with a predicted risk of increased flooding and pollution. Wessex Water has undertaken an initial study to understand the scope of capacity improvements; these improvements will require confirmation and refinement by network modelling. Environmental screening has not been undertaken within the initial study.

Initial study suggests to mitigate against the extra foul flows, as described above, the following capacity improvements will be required:

Replace approximately 150m of existing 300mm diameter sewer with a 2m x 1m box culvert with a hydroslide to restrict pass forward flow.
Replace a further approximately 240m of existing 300mm diameter sewer with 375mm diameter sewer
Construct a new 800m x 1600mm diameter attentuation pipe connected to the existing sewer with a bifurcation manhole
Provide additional capacity at Brickyard SPS

The capacity improvements as described have not been subject to environmental screening nor received necessary procedural approvement. Please regard the information as indicative subject to further network modelling. Please ensure the information is not transferred to the public domain without prior agreement from Wessex Water.

I can advise your understanding of water supply network modelling arrangements are correct.

Regards

Gillian Sanders
Planning Liaison
Phone: **01225 526303**
Fax: 01225 528000
e-mail: gillian.sanders@wessexwater.co.uk
Web: www.wessexwater.co.uk

-----Original Message-----
From: lee.aldridge [mailto:lee.aldridge@wyg.com]
Sent: 11 February 2013 11:15
To: Gillian Sanders
Cc: richard.winn
Subject: RE: Enquiry - Gillingham, Dorset Network Modelling arrangements

Gillian

We would be pleased to receive an outline foul sewer scheme as per your email below, for which we understand there is no cost. Please note, at this stage we have been instructed not to request any WW chargeable appraisal work.

We would be also be pleased to receive mains water supply details (point of connection, off site reinforcement requirements) , for which we understand there is no cost. I have requested phasing details for the development and will forward once received.

Can you please confirm timescale for issue of the foul network information?

We understand the mains water supply will be provided 4 to 6 weeks from our confirmation of phasing.

I trust the above is satisfactory, if you need any further information please let me know.

Regards

Lee Aldridge
Senior Civil Engineer

Tel: +44 (0)1623 684592

From: Gillian Sanders [mailto:Gillian.Sanders@wessexwater.co.uk]
Sent: 07 February 2013 15:50
To: lee.aldridge
Cc: Dave Cherrett; Stuart Durant
Subject: RE: Enquiry - Gillingham, Dorset Network Modelling arrangements

Lee,

We can provide details of outline foul sewerage capacity improvements recommended to accomodate proposed development (DM1485928) which will need to be refined and developed by network modelling. Contribution for appraisal costs likely to be between £20 - £30K (off set against any scheme implemented to serve the sites). Our modelling programme is full until April, but I am happy to provide details of the indicative outline scheme.

Water Supply - Network modelling required to advise points of connection and off site re-inforcement. There is no cost for water supply modelling which can be instructed upon receipt of your phasing arrangements - modelling likely to take between 4 - 6 weeks to complete.

Regards

Gillian Sanders
Planning Liaison

Phone: **01225 526303**
Fax: 01225 528000
e-mail: gillian.sanders@wessexwater.co.uk
Web: www.wessexwater.co.uk

-----Original Message-----
From: lee.aldridge [mailto:lee.aldridge@wyg.com]
Sent: 05 February 2013 15:32
To: Gillian Sanders
Cc: richard.winn
Subject: Enquiry - Gillingham, Dorset

Gillian

Foul Drainage and Mains Water Supply Enquiry for Development Proposals at land in Gillingham, Dorset

WYG are engaged by CG Fry & Sons to prepare a Preliminary Infrastructure Appraisal for proposed development at land in Gillingham. The site is centred on OS grid ref: 381600, 125350, please refer to attached location plan. We understand that Wessex Water operate the foul sewer and mains water networks in this area.

The current masterplan (copy attached) comprises three separate areas for development summarised below: -

PARK FARM: 600 No new residential dwellings plus a new primary school (650 pupils & staff)

Description	Total No	**Peak Foul Flow Rate**	Assumptions
Residential	600 No Dwellings	**27.8 l/s**	4000 l/day per dwelling
Primary School	650 No persons	**12.0 l/s**	90 l/day per person

Description	Total No	**Mains Water Demand**	Assumptions
Residential	600 No Dwellings	**7.62 l/s**	146 l/day per person
Primary School	650 No persons	**0.34 l/s**	15 l/day per person

(assumed residential 2.5 No persons per dwelling with peak factor of 3, Primary School 8 hour day)

HAM FARM: 1200 No new residential dwellings

Description	Total No	**Peak Foul Flow Rate**	Assumptions
Residential	1200 No Dwellings	**55.6 l/s**	4000 l/day per dwelling

Description	Total No	**Mains Water Demand**	Assumptions
Residential	1200 No Dwellings	**15.24 l/s**	146 l/day per person

(assumed residential 2.5 No persons per dwelling with peak factor of 3)

LODEN LAKES: 6.5 ha commercial / industrial development land

Description	Total No	**Peak Foul Flow Rate**	Assumptions
Class B2: General	3610 No persons	**25.2 l/s**	100 l/day per person

(assumed 50% building floor area of 3.25 ha, population density 18 m^2 per persons with 2 No shifts per day)

Description	Total No	**Mains Water Demand**	Assumptions
Class B2: General	3610 No persons	**1.90 l/s**	45 l/day per person

(assumed 50% building floor area of 3.25 ha, population density 18 m^2 per persons with 2 No shifts per day)

Please can you confirm whether your existing networks within the vicinity of the site have sufficient capacity to receive the discharges from / provide the supply to the development areas and provide details of the nearest point of connection? Should hydraulic modelling of the existing system be required, can you please provide a fee proposal to undertake this work?

If off-site network reinforcement is necessary; please could you provide an indicative scope of work required including a budget cost estimate In addition, I would appreciate it if you could provide an indication of the likely number of properties that could be supplied before the off-site reinforcement is triggered.

I trust the above is satisfactory to proceed. Should you have any problems or wish to discuss please call.

Regards

Lee Aldridge
Senior Civil Engineer

WYG ENGINEERING LTD
Geneva Building, Lake View Drive, Sherwood Business Park, Annesley, Nottingham, NG15 0ED
Tel: +44 (0)1623 684592

Wessex Water
Claverton Down Bath BA2 7WW Telephone 01225 526000
www.wessexwater.co.uk

Colin Davidson
colin.davidson@wyg.com
Principal Engineer
WYG, Geneva Building
Annesley, Notts
NG15 0ED

2 December 2015

Dear Colin,

Re: Gillingham Urban Extension; 1800 dwellings.

I refer to previous correspondence and agreement to scope the foul network modelling required for consideration of the impact of the predicted foul flows from major development at Gillingham upon the existing downstream public sewer network.

The proposed 1,800 residential "urban extension" sits in four areas (Appendix 1)

The Gillingham sewerage catchment consists of the conurbation which forms Gillingham, situated on the northern bank of the River Stour, together with Motcombe village which is 2km to the east.

The area is served by Common Mead Lane Sewage Treatment Works (STW, site i.d 13132).

The combined sewerage from the main sub-catchments discharge to two sewerage pumping stations; Buckingham SPS to the north and Brickyard Lane SPS to the south. Both SPS pump directly to the STW.

There is a small area of residential development immediately to the north of the STW, which drains by gravity direct to the inlet works.

There is an existing 300mm foul sewer which drains through the development site in two areas to Brickyard SPS. The 300mm sewer is up to 8m deep as it passes under a ridge towards Brickyard SPS.

As the size of the Brickyard SPS catchment is doubling with the proposed urban extension, significant new infrastructure will be required in addition to an EA permit review for Brickyard SPS operation.

Two options are currently proposed for further modelling appraisal and consideration;

Option 1 – "Business Plan Option" (Appendix 2)

Detailed appraisal of this option is required to consider its suitability for phasing arrangements within the urban extension. Possible reduction in previously recommended storage will be considered based upon improvements and consent reviews at Brickyard SPS and Gillingham STW.

Option 2 – "New SPS Option" (Appendix 3)

An alternative option is for a new SPS at the south-western corner of the urban extension to serve the entire development only. This is likely to include (excluding on site sewers):

- Constructing 1km of offsite new 225mm/300mm sewer (approximately 600 properties served = 27 l/s) 2-3m deep
- Constructing 0.5km of onsite new oversized 300mm sewer (approximately 850 properties served = 39l/s)
- Construct new SPS, Pumping Rate = 40l/s (5xDWF), 9m deep, Storage Volume = 288m3 [9m shaft by 5m mobilised depth]
- Lay 800m of new 250mm rising main 1m deep discharging to Brickyard SPS (221mm internal @40l/s = 1.043m/s)
- Construct new SPS wetwell at Brickyard SPS, with ~300m3 of storage.
- Uprate pumps at Brickyard SPS to discharge at 85l/s, lay 400m of new 400mm rising main 1m deep discharging to STW Inlet Works (353mm internal @85l/s = 0.869m/s) – (dependent upon the capacity of the STW inlet which is to be determined)

In view of Gillingham Masterplan progression and commencement of the associated Infrastructure Delivery Plan Wessex Water will bring forward work on the Gillingham Drainage Area Plan. This will ensure that an up to date verified compute model is available to consider drainage options.

Internal approval will be sought within the next two weeks for the installation of a 32 monitor flow survey of Gillingham to verify a new hydraulic model of the catchment. The model can be used to consider the options as stated above and any alternatives evaluated during optioneering post model verification.

Assuming internal approval is gained the flow survey will take approximately 6 weeks to plan and install. Depending upon rainfall in the catchment (a minimum of three events required which need to meet specific criteria) the flow survey is likely to be installed for between 8-16 weeks. Once the data has been obtained and the model verified a meeting will be beneficial for an update on development proposals and agreement on modelling arrangements.

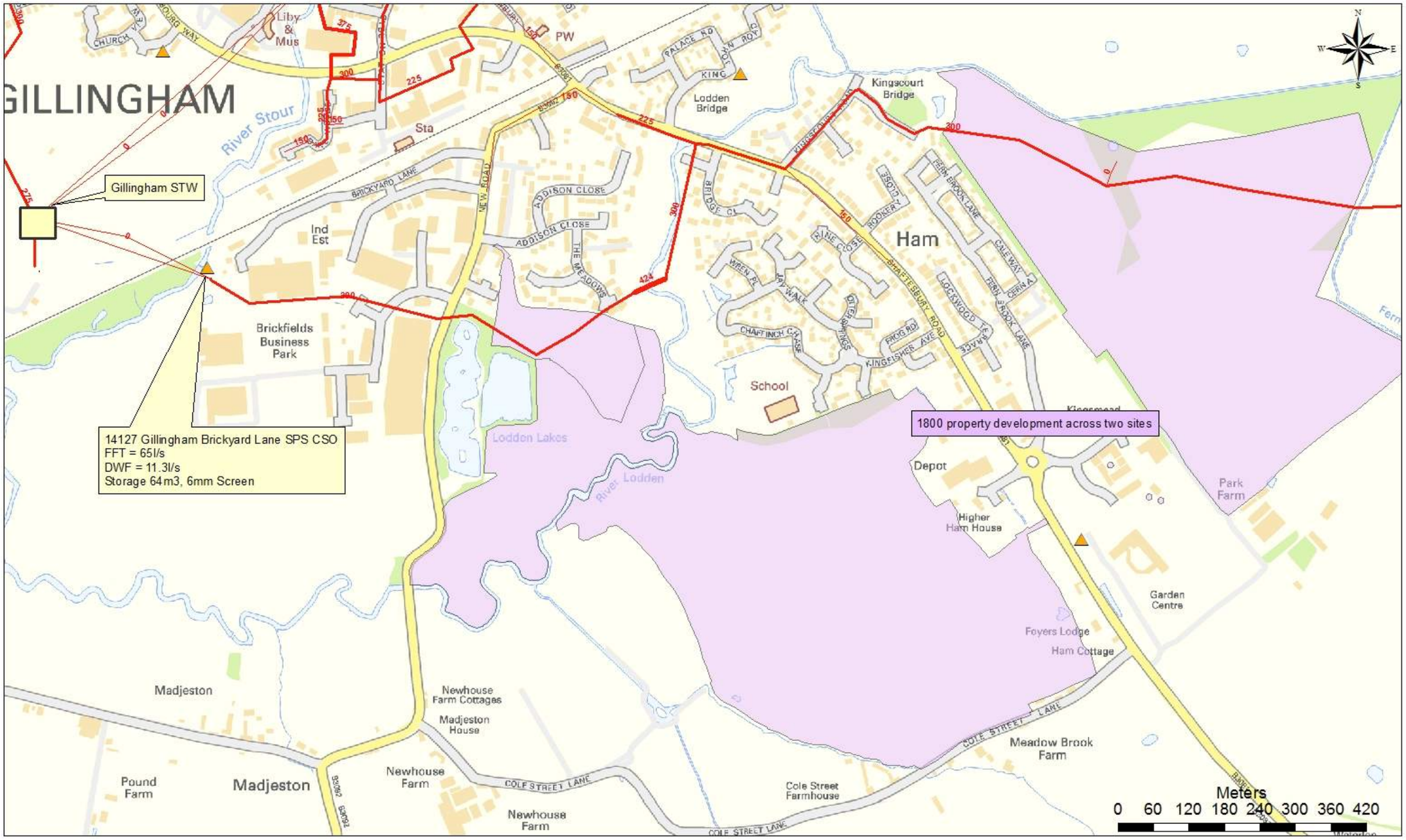
Whilst the flow survey is installed we can undertake other surveying specifically for development proposals. These will include manhole and pumping station surveys; the cost for the additional surveying for which a developer contribution will be required is £14,000. The total cost of the modelling for the development including optioneering, outline scheme and budget estimate will be £27,500 (+ vat). The £14,000 also includes the cost for 5 flow monitors out of the 32 monitors required. The cost for the DAP activities which will contribute to the main model build will be met by Wessex Water.

I trust our modelling / DAP proposals are acceptable and look forward to hearing how you plan to proceed.

Yours sincerely,

Gillian Sanders
Planning Liaison
Developer Services
gillian.sanders@wessexwater.co.uk

cc Mike Gale, Development Engineer



Wessex Water
a YTL company

CH155 South Gillingham Development

Scale1:5762

Appendix 1

Overall Plan

Centre: 381,487 125,645

Printed on: 19/11/2015 10:20

WA STE NETWORK LEGEND

Colours generally indicate the use of the sewer/drain
e.g. Red Foul
Dark Blue Surface
Magenta Combined/Dual Use
Light Green Highway Drain
Mid Green Overflow
Styles of line are shown on the key in simple/typical colours

BOUNDARIES
Section 104 Site

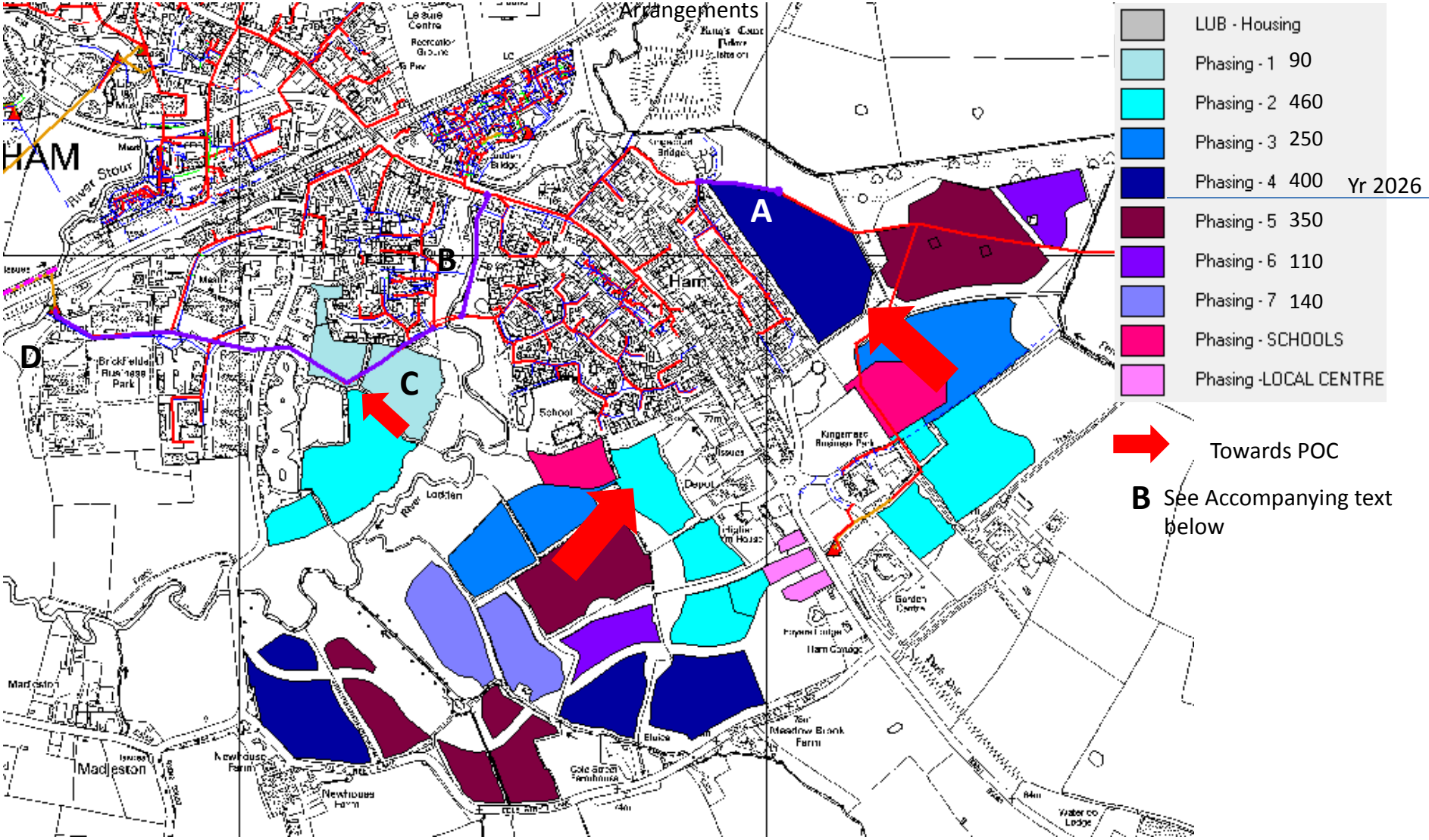
STRUCTURES
Manhole - Foul
Manhole - Surface
Manhole - Combined
Outfall
Inlet
Lamphole
Bifurcation - Foul
Bifurcation - Surface
Bifurcation - Combined
Combined Sewage Overflow
Pumping Station - Surface
Pumping Station - Foul/Combined
Gully
Vent Column
Rodding Eye
Catchpit
Flushing Chamber
Beakaway
Non Return Valve
Air Valve
Warehout
Hatch Box
Other

PUBLIC SEWERS
Foul Sewer
Surface Water Sewer
Combined Sewer
Rising Main
Syphon
Overflow
Use Unknown

OTHER STRUCTURES
Attenuation Tank
Storage Tank
Chamber
Tunnel
Interceptor

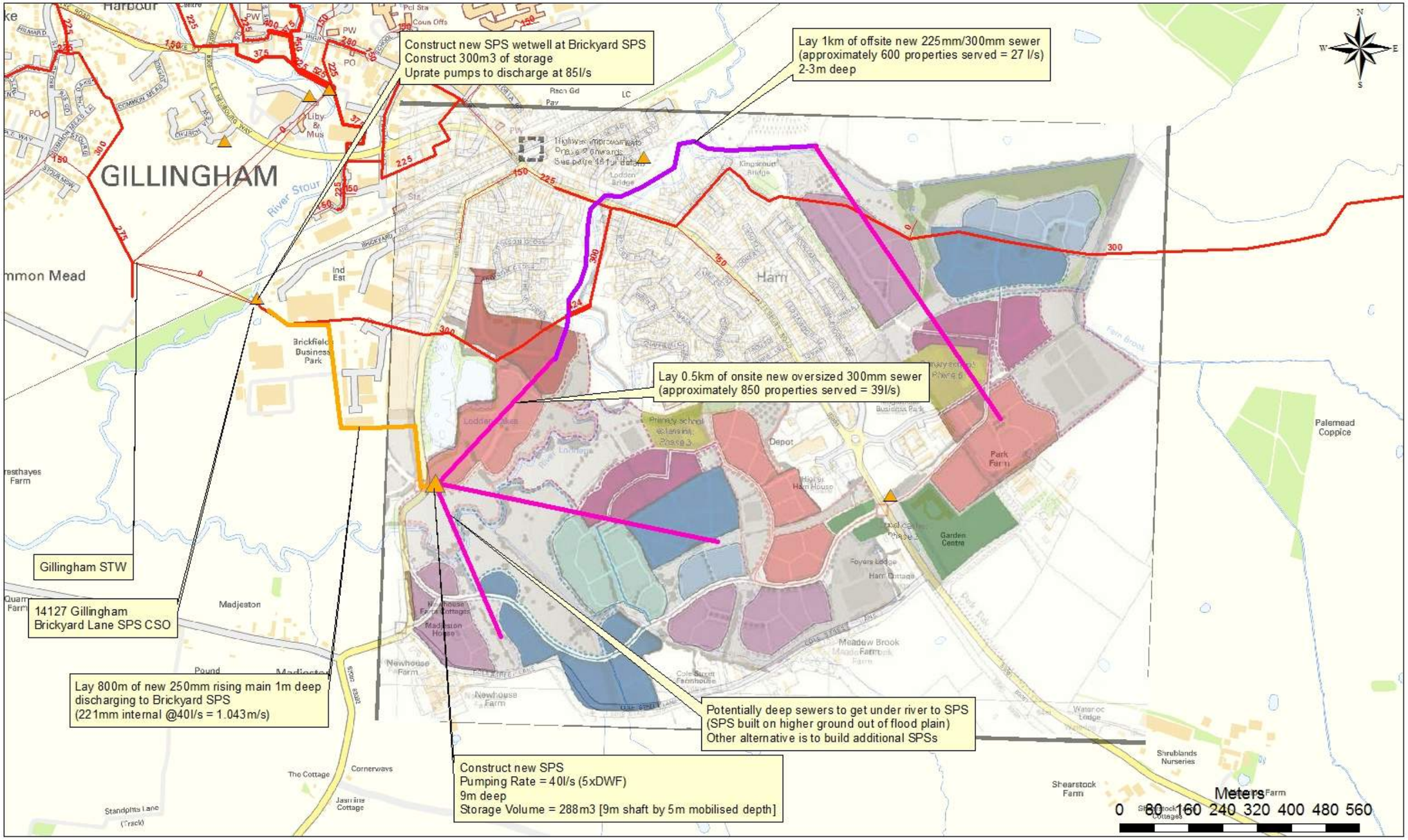
NON-PUBLIC SEWERS & PIPELINES
Private Sewer/Drain
Highway Drain
Culverted Watercourse
Abandoned Sewer
Status Unknown
Section 104 - Foul
Section 104 - Surface
Section 104 - Combined
Private Rising Main
Effluent Disposal Main

Appendix 2 option 1 For internal use Wessex Water /WYG only Gillingham Southern Extension Draft High Level Foul Drainage Arrangements



A Replace the existing 300mm diameter sewer (ST8126 8103 to ST8226 0101) with a 2.0m x 1.0m culvert over a length of approximately 150m.
Pass forward flow to be restricted at the downstream end to 40l/s via a hydro-slide or similar (developers of this area to provide adequate attenuation on site)
B Upsize the existing 300mm diameter sewer, between ST8125 4801 and ST8126 4102 (approximately 240m) to 375mm diameter.
C Form a bifurcation at manhole ST8125 3818 to divert excess flows from the existing sewer to a parallel 1600mm diameter attenuation pipe over 800m which will discharge to the wet well at the Brickyard Lane SPS
D Provide additional capacity to the wet well to the Brickyard Lane SPS – anticipated to be 6.0m diameter and 6.0m deep.

Appendix 3 Option 2



CH155 South Gillingham Development — Scale 1:7960

Appendix 7

Option B
Pumped strategy for 1800 property development site
Mitigation only

Centre: 381,691 125,619 — Printed on: 25/11/2015 08:35

WA STE NETWORK LEGEND

Appendix C

Foul Drainage Strategy Plans A055606-001 and A055606-002

DO NOT SCALE: CONTRACTOR TO CHECK ALL DIMENSIONS AND REPORT ANY OMISSIONS OR ERRORS

GENERAL NOTES

1. DO NOT SCALE. ALL DIMENSIONS ARE IN MILLIMETRES
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT CONTRACT DRAWINGS
3. THE CONTRACTOR SHOULD SITE CHECK ALL EXISTING DIMENSIONS SHOWN. ANY DISCREPANCIES ON THIS DRAWING IDENTIFIED BY THE CONTRACTOR SHOULD BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO CONSTRUCTION ON SITE
4. THE CONTRACTOR SHALL CONFORM TO ALL STATUTORY AUTHORITY REQUIREMENTS, CHECKING WITH THE EMPLOYER/CLIENT TO IDENTIFY BOTH BELOW GROUND AND OVERHEAD SERVICES. CONTRACTOR TO FULLY COMPLY WITH ALL CDM, H&S AND PARTY WALL ACTS THAT ARE CURRENT. ALL BS REFERENCES ARE TO CURRENT EDITIONS.
5. ALL TEMPORARY WORKS FOR FORMWORK, EXCAVATIONS ETC., TO BE THE DESIGN RESPONSIBILITY OF THE CONTRACTOR.
6. ALL LEVELS ARE IN METRES (A.O.D.)

KEY

- PROPOSED FOUL SEWER
- PROPOSED FOUL MANHOLE
- PROPOSED FOUL RISING MAIN
- PROPOSED FOUL PUMPING STATION
- EXISTING FOUL SEWER

- Residential
- School site and indicative location of school building
- Community building
- Local centre option locations
- Employment
- Sports provision
- Informal open space
- Attenuation basins
- Allotments
- Children's play
- Pedestrian links

PROPOSED FOUL RISING MAIN DISCHARGES TO THE PROPOSED NEW FOUL DRAINAGE NETWORK SERVING THE WESTERN CATCHMENTS.

PROPOSED FOUL DRAINAGE NETWORK SERVING THE WESTERN CATCHMENTS, SEE DRAWING A055606-C-21-002 FOR DETAILS.

INDICATIVE

REV	DESCRIPTION	BY	CHK	APP	DATE

CG FRY
TAYLOR WIMPEY
WELBECK LAND

GENEVA BUILDING,
LAKE VIEW DRIVE,
SHERWOOD BUSINESS PARK,
ANNESLEY, NOTTINGHAMSHIRE
NG15 0ED

TEL: +44 (0)1623 684 550
e-mail: nottingham@wyg.com

Project:
GILLINGHAM SOUTHERN EXTENSION

Drawing Title:
INIDICATIVE FOUL DRAINAGE STRATEGY
EASTERN CATCHMENT

Scale @ A1	Drawn Date	Checked Date	Approved Date
1:1000	TS 15.11.16	CD 15.11.16	CD 15.11.16

Project No.	Office	Type	Drawing No.	Revision
A055606	21	C	001	-

SCALE 1:2000

DO NOT SCALE: CONTRACTOR TO CHECK ALL DIMENSIONS AND REPORT ANY OMISSIONS OR ERRORS

GENERAL NOTES

1. DO NOT SCALE. ALL DIMENSIONS ARE IN MILLIMETRES
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3. THE CONTRACTOR SHOULD SITE CHECK ALL EXISTING DIMENSIONS SHOWN. ANY DISCREPANCIES ON THIS DRAWING IDENTIFIED BY THE CONTRACTOR SHOULD BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO CONSTRUCTION ON SITE
4. THE CONTRACTOR SHALL CONFORM TO ALL STATUTORY AUTHORITY REQUIREMENTS, CHECKING WITH THE EMPLOYER/CLIENT TO IDENTIFY BOTH BELOW GROUND AND OVERHEAD SERVICES. CONTRACTOR TO FULLY COMPLY WITH ALL CDM, H&S AND PARTY WALL ACTS THAT ARE CURRENT. ALL BS REFERENCES ARE TO CURRENT EDITIONS.
5. ALL TEMPORARY WORKS FOR FORMWORK, EXCAVATIONS ETC., TO BE THE DESIGN RESPONSIBILITY OF THE CONTRACTOR.
6. ALL LEVELS ARE IN METRES (A.O.D.)

KEY

- PROPOSED FOUL SEWER
- PROPOSED FOUL MANHOLE
- PROPOSED FOUL RISING MAIN
- PROPOSED FOUL PUMPING STATION
- EXISTING FOUL SEWER

FOUL SEWAGE PUMPED TO BRICKYARD LANE SEWAGE PUMPING STATION TO THE NORTH WEST OF THE SITE

PROPOSED FOUL RISING MAIN DISCHARGES TO THE PROPOSED NEW FOUL DRAINAGE NETWORK SERVING THE WESTERN CATCHMENTS.

- Residential
- School site and indicative location of school building
- Community building
- Local centre option locations
- Employment
- Sports provision
- Informal open space
- Attenuation basins
- Allotments
- Children's play
- Pedestrian links

INDICATIVE

REV	DESCRIPTION	BY	CHK	APP	DATE

CG FRY
TAYLOR WIMPEY
WELBECK LAND

GENEVA BUILDING,
LAKE VIEW DRIVE,
SHERWOOD BUSINESS PARK,
ANNESLEY, NOTTINGHAMSHIRE
NG15 0ED

TEL: +44 (0)1623 684 550
e-mail: nottingham@wyg.com

Project:
GILLINGHAM SOUTHERN EXTENSION

Drawing Title:
INIDICATIVE FOUL DRAINAGE STRATEGY
WESTERN CATCHMENT

Scale @ A1	Drawn Date	Checked Date	Approved Date
1:1000	TS 15.11.16	CD 15.11.16	CD 15.11.16

Project No.	Office	Type	Drawing No.	Revision
A055606	21	C	002	-

0 20 40 60 80 100 m
SCALE 1:2000

Appendix D

MicroDrainage Network Details

User Report O:\Engineer\Projects A000000 to A999999\A055606 Gillingham Southern Extension\2016 Foul drainage strategy\Design Data\Network 1 Model Details.spdx for Foul - Main

PN	USIL (m)	DSIL (m)	USCL (m)	Length (m)	Slope (1:X)	Dia (mm)	k (mm)	Houses	Base Flow (l/s)
F1.000	78.407	76.815	79.757	65.825	41.4	150	1.500	40	0.0
F1.001	76.815	76.286	78.165	79.439	150.0	150	1.500	52	0.0
F1.002	76.286	75.937	77.895	52.328	150.0	150	1.500	0	7.9
F2.000	75.709	75.234	77.059	71.167	150.0	150	1.500	35	0.0
F2.001	75.234	74.633	77.832	90.174	150.0	150	1.500	35	0.0
F1.003	74.558	73.305	78.063	127.273	101.6	225	1.500	0	0.0
F1.004	73.305	72.877	77.096	46.856	109.4	225	1.500	30	0.0
F1.005	72.877	72.488	77.808	44.372	113.9	225	1.500	20	0.0
F1.006	72.488	71.765	77.231	85.777	118.6	225	1.500	18	0.0
F1.007	71.765	71.227	77.472	63.735	118.6	225	1.500	0	0.0
F1.008	71.227	70.632	76.632	75.000	126.0	225	1.500	30	0.0
F1.009	70.632	70.004	76.034	84.150	133.9	225	1.500	30	0.0
F1.010	70.004	69.748	75.803	35.645	139.4	225	1.500	30	0.0
F3.000	73.356	73.097	74.706	38.786	150.0	150	1.500	13	0.0
F3.001	73.097	72.626	74.923	70.649	150.0	150	1.500	10	0.0
F3.002	72.626	72.221	75.051	60.730	150.0	150	1.500	10	0.0
F3.003	72.221	71.877	75.523	51.584	150.0	150	1.500	20	0.0
F3.004	71.877	71.765	75.330	16.913	150.0	150	1.500	10	0.0
F3.005	71.765	71.702	74.906	9.375	150.0	150	1.500	10	0.0
F3.006	71.702	71.230	74.713	70.791	150.0	150	1.500	11	0.0
F1.011	69.748	69.450	74.970	47.833	160.6	225	1.500	10	0.0
F1.012	69.450	68.844	74.294	97.375	160.6	225	1.500	0	0.0
F1.013	68.844	68.073	74.399	134.154	174.1	225	1.500	60	0.0
F1.014	68.073	67.652	74.000	78.025	185.0	225	1.500	60	0.0
F4.000	76.444	76.054	77.794	58.503	150.0	150	1.500	30	0.0
F4.001	76.054	75.339	77.963	107.202	150.0	150	1.500	25	0.0
F4.002	75.339	75.211	78.513	19.192	150.0	150	1.500	12	0.0
F4.003	75.211	74.944	78.283	40.086	150.0	150	1.500	0	0.0
F4.004	74.944	73.851	77.500	163.909	150.0	150	1.500	0	0.0
F4.005	73.851	72.919	75.917	139.847	150.0	150	1.500	15	0.0
F4.006	72.919	72.686	75.311	34.970	150.0	150	1.500	10	0.0

User Report O:\Engineer\Projects A000000 to A999999\A055606 Gillingham Southern Extension\2016 Foul drainage strategy\Design Data\Network 1 Results.spdx

PN	Σ Houses	Σ Base Flow (l/s)	US C.Depth (m)	Pro Vel (m/s)	Pro Depth (mm)	Pro Vel @1/3 Flow (m/s)	Full Bore Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	40	0.0	1.200	0.80	28	0.57	1.36	24.1	1.9
F1.001	92	0.0	1.200	0.64	60	0.47	0.71	12.6	4.3
F1.002	92	7.9	1.460	0.81	118	0.64	0.71	12.6	12.2
F2.000	35	0.0	1.200	0.49	36	0.35	0.71	12.6	1.6
F2.001	70	0.0	2.448	0.60	52	0.43	0.71	12.6	3.2
F1.003	162	7.9	3.280	1.03	90	0.75	1.14	45.3	15.4
F1.004	192	7.9	3.566	1.03	97	0.75	1.10	43.6	16.8
F1.005	212	7.9	4.706	1.02	101	0.75	1.08	42.7	17.7
F1.006	230	7.9	4.518	1.02	105	0.75	1.05	41.9	18.5
F1.007	230	7.9	5.482	1.02	105	0.75	1.05	41.9	18.5
F1.008	260	7.9	5.180	1.02	111	0.75	1.02	40.6	19.9
F1.009	290	7.9	5.176	1.01	118	0.75	0.99	39.4	21.3
F1.010	320	7.9	5.575	1.01	124	0.75	0.97	38.6	22.7
F3.000	13	0.0	1.200	0.36	23	0.25	0.71	12.6	0.6
F3.001	23	0.0	1.675	0.43	30	0.31	0.71	12.6	1.1
F3.002	33	0.0	2.274	0.48	35	0.34	0.71	12.6	1.5
F3.003	53	0.0	3.152	0.55	45	0.40	0.71	12.6	2.5
F3.004	63	0.0	3.303	0.58	49	0.42	0.71	12.6	2.9
F3.005	73	0.0	2.991	0.60	53	0.44	0.71	12.6	3.4
F3.006	84	0.0	2.861	0.63	57	0.46	0.71	12.6	3.9
F1.011	414	7.9	4.997	0.99	146	0.75	0.90	36.0	27.0
F1.012	414	7.9	4.619	0.99	146	0.75	0.90	36.0	27.0
F1.013	474	7.9	5.330	0.98	161	0.75	0.87	34.5	29.8
F1.014	534	7.9	5.701	0.96	180	0.75	0.84	33.5	32.6
F4.000	30	0.0	1.200	0.47	34	0.33	0.71	12.6	1.4
F4.001	55	0.0	1.759	0.56	46	0.40	0.71	12.6	2.5
F4.002	67	0.0	3.024	0.59	51	0.43	0.71	12.6	3.1
F4.003	67	0.0	2.921	0.59	51	0.43	0.71	12.6	3.1
F4.004	67	0.0	2.406	0.59	51	0.43	0.71	12.6	3.1
F4.005	82	0.0	1.916	0.62	56	0.45	0.71	12.6	3.8
F4.006	92	0.0	2.242	0.64	60	0.47	0.71	12.6	4.3

User Report O:\Engineer\Projects A000000 to A999999\A055606 Gillingham Southern Extension\2016 Foul drainage strategy \Design Data\Network 2 Model Details.spdx for Storm

PN	USIL (m)	DSIL (m)	USCL (m)	Length (m)	Slope (1:X)	Dia (mm)	k (mm)	Houses	Base Flow (l/s)
5.000	80.825	78.378	82.250	62.872	25.7	225	1.500	626	7.9
5.001	78.378	77.164	79.803	54.399	44.8	225	1.500	0	0.0
5.002	77.164	76.575	78.589	34.537	58.6	225	1.500	0	0.0
5.003	76.575	76.324	78.000	33.009	131.4	225	1.500	0	0.0
5.004	76.324	75.705	77.750	81.361	131.4	225	1.500	0	0.0
5.005	75.705	75.456	77.733	32.657	131.4	225	1.500	0	0.0
5.006	75.456	75.048	77.624	53.555	131.4	225	1.500	0	2.9
5.007	75.048	74.184	77.932	96.668	111.8	225	1.500	70	0.0
5.008	74.184	73.389	78.394	88.780	111.8	225	1.500	0	0.0
5.009	73.389	72.600	78.500	88.200	111.8	225	1.500	0	0.0
5.010	72.600	71.795	78.270	86.463	107.4	225	1.500	20	0.0
5.011	71.720	71.355	76.548	69.234	189.8	300	1.500	20	0.0
5.012	71.355	71.173	74.681	34.682	189.8	300	1.500	20	0.0
5.013	71.173	70.914	74.405	49.134	189.8	300	1.500	20	0.0
5.014	70.914	70.584	74.286	62.542	189.8	300	1.500	0	0.0
5.015	70.584	70.306	72.502	52.815	189.8	300	1.500	20	0.0
5.016	70.306	69.985	72.124	60.875	189.8	300	1.500	20	0.0
5.017	69.985	67.700	71.721	58.787	25.7	300	1.500	19	0.0
6.000	79.630	78.421	80.930	53.276	44.1	150	1.500	30	0.0
6.001	78.421	77.568	79.796	54.524	63.9	150	1.500	65	0.0
6.002	77.568	75.642	78.918	58.530	30.4	150	1.500	0	7.9
6.003	75.642	74.866	76.992	59.097	76.2	150	1.500	18	0.0
6.004	74.866	73.886	76.670	43.864	44.8	150	1.500	36	0.0
6.005	73.886	71.046	75.236	85.849	30.2	150	1.500	30	0.0
6.006	71.046	70.251	72.396	60.404	76.0	150	1.500	30	0.0
6.007	70.251	69.836	72.228	31.595	76.0	150	1.500	0	0.0
6.008	69.761	68.464	71.819	167.448	129.1	225	1.500	160	0.0
6.009	68.464	68.068	71.109	51.106	129.1	225	1.500	66	0.0

User Report O:\Engineer\Projects A000000 to A999999\A055606 Gillingham Southern Extension\2016 Foul drainage strategy \Design Data\Network 2 Model Details.spdx for Storm

PN	USIL (m)	DSIL (m)	USCL (m)	Length (m)	Slope (1:X)	Dia (mm)	k (mm)	Houses	Base Flow (l/s)
6.010	68.068	67.775	71.624	37.879	129.1	225	1.500	18	0.0
7.000	78.449	77.203	79.749	54.925	44.1	150	1.500	28	0.0
7.001	77.203	76.401	79.203	60.527	75.5	150	1.500	28	0.0
7.002	76.401	75.941	79.030	34.759	75.5	150	1.500	0	0.0
7.003	75.941	75.480	79.278	34.759	75.5	150	1.500	0	0.0
7.004	75.480	74.754	79.248	54.826	75.5	150	1.500	15	0.0
7.005	74.754	74.029	77.927	54.710	75.5	150	1.500	15	0.0
7.006	74.029	72.386	75.609	55.367	33.7	150	1.500	15	0.0
7.007	72.386	67.850	73.736	76.649	16.9	150	1.500	0	0.0
5.018	67.625	67.290	71.349	84.433	251.9	375	1.500	7	0.0
5.019	67.290	67.093	72.219	49.613	251.9	375	1.500	48	0.0
5.020	67.093	66.896	70.253	49.513	251.9	375	1.500	12	0.0
5.021	66.896	66.573	70.700	81.281	251.9	375	1.500	15	0.0
5.022	66.573	66.096	70.865	120.199	251.9	375	1.500	18	0.0
5.023	66.096	65.936	70.778	40.452	251.9	375	1.500	18	0.0
5.024	65.936	65.723	71.255	53.591	251.9	375	1.500	0	0.0
5.025	65.723	65.384	71.215	85.237	251.9	375	1.500	62	0.0
5.026	65.384	65.274	70.350	27.793	251.9	375	1.500	11	0.0
5.027	65.274	64.684	70.379	148.680	251.9	375	1.500	11	0.0
8.000	70.816	68.816	72.166	54.405	27.2	150	1.500	30	0.0
8.001	68.816	68.344	70.834	70.771	150.0	150	1.500	30	0.0
8.002	68.344	67.976	70.750	55.270	150.0	150	1.500	30	0.0
8.003	67.976	67.396	71.000	87.057	150.0	150	1.500	0	0.0
8.004	67.396	66.838	70.616	83.633	150.0	150	1.500	47	0.0
8.005	66.838	66.165	69.500	64.624	96.0	150	1.500	46	0.0
8.006	66.165	65.545	70.542	47.624	76.8	150	1.500	0	0.0
8.007	65.545	64.660	69.698	67.978	76.8	150	1.500	23	0.0

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PN	Σ Houses	Σ Base Flow (l/s)	US C.Depth (m)	Pro Vel (m/s)	Pro Depth (mm)	Pro Vel @1/3 Flow (m/s)	Full Bore Vel (m/s)	Cap (l/s)	Flow (l/s)
5.000	626	7.9	1.200	2.16	100	1.59	2.27	90.2	36.9
5.001	626	7.9	1.200	1.75	118	1.30	1.72	68.3	36.9
5.002	626	7.9	1.200	1.58	128	1.18	1.50	59.7	36.9
5.003	626	7.9	1.200	1.13	171	0.88	1.00	39.8	36.9
5.004	626	7.9	1.201	1.13	171	0.88	1.00	39.8	36.9
5.005	626	7.9	1.804	1.13	171	0.88	1.00	39.8	36.9
5.006	626	10.8	1.943	1.14	185	0.90	1.00	39.8	39.8
5.007	696	10.8	2.658	1.24	184	0.98	1.09	43.2	43.0
5.008	696	10.8	3.985	1.24	184	0.98	1.09	43.2	43.0
5.009	696	10.8	4.886	1.24	184	0.98	1.09	43.2	43.0
5.010	716	10.8	5.444	1.26	184	1.00	1.11	44.0	43.9
5.011	736	10.8	4.528	1.06	173	0.80	1.01	71.1	44.8
5.012	756	10.8	3.026	1.07	175	0.80	1.01	71.1	45.8
5.013	776	10.8	2.932	1.07	177	0.81	1.01	71.1	46.7
5.014	776	10.8	3.072	1.07	177	0.81	1.01	71.1	46.7
5.015	796	10.8	1.617	1.08	180	0.81	1.01	71.1	47.6
5.016	816	10.8	1.518	1.08	182	0.82	1.01	71.1	48.5
5.017	835	10.8	1.435	2.30	103	1.68	2.74	193.7	49.4
6.000	30	0.0	1.150	0.72	25	0.51	1.32	23.4	1.4
6.001	95	0.0	1.225	0.89	49	0.64	1.10	19.4	4.4
6.002	95	7.9	1.200	1.54	69	1.13	1.59	28.2	12.3
6.003	113	7.9	1.200	1.10	96	0.83	1.00	17.8	13.1
6.004	149	7.9	1.654	1.39	87	1.04	1.31	23.2	14.8
6.005	179	7.9	1.200	1.65	81	1.23	1.60	28.2	16.2
6.006	209	7.9	1.200	1.15	121	0.90	1.01	17.8	17.6
6.007	209	7.9	1.827	1.15	121	0.90	1.01	17.8	17.6
6.008	369	7.9	1.833	1.06	129	0.80	1.01	40.1	25.0
6.009	435	7.9	2.420	1.09	138	0.82	1.01	40.1	28.0

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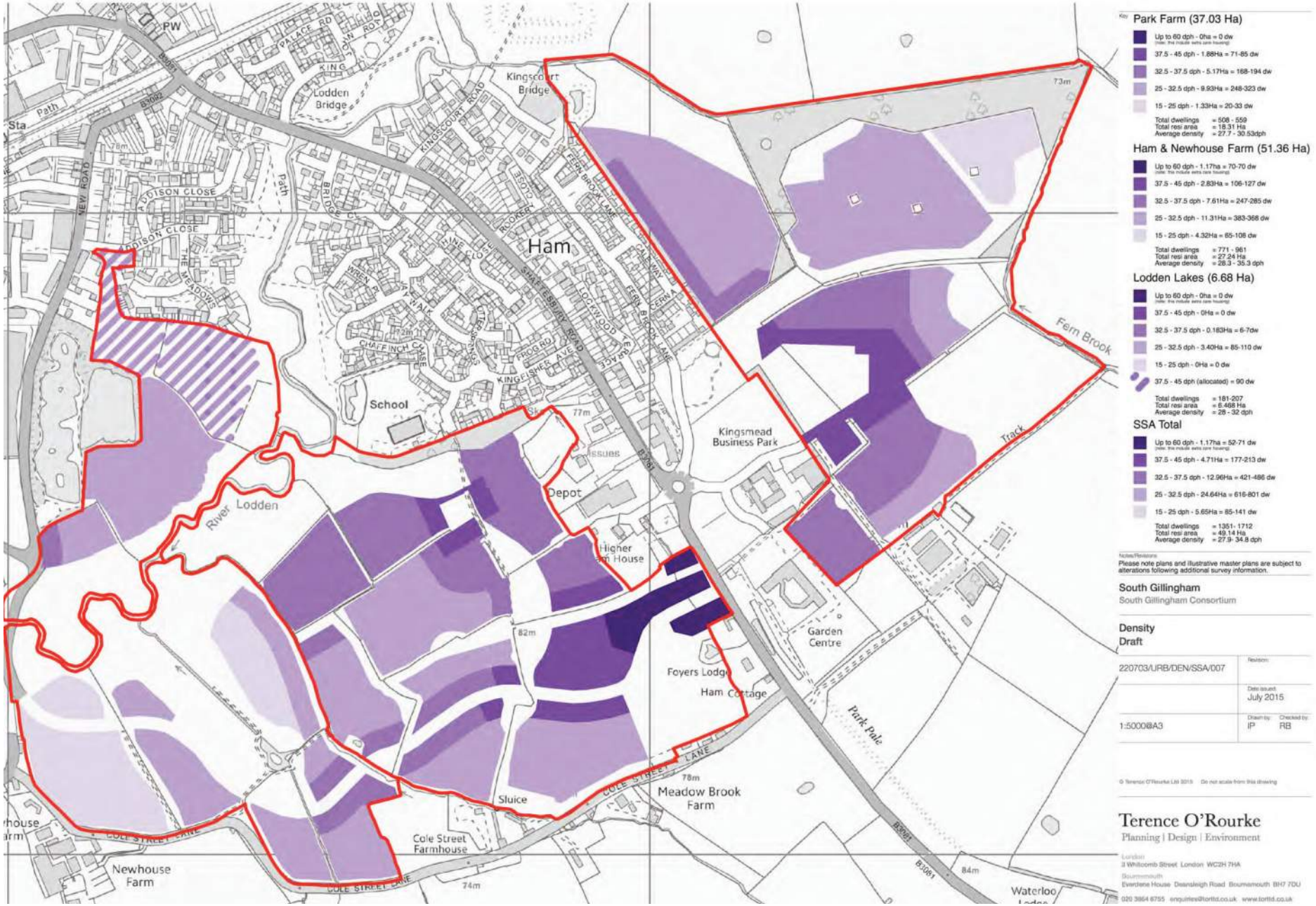
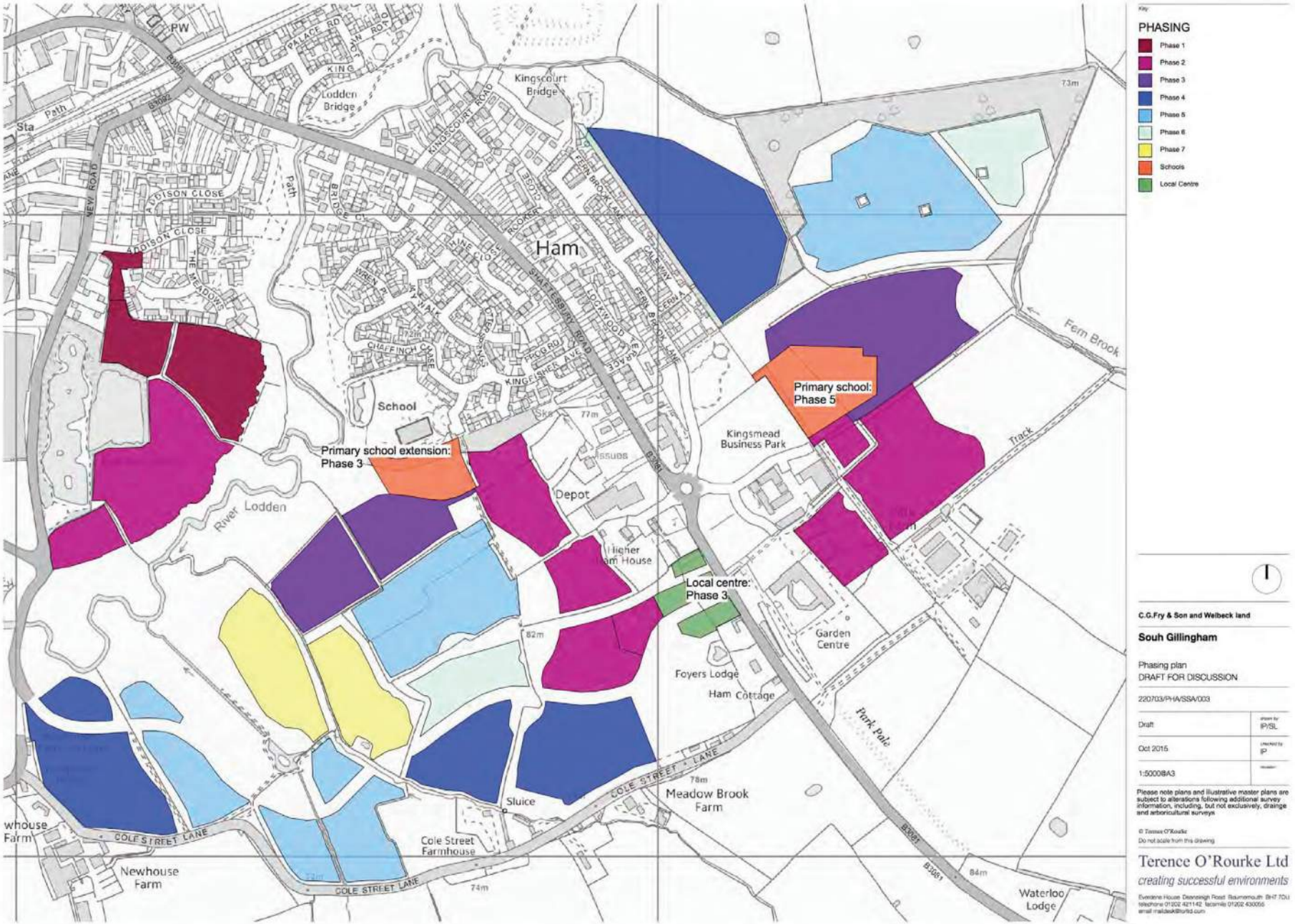
PN	Σ Houses	Σ Base Flow (l/s)	US C.Depth (m)	Pro Vel (m/s)	Pro Depth (mm)	Pro Vel @1/3 Flow (m/s)	Full Bore Vel (m/s)	Cap (l/s)	Flow (l/s)
6.010	453	7.9	3.330	1.10	141	0.83	1.01	40.1	28.9
7.000	28	0.0	1.150	0.70	24	0.50	1.32	23.4	1.3
7.001	56	0.0	1.850	0.71	39	0.51	1.01	17.8	2.6
7.002	56	0.0	2.479	0.71	39	0.51	1.01	17.8	2.6
7.003	56	0.0	3.187	0.71	39	0.51	1.01	17.8	2.6
7.004	71	0.0	3.618	0.77	44	0.55	1.01	17.8	3.3
7.005	86	0.0	3.024	0.81	48	0.58	1.01	17.8	4.0
7.006	101	0.0	1.430	1.13	42	0.81	1.51	26.7	4.7
7.007	101	0.0	1.200	1.45	36	1.03	2.14	37.8	4.7
5.018	1396	18.7	3.349	1.10	242	0.84	1.01	111.4	83.3
5.019	1444	18.7	4.554	1.11	247	0.85	1.01	111.4	85.5
5.020	1456	18.7	2.785	1.11	248	0.85	1.01	111.4	86.0
5.021	1471	18.7	3.429	1.11	249	0.85	1.01	111.4	86.7
5.022	1489	18.7	3.916	1.11	251	0.85	1.01	111.4	87.6
5.023	1507	18.7	4.307	1.12	253	0.85	1.01	111.4	88.4
5.024	1507	18.7	4.944	1.12	253	0.85	1.01	111.4	88.4
5.025	1569	18.7	5.117	1.12	259	0.86	1.01	111.4	91.3
5.026	1580	18.7	4.590	1.12	260	0.86	1.01	111.4	91.8
5.027	1591	18.7	4.730	1.12	261	0.86	1.01	111.4	92.3
8.000	30	0.0	1.200	0.85	22	0.60	1.68	29.8	1.4
8.001	60	0.0	1.868	0.57	48	0.41	0.71	12.6	2.8
8.002	90	0.0	2.256	0.64	59	0.47	0.71	12.6	4.2
8.003	90	0.0	2.874	0.64	59	0.47	0.71	12.6	4.2
8.004	137	0.0	3.070	0.72	75	0.53	0.71	12.6	6.3
8.005	183	0.0	2.512	0.91	78	0.67	0.89	15.8	8.5
8.006	183	0.0	4.227	0.99	73	0.73	1.00	17.7	8.5
8.007	206	0.0	4.003	1.02	78	0.76	1.00	17.7	9.5

Appendix E

Terence O' Rourke Density Plan and Phasing Plan



Consortium density plan



Phasing plan