Sewer Capacity Assessment

Hydraulic Modelling Summary Report

Stafford Strategic Growth Study

Beaconside SF2, Brancote

S1488

DRAFT

April 2012

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Executive Summary

- This report examines the impact of one of the potential developments in Beaconside, Brancote, known as SF2. The development site is north of the A513 in Brancote.
- The work is required in order to assess the impact that the development will have upon the sewer network.
- The site has been represented in the model by 8 subcatchments which apply the additional domestic and trade foul flows to the network.
- The addition of the proposed development offers significant risk to the existing sewer network. Analysis has shown that the development will increase the frequency of surcharge in the system at 112 manholes and increase the effects of flooding at 75 manholes.
- Capacity Improvements are required before any development can connect to the network.
- Due to the negative impact of the proposed development on the existing network, 3 notional solutions have been assessed on the basis of feasibility, cost and carbon footprint.
- Notional Option 1 is to connect the development at SJ92257104 and gravitate the flow to Prospect Road SPS where it would be pumped along Corporation Street. The flow then gravitates through the existing network until it reaches Lammascote PS; it is then pumped directly to Brancote STW. This option offers the lowest whole life cost solution. Additionally it allows for the potential future development site of SF1 (to the east of this site).
- Severn Trent Water is currently looking at all strategic development within the sewerage catchment to develop a holistic capacity improvement solution.

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1 Introduction

1.1 Site Details

The proposed development site is located north of the A513 in Beaconside (Figure 1-1). The land for development is mainly agricultural and is currently not served by a pubic sewer network. The nearest connection point on the public sewer network is south of the A513 in Chaulden Road and Tollgate Drive. The foul flows from Tollgate Drive gravitate to Tollgate SPS where they are lifted before they continue via gravity system to Prospect Road SPS. The foul flows from Chaulden Road gravitate to Prospect Road SPS where flows are lifted up and continue via gravity to Lammascote TPS, before being pumped to Brancote Sewage Treatment Works in the southeast.

The surface water flows are likely to discharge into the Kingston Brook and the Marston Brook via the surface water sewer network.

The location of the site in relation to the existing sewer network and critical assets is provided in Appendix A.

There are no records of flooding in the vicinity of the site. Flooding locations are provided in Appendix D[1].

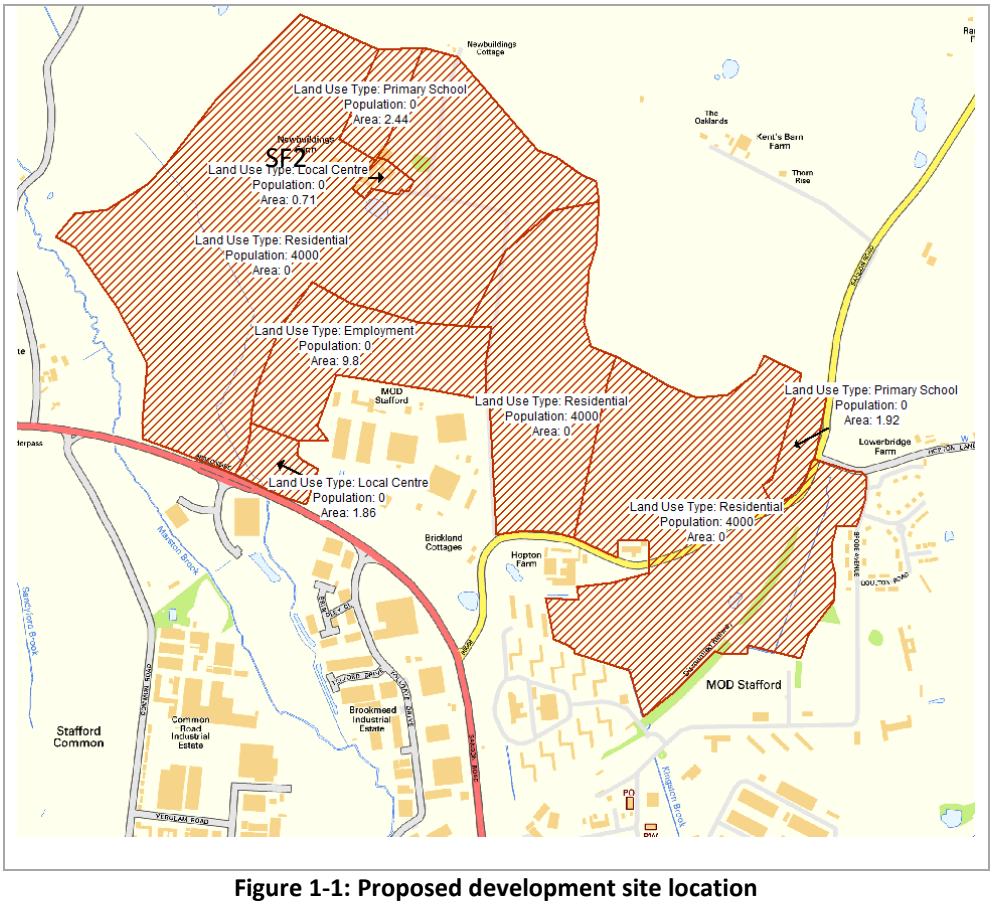


Figure 1-1: Proposed development site location

[1] Please note that Appendix D contains sensitive Severn Trent Water information and is removed from this report for external distribution.

1.2 Proposed Development

The proposed development is for 3000 dwellings, two schools covering an area of 4.36 ha, with 800 pupils, 9.8 ha of office space and two local centres, covering 2.57 ha. It has been proposed that the development would connect into the existing foul network; however no location has been specified in the scope.

The proposed development is summarised in Table 1-1. Proposed development plans are included in Appendix B.

Table 1-1: Summary of proposed development

Development Type	Units
Dwellings	3000 units
Employment (Offices)	9.8 ha
2 x Local Centres	2.57 ha
2 x Primary Schools	4.36 ha

1.3 Study Aims and Objectives

The aims of this study are as follows:

- Determine the impact of the development on the receiving foul sewer network considering feasible connection locations.
- Identify options for accommodating foul flows from 3000 dwellings and accompanying commercial development in terms of connection location and mitigation measures.
- Identify the least cost, whole life solution to allow the development to go ahead.
- Determine the number of properties that can be accommodated by the existing network, if any, without requiring capacity improvements.

2 Sewer Capacity Assessment

2.1 Modelling Methodology

The modelling methodology used to assess the impacts of the proposed development is summarised below:

- The development has been connected in the model into the existing foul network using eight subcatchments at SJ92257104 along the disused railway line, downstream of Tollgate Pumping Station. The flows would gravitate to this location via new sewers along the A513, B5066 and the disused railway line. Although there are potential connection locations closer to the development site in Tollgate Drive (SJ92257702) and Parkside Avenue (SJ91267101) a considerable amount of work would need to be carried out on these networks to prevent flooding from the additional flows. The Tollgate Drive branch would also have to flow through Tollgate Pumping Station, which would need considerable upgrading to accommodate the flows. As a result it is felt that the location chosen is the most appropriate at this stage.

- The population was calculated on the basis that the occupancy rate will be 4 per dwelling; supplied by the developer. The resulting population of 12,000 was split equally across the three residential subcatchments giving a population of 4,000 in each. The trade flow for the development was calculated using figures provided by Severn Trent Water based on the area each trade covers.

- The baseline and development models were run for a suite of design storms.

Subcatchment Name	Area Type	Population	Trade Flow (m^3/s)
EA1	Employment (Offices)	N/A	0.00280
LC1	Local Centre	N/A	0.00032
LC2	Local Centre	N/A	0.00012
PS1	Primary School	N/A	0.00037
PS2	Primary School	N/A	0.00037
R1	Residential	4000	N/A
R2	Residential	4000	N/A
R3	Residential	4000	N/A

Table 2-1: Summary of assumed flows used for modelling

2.2 Assumptions and Limitations

Key assumptions and limitations of the modelling methodology are summarised below:

- The Model Review Proforma is included in Appendix C

- The development is likely to impact on a number of critical assets within the existing network. Those most likely at risk are Prospect Road SPS and Lammascote TPS. While Lammascote TPS is likely to have the additional capacity available to deal with the Dry Weather Flow (DWF) of 24 l/s, Prospect Road SPS screw pumps are based on a head discharge relationship. Therefore additional surcharging will be created in order for the pumps to reach a sufficient discharge rate.

2.3 System Performance

Table 2-2: System performance for modelled scenarios (existing and post-development)

Location	Modelled scenario	
	Existing (baseline)	Post-development
Flooding		
Burlington Drive	0.478 m^3 of flooding on a 1 in 10 year	No change
Jubilee Court	0.478 m^3 of flooding on a 1 in 10 year	No change
Doxey Road	22.45 m^3 of flooding on a 1 in 6 month	22.706 m^3 of flooding on a 1 in 6 month
The Drive	6.037 m^3 of flooding on a 1 in 2 year	No change
Meakin Drive	9.686 m^3 of flooding on a 1 in 20 year	No change
Newport Road	0.812 m^3 of flooding on a 1 in 10 year	No change
Doxey Road	3.363 m^3 of flooding on a 1 in 5 year	3.394 m^3 of flooding on a 1 in 5 year
Doxey Road	0.604 m^3 of flooding on a 1 in 1 year	0.498 m^3 of flooding on a 1 in 1 year
Alliance Street	2.539 m^3 of flooding on a 1 in 20 year	No change
Izaak Walton Close	2.422 m^3 of flooding on a 1 in 2 year	No change
Grey Frairs Place	1.333 m^3 of flooding on a 1 in 30 year	No change
Grey Frairs Way	1.798 m^3 of flooding on a 1 in 5 year	1.815 m^3 of flooding on a 1 in 5 year
Grey Frairs	3.798 m^3 of flooding on a 1 in 40 year	3.819 m^3 of flooding on a 1 in 40 year
Grey Frairs Place	1.203 m^3 of flooding on a 1 in 30 year	1.233 m^3 of flooding on a 1 in 30 year

Stafford Common	13.966 m^3 of flooding on a 1 in 20 year	0.71 m^3 of flooding on a 1 in 10 year
Rising Brook allotments	15.592 m^3 of flooding on a 1 in 10 year	No change
Brook Glen Road	20.697 m^3 of flooding on a 1 in 20 year	20.704 m^3 of flooding on a 1 in 20 year
Brook Glen Road	2.105 m^3 of flooding on a 1 in 20 year	No change
Newport Road	5.196 m^3 of flooding on a 1 in 30 year	5.163 m^3 of flooding on a 1 in 30 year
Pilgrim Place	1.197 m^3 of flooding on a 1 in 40 year	No change
Drummond Road	10.571 m^3 of flooding on a 1 in 10 year	0.001 m^3 of flooding on a 1 in 5 year
Drummond Road	0.081 m^3 of flooding on a 1 in 40 year	0.062 m^3 of flooding on a 1 in 30 year
Jubilee Court	2.795 m^3 of flooding on a 1 in 50 year	2.616 m^3 of flooding on a 1 in 20 year
Sandon Mews	15.32 m^3 of flooding on a 1 in 2 year	11.919 m^3 of flooding on a 1 in 6 month
Drummond Road	8.545 m^3 of flooding on a 1 in 6 month	6.087 m^3 of flooding on a 1 in 1 month
Marston Brook	14.987 m^3 of flooding on a 1 in 1 year	89.866 m^3 of flooding on a 1 in 1 month
Edison Road	0.182 m^3 of flooding on a 1 in 30 year	0.163 m^3 of flooding on a 1 in 20 year
Sandon Road	0.13 m^3 of flooding on a 1 in 2	10.792 m^3 of flooding on a 1 in 2 year
Edison Road	0.011 m^3 of flooding on a 1 in 40 year	0.359 m^3 of flooding on a 1 in 30 year
Sandon Road	0.115 m^3 of flooding on a 1 in 30 year	0.145 m^3 of flooding on a 1 in 30 year
Oxford Gardens	16.264 m^3 of flooding on a 1 in 5 year	1.461 m^3 of flooding on a 1 in 2 year
Oxford Gardens	0.358 m^3 of flooding on a 1 in 10 year	0.532 m^3 of flooding on a 1 in 10 year

Cheshams Road	3.816 m^3 of flooding on a 1 in 10 year	0.077 m^3 of flooding on a 1 in 5 year
Fonthill Road	0.155 m^3 of flooding on a 1 in 10 year	0.3 m^3 of flooding on a 1 in 10 year
St Albans Road	1.56 m^3 of flooding on a 1 in 10 year	1.614 m^3 of flooding on a 1 in 10 year
Sandon Road	1.653 m^3 of flooding on a 1 in 20 year	1.912 m^3 of flooding on a 1 in 20 year
Tollgate Drive	26.004 m^3 of flooding on a 1 in 5 year	26.194 m^3 of flooding on a 1 in 5 year
Sandon Road	0.239 m^3 of flooding on a 1 in 30 year	0.006 m^3 of flooding on a 1 in 20 year
Rickerscote Avenue	4.027 m^3 of flooding on a 1 in 5 year	4.022 m^3 of flooding on a 1 in 5 year
Radford Bank	20.292 m^3 of flooding on a 1 in 6 month	20.385 m^3 of flooding on a 1 in 6 month
Coronation Road	0.036 m^3 of flooding on a 1 in 10 year	0.07 m^3 of flooding on a 1 in 10 year
Douglas Road west	0.448 m^3 of flooding on a 1 in 5 year	0.582 m^3 of flooding on a 1 in 5 year
Combined Sewer Overflows		
Lammascote EO		No effect from development
Sewer Pumping Stations		
Results taken for Dry Weather Flow		
Prospect Road SPS	Pumped a total of 853.68 m^3 while operating for three quarters of the day. The pump ran on 3 separate occasions.	Pumped a total of 2717.31 m^3 and was operating for almost the entire day. The pump started twice.
Lammascote PS (Duty)	Pumped a total of 8605.86 m^3 while operating for half the day. The pump ran on 114 separate occasions. The assist pump also runs 16 times during a typical dry weather day, pumping a total of 264.91 m^3 during 1.5 hours of operation.	Pumped a total of 9920.79 m^3 while operating for two thirds of the day. The pump ran on 95 separate occasions. The assist pump also runs 28 times during a typical dry weather day, pumping a total of 821.43 m^3 and operating for

approximately 1/5 of a day.

3 Notional Solutions

3.1 Notional Solutions

There are 3 notional solutions that have been modelled. The drainage routes for the proposed development have been altered as to allow for minimal pumping. It was attempted to entirely gravity drain the new development, but it was not possible to meet a self-cleansing velocity of 0.76 m/s in the north-west branch of new sewer network. A Diagram of the notional drainage paths for the new development can be seen in figure 3-1. It is proposed that subcatchments EA1a, LC1 & R1a would now be pumped in-situ to the northern branch of the sewer network; through SJ93260001. While PS1, LC2, R1b, EA1b and R2 would gravitate to SJ93250901.This is to minimise the pumping requirements in-situ and to avoid Tollgate SPS which already causes flooding during a 1 in 5 year event.

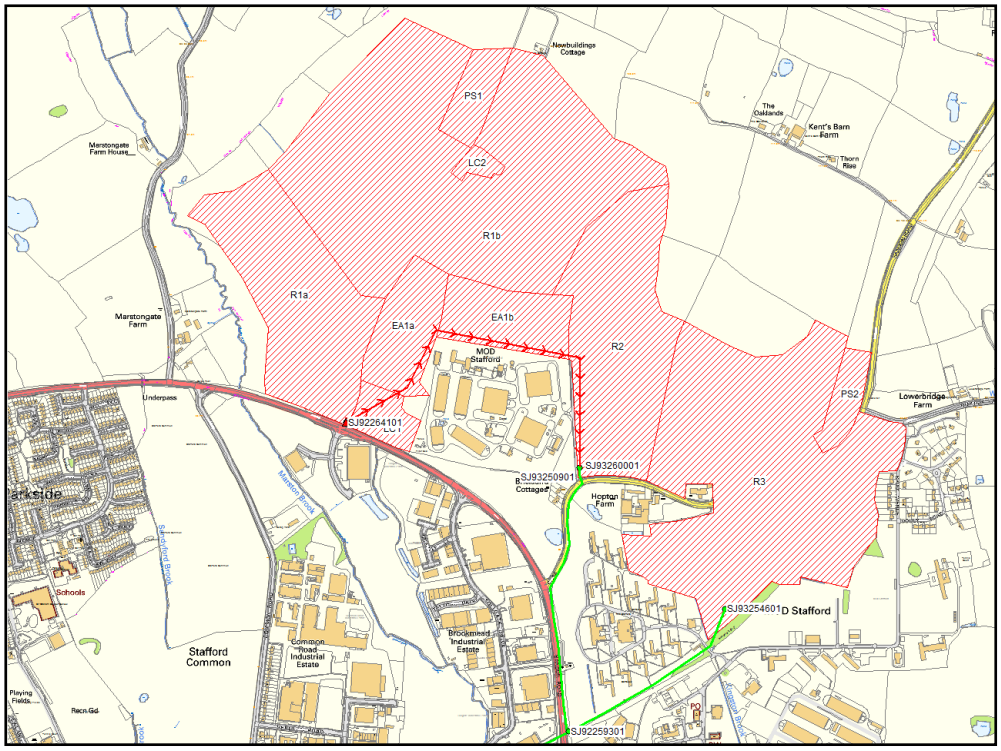


Figure 3-1: Proposed Subcatchment division

For options 1 & 3 the development will gravitate via two branches of new sewer network totalling 1.22kms from SJ93250901 and SJ93254501. These two branches converge at manhole SJ92259301 where the disused railway line meets Sandon Road (A513). The branch running from SJ93250901 consists of 0.7km of 375mm diameter circular pipe, and the branch running from SJ93254501 consists of 0.5km of 225mm diameter circular pipe.

3.1.1 Option 1

One of the notional solutions is to connect the new development into the existing sewer network downstream of Tollgate SPS at node SJ92257104. This will route the flow from the development through both Prospect Road SPS and Lammascote TPS. An additional pump has been provided at Prospect Road SPS so that it is able to cope with the additional flow. The new pump has a pump rate of 164 l/s and a switch on

level of 75.0m AD and switch off level of 74.5m AD. The wet well has also been increased in size to a plan area of 13.32m^2 from 5.375m^2, to allow for the additional flows.

A further 1.53km of sewer network has been added, upsized or cleansed to alleviate the flooding created by the new development. This work takes place along Common Road, Drummond Road, Sandon Road, Henry Street, Kingsmead Hospital and alongside the Marston Brook Stilling Ponds.

This solution deals with both the additional flow input into the network from development 'SF2' and the smaller development 'SF1'to the west.

Layout and further details can be found in Appendix E: Plan 1-1 & 1-2.

3.1.2 Option 2

Option 2 consists of pumping the new development straight to a Wastewater Treatment Works. The proposed WwTW is Sandon STW that is to the north of the current development. This would consist of pumping some of the development to a terminal pumping station that would then pump directly to the works. The rising main would be 450mm in diameter and approximately 4.3km in length.

The current Sewage Treatment Works is likely to need significant upsizing in order to deal with the new development, and, potentially other developments in the surrounding area. It is seen as beneficial to move the existing works southwards of the Railway line (immediately south of the current works) for future connectivity. This is however beyond the scope of this work.

It is proposed that the terminal pumping station at SJ92264101 could be designed to accept the flows from development 'SF1' should both developments go ahead.

Layout and further details can be found in Appendix E: Plan 2-1.

3.1.3 Option 3

Option 3 consists of draining the development by gravity to a new pumping station at the junction of Sandon Road and Beaconside, much the same as Option 1. The flows are then pumped along the Beaconside (A513) and connect into the existing network at SJ94233702. The pump at this station has been given an on level of 79.0m AD and off level of 78.5m AD; the pump rate is 148 l/s. The flow from the new development will then pass through the existing network alongside the Kingston Brook until it reaches Beaconside WRPS. An additional duty pump has been modelled to assist the current pump, this has been given the same on/off levels as the existing pump and a pump rate of 148l/s. The wet well at this pumping station has been upsized by 13.32m^2 from 19.63m^2 to accommodate the additional volume. The flows from Beaconside WRPS will then be pumped directly to the works.

The notional solution deals solely with the additional flow from 'SF2'. The network would therefore need additional upgrades to allow for other developments.

Layout and further details can be found in Appendix E: Plan 3-1 & 3-2.

3.2 Costs

Costs have been provided to Severn Trent Water based on their Project Estimator Tool. This information has been removed from the report for external distribution.

4 Conclusions and Recommendations

4.1 Conclusions

- The development increases the onset of flooding at 75 manholes, and increases the onset of surcharge at 112 manholes.

- Capacity improvements are required before development can connect onto the network. This report demonstrates that there are feasible options for accommodating additional flows from the development.

- Option 1 is the least cost option. It requires all flows from the development to be pumped twice (1.72km) before it reaches treatment, making it the least carbon intensive option. This requires the critical asset, Prospect Road SPS, to be refurbished to allow for the additional flows. This has been modelled as a 22 kW submersible pump which assists the screw pumps currently in use. A further 1.53km of existing network will also require mitigation work to accommodate the new development. Furthermore, Option 1 allows for future development (adjacent site to the west) unlike the other 2 options.

- Option 2 is the highest cost option. It requires all flows from the development to be pumped once (4.30km) before it reaches treatment, making it the most carbon intensive option. This option does not interact with the existing network (Brancote) but will require either a new sewage treatment works or an upsized/refurbished sewage treatment works at Sandon.

- Option 3 is the intermediate cost option. It requires all the flows from the development to be pumped twice (3.17km) before it reaches treatment, making it the intermediate carbon intensive option. This requires the critical asset, Beaconside WRPS, to be refurbished. This has been modelled as an additional 30 kW submersible pump which will assist the pumps currently in use. No further changes are required to the existing network.

4.2 Recommendations

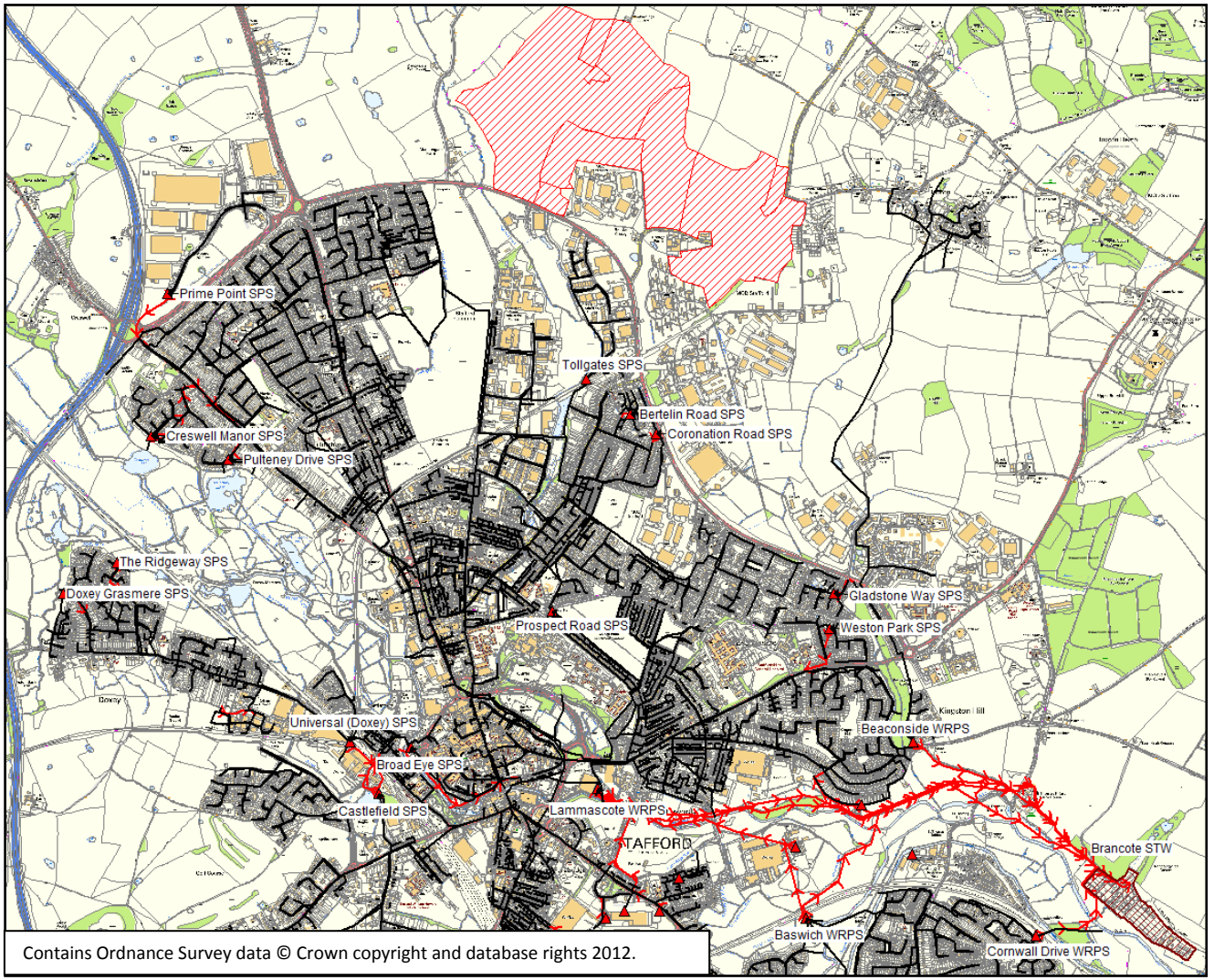
- It is recommended that Option 1 be taken in to consideration for the mitigation of the impact created by the proposed development SF2. Firstly it has the lowest upfront cost of the three proposed options, making it the most desirable option at present. Secondly it has the lowest carbon cost of the three options, making it the most desirable option in the future. This is coupled with the fact that it makes allowances for the potential development site 'SF1' which the others do not. The drawback of this option is that it requires the most mitigation work to take place within the existing network and will require the disruption along Corporation Street while the rising main is put in place. This was however seen as favourable compared to mitigation work along the Coton Field Allotment Gardens.

- Severn Trent Water is currently undertaking strategic scale modelling to determine the most feasible capacity improvement solution for four sites in the catchment that feature in the Borough Council's Core Strategy, of which this site is one. Whilst this report demonstrates that there are feasible options for accommodating additional flows from this site, the additional modelling work may find

an alternative solution that accommodates flows from all four sites. It is strongly recommended that the developer contacts Severn Trent Water before developing a drainage strategy for the site.

Appendix A: Existing site information

- Sewer records and critical assets



Appendix B: Proposed Development Plans

- No proposed development plans available

Appendix C: Model Review Proforma

Sewer Capacity Assessment – Model Review Checklist			
Date of Model	**03-11-2011**	Date of Model Verification	**27-10-2008**
Confirm Name of Model Network Reviewed	**523-019-Brancote MM#2**		
List Associated Modelling Files	**Trade: V89701 Trade Flow Profiles + 7, Waste Water: Waste Water_hour earlier & 2 Design**		
Model Status (Verified, Needs, Options)	**Verified**		

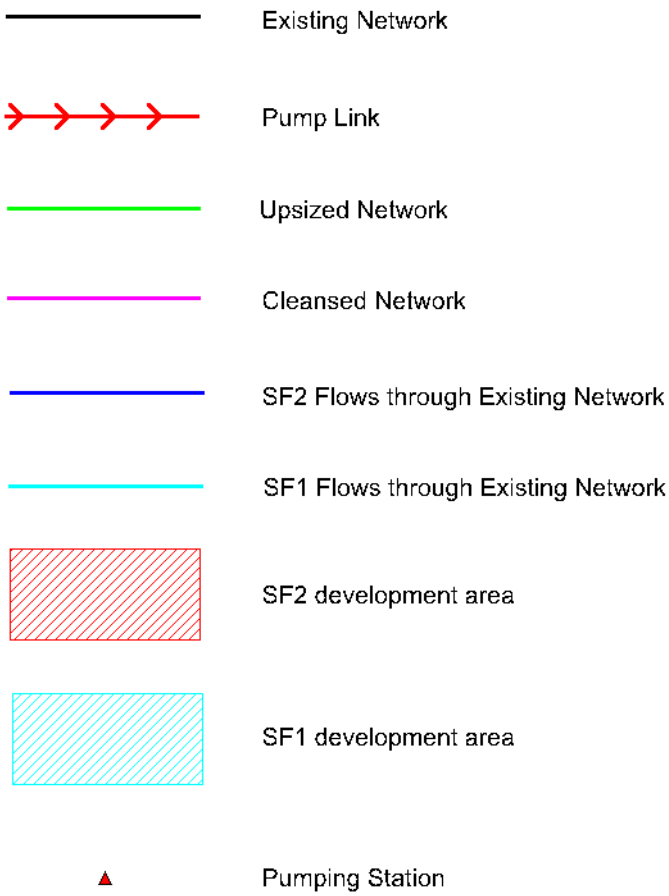
Key factor assessed in vicinity of site	Comments	Impact on Model Accuracy (H/M/L)
Software Suitability – Is model in HydroWorks or non-InfoWorks Software?	Suitable (InfoWorks)	L
Software Suitability – Does model require upgrading to more recent version of InfoWorks?	Does Not Require Updating	L
Suitability of Modelling Specification – Does model require converting to current modelling specification (Procedure 264 – AMP3 Model Conversion Process)?	Does Not Require Converting	L
Is adequate Model Build Documentation available identifying modelling process and any limitations in model?	Yes	L
Have all relevant documented limitations been assessed and identified?	Yes	L
Does the model require upgrading to improve the representation of extents, detail or known ancillaries?	No	L
Are there any significant changes to the catchment since model build that require including in the model?	No	L
Are there any significant changes to the sewer network or ancillaries that need to be included in the model?	No	L
Is the existing model flow survey and verification adequate?	Yes	L
Is there a need to combine a number of DAP models to assess this site?	No	L
Other issues?		

Appendix D: Sensitive Information

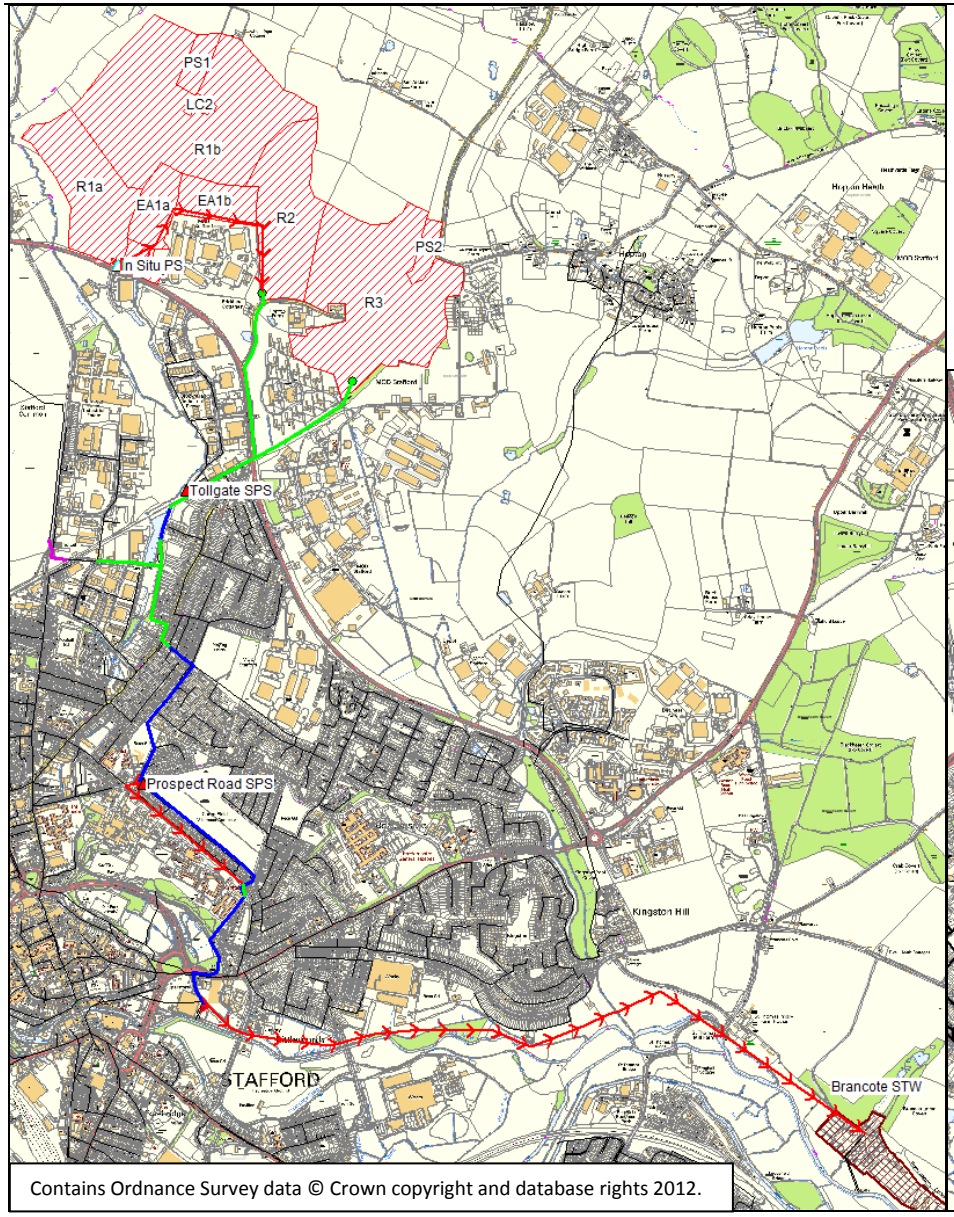
- This Appendix contains sensitive information that has been removed for external distribution.

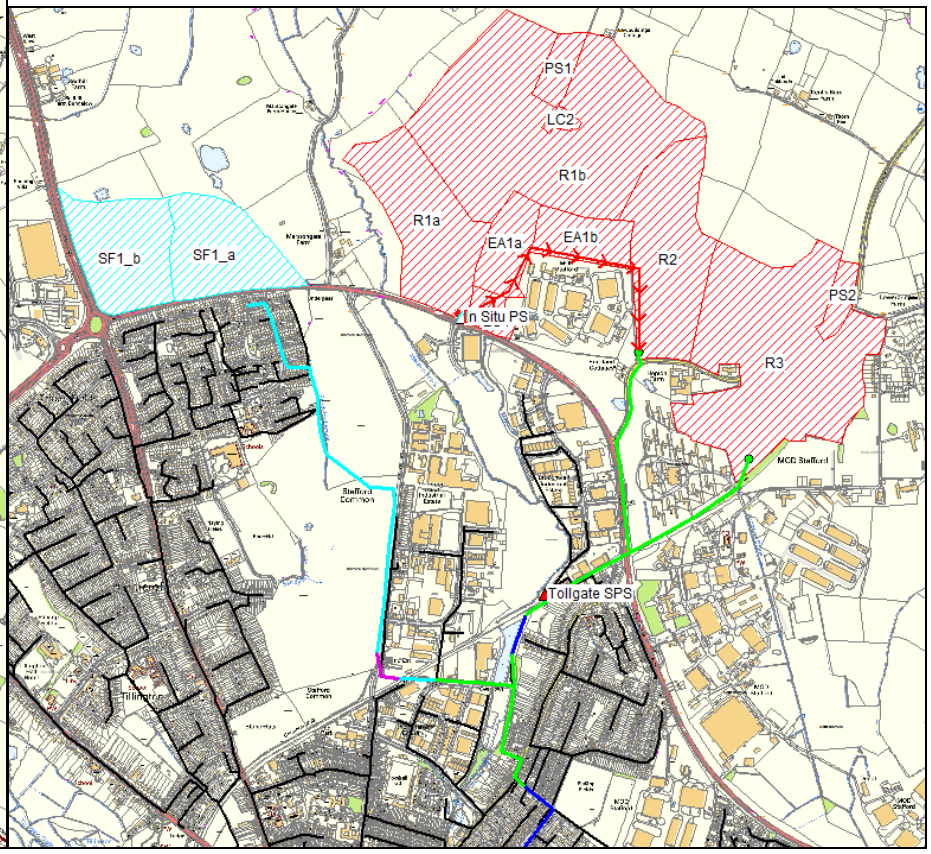
Appendix E: Notional Solution Plans

Key for Plans

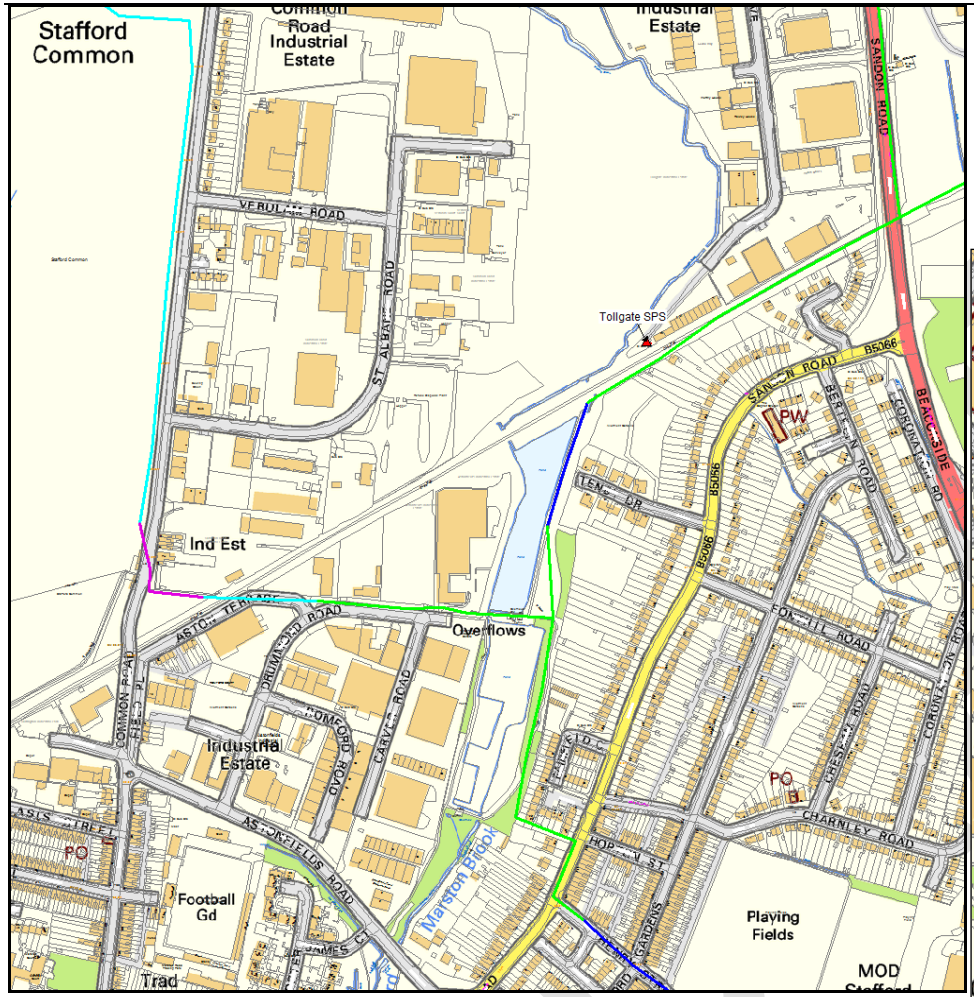


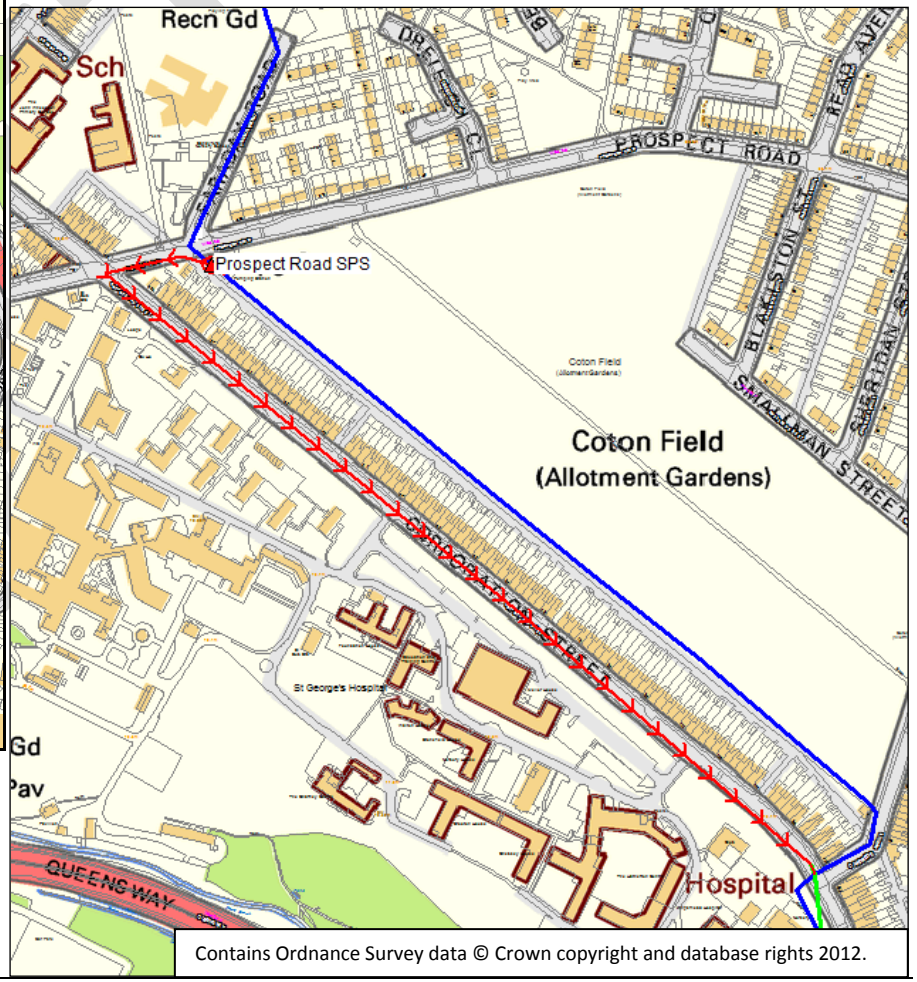
Plan 1-1: Option 1



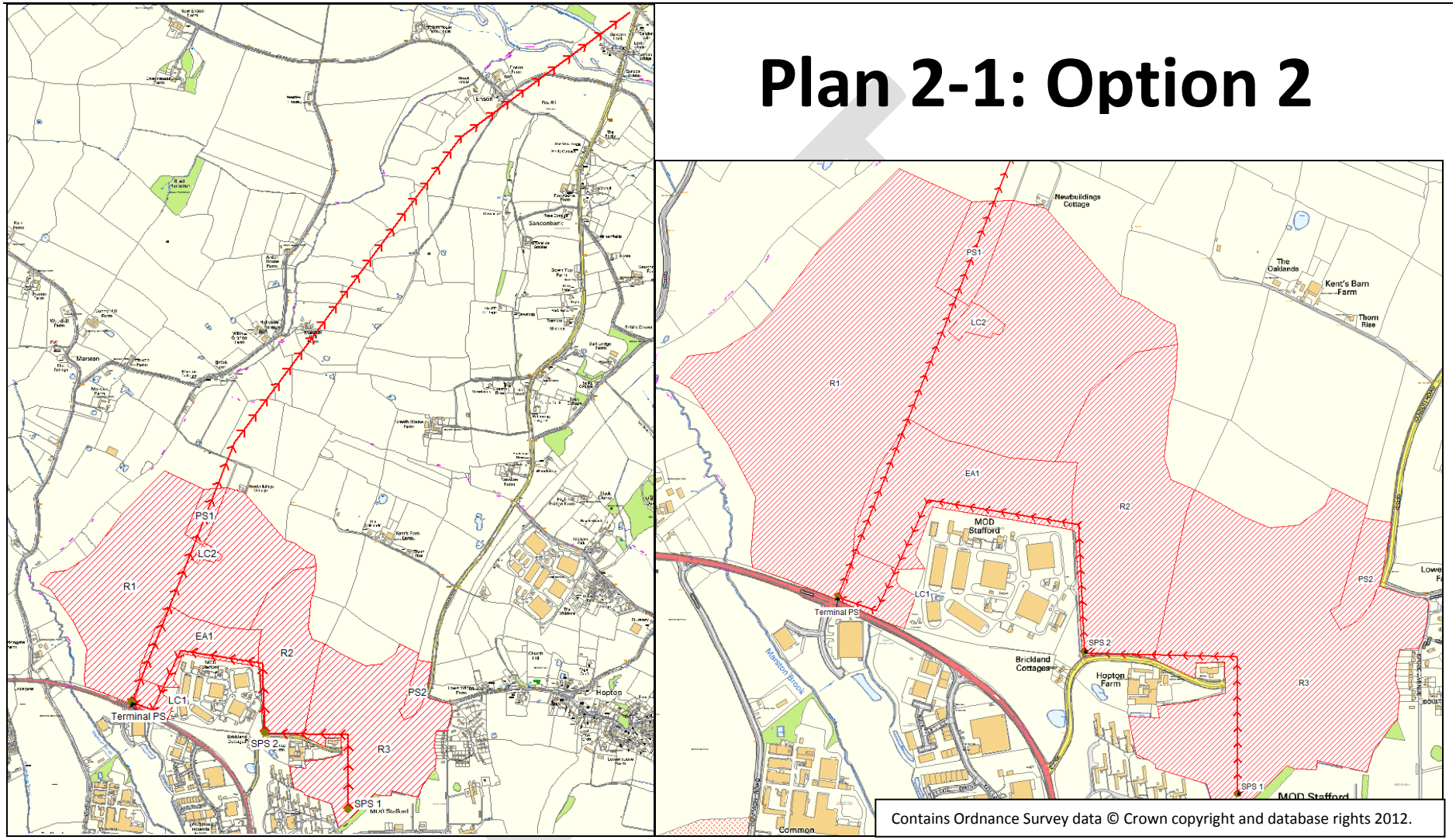


Plan 1-2: Option 1

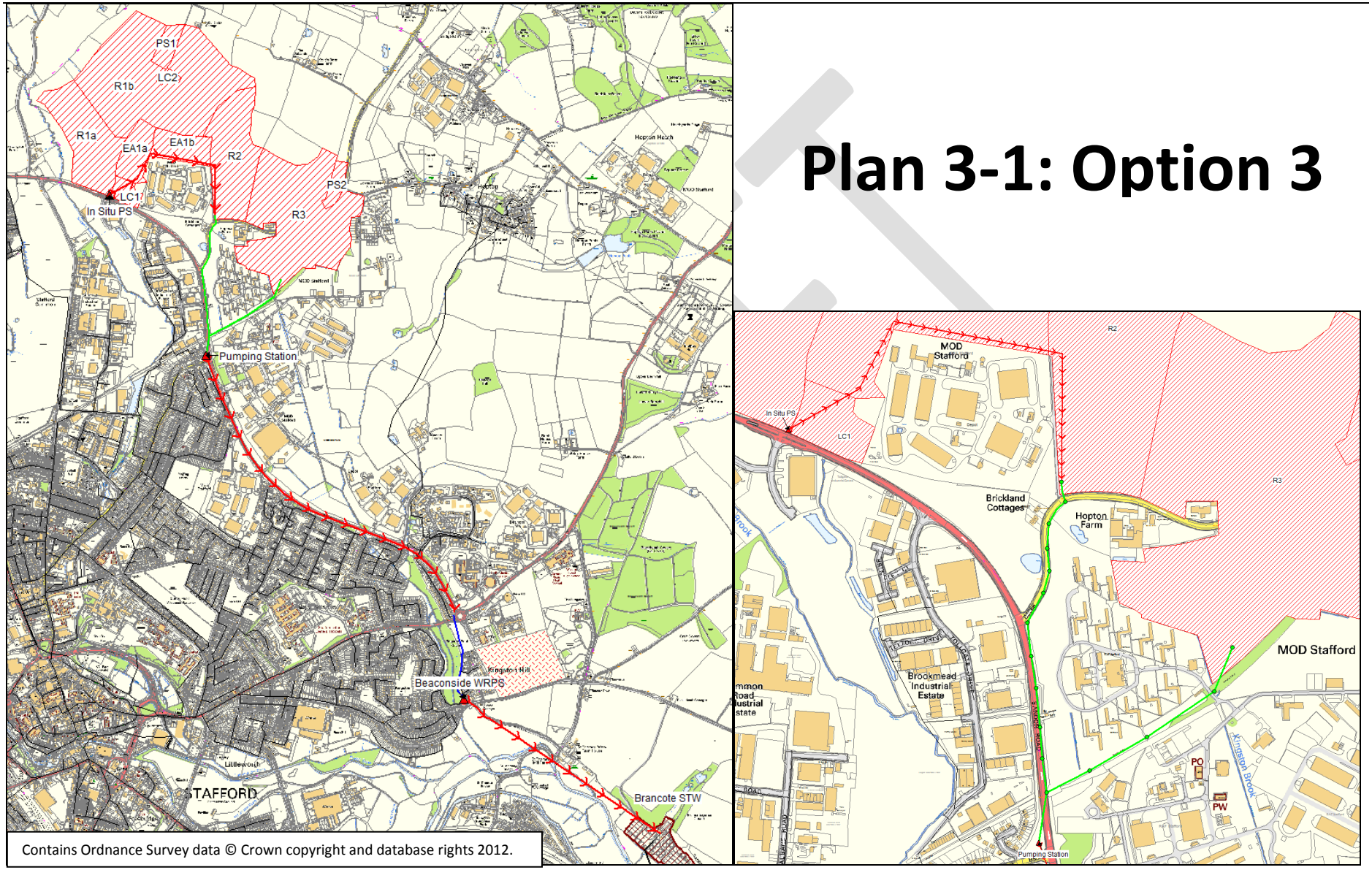


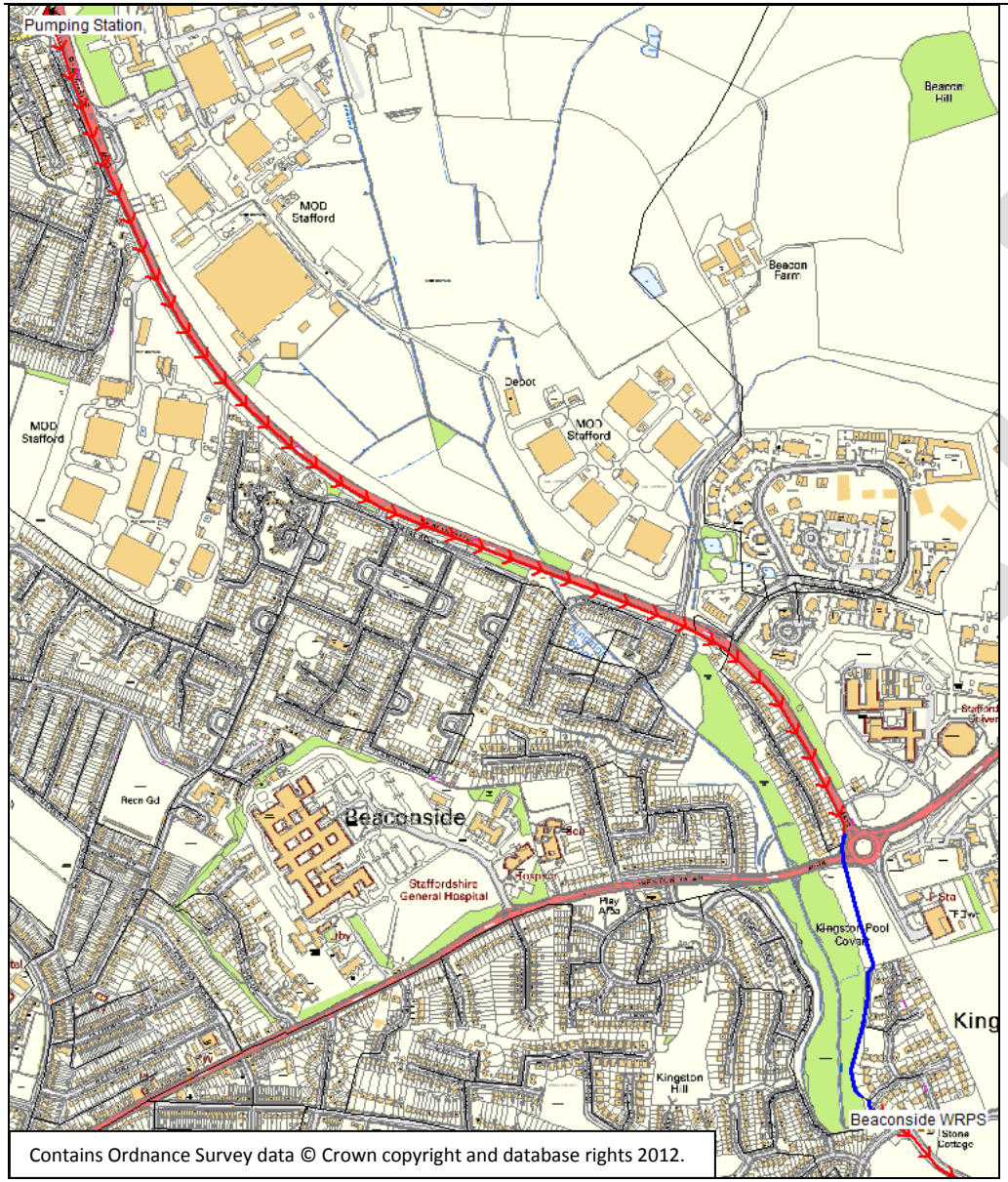


Plan 2-1: Option 2



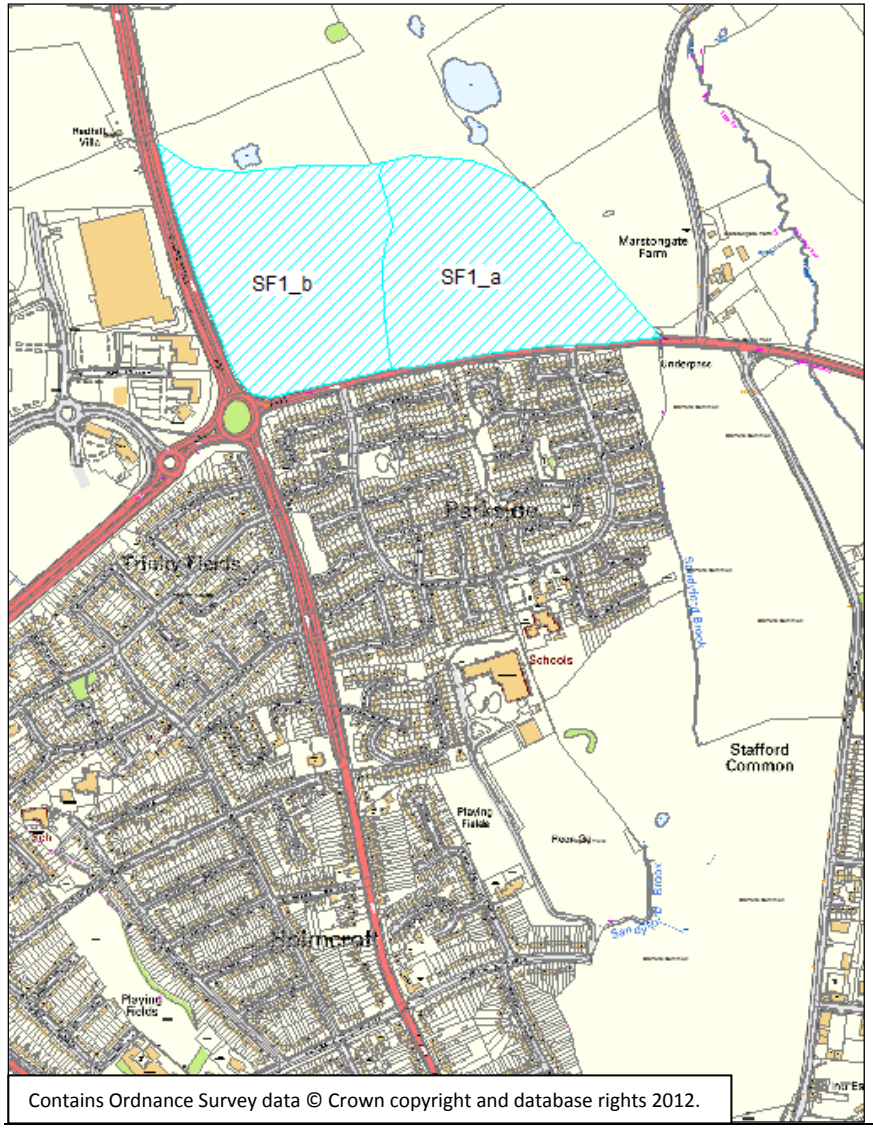
Plan 3-1: Option 3





Plan 3-2: Option 3

Appendix F: Proposed Development SF1



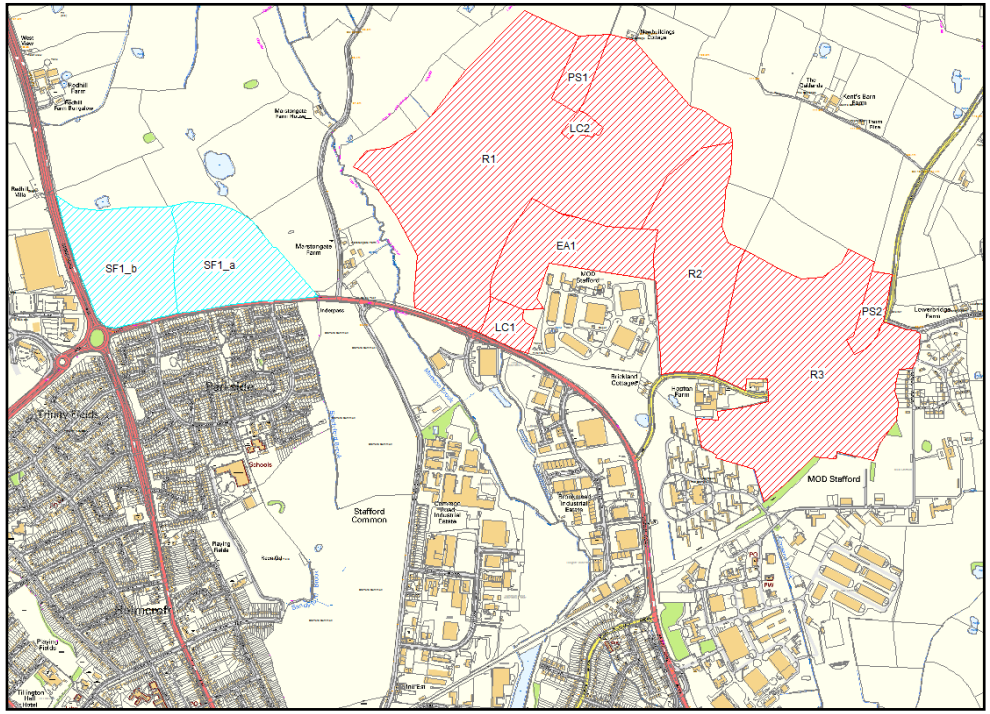


Table F-1: Assumed flows used for modelling

Subcatchment Name	Area Type	Population	Trade Flow (m^3/s)
SF1_a	Residential	652	N/A