MANSFIELD DISTRICT COUNCIL

Water Cycle Strategy - Scoping Study

Final Report

June 2009

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Notice to Interested Parties

To achieve the study objectives stated in this report, we were required to base our conclusions on the best information available during the period of the investigation and within the limits prescribed by our client in the agreement.

No investigative method can completely eliminate the possibility of obtaining partially imprecise or incomplete information. Thus, we cannot guarantee that the investigations completely defined the degree or extent of e.g. species abundances or habitat management efficacy described in the report.

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Glossary of terms

AMP	Asset Management Plan
ASPT	Average Score per Taxon
BOD	Biochemical Oxygen Demand
CAMS	Catchment Abstraction Management Strategy
DAP	Drainage Area Plan
DO	Deployable Output
D/s	Downstream
EA	Environment Agency
EQI	Ecological Quality Indices
GQA	General Quality Assessment
GWMU	Ground Water Management Unit
IPG	Interim Planning Guidance
JSP	Joint Structure Plan
LDF	Local Development Framework
LNR	Local Nature Reserve
MARR	Mansfield Ashfield Regeneration Route
ML/d	Million Litres Per Day
PCC	Per Capita Consumption
PPS	Planning Policy Statement
QUELS	Quality of Employment Land Supply Study
RELPS	Regional Employment Land Priority Study
RPA	Return Period Analysis

RQO	River Quality Objectives
RSA	Restoring Sustainable Abstraction
RSS	Regional Spatial Strategy
SFRA	Strategic Flood Risk Assessment
SHLAA	Strategic Housing Land Availability Assessment
SRC	Sub-Regional Centre
SRS	Sub-Regional Strategies (East Midlands Regional Plan)
SSSI	Site of Special Scientific Interest
STW	Sewage Treatment Works
SUDS	Sustainable Urban Drainage Systems
SUE	Sustainable Urban Extension
UID	Unsatisfactory Intermittent Discharge
U/s	Upstream
UKCIP	United Kingdom Climate Impacts Programme
UWWTD	Urban Waste Water Treatment Directive
WAFU	Water Available For Use
WCS	Water Cycle Strategy
WFD	Water Framework Directive
WRMP	Water Resources Management Plan
WRMU	Water Resources Management Unit
WRZ	Water Resource Zone

0 EXECUTIVE SUMMARY

Scoping study objectives

0.1 This Water Cycle Strategy (WCS) scoping study for Mansfield District Council outlines the main water infrastructure issues that will arise from the scale of proposed growth. It considers the following aspects, identifying the main constraints and opportunities for each:

- Flood risk;
- Water resources and water supply;
- Waste water collection systems and treatment; and
- Water environment.

0.2 The WCS process provides Mansfield District Council and other bodies, notably the Environment Agency and Severn Trent Water, with increased awareness about the implications of potential areas for development on water infrastructure and the water environment in general. This will reduce the number of assumptions that are necessary in making decisions in relation to future planning of resource and infrastructure requirements.

Outputs

0.3 This report focuses upon five potential areas for significant growth provided by Mansfield Council and in the context of the latest prediction for growth presented in the final version of the East Midlands Regional Plan. It assesses the flood risk, water supply and waste water infrastructure for each potential area of growth. In addition, river quality, demand management and biodiversity issues are discussed in more general terms. The report concludes with a discussion of the main issues that have been identified and gives recommendations on the way forward.

Data sources

0.4 The results of a preceding Strategic Flood Risk Assessment (SFRA) have been used as the basis for the flood risk section of this study. The other sections have been based on data and information obtained from the EA and Severn Trent Water, including their Strategic Direction Statement and draft Water Resources Management Plan (WRMP) published in May 2008. As some of the main source documents are currently in draft form, the assumptions and recommendations of this scoping study may need to be reviewed during subsequent stages of producing a WCS. However, as the draft WRMP is well advanced, it is considered unlikely that there will be significant changes to the information presented.

Co-operation

0.5 At the behest of Mansfield District Council, this WCS scoping study was carried out with the involvement of Severn Trent Water and the EA. This was because they are the key infrastructure providers in relation to the water cycle, including flood risk issues.

1 INTRODUCTION

Background

1.1 In January 2009, RPS was commissioned to undertake a Water Cycle Strategy (WCS) scoping study for Mansfield District Council.

1.2 The WCS scoping study will provide an important input into the Local Development Framework that Mansfield District Council is preparing, as well as providing evidence about the water environment capacity and what water infrastructure will be needed to enable development.

1.3 Situated approximately 15 miles north of Nottingham, Mansfield District lies within North Nottinghamshire and is covered by the Northern Sub-region of the Regional Plan for the East Midlands. Covering 78 square kilometres, 37% of the total land area is built-up, including the urban areas of Mansfield and Mansfield Woodhouse. Having received its charter in 1227, Mansfield is one of the oldest market towns in the Nottinghamshire and reportedly the historical centre of Sherwood Forest (Visitnottingham, 2009).

1.4 To the north of the District are the small market town of Market Warsop and the satellite villages of Church Warsop, Meden Vale, and Warsop Vale. The District also includes small parts of Clipstone to the east and Rainworth to the southeast. As of March 2007, there were 46,305 dwellings in the District and based on 2005 Office for National Statistics population estimates just under 100,000 residents (Ashfield, Mansfield and Newark and Sherwood District Councils, 2008).

1.5 The landscape of some parts of the district is dominated by former mining and textile industry. Despite this, much of the area has been recognised for its environmental assets and the district is home to a network of green infrastructure including the corridors provided by the River Maun and River Meden (Mansfield District Council, 2009).

1.6 Mansfield District benefits from the new multi-million pound Sherwood Way, previously known as the Mansfield-Ashfield Regeneration Route. This allows good local and national road connections to the M1 and A1 and offers opportunities for development around the southern and western side of Mansfield Urban Area. In addition, a bus network and a railway line, that links the town with Nottingham City, provide good public transport connections. Mansfield therefore acts as a sub-regional centre for people living within the district, as well as those of neighbouring areas just beyond the district boundary in North Derbyshire.

1.7 In order to maintain an adequate supply of land for housing in the longer term, it will be necessary to allocate additional sites for development. The key challenges ahead are about providing sufficient land in sustainable locations to meet the increased housing requirement.

Objectives of this water cycle scoping study

1.8 Production of Water Cycle Strategies has been separated into three phases;

- A scoping study undertaken at a very early stage to identify the main issues and to determine if further work is needed to inform strategic planning decisions;
- An outline study (Phase 1) which involves gathering and assessing the available data, identifying the environmental and major infrastructure constraints and deciding if detailed assessments are needed;
- A detailed study that seeks to resolve any issues that have been raised in the scoping or outline phases and which informs planning policy for the area. Detailed sustainability and funding issues are also addressed at this stage.

1.9 A WCS scoping study outlines the main water infrastructure issues that will arise from the scale of proposed growth. It considers the following aspects, identifying the main constraints and opportunities for each:

- Flood risk;
- Water resources and water supply;
- Waste water collection systems and treatment; and
- Water environment (i.e. climate change and biodiversity).

1.10 The main objectives of this WCS scoping study are to:

- Identify the studies already carried out, gather together what data is already available and assess whether there are any significant information gaps;
- Review at a high level the existing natural and engineered water infrastructure and any opportunities and/or constraints these impose;
- Establish the main water infrastructure requirements and risks associated with the main development scenarios; and
- Agree a project plan for any further stages in producing a WCS.

1.11 The WCS scoping process provides Mansfield District Council and other bodies, notably the Environment Agency (EA) and Severn Trent Water, with increased awareness about the implications of potential areas for development on water infrastructure and the water environment in general. This will reduce the number of assumptions that are necessary in making decisions in relation to future planning of resource and water infrastructure requirements.

2 DATA COLLECTION AND METHODOLOGY

Overview

2.1 Production of this WCS scoping study has followed the procedure set out in the WCS manual produced for the EA (Halcrow, 2009). A sequential approach was adopted:

- Firstly, the existing water service infrastructure within Mansfield District was reviewed in order to gain an insight into the demands placed upon it, as well as establish management practices and strategies;
- Secondly, based on the information available at the time of writing, the likely locations and scale of significant growth were determined;
- Thirdly, the implications of significant development in each of the potential areas for growth on the existing water service infrastructure were scoped;
- Fourthly, the main issues in relation to the water environment (e.g. climate change and biodiversity) were scoped;
- Finally, conclusions were drawn on the main water service infrastructure constraints and opportunities, together with recommendations on next steps.

2.2 This WCS scoping study has been produced in consultation with Mansfield District Council. The initial scope and approach adopted was agreed as part of the commissioning process. It has been refined as the study has progressed, as well as at meetings held specifically to discuss the WCS scoping study.

2.3 The scoping study has principally been based on a desk review of publicly available documents sourced from the relevant organisations, notably the Regional Plan for the East Midlands and draft Water Resources Management Plan (WRMP) produced by Severn Trent Water in May 2008.

2.4 The WRMP produced by Severn Trent Water, which provides much of the basis of this study, is currently in draft form. As this key document is not expected to be finalised before the WCS scoping study is completed, any subsequent stages of the WCS will therefore need to take any significant changes in the final version into account. Mansfield District Council has also advised that whilst there may be some further uplift in growth requirements in the future, the figures presented in the Regional Plan for the East Midlands are to be used in this scoping report.

2.5 In addition to the WRMP, water companies like Severn Trent Water are required to produce an Asset Management Plan (AMP) every five years. This identifies what the company intends to deliver over the next five years and what impact this will have on customer bills. Currently, water companies are operating under AMP4, which covers the period 2005-2010. AMP5 will cover 2010-2015. Available information on Severn Trent Water AMP programmes, including annual returns in June to Ofwat, have also been reviewed to inform this WCS scoping study.

2.6 Focused discussions were also held with the EA and Severn Trent Water to ensure the latest data and thinking was taken into account.

2.7 In order to help identify the most significant water cycle constraints to development, each issue has been broken down into a series of key component factors. A standard traffic light approach has been adopted throughout this study as follows:

Low Risk (green)

Medium Risk (amber)

High Risk (red)

2.8 An overall score for each issue in relation to each potential growth area has then been determined by taking the highest risk in any factor.

2.9 The water cycle infrastructure constraints and opportunities outlined in this study are only assessed at a strategic scale. Detailed schematics, notably in relation to water supply and sewer infrastructure, were not available at the level of potential growth areas. Whilst no detailed analysis has been carried out to reveal the true location and condition of the water cycle infrastructure in these areas, the broad network and how it functions have been determined at a strategic level and used to inform this study.

2.10 This scoping study gives an early indication of areas that may have a problem with additional significant growth given the existing water service infrastructure and any plans for improvements. It is a 'broad-brush' assessment that does not look in detail at the local circumstances of each issue. It is therefore likely that further work will be necessary to identify specific issues in each potential growth area.

Location of growth

2.11 During preliminary discussions over the scope of the WCS scoping study, Mansfield District Council provided information on five potential areas for significant development as follows:

- (A) Mansfield Urban Area – a sub-regional centre with a population of approximately 86,000;
- (B) Southern Corridor – principally a greenfield area to the south of Mansfield on either side of the Mansfield Ashfield Regeneration Route (MARR) between the A60 and A617;

- (C) Pleasley Hill Regeneration Area – a major development opportunity involving the large scale re-development of poor quality housing together with some greenfield land release adjoining Mansfield Urban Area;

- (D) North of Forest Town – principally a greenfield area within the Sherwood Forest Special Landscape area and traditionally viewed as part of Sherwood Forest with potential for tourist and recreational development that protects the ecological value of the area; and

- (E) Market Warsop Urban Area – acts as a local service centre for other rural settlements in the northern part of the district which collectively have a population of approximately 12,000.

2.12 All five potential areas for growth were overlaid upon Ordnance Survey mapping for the District and used as a basis for discussion with Severn Trent Water and the EA. They are shown along with their reference letters allocated for the purposes of this WCS scoping study in Figure 1.

2.13 These five broad locations for growth are focussed on the District's main urban areas, namely Mansfield and Market Warsop. Within the urban area of Mansfield (Area A) and Market Warsop (Area E), opportunities will be taken to maximise development of suitable brownfield and underused greenfield land in line with the sequential approach to development set out in PPS3 and the Regional Plan. However, in order to meet the District's long term strategic housing requirements, it is likely that sustainable urban extensions (SUEs) on greenfield land will be required. The potential areas identified for the location of SUEs and assessed in this WCS scoping study are Areas B, C and D.

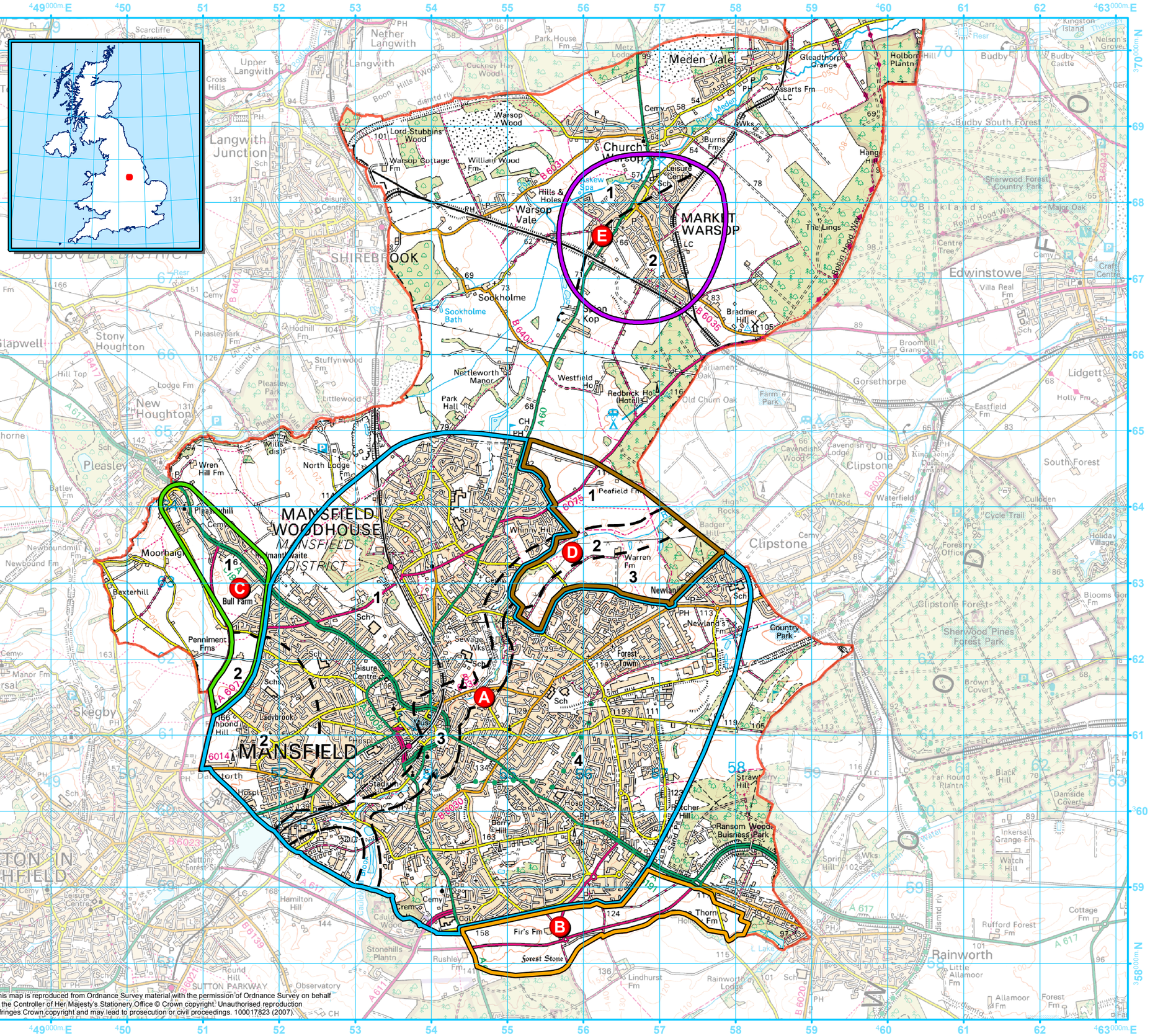
2.14 The inherent difficulty in determining the location of future development should be recognised as dependent upon an overall assessment of the findings of numerous studies. Whilst these include this WCS scoping study, it is only one of a range of considerations that will determine where and when development occurs, not least of which are the market forces that determine what proposals are brought forward by potential developers.

Flood risk

2.15 This WCS scoping study has been prepared following production of a Strategic Flood Risk Assessment (SFRA) for the District. The findings in relation to flood risk are therefore based on the SFRA report.

Water resources and supply

2.16 Potable water within the whole of Mansfield District is provided by Severn Trent Water. All information included within this report has been collected through consultation with Severn Trent Water, supplemented by documentation from Ofwat and the EA.



Project Ref: O:\JPP2178 Mansfield DC Water Cycle Strategy\GIS\JPP2178_MansfieldCounty.mxd

Legend

Mansfield district council boundary

Growth Areas (indicative)

A. Mansfield Urban Area
B. Southern Corridor
C. Pleasley Hill Regeneration Area
D. North of Forest Town
E. Market Warsop
Sub areas

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2009

Status: **FINAL**

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Project: Water Cycle Strategy Scoping Study

Title: Indicative Growth Areas

Scale: 1:50,000 @A3

0 500 1,000 2,000

Date: 10/02/2009 Datum: OSGB36 Projection: BNG

Drawn: BF Checked: RP Job Ref: JPP2178

Figure No: **1** Revision: **B**

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2.17 Severn Trent Water published their Strategic Direction Statement in December 2007 and draft WRMP covering the period 2010 – 2035, in May 2008. In August 2008, Severn Trent Water submitted their draft Business Plan to Ofwat. This sets out the steps they intend to take over the next five years in working towards delivering the Key Strategic Intentions set out in the Strategic Direction Statement. These include proposals for delivering water and waste water services for the next AMP period (AMP5) of 2010-2015. Following feedback from Ofwat and other stakeholders, they will produce their Final Business Plan in 2009.

2.18 In response to the public consultation on the draft WRMP, Severn Trent Water published a Statement of Response in February 2009. This outlines how they have addressed the comments received, their latest assessment of the supply/demand balance and changes to scheme options.

2.19 Subject to Defra's approval, Severn Trent Water will be publishing their final WRMP in 2009. Unless they are required to make any further changes, the final plan will reflect the position as set out in this Statement of Response.

Waste water collection and treatment

2.20 Waste water collection and treatment services are primarily provided by Severn Trent Water over the entire of Mansfield District. Information regarding the standard, capacity and location of the relevant infrastructure has been obtained from Severn Trent Water and Mansfield District Council. Severn Trent Water has an extensive library holding asset location information detailing its sewerage network. Plans are available at an individual site scale but are supplied only as a general guide and as such should not be relied upon.

2.21 The Mansfield (West and East) Drainage Area Plan (DAP) was initiated in 1999 to update two earlier separate studies commissioned by Mansfield District Council as the then sewerage agent. The Mansfield West study, completed in 1999, covered an area of 1,200 ha containing a population of approximately 50,000 people. Its sewerage system consisted of 3.2 km of category 'A' strategic sewer and 28 km of category 'B' sewer, 3 sewerage pumping stations and 18 combined sewer overflows. The Mansfield East study, completed in 1990 covered an area of 1,750 ha containing a population of 38,000 people. Its sewerage system consisted of 12 km of category 'A' strategic sewer and 20 km of category 'B' sewer, 6 sewerage pumping stations and 16 combined sewer overflows.

2.22 The Mansfield (West and East) DAP was completed in 2001 and used as one of the source documents for production of the Mansfield District SFRA. No evidence of more recent models of the sewerage network within the area has been identified.

2.23 The EA has provided the General Quality Assessment (GQA) grades and River Quality Objectives (RQO) for the main watercourses within Mansfield District along with the Idle and Torne Catchment Abstraction Management Strategy (CAMS). This data, together with a literature search, has been used to scope water quality issues in the District.

Data Limitations

2.24 Although consultees have been helpful with their provision of data and information, there are limitations to the analysis due to the level of detail available. For example, schematics regarding water supply and sewer infrastructure were not available at the District level. As such, the schematic provided within this report is for indicative purposes only and does not provide a true representation of the locations of the infrastructure or the exact distance of potential growth areas to pipelines.

2.25 Production of this scoping report commenced prior to finalisation of both the Regional Spatial Strategy for the East Midlands and Severn Trent Water WRMP. As these documents have evolved, this report has been updated to reflect the most current thinking. This final report has been produced following publication of the East Midlands Regional Plan. However, the Severn Trent Water WRMP was still in draft.

3 GROWTH AND DEVELOPMENT

Policy context

National – Planning Policy Statements (PPS)

3.1 The most relevant Planning Policy Statements to this WCS scoping study are:

- PPS1 – sets out the overarching planning policies for the delivery of sustainable development;
- Supplement to PPS1 – Planning and Climate Change;
- PPS8 – Biodiversity and Geological Conservation;
- PPS9 – calls for local authorities to identify readily available sites which can be developed for housing within five years, within six to ten years and within 11 to 15 years to enable the supply to be sustained in the longer term. Where it is not possible to identify sites, broad locations for future growth should be given;
- PPS12 – sets out the key ingredients of local spatial plans and the key government policies on how they should be prepared;
- PPS23 – is intended to complement the pollution control framework under the Pollution Prevention and Control Act 1999 and the PPC Regulations 2000 and details the Government's policy on water quality; and
- PPS25 – shows how flood risk issues from all potential routes should be handled in regional planning guidance, development plans and in dealing with planning applications.

The East Midlands Regional Plan

3.2 Nottinghamshire County Council and Nottingham City Council adopted the Joint Structure Plan (JSP) in February 2006. This set out strategic land use policies to guide the scale and location of development and promote sustainable development. Following publication of an independent panel report on the draft Regional Spatial Strategy (RSS) for the East Midlands in November 2007 and publication of the Proposed Changes to RSS by the Secretary of State for Communities and Local Government In July 2008, the East Midlands Regional Plan was published in March 2009. This now supersedes the JSP.

3.3 The East Midlands Regional Plan provides a broad development strategy up to 2026. Mansfield District falls within the Northern sub-area which has been subject to major industrial structural change as a result of the decline in the coal industry.

3.4 Policy 3 on the Distribution of New Development identifies Mansfield/Ashfield as a Sub-Regional Centre (SRC). Policy 7 on the Regeneration of the Northern Sub-Area established this sub-region as a priority area for social, economic and environmental regeneration and significant strengthening of the Mansfield/Ashfield SRC.

3.5 In terms of Sub-Regional Strategies (SRS), Policy Northern SRS1 on development priorities promotes growth at the Mansfield/Ashfield SRC and to a lesser extent the Market Warsop Urban Area. Policy Northern SRS3 on employment regeneration priorities designates an area along the MARR as a potential area for growth.

3.6 Two further policies within the East Midlands Regional Plan are also material to this WCS scoping study: Policy 32 – a regional approach to water resources and water quality and Policy 35 – a regional approach to managing flood risk.

Housing

3.7 The East Midlands Regional Plan (March 2009) provides a target for housing development for Mansfield District over the period 2006 – 2026 of a net addition of 10,600. This equates to an average of 530 new houses per annum. Between 2001 and 2008, there were 319 net completions on average per annum within the District. Mansfield District is therefore expected to accommodate a higher rate of growth than has taken place in the recent past to allow for the likely impact of regeneration initiatives.

Employment

3.8 In terms of employment land, the Regional Quality of Employment Land Supply Study (QUELS) undertook a comprehensive analysis of the current supply of employment land against a strategic long term market assessment. The subsequent Regional Employment Land Priority Study (RELPS) analysed more specific employment needs.

3.9 At the general level, it was found that there would be a significant decline in demand for industrial floorspace, and a significant increase in demand for office floorspace over the next 10-15 years. Because office jobs occupy space at far higher densities, the demand for additional employment land is estimated to grow at less than 3 hectares per annum region-wide. There is however a need for sites to be brought forward in response to strategic priorities and to provide suitable accommodation for the growth of local undertakings. In the Northern Sub-area, it was concluded that that there is an inadequate supply of office space, particularly in and around existing urban centres.

3.10 The conclusions of both studies were used to inform Policy 20 of the East Midlands Regional Plan. This notes there is a need to consider whether sites which may currently be allocated for employment uses are likely to become surplus to requirements. In such cases, planning authorities should consider what other uses might be appropriate on such sites. For the Northern Sub-area, it was concluded that there is an extensive supply of allocated industrial land, much is of poor quality and around 25% could be de-allocated without market detriment.

3.11 Prompted by the draft RSS which expected partnership working to undertake and keep up to date employment land reviews, Planning Ove Arup and Associates together with Savills undertook a review of employment land across the Northern sub-area of the East Midlands.

3.12 The commission was made jointly by Nottinghamshire County Council and Derbyshire County Council on behalf of seven other authorities, including Mansfield District Council, and the Alliance Sub-regional strategic partnership. The final report, published in March 2008, gave a net employment land figure for Mansfield District of 23.7 - 35.2 ha. In addition to existing sites currently or lastly in employment use and undeveloped sites allocated for employment in the Mansfield District Local Plan (1998) the study assessed potential areas for new employment along the MARR in the south and west of the Mansfield urban area.

Potential growth areas

3.13 In order to scope the water cycle infrastructure issues in relation to meeting the likely requirements of future development, it is necessary to identify potential areas for growth.

3.14 The Mansfield District Local Plan (1998) which covers the period 1996-2006 states that in order to meet sustainable patterns of development, it is preferable to concentrate development with the main urban areas of Mansfield, Woodhouse and Warsop (DPS2). Mansfield District Council is in the process of preparing a new development plan for the District known as the Local Development Framework (LDF), as required by the Planning and Compulsory Purchase Act 2004. In 2009 the Council will submit to the Government Office a new Local Development Scheme setting out the programme for the preparation of Development Plan Documents. This will propose a different approach involving preparation of a number of Area Action Plans focussing on specific spatial areas of the district.

3.15 Mansfield District Council is also in the process of undertaking a Strategic Housing Land Availability Assessment (SHLAA). Key outputs will be to identify:

- The area of land that has housing potential, allocated or otherwise, but on which no planning permissions have yet been granted; and
- The area of land that has been granted planning permission for housing but which has yet to be developed, either partly of completely.

3.16 As the results are not yet available for use within this scoping study, a brief review by Mansfield District Council of planning permissions indicates that since 2006, there have been:

- 757 completions
- 503 permissions granted within the Warsop area that have not yet been completed; and
- 3,117 permissions granted within the Mansfield Urban Area that have not yet been completed

3.17 Provided all the outstanding permissions are completed, in order to achieve the growth target of 10,600 new houses, provision will need to be made for at least a further 6,223 new houses. A slightly higher provision will be needed to ensure a sufficient net increase in the light of dereliction of existing housing stock.

3.18 Based on the planning context outlined above, preliminary review of progress with the SHLAA and the expected market demand, Mansfield District Council has identified five potential areas for growth. Table 1 summarises the estimated development potential of each of these areas.

Table 1: Estimated development potential

Potential Growth Area	Estimated Nos. of Dwellings (net)	Estimated Land for Employment (net)	Total ha required
(A) Mansfield Urban Area	1,800-2,300	-	45-57.5
(B) Southern Corridor	2,000	25	75
(C) Pleasley Hill Regeneration Area	1,000	18	43
(D) North of Forest Town	500	-	12.5
(E) Market Warsop Urban Area	500-1,000	-	12.5-25
Total	5,800-6,800	43	188-213

3.19 Whilst densities of about 70 dwellings per hectare are likely to be required within Town or District centres, this study has used the more conservative approach of 40 dwellings per hectare across all five potential growth areas to give an indication of the area required for development.

4 WATER CYCLE INFRASTRUCTURE AND ASSETS

Flood risk

4.1 The River Maun and River Meden, which rise in the hills west of Mansfield, flow eastwards across the district. According to Natural England they are of particular value in terms of habitats, diversity and landscape (Natural England, 1997). The River Idle is formed at the confluence of the Rivers Maun and Meden near Markham Moor in South Yorkshire. This initially flows north through Retford and Bawtry before turning eastward to join the tidal reach of the River Trent at West Stockwith, just north of Gainsborough. Consequently, the River Maun and River Meden are not significant to the flows of the River Trent.

4.2 The River Maun dissects Mansfield town centre and the River Meden flows to the north of Market Warsop. Lees Brook flows north from Mansfield Woodhouse and joins the River Meden. Other tributaries to the River Maun include Caudwell Brook, Vicar Water, Rainworth Water and Foul Evil Brook.

4.3 Severn Trent Water operates the sewer network within Mansfield District. This predominantly consists of a combined foul and surface water network which discharges to the Bath Lane Sewage Treatment Works (STW). Outlying areas discharge to STWs at Rainworth, Church Warsop and Edwinstowe. Low lying areas are served by a number of pumping stations which generally discharge effluent into adjacent gravity mains. Mansfield Woodhouse has a network of surface water sewers which discharge into Lees Brook. Other than this, the surface water sewer network is localised and does not extend far beyond the River corridor.

4.4 The extensive combined sewer network within the District means that heavy rainfall places a significant demand on the sewer network, leading to localised sewer flooding and the discharge of untreated effluent into the rivers via the combined sewer overflows.

4.5 A Strategic Flood Risk Assessment (SFRA) for Mansfield District Council was completed by RPS for Mansfield District Council in June 2008. It was produced with reference to Planning Policy Statement 25 (PPS25): Development and Flood Risk, and in consultation with the EA, Severn Trent Water, Nottinghamshire Wildlife Trust and the Citizens Panel.

4.6 The main objectives of the SFRA were to:

- Contribute to the Sustainability Appraisal of Local Development Documents
- Positively inform the planning process in deciding the location of new development.

4.7 The areas identified as being at risk of flooding are as follows:

River Meden Catchment

4.8 The following areas fall within areas of high risk from surface runoff and flood mitigation must be considered:

- Meden Vale – parts.

4.9 The following areas fall within areas at risk from Fluvial flooding:

- Pleasley – vicinity of Pleasley Square.

4.10 The following areas fall within flood Zone 2 and 3:

- Sookholme & Spion Kop.
- Market Warsop – Northern end and the vicinity of A60 and Church Road.
- Church Warsop – area to the south-east adjacent to the River Meden.

4.11 The following areas fall within flood Zone 3:

- Meden Vale – south of Netherfield Lane.

River Maun Catchment

4.12 The following areas fall within areas at risk from overtopping:

- Kings Mill Reservoir to Hermitage Pond – d/s of reservoir embankment.
- Field Mill to Bath Street – d/s of Field Mill Pond (unless mitigation works undertaken).

4.13 The following areas fall within areas at risk from fluvial flooding:

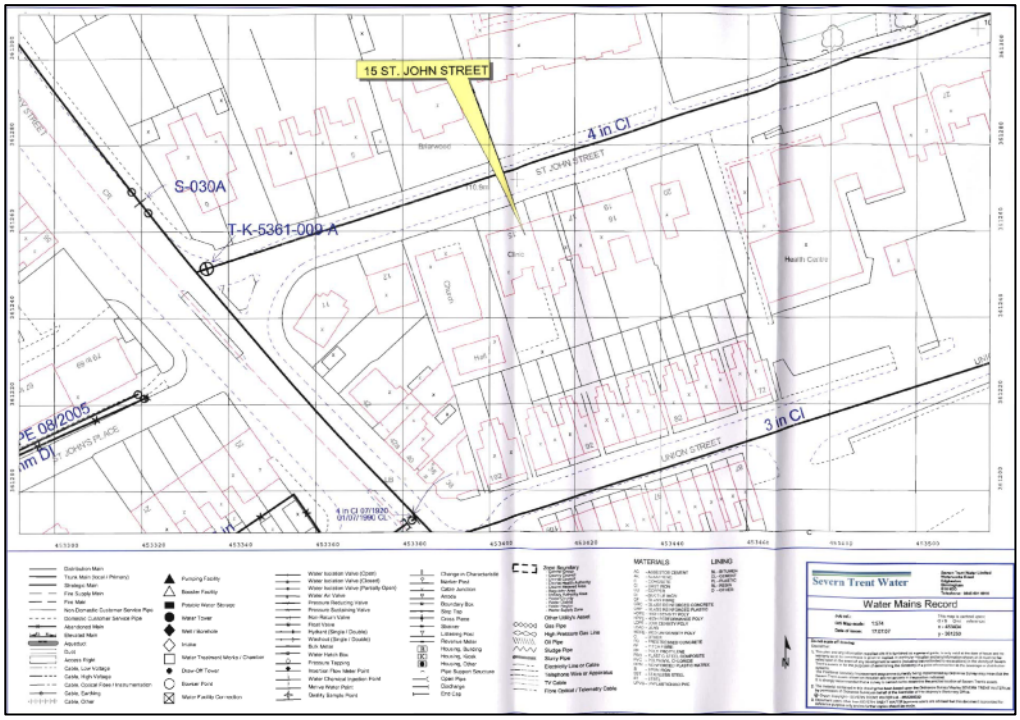
- Bleak Hills - vicinity of the culverted section of Cauldwell Brook (unless mitigation works undertaken).
- Old Mill Lane to Snake Hill - within the floodplain.

Water resources and supply

4.14 The assessment of water supply and management included in this WCS scoping study has been primarily based on documentation produced by Severn Trent Water. This has been supplemented by a literature review and consultation with both Severn Trent Water and the EA. Unfortunately Severn Trent Water was unable to provide any additional District scale schematics to those available within their publicly available documentation. Schematics are generally only provided on a site by site basis in response to specific requests. An example is illustrated in Figure 2.

Figure 2 – Example site specific water mains schematic

(*Source: Nottingham County Council website: http://www.nottinghamshire.gov.uk*).



4.15 Mansfield's water supply was originally obtained from hand-pumped wells drawing from springs feeding the River Maun. Mansfield sits on two major aquifers, namely the Lower Magnesian Limestone and the Triassic Sherwood Sandstone outcrops (Environment Agency, 2007a).

4.16 In 1872, a small waterworks drawing up groundwater from a 60 ft deep well was built along Nottingham Road (now the A60) to the south of Mansfield Town. Until 1895 this was Mansfield's only permanent pumping station (Papplewickpumping station.co.uk). In 1889, plans were made to sink further wells at Rainworth. The main well was 110 ft deep and gave a maximum yield of nearly two million gallons per day.

4.17 By 1905 this had become inadequate and authority was given to construct Clipstone Waterworks. This pumping station delivered a further 750,000 gallons of water per day from a 150 ft deep well to a reservoir at Mansfield Woodhouse. The steam plant at Rainworth waterworks remained in service until 1944 when a new borehole was sunk and an electric pump was installed. The steam plant was retained for standby use only.

4.18 Both Rainworth and Clipstone works were entirely converted to electric pumps in 1953. A new pump house was installed at Rainworth in 1953. This building remains in use by Severn Trent Water, pumping water from three boreholes and

the majority of the District is now connected through a network of pipework to water supply mains.

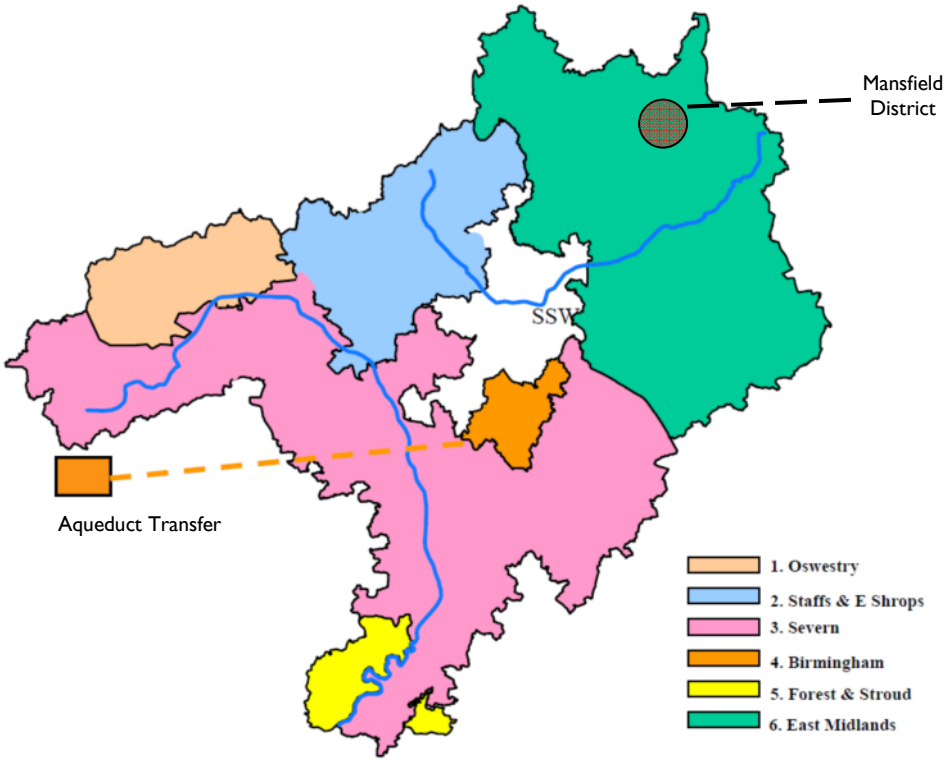
4.19 Severn Trent Water is currently responsible for providing potable water throughout the District. Severn Trent Water is one of the largest water companies in England and supplies a population of 7.4 million people with around 1,900 million litres of potable water over an area of 21,000 square kilometres.

4.20 A Water Resource Zone (WRZ) is the largest zone in which all resources, including external transfers, can be shared and hence the zone in which all customers as well as potential customers of new development experience the same risk of failure in supply.

4.21 The area supplied by Severn Trent Water consists of six WRZs originally identified for their 2004 Water Resources Plan (Figure 3). Mansfield District is in the northeast corner of the East Midlands WRZ (WRZ6) which extends to Derby in the west and almost Rugby in the south. In 2007 Severn Trent Water supplied 843.04 million litres per day (Ml/d) of water to around 2,894,000 consumers within the East Midlands WRZ (Severn Trent Water, 2008).

4.22 Following concerns raised by the EA over the size of the WRZs, Severn Trent Water are setting up a network of between 40 to 50 water accountability zones to take forward water supply and leakage management at a sub WRZ level. Once these zones have been made publicly available, it would be useful to consider their implications to the water supply of Mansfield in any subsequent more detailed stages of the WCS process.

Figure 3 – Severn Trent Water, Water Resource Zones
(Source: Severn Trent Water – Draft Water Resources Management Plan, 2009)



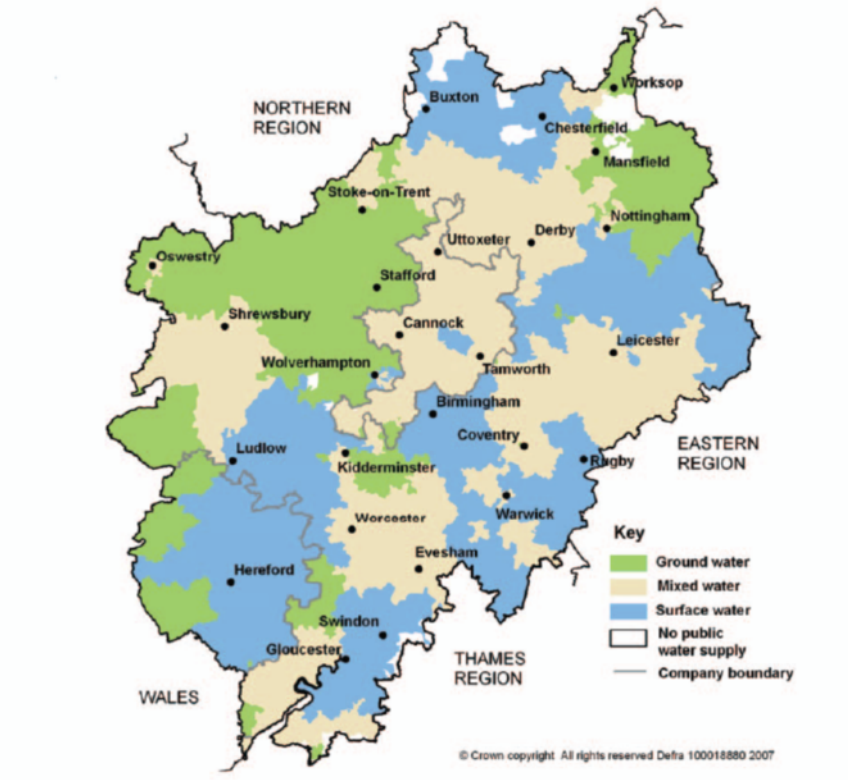
4.23 Over its entire supply area, 60% of supply is split equally between groundwater sources and reservoirs. In total, Severn Trent Water operates around 180 groundwater abstraction sources and 15 reservoirs, most of which are naturally filled by gravity. The groundwater sources draw mainly from the Triassic Sandstone Aquifers, though within Nottinghamshire, around 80% of public supply is abstracted mainly from the Sherwood Sandstone Aquifer (Mansfield District Council, 1998). These aquifers therefore provide a strategically important groundwater resource and are the source of significant public water supply, industrial and agricultural abstractions (Environment Agency, 2007a).

4.24 Severn Trent Water obtains the other 40% of its water from river abstraction points. In total they operate 17 major surface water abstractions. In addition, Severn Trent Water has historically imported small quantities of water from neighbouring water undertakers, principally South Staffordshire Water, Dwr Cymru (Welsh Water), United Utilities and Anglian Water.

4.25 The agreement for an import from United Utilities at Llanforda in Oswestry was terminated in April 2009. The Wing 2 Agreement which provided an import from Anglian Water into Whatborough Service Reservoir in Leicestershire has also been terminated. However, as the value of the import under the Wing 2 Agreement was not guaranteed in a dry weather season this has not affected the water available for use (WAFU). The original Wing 1 Agreement is still in place and this is included in the WAFU calculations.

Figure 4 – Source of water in the Midlands Region

(*Source: Drinking Water Inspectorate, Drinking Water 2006 Midlands Region, 2007*)



Waste water collection and treatment

4.26 There are three main types of waste water collection infrastructure. Foul sewers carry waste water from flushed toilets, baths, dishwashers, industry, etc to STWs managed by water companies. Surface water sewers carry runoff from guttering, driveways, roads etc and generally discharge into watercourses or balancing ponds. Whilst water companies have no legal requirement to take highway drainage, some areas, notably the older parts of Mansfield and Warsop, are serviced by combined sewers that carry both surface and foul water.

4.27 Foul water collection and treatment within Mansfield District is primarily the responsibility of Severn Trent Water. However, pipe works serving one or more properties are considered private sewers until they join the public sewer network. Maintenance of private sewers is the responsibility of property owners or those who make use of them. Some more rural areas also have privately maintained septic tanks and cess pits.

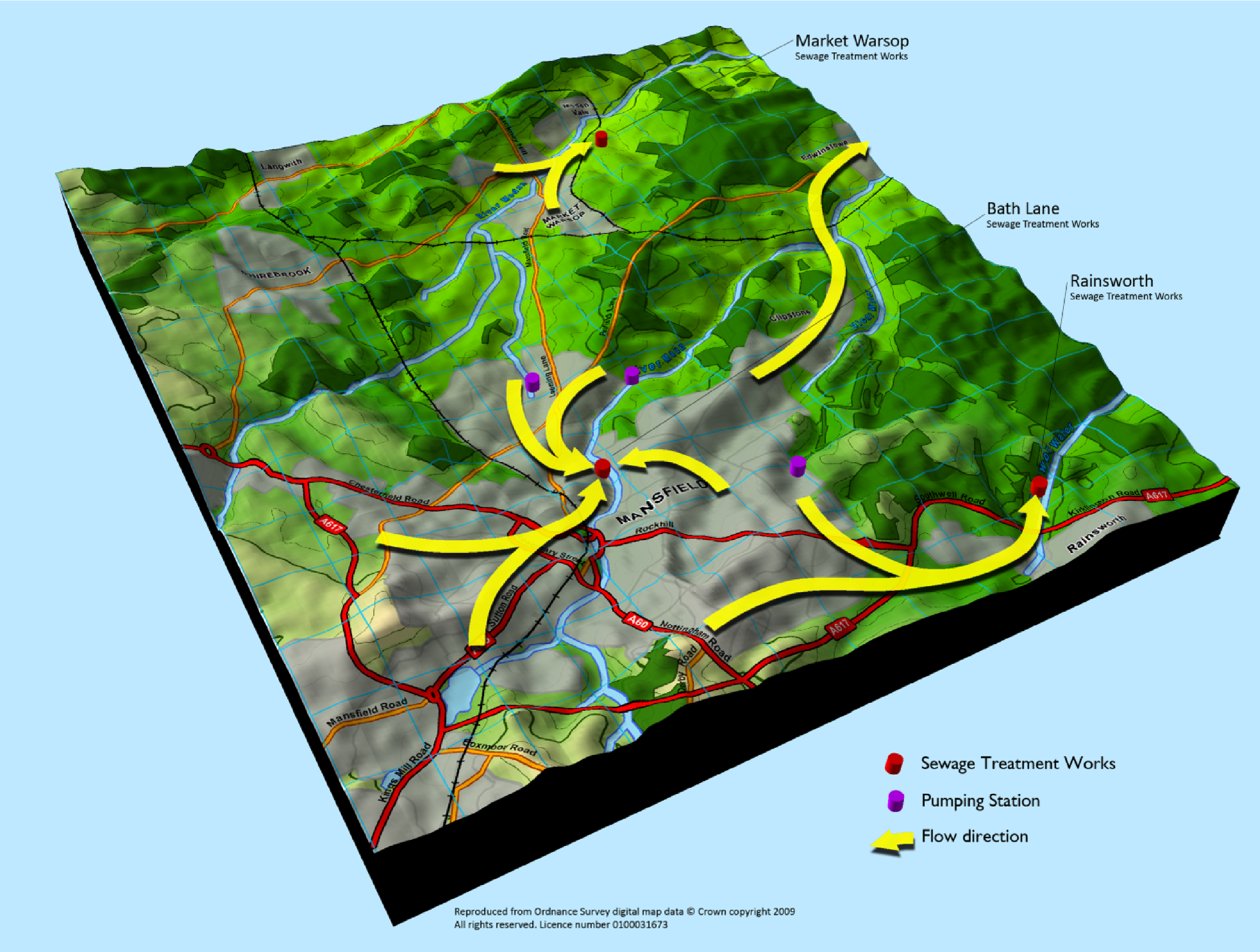
4.28 The waste water collection infrastructure considered in this WCS scoping study primarily concerns that which is the responsibility of Severn Trent Water. Figure 5 illustrates the general existing waste water collection and treatment system for Mansfield District based on information made available by Severn Trent Water.

4.29 Mansfield District has a relatively simple waste water collection and treatment system. There are two main catchments divided by the ridge of higher ground which runs southwest to northeast between Mansfield and Market Warsop.

4.30 The majority of the foul sewer network south of the ridge drains to the Mansfield Bath Lane STW. Due to the height of most of the land above this STW, the majority of the sewers rely on gravity to take waste water to the Bath lane inlet. However, flows from the Mansfield Woodhouse area are pumped via the Mansfield Woodhouse, Maun Valley and Forest Barn pumping stations. There is also a small pumping station that lifts flows from the Old Mill Lane area of Mansfield Woodhouse.

4.31 Market Warsop has its own STW at Broomhill Lane, Church Warsop. Parts of Forest Town in the east of the district drain to the Edwinstowe STW on Ollerton Road outside the boundary of the district, whilst part of Berry Hill and Lindhurst in the south east of the district drain to the Rainworth STW on Rufford Colliery Lane, Rainworth, again outside the boundary of the district.

Figure 5 – Schematic of waste water collection and treatment network



5 WATER CYCLE MANAGEMENT

Flood risk management

5.1 The strategic framework for managing flood risk from the rivers flowing through Mansfield District is provided by the River Trent Catchment Flood Management Plan (CFMP) produced by the EA (2007b). Following extensive consultation on a final draft the CFMP has now been finalised and the EA are currently considering the most effective way to communicate the outputs (Environment Agency, 2009).

5.2 The River Trent CFMP provides a basic policy framework beneath which more detailed assessments of flood risk can be undertaken. Modelling work on the CFMP is based primarily on the main rivers. Policy Unit 2 - Sherwood applies to the catchment of the River Idle and therefore includes the Rivers Maun and Medan. Future flood risk is currently assessed as low and it is not expected to rise significantly. However, the CFMP identifies that there are many small watercourses which respond quite rapidly to heavy rainfall. Climate change predictions of an increase in storminess, particularly intense storms, could have an impact on the frequency of urban flooding experienced in the district.

5.3 A number of options are available to manage the risk of flooding. The most effective approach is to avoid the risk by zoning as much new development as possible away from flood risk zones. It is recognised however that the overall sustainability of the growth in terms of existing communities and other targets requiring priority use of brownfield sites will make complete avoidance difficult if not impossible.

5.4 Raising ground levels is sometimes proposed as a way of reducing the risk of flooding to an area. As this may potentially increase flood risk elsewhere, it is not always an appropriate mitigation measure. This will need more detailed consideration on a site by site basis.

5.5 Flood defences have historically been seen as the conventional way of managing flood risk from rivers, although their construction and upkeep can be costly. As compared with avoidance measures, flood defences only increase the standard of protection and measures still need to be in place to forecast and manage extreme events above this standard, including safe evacuation when necessary. Due to the steep nature of the terrain, relatively little of the district is currently protected by flood defences.

5.6 Reducing the amount of surface water running off development can also reduce and hence manage the risk of flooding. Balancing ponds and other sustainable urban drainage systems (SUDS) can be suitable in many areas. These can also help in those situations where inadequacy of the surface / foul water drainage network contributes to flooding.

Abstraction management

5.7 To remove or abstract water from a surface source (e.g. river, stream, etc) or from an underground source and take more than 20 cubic metres (approximately 4,400 gallons) a day will in most cases require an abstraction licence from the Environment Agency. This includes abstraction for public water supply and is intended to ensure that water resources are safeguarded and that abstractions do not damage the environment. Unregulated abstraction could lead to water supply shortages, damage to wildlife habitats and loss of enjoyment.

5.8 River flows are often difficult to measure precisely, particularly in flood or drought conditions, and can be substantially affected by geology and land use. To help inform the appraisal process, the Environment Agency has installed hydrometric gauging stations. Flow monitoring data from the stations relevant to Mansfield District (Marsh and Hannaford, 2008) is presented in Table 2. The location of these stations is illustrated in Figure 6.

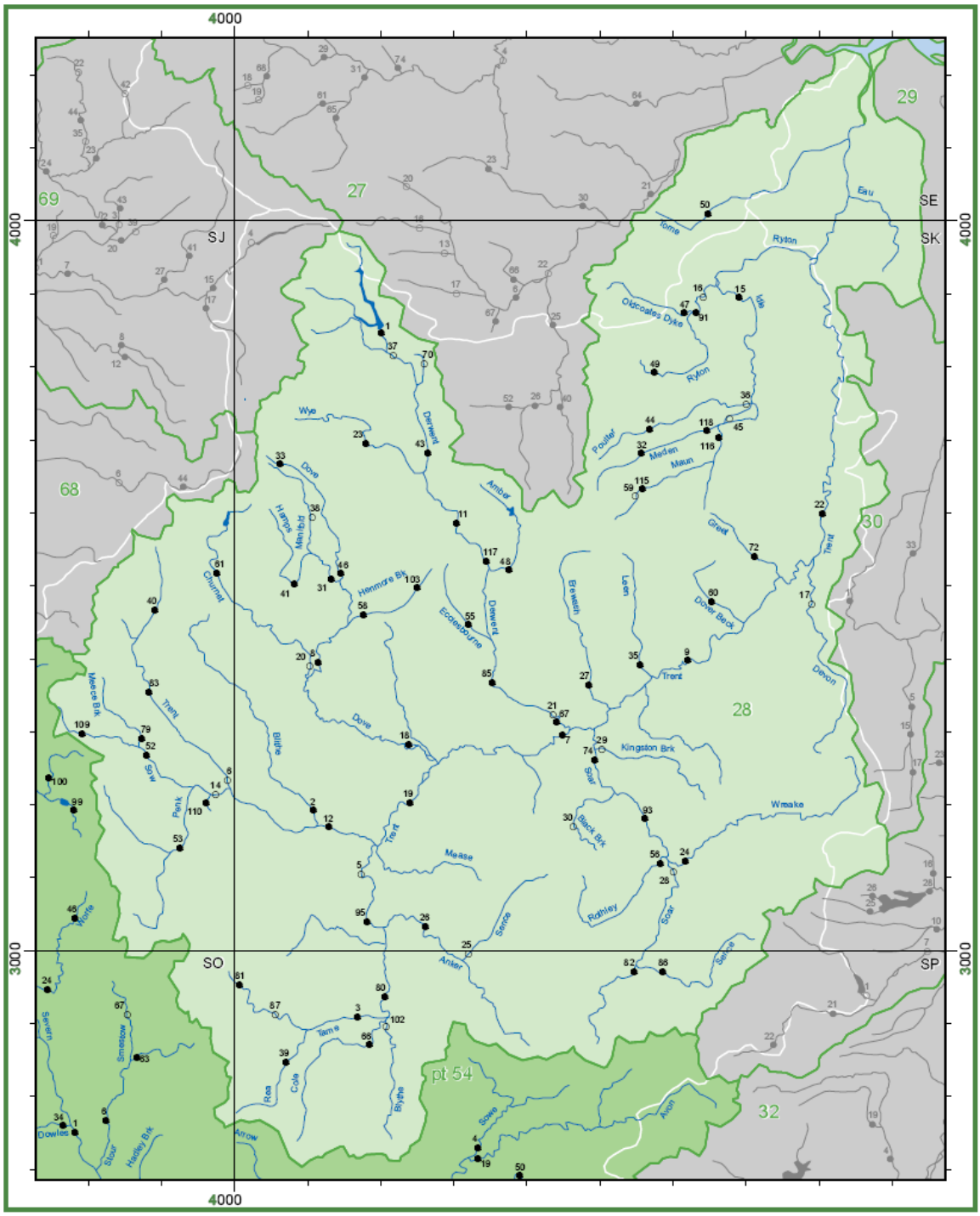
Table 2: Gauging Station Register
(*Source: Marsh and Hannaford, UK Hydrometric Register - hydrological data UK series. Centre for Ecology and Hydrology, 2008*)

Gauging Station *(ref.)*	Catchment (km^2)	Record History	Mean Flow (m^3s^{-1})	Peak Flow (m^3s^{-1})	Minimum Flow(m^3S^{-1})
River Maun					
Mansfield STW *(59)*	28.8	1966-1984	0.46	21.3 (1979)	0.14 (1976)
Mansfield at the Dykes *(115)*	31.5	1996-2005	0.68	18.7 (2004)	0.34 (1996)
Whitewater Bridge *(116)*	157.0	1997-2005	0.87	10.1 (2000)	N/A
River Meden					
Church Warsop *(32)*	63.0	1965-2005	0.59	13.0 (1977)	0.15 (1978)
Perlethorpe *(118)*	97.0	2002-2005	0.72	N/A	N/A
River Idle					
Meden/Maun Confluence *(45)*	262.6	1965-1984	1.69	N/A	N/A

5.9 The River Maun and River Meden have a relatively small flow and consequently have a mean flow of less than 1 cubic metre per second. There is no significant increase in the mean flow downstream despite there being a reasonable increase in the catchment, particularly in the River Maun. The flow data presented in Table 2 supports the view that the rivers in Mansfield are generally unable to support large abstractions. There is limited water to dilute pollution sources, and as such the water quality within the rivers will be particularly sensitive to effluent discharge.

Figure 6 – Location of River Trent Gauging Stations

(*Source: Marsh and Hannaford, UK Hydrometric Register - hydrological data UK series. Centre for Ecology and Hydrology, 2008)*



5.10 The Mansfield STW gauge was situated immediately d/s of the STW. The flows were augmented by runoff from the urban areas of Mansfield and Sutton in Ashfield which was considered to effectively increase the catchment area by 5km^2. River rises on Magnesian Limestone and crosses onto Permian Sandstone. Due to drowning out as a result of summer weed growth and rubbish accumulation, the station closed in 1984.

5.11 The Mansfield at the Dykes station was also reported prone to u/s siltation affecting calibration. With low flows dominated by sewage effluent the station was considered to have a very atypical water balance.

5.12 The Whitewater Bridge Station was built to measure flows d/s of the Sherwood Sandstone aquifer. The River Maun is considered influent in Sherwood Sandstone reaches (i.e. it loses water as flows above the watertable and contributes to it by natural leakage through the bed.

5.13 The River Maun rises on generally sandy faces of the Magnesian Limestone. The Church Warsop gauging station measures flows entering the Sherwood Sandstone outcrop. Mining subsidence in 1976 caused drowning of the flume until d/s channel regarded in 1981. Station closed 1984-1990.

5.14 The Perlethorpe gauging station is influenced by sewage effluent augmenting low flows and the catchment is influenced by urban areas, including Sutton in Ashfield in the headwaters and parts of Mansfield Woodhouse.

5.15 The Meden/Maun confluence station is a combination of flows from the daily mean flows from the Meden at Bothamshall and the Maun at Haughton.

5.16 The EA (2002) produced *Water Resources for the Future – a strategy for the East Midlands*. This forms a framework for the management of water resources over the next 25 years. The Strategy concludes that:

- Future developments in the East Midlands should recognise the limited availability of water as an influence on their location and timing, and should incorporate water efficiency measures and sustainable drainage systems at the feasibility or planning stage;
- Water abstraction cut-backs are necessary in some areas to improve the environment;
- A 'twin-track' approach to meeting future demands should be followed, combining further water resource developments and improvements with sensible management of demands through efficient use;
- The River Trent Water has the potential to provide a sustainable source for public water supplies in the East Midlands;
- Water companies should maintain the good progress made in recent years to reduce mains leakage and give further attention to leakage control if necessary;

- Over the next 25 years, it is expected that household water metering will become more widespread, providing a greater incentive for sensible use of water in the home, with appropriate tariffs to protect vulnerable households;

- Industry should strive to use water efficiently;

- Farmers should strive to use water efficiently and consider opportunities to work with others to develop new sources of water and consider the development of winter storage to ensure reliable supplies; and

- Climate change studies suggest summers could become drier and winters wetter. Water resource options that are flexible to the possible impacts of climate change are preferred.

5.17 Consequently, increased restrictions are expected to be placed on abstraction licences to protect existing licences and improve environmental performance.

Waste water management

5.18 Although local hydrologic models exist for some areas within Mansfield District (e.g. in response to sewer flooding), at present no district wide models are available for the capacity of the waste water collection system. Severn Trent Water has confirmed they have commissioned Jacobs Babtie (Jacobs) to construct hydraulic sewer models for the New Growth areas within their service area, but are not proposing to have any constructed for sites in Mansfield District.

5.19 Combined sewers can be affected by unattenuated runoff and in times of extreme rainfall, the capacity of the combined system may be exceeded resulting in overflow, usually to a river through a combined sewer outfall. Some kind of remediation works, such as diverting sewer flows or attenuating surface water inputs through suitable storage systems is therefore likely to be required where future development would exacerbate this situation.

5.20 The release of effluent into the environment is regulated under the Water Resources Act, 1991 by the EA through the issuing of discharge consents. The EA calculates discharge consents based on the quality and volume of the waste water and the quality and volume of the receiving watercourse. The waste water must not contain more polluting material than can be broken down in the river without significant impact on water quality or biodiversity.

5.21 The polluting capacity of treated sewage effluent is principally determined using its Biochemical Oxygen Demand (BOD) which measures the capacity of the waste water to use up oxygen in the river and ammonia which also uses up oxygen in the river, but is also toxic in its own right. If a river is small and the volume of effluent large, then the quality of effluent must be high in order to protect river quality. If however the river is large then there is more dilution and a more relaxed standard can be applied to the effluent.

5.22 An essential element of the Urban Waste Water Treatment Directive (UWWTD) and its subsequent amendments is that quality standards for effluent fall into categories depending on size of the STW and sensitivity of receiving watercourse.

5.23 The Directive has been transposed into UK legislation through the Urban Waste Water Treatment (England and Wales) Regulations, 1994. These were amended in 2003 to clarify matters concerning Sensitive Areas and require all significant discharges to be treated to at least secondary treatment, i.e. using a biological treatment process, prior to discharge to the environment (Defra, 2003).

5.24 Severn Trent Water has continued capital investment in its STW assets either for maintenance or to improve performance to meet any new health, safety or environmental requirements through its AMP submissions. Sewerage undertakers have extensive rights to carry out development without the need to obtain planning permission under the General Permitted Development Order 1995. Development, involving large items of plant and machinery (excluding buildings), and repairs to sewers, can be carried out within existing operational sites without the submission and approval of a planning application.

5.25 New STWs require planning permission due to potential environmental impacts of STWs, including offensive odours and flies. In some instances, an Environmental Statement will be required, depending on the size, nature and location of the development proposed.

5.26 To reduce the scale of environmental impacts, STWs are often located in areas relatively remote from housing on the edge of settlements. In addition, water companies like Severn Trent Water operate a "*cordon sanitaire*" policy, which seeks to influence the type of development which might take place near existing STWs. The "cordon sanitaire" is a site specific limit ranging from 25 to 400 metres, which varies according to the type of processes carried out, the size of works, industrial effluents involved, landuse around the site, any anticipated extensions and site topography.

5.27 STW developments that require planning permission are County matters and over the last ten years Nottingham County Council (2009) has granted permission for the following:

- Digestion plant at Mansfield STW in 1997 (PL0652);
- Chemical dosing plant at Church Warsop STW in 2001 (PL1325);
- Erection of three kiosks at Edwinstowe STW in 2001 (PL1328);
- Erection of two chemical dosing kiosks and one tertiary kiosk at Rainworth STW in 2001 (PL1330);
- Construction of a sludge thickener building, blower and control building and creation of temporary adjoining storage area at Mansfield STW in 2003 (PL1803);
- Installation of activated sludge plant at Sutton in Ashfield STW, Unwin Road, (u/s of Mansfield STW) in 2003 (PL1741);
- Erection of a control kiosk and blower kiosk at Skegby STW, Dawgates Lane, (u/s of Warsop STW) in 2003 (PL1765);

5.28 During 2004, all of Severn Trent Water STWs complied with the regulatory water quality standards. Their record of compliance shows they have consistently met these standards for discharges at, or very close to, 100% for the past 10 years.

5.29 Despite this record, it was confirmed in the further action was necessary in AMP4 to further reduce the environmental impact of the company's effluent discharges. This included reducing phosphorus levels in sewage effluents at 22 sites to reduce eutrophication (the effects of excessive growth of plants and algae) in waters designated as Sensitive Areas under the UWWTD. As this includes the River Idle, Mansfield Bath Lane STW, Warsop STW, Edwinstowe STW and Rainworth STW were all included, as was the Sutton in Ashfield STW on the River Maun upstream of Mansfield.

5.30 In the June 2005 return (Ofwat, 2009), it was reported that the Mansfield STW and Sutton in Ashfield STW improvements required under the UWWTD had been delivered. In the June 2007 return, it was reported that the Church Warsop STW had been upgraded. The two outstanding schemes remain to be reported. Ofwat has confirmed they intend to publish the June 2009 return (excluding commercial in confidence data) as submitted by water companies in June 2009 – without accompanying commentaries at that point.

5.31 In June 2007, Severn Trent Water also detailed progress on improvement schemes identified as necessary to accommodate growth (Ofwat, 2009). Of the STWs relevant to Mansfield District, only Edwinstowe had been identified. The report on status confirmed that no assessment had been completed to date.

5.32 Future improvements to the waste water collection and treatment network to accommodate growth are difficult to predict as reliant on detailed capacity studies or reports of failures or predicted failures. Within their draft business plan for 2010-2015, Severn Trent Water stated that the serviceability of water treatment assets is stable in terms of complying with performance measures. However, their models for forecasting asset deterioration and service impacts indicate that an increase in maintenance spend will be needed in AMP5 in order to maintain a high level of performance compliance.

5.33 Details are awaited from Severn Trent Water on what, if any, schemes for growth relevant to Mansfield District will be delivered through AMP5. If additional schemes are needed, unless they can be justified through the Change Protocol, it is likely any necessary improvements will only be accommodated in future AMP rounds.

5.34 If a STW needs to expand due to new development it may also be necessary to apply to the EA for a new discharge consent to cater for the increased flow. The EA may grant this, but is likely to set tighter limits on the pollutant concentrations to ensure the overall loading is unaltered.

5.35 Within the East Midlands, river water quality is affected by many factors. These can generally be divided into point sources, which have a traceable discharge point such as STWs, and diffuse sources, such as runoff.

5.36 The EA method for comparing the water quality of individual stretches of watercourses is known as the General Quality Assessment scheme (GQA). It is designed to provide a consistent assessment and hence indicate changes over time.

5.37 Quality grades are assigned to various attributes. The three most commonly reported are:

- Water chemistry – based on dissolved oxygen, biochemical oxygen demand and ammonia (A: Very Good to F: Bad);
- Biological quality – based on macro-invertebrates (A: Very Good to F: Bad);
- Nutrient status – based on levels of phosphate (1: Very Low to 6: Excessively High) and levels of nitrate with grades (1: Very Low to 6: Very High);

5.38 The EA has provided the 2007 GQA grades for watercourses within Mansfield District relevant to this WCS. These are summarised in the Appendix.

5.39 The criteria used to establish these grades are set out in Table 3 below.

Table 3a: Water Chemistry Grades

Water Quality	Grade	Dissolved Oxygen (% Saturation) 10%ile	BOD (mg/l) 90%ile	Ammonia (mg/l) 90%ile
Very Good	A	80	2.5	0.25
Good	B	70	4	0.6
Fairly Good	C	60	6	1.3
Fairly Good	D	50	8	2.5
Poor	E	20	15	9
Bad	F	<20	>15	>9

Table 3b: Biology Grades

Water Quality	Grade	EQI for Taxa	EQI for ASPT
Very Good	A	0.85	1
Good	B	0.7	0.9
Fairly Good	C	0.55	0.77
Fairly Good	D	0.45	0.65
Poor	E	0.3	0.5
Bad	F	<0.30	<0.50

Table 3c: Phosphate Grades

Classification for Phosphate Grade	Grade Limit (mg P/l) Average	Description
1	<0.02	Very Low
2	>0.02 to 0.06	Low
3	>0.06 to 0.1	Moderate
4	>0.1 to 0.2	High
5	>0.2 to 1.0	Very High
6	>1.0	Excessively High

Table 3d: Nitrate Grades

Classification for Nitrate Grade	Grade Limit (mg NO3/l) Average	Description
1	<5	Very Low
2	>5 to 10	Low
3	>10 to 20	Moderately Low
4	>20 to 30	Moderate
5	>30 to 40	High
6	>40	Very High

5.40 Whereas GQA is an assessment of current water quality, River Quality Objectives (RQOs) are targets for water quality. The RQO target is based on the potential use that could be made of the water and is therefore specific to each stretch. It is calculated using eight parameters: Dissolved Oxygen, Biological Oxygen Demand, Total Ammonia, Un-ionised Ammonia, pH, Hardness, Dissolved Copper and Total Zinc. A river will be classified as either a Pass, Marginal or Fail. Pass and Marginal (where the size of the failure was too small to be statistically significant and could have been due to natural variability) are both treated as compliance. Across the East Midlands as a whole

- 77% of watercourses passed;
- 11% had significant failures
- 13% had marginal failures,

5.41 If a river fails to meet its target an action plan is put in place. Actions can range from improving water quality so that it can support fish to being suitable for drinking water supply. The EA has confirmed that there are no current strategies in place to improve the RQOs of any watercourses within Mansfield District.

Water management

Water demand management

5.42 PPS11 and PPS12 emphasise the need for water efficiency as part of sustainable development. In addition, Department of Communities and Local Government requirements for the sustainable communities' plan include higher standards of water efficiency and 25% savings. Government has stated a greater need for higher standards of water efficiency in response to the regional water resources position and the Water Act 2003 places a duty on statutory undertakers to achieve further water conservation and on public authorities to take into account the desirability of conserving water supplied to premises.

5.43 Per Capita Consumption (PCC) figures used by Severn Trent Water take into account factors such as occupancy, house type and a classification of residential neighbourhood class. Unmeasured household PCC is predicted to fall from 145 l/h/d in 2006/07 to 135 l/h/d in 2034/35, whilst measured household PCC is predicted to rise from 122.50 l/h/d in 2006/07 to 140 l/h/d in the same period.

5.44 Whilst growth within Mansfield District could be expected to increase demand for water, to meet Government requirements, new development in the long term should expect to be as water neutral as possible (i.e. water demand remains as if the development had not taken place). In addition to leakage control and metering, this is likely to require innovative water management techniques such as rain water harvesting and dual water systems.

5.45 Severn Trent Water expects to meet leakage targets set by Ofwat. Whilst the EA wish to see Water Companies continuing to use new technology to drive leakage down further in future, especially where water resources are scarce, Severn Trent Water consider that higher capital investment will be needed to achieve significant further reductions in leakage.

5.46 Some 27% of treated water within the Severn Trent Water supply zone is currently unaccounted for and therefore classed as leakage. Within their draft WRMP, Severn Trent Water state that their strategy in AMP4 was to drive leakage down by 17Ml/d through a combination of measures, including:

- Improving proactive and reactive leakage control;
- Implementing their Accountability Zones programme to enable improved leakage reporting and targeting in trunk mains;
- Replacing around 300 km of water mains per annum;
- Installing continuous pressure monitoring at around 4000 critical pressure points within the Severn Trent Water network;
- Offering a free or subsidised customer owned supply pipe repair and replacement service;
- Working with contractors and academics to improve leak detecting technology.

5.47 Their policy is to continue to achieve and maintain the economic level of leakage during AMP5 and over the longer term.

5.48 As use of metered water is generally 5-15% lower than unmetered water, metering can encourage more conservative water usage in properties. All new build is now metered and increasingly more existing customers are to be metered in the long term. In 2006/2007, Severn Trent Water considered 28% of households within their supply region to be metered. The draft WRMP predicts that as a minimum this will rise to 66% of the housing stock by 2035. This is expected to be achieved through the uptake of free meters rather than compulsory metering of existing customers.

5.49 The Sustainable and Secure Buildings Act, 2004 strengthens the Building Act 1984 to improve sustainability of buildings especially in the areas of energy and water use, and the enhancement of biodiversity.

5.50 The Code for Sustainable Homes current target restricts water in new houses to 105 litres per capita per day (Code Level 3). Government has set a target for all houses assessed to achieve 80 litres per capita per day (Code Level 6) by 2016. The Code uses a points system, with higher degrees of sustainability achieving higher points. In relation to water use, points are awarded for internal potable water consumption, (i.e. reduced toilet cistern sizes), external potable water consumption (i.e. water butts, grey water recycling and rainwater harvesting), surface water run off (specifically the use of SUDS) and flood risk, which is generally based on development location.

Water Framework Directive

5.51 The Water Framework Directive (WFD) is a way of developing strategic approaches to the management of water quality and quantity. The aim of the Directive is that all water bodies should reach good ecological status or good potential in the case of heavily modified water bodies. This will be achieved through a programme of measures contained in River Basin Management Plans.

5.52 The EA published draft River Basin Management Plans in December 2008. Mansfield District is within the Humber River Basin Management Plan. A great deal of work has already been done to identify the environmental pressure in each catchment and whilst detailed measures and mechanisms by which targets will be achieved have yet to be fully established, it is foreseeable that this is likely to have implications both on the location and design of at least some future development.

5.53 The WFD provides for river quality objectives to be achieved by the most cost-effective means, and that objectives can be modified if they can only be achieved at disproportionate cost. Some of the currently suggested solutions will require specialist treatment equipment such as membrane bio-reactors. In its draft business plan 2010-2015, Severn Trent Water states that it does not consider that very tight ammonia or BOD consents will be cost effective solutions to achieve river quality standards, in view of the power and chemical costs involved. They intend to discuss this issue further with the EA before submission of the Final Business Plan.

5.54 Severn Trent Water is proposing to achieve WFD objectives over three six-year cycles through to 2027. They believe this will give them the maximum opportunity to develop cost-effective solutions, timed to coincide with schemes to maintain assets or increase capacity to meet increased demand as a result of growth. Discussions with the EA indicate that there is potential for very large numbers of obligations for future AMP cycles.

Biodiversity

5.55 Within the draft WRMP, Severn Trent Water identify Sites of Special Scientific Interest (SSSIs), water related SSSIs, Special Areas of Conservation and Special Protection Areas across their supply area. It is noted that within the East Midlands Water Resource Zones (WRZ) there are eight Natura 2000 sites (sites designated under the Habitat Regulations) and 123 water-dependent SSSIs.

5.56 No Natura 2000 sites are located within Mansfield District Council. However, two SSSIs are located within the District and are dependent upon receiving water from the Triassic Sandstone aquifer and/or watercourses and therefore classed as water-dependant SSSIs:

- Hills and Holes and Sookholme Brook, Warsop SSSI
- Rainworth Lakes SSSI

Hills and Holes and Sookholme Brook SSSI

5.57 This site is situated on the River Meden, just west of Market Warsop. Water abstraction may affect this SSSI.

5.58 It is noted in the Idle and Torne CAMS that Natural England has identified the vulnerability of the Hills and Holes and the Sookholme Brook SSSI on the River Meden to damage as a result of abstraction and have produced a 'Views About Management' plan. The SSSI has also been included within the EA Restoring Sustainable Abstraction (RSA) Programme under which monitoring of the impact of abstraction on the site is underway.

5.59 The SSSI condition report for Hills and Holes and Sookholme Brook SSSI (Natural England, 2009), indicates that almost 89% of the designated area is in unfavourable but recovering condition. This applies to the grassland areas of the site. The rivers and streams of the site are considered to be in unfavourable condition due to drainage and water pollution from farm runoff.

Rainworth Lakes SSSI

5.60 This site is situated south-west of Rainworth on Rainworth Water a tributary of the River Maun.

5.61 The SSSI condition report for Rainworth Lakes SSSI (Natural England, 2009) indicates that 71% of the designated area is in unfavourable but recovering condition. The standing open water on the site is considered to be in unfavourable condition due to siltation and water pollution in the form of discharges.

Other SSSIs

5.62 Taversal Pasture is situated on the River Meden. The site occurs outside of the Mansfield Boundary, but within the 2 km buffer of the Mansfield District Boundary shown within the Mansfield SFRA. The site is situated north of Skegby.

5.63 One of the habitats on site is classified as fen, marsh and swamp and could therefore be affected by abstraction. Where water levels of flows are under pressure, from over abstraction or low flows, special care must be taken not to let the natural water supply fall below critical thresholds. This may become especially problematic with the extra demands on water supply from increased development. Due to concerns that some abstraction of water could be contributing to environmental damage of rivers and wetlands, the EA RSA programme may result in abstraction reductions being identified.

5.64 Water Vole *Arvicola terrestris*, Otter *Lutra lutra,* and Fresh-water White-clawed Crayfish *Austropotamobius pallipes* are listed as BAP priority species by the Nottinghamshire local Biodiversity Action Plan which covers Mansfield District.

5.65 Water Vole and White-clawed Crayfish are shown by the Mansfield SFRA to be present in both River Maun and River Meden.

5.66 BAP priority habitat listed in the Nottinghamshire local BAP includes rivers and streams, standing open water and canals, eutrophic standing water, mesotrophic lakes, reedbeds and wet woodland.

Green infrastructure

5.67 The concept of green infrastructure is rooted in sustainable development and provides multiple benefits for people and wildlife alike. These include:

- Ensuring a more resilient environment which is better adapted to mitigating impacts associated with climate change such as increased flooding, rising temperatures and losses to biodiversity;

- Providing a pleasant environment for attracting inward investment including improving and sustaining land values, providing resources for tourism, and attracting people to the district to live, work and spend their leisure time; and

- Providing a range of outdoor recreation and healthy lifestyle opportunities though cycle routes, public rights of way, play areas, outdoor sports pitches and informal recreational pursuits such as allotment gardening and fishing.

5.68 Green infrastructure comprises a range of 'green' assets and resources including open countryside, nature reserves, parks, woodlands, hedgerow, watercourses and potentially surface water management measures such as SUDS. Together, these form networks of natural and managed green areas within urban, urban fringe and rural settings.

5.69 Mansfield has nine local nature reserves (LNRs) and three popular trails - the Meden Trail, Maun Valley Trail and the well known Timberland Trail. The Timberland Trail links the people of Mansfield with the Maun Valley LNR, Titchfield Park, the town centre and Vicar Water Country. In doing so, it creates opportunities for both recreation and enjoyment of nature.

5.70 The rivers Maun and Meden also provide important green corridors for people and wildlife. The river corridors play strategic roles in linking green spaces together and providing opportunities for urban regeneration and wildlife enhancement.

5.71 Within Mansfield District, the River Maun makes its way through Hermitage, Oakham and Quarry Lane LNR, Mansfield Town centre, the Maun Valley LNR and then through the countryside towards Edwinstowe. Whilst an open channel for much of its course, it is culverted underground in two sections near the town centre. The Maun supports rare species such as the White-clawed Crayfish and Water Voles and is popular with both anglers and walkers (Mansfield District Council, 2009).

Photograph 1: Sign board of Maun Valley Park Local Nature Reserve

5.72 In contrast, the River Meden is less developed and has a more rural character. It supports rare habitats such as wet grasslands and wet woodlands and historic water meadows. The Meden flows through the Pleasley Vale area along the Meden trail towards Sookholme and up through Market Warsop, Meden Vale and then on towards Budby Forest within the Sherwood Forest region.

5.73 The current Mansfield District Local Plan was adopted in 1998 and was intended to guide development in the district until 2006. It is noted in the Mansfield District Local Plan that besides being an important green spur into the built up area of Mansfield Urban Area, the area along the Cauldwell Brook is a buffer between the industrial area off Hermitage Lane and housing to the east. Under Policy NE5, planning permission will not be granted for developments which would either detract from the openness and landscape quality of this green wedge. This is relevant to the River Corridor component of potential growth area A – Mansfield Urban Area.

5.74 It is also noted in the Mansfield District Local Plan that the green wedge along the Maun Valley brings the countryside to within half a mile of Mansfield Town Centre. The area provides a valuable recreational; and ecological asset close to the communities of Mansfield Woodhouse and Forest Town. Under Policy NE5, planning permission will not be granted for developments which would detract from the openness and landscape quality of this green wedge. This applies to the river corridor component of potential growth area D - North of Forest Town.

5.75 Under Policy NE4 of the Mansfield District Local Plan, planning permission will also not be granted for any developments which would detract from the open character of sensitive gaps between settlements. This includes the open break along the River Meden valley that helps prevent coalescence of Market Warsop with Church Warsop. This is relevant to the north and west component of potential growth area E – Market Warsop.

5.76 Mansfield District Council has taken the opportunity to bring forward a number of Interim Planning Guidance (IPG) notes to be used as material planning considerations in the interim period before new policy documents can be brought forward as part of the LDF. In accordance with the Government agenda on sustainable development, Mansfield District Council considered it important to have guidance in place in reference to Green Infrastructure. Consequently, IPG Note 11 was produced by Mansfield District Council in partnership with Nottinghamshire Wildlife Trust and with support from the Greenwood Community Forest and Nottinghamshire County Council (Mansfield District Council, 2009).

5.77 The production of this green infrastructure IPG opens opportunities for maintaining and enhancing the ecological and recreational potential of the five potential growth areas. These, along with opportunities for combined flood risk management solutions are unlikely to be fully realised without being integrated with a WCS.

5.78 Enhancement opportunities specific to the Meden catchment include introduction of Green SUDS between Hills and Holes and Sookholme Brook SSSI and The Carrs LNR. Green SUDS are considered to be systems which have a notable ecological benefit through the creation of wildlife habitats and can provide a link between existing fragmented areas of habitats or wildlife populations (RPS 2008). Restoration of flows to Vicar Water, Rainworth Water and Foul Evil Brook presents a significant opportunity to enhance the biodiversity at these locations. The restoration of flows could be achieved through the following:

- Prioritise the use of soakaways throughout the low flow catchment;
- Minimise surface water discharge into public sewers which drain surface water away from its natural catchment; and
- Maximise opportunities for controlled discharge into Vicar Water, Rainworth Water and Foul Evil Brook (SFRA, 2008).

Climate change

5.79 Whilst the UK climate has varied greatly over time due to natural causes, human activities are now considered to be causing major and rapid changes. Whilst the detail of what climate change will mean, the East Midlands Sustainable Development Round Table published a report in 2000 following a study to investigate the potential impacts of climate change in the East Midlands. An update to the report based on reviewed climate models was published in 2004 (Waters, 2004).

5.80 By 2050, it is anticipated that:

- Annual mean temperatures could rise by up to 2.3°C;
- Winter rainfall could increase by up to 13%; and
- Summer rainfall could decrease by up to 18%

5.81 By 2080, it is anticipated that:

- Average annual temperatures may increase by up to 5°C;
- Winter rainfall may increase by up to 30%; and
- Summer rainfall may decrease by up as much as 60%.

5.82 These predictions have been made by the UK Climate Impacts Programme (UKCIP) using a computer model based on natural variation and human influence. As the main human influence is the emission of greenhouse gases, climate change depends upon how much of these are released. The model was used to predict changes in climate based on two different scenarios; one using high emissions of greenhouse gases, the another using low emissions.

5.83 In both scenarios, in addition to winters becoming wetter, there will also be increased risk of extreme weather events such as storms, floods and droughts. Responding and adapting to climate change requires well-informed planning policy. Examples of climate change adaptation measures potentially include sustainable drainage systems, more efficient and integrated distribution networks for potable water, demand management though measures such as metering, low water use toilets and rainwater harvesting, and re-use of waste water.

5.84 In their response to comments received on the assessment presented in the draft WRMP, Severn Water recognise the need to do more detailed analysis of the implied climate change impacts on future supply / demand balance, notably because this issue is driving significant future investment in new water resources.

5.85 Comments received on the draft WRMP also suggested that Severn Trent Water should be using the latest climate change scenarios from UKCIP09, rather than UKCIP02. In response, Severn Trent Water noted the new UKCIP09 Climate Change Impact Scenarios were not published in time to inform the final WRMP plan. Severn Trent Water has agreed to review how the new scenarios affect their plans when they become available and report the results of this analysis through the annual review of the WRMP.

5.86 Severn Trent Water also noted that in the draft WRMP they were following the methodology prescribed by the EA for assessing the impacts of climate change on deployable output. Because of time limitations, to assess the likely scale of impact, they used the 'factors' method rather than the more detailed rainfall – runoff of approach. Since publication of the draft WRMP, they have extended the record of river flows used and assessed the impact of climate change using the full rainfall-runoff method across four river flows scenarios:

- No-impact baseline;
- Dry climate change;
- Mid-range climate change; and
- Wet climate change

5.87 This has enabled Severn Trent Water to re-analyse the likely impact of climate change on deployable output down to the local catchment scale.

5.88 Since the draft WRMP, they have also done more work to assess the impacts of climate change on their groundwater sources, including those in limestone aquifers. Under the mid range climate change scenario, the impacts are not as significant as predicted. Instead of East Midlands WRZ having deficit of -85.63 Ml/d as reported in the draft WRMP, the deficit to be reported in the final WRMP is -38.82 Ml/d. However, under the more extreme, dry scenario there are some potentially large reductions in recharge and deployable output. These more extreme impacts have been incorporated into their headroom assessments.

6 WATER CYCLE INFRASTRUCTURE CONSTRAINTS ON GROWTH

Flood risk scoping

6.1 The three main flood risks to growth are:

- Flooding from a watercourse
- Flooding from runoff
- Flooding from sewers

Flooding from a watercourse

6.2 Despite their prominence within the study area, the relatively steep topography means that flooding from the River Maun and River Meden and their contributory streams only impacts 3% of the district (RPS 2008). In Mansfield District, only 20 properties flooded in the summer floods of 2007 (Nottingham County Council, 2008).

6.3 Developments within those areas of the district close to watercourses will be affected by land drainage problems due to the limited carrying capacity under high flows. This has been captured within this WCS scoping study through identification of the river corridors within the potential areas for growth as separate sub-areas.

6.4 The Mansfield SFRA (RPS 2008) also identified land to the south-east of district (eastern end of potential growth area B) and land to the west of Abbott Road (southern end of area C) as the two areas with least available capacity for watercourse drainage. The MARR at Pleasley was closed twice in 2007 due to flooding.

6.5 The risk assessment in relation to surface flooding for each of the five potential areas under consideration in this WCS scoping has been summarised in Appendix A (Table A1). As developments can significantly increase water discharges, developers are likely to be required to provide off-site watercourse improvements, on-site water balancing or other measures to mitigate the effects.

Flooding from runoff

6.6 Mansfield District has steep topography such that the risk of flooding from surface runoff requires consideration. Much of the District has good ground permeability such that average surface water runoff in wet weather is very low with most rain on soft areas being absorbed by the ground.

6.7 There are several sources within Mansfield District which contribute to an increased risk of flooding from surface runoff, namely; densely urbanised areas, highways and disused coal tips. Higher rates of runoff from the extensive Mansfield Urban Area and Sutton in Ashfield upstream effectively increases the catchment area by approximately 5km^2

6.8 The likelihood and severity of surface runoff is increased where topography tends to concentrate flows, such as valleys or at the base of hills. The risk of surface runoff is also associated with large areas of impermeable or low permeability. The SFRA prepared for the district (RPS, 2008) identifies the following areas as being at risk from concentrated runoff and/or low permeability of the ground:

- Mansfield Woodhouse where the combination of dense urbanisation and low permeability soils will contribute to an increased risk of surface runoff, although no significant flow concentrations were identified in the SFRA;

- Southwest Mansfield where an extensive area of low permeability soil on the western boundary of the district is considered to contribute to a high risk of surface runoff. Surface runoff has historically affected parts of the MARR further north where topography and infrastructure leads to a concentration of flows. However, it was concluded that this should not preclude development.

- Properties in the vicinity of Pleasley Square are considered to be at risk of surface runoff. Although this would normally be mitigated by storm drainage which discharges surface water into the River Meden, the SFRA recommends avoiding development in this area;

- The northern end of Market Warsop where an area of low permeability soil will contribute to an increased risk of surface runoff, although for the most part this is already characterised by urbanised areas.

6.9 Across the district as a whole, whilst the overall risk of surface runoff remains moderate to low due to topography and dense urbanisation, the risk of incident remains moderate to high in localised areas. Where these areas overlap with the five potential areas under consideration in this WCS scoping has been summarised in Appendix A (Table A2).

Flooding from sewers

6.10 The most recently constructed sewers in Mansfield District have been designed to a 1 in 40 year storm and therefore have some spare capacity. Most of the network across Mansfield District will fall well below this standard as it was constructed in the past when design standards were lower.

6.11 Whilst Severn Trent Water has been unable to provide information on the design standard of specific sewers, they have confirmed that a strategic Return Period Analysis (RPA) undertaken on their behalf has revealed that the sewer system in general does not have significant spare capacity.

6.12 According to Severn Trent Water (2007), sewer flooding is the worst service failure their customers can experience. There are two main reasons why sewer flooding occurs:

- Sewers become overloaded at times of high rainfall; and

- Sewers fail to operate effectively due to problems such as blockages, collapses or pumping station failures.

6.13 In the June 2007 return (Ofwat, 2009), Severn Trent Water confirmed their practice for defining sewer flooding as an escape of sewage from the public sewerage system where the following criteria are met:

- Damage to a property or belongings, or
- Sewer flooding affects a widespread area, or
- Clean up and disinfection takes more than 15 minutes

6.14 It was noted in both the Mansfield SFRA (RPS 2008) and more recent Ashfield SFRA (Ashfield District Council, 2009), as well as confirmed during discussions over this WCS scoping study, that Severn Trent Water are unable to publicly identify specific locations where there has been an incident of sewer flooding.

6.15 As no information specific to the potential growth areas was forthcoming from Severn Trent Water, it is not possible in this WCS scoping study to comprehensively scope those locations in the District that may be at risk of sewer flooding.

6.16 A literature review has revealed very few incidents of sewer flooding in the District. There have been a few reported incidents within Mansfield itself, most recently during the June 2007 flooding when manholes surcharged in Bridge Street. The SFRA also showed that the Bridge Street area of Mansfield Town was particularly vulnerable to sewer flooding (RPS, 2008). Other areas that appear to have limited storm water capacity in the sewer network are land towards the south-east of Mansfield between Bellamy Road and Rainworth and land to the west of Abbott Road.

6.17 Developments in these areas, as well as elsewhere, which result in significant surface water discharges that cannot be accommodated by current storm water sewerage systems without undertaking improvements to the system should expect to be required to provide on-site mitigation. This is in accordance with Government advice contained within Circular 30/92 "Development and Flood Risk".

6.18 Severn Trent Water (2007) research has shown that their customers would be prepared to pay for significant reductions in sewer flooding, particularly for internal flooding. Therefore a particularly strong focus of their future programme will be minimizing the number of properties subject to internal flooding.

6.19 In the June 2007 return, Ofwat (2009) noted Severn Trent Water had developed its own 'Cost-Benefit Analysis' tool to prioritise properties at risk of internal and external sewer flooding. This takes account of location, frequency and severity of the flooding. Application of this tool commenced in January 2007 but it will only fully apply to new flooding problems which arise after March 2007. Severn Trent Water states that a process to provide a complete cost-benefit assessment to meet Ofwat reporting requirements has been developed and will be ready for all schemes dealing solely with any problems that emerge in the future.

6.20 In response to two reported incidents of sewer flooding at unspecified locations in 2007, Severn Trent Water confirmed hydraulic modelling indicated the properties concerned had 20 year external protection. Whilst no action was taken in this instance, their aim is to eliminate sewer flooding of properties except as a result of exceptionally high rainfall which exceeds the design standards for their system. To achieve this they will increase their rate of addressing currently-known problems and dealing with any new ones that arise. They will also aim to improve forecasting to identify and resolve potential sewer flooding problems before they actually occur.

6.21 It is recognised that new problems are most likely to arise as a result of:

- New developments over previously permeable surfaces;
- Problems coming to light that had previously been unreported; and
- Changing weather patterns, with climate change predicted to lead to increased storm frequency, with storms spread throughout the year rather than concentrated in the summer. The implications of climate change are that addressing new sewer flooding problems arising from overloaded sewers will continue to be a significant part of the capital programme

6.22 Their intention is to have all sewer flooding incidents compliant with their cost-benefit analysis tool resolved within the relevant 5 year AMP period.

6.23 A key aspect of keeping down the growth in sewer flooding problems is dealing more effectively with surface water (rain water). Retaining surface water in the foul or combined sewerage system and passing it to sewage works for treatment is an inefficient use of the network and assets and potentially leads to flooding, reduced sewer capacity and an increased carbon footprint.

6.24 Severn Trent Water (2004) has also given a commitment to provide additional sewers and associated pumping stations to address new instances of flooding from their sewers which arise due to growth in water consumption; growth in runoff from new and existing developments, redevelopment, highway improvements; and changes in rainfall patterns. As such, they have stated that in their opinion there should be no long term issues of sewer flooding within Mansfield District.

6.25 In this context and the absence of detailed information, the issue of sewer flooding is not considered further within this section of the WCS scoping study.

6.26 The technical scoping of two other flood risk issues in relation to the five potential areas for growth is summarised in Table 4. Those areas with a low risk (green) means that they are deemed:

- Currently not subject to or at risk from undue flooding; and
- Not in areas of low permeability.

6.27 Those areas with a medium risk (amber) means that they are deemed:

- Subject to infrequent flooding (>100 year) or surface water flooding; and
- Subject to, or at some risk from, surface runoff.

6.28 Those areas with a high risk (red) means that they are deemed:

- Currently at direct risk of flooding from a watercourse; and
- In highly impermeable areas and therefore at risk of flooding from runoff.

Table 4: Flood risk constraints

Potential Development Area	Risk of flooding from a watercourse	Risk of runoff	Overall flood risk
(A) Mansfield Urban Area			
North West	Low	Medium	Medium
South West	Low	Medium	Medium
River Corridor	High	Medium	High
East	Low	Medium	Medium
(B) Southern Corridor			
Southern Corridor	Medium	Medium	Medium
(C) Pleasley Hill Regeneration Area			
North	Low	Medium	Medium
South	Medium	High	High
(D) North of Forest Town			
North	Low	Low	Low
River Corridor	High	Low	High
South	Low	Low	Low
(E) Market Warsop			
North & West	High	Medium	High
South & East	Low	Medium	Medium

6.29 Development to the north and south of North of Forest Town has the least risk in relation to overall flooding. Development in the north and east of Mansfield Urban Area, along the southern corridor and south or east of Market Warsop, constitute medium risk potential growth areas. Development in any other potential growth area constitutes a high risk largely due to the presence of the River Meden and River Maun floodplains or areas of low permeability in the case of the southern end of the Pleasley Hill Regeneration Area.

6.30 The southern section of this potential growth area has been earmarked for development as a business park (Photograph 2). In view of the low permeability of this area it will require careful design of its surface water and sewer drainage system.

Photograph 2: Sign board alongside MARR, south of Bull Farm

Water resources and supply risks scoping

6.31 The two main water resources and supply risks to growth are:

- Failure of water supply
- Inadequate water supply delivery infrastructure

Failure of water supply

6.32 Although Mansfield District is generally well served for water supplies, research at the regional level (Environment Agency, 2006) indicates potential water supply deficits in parts of the East Midlands WRZ over the period of the East Midlands Regional Plan. However, this assumes a continuation of current levels of leakage and water usage, and that no new water resources over and above those proposed in the current Water Resource Plan (2004) are developed.

6.33 Water companies have a duty to maintain the security of their supplies. To help achieve this they are required to update their Water Resource Plan every five years. This sets out forecasts of supply and demand over a twenty-five year horizon and addresses how they intend to provide sufficient water to meet the needs of the customer whilst protecting the environment. The draft WRMP (2009) published by Severn Trent Water followed guidance produced by the EA and was in line with the Severn Trent Water 2010-2035 Strategic Direction Statement produced for Ofwat in December 2007.

6.34 Table 5 shows that the East Midlands WRZ has a negative supply-demand balance throughout the 25 year planning period, becoming increasingly negative over time. All values refer to the balance of supply and demand averaged over the year with an allowance for climate change impacts but without further measures to bring supply and demand into balance.

Table 5: Projected supply-demand balances for the East Midlands WRZ

Year supply demand balance becomes negative	Supply demand balance in 2014/2015 (Ml/d)	Supply demand balance in 2019/2020 (Ml/d)	Supply demand balance in 2024/2025 (Ml/d)	Supply demand balance in 2029/2030 (Ml/d)	Supply demand balance in 2034/2035 (Ml/d)
2011/2012	-29.30	-76.86	-88.73	-104.92	-112.43

6.35 Analysis is currently underway by Severn Trent Water to establish the options available to meet future demand for potable water in the East Midlands WRZ.

6.36 The options being considered include:

- Removal of a constraint on the strategic grid at Elms Farm to allow greater quantities of water to be distributed north or south;
- Triplication of the Derwent Valley Aqueduct to allow greater quantities of water to be distributed north or south;
- Emergency import from Yorkshire Water and new emergency borehole sources near Hayton in Southern Nottinghamshire or at Worksop;
- Aquifer storage recovery in Newark and/or Ompton (about eight miles east of Mansfield); and
- Increased peaks at Markham Clinton, Clay Lane and Caunton boreholes.

6.37 Although the East Midlands WRZ is already in deficit, Severn Trent Water has confirmed that the mitigation measures proposed will enable them to balance supply and demand. They have indicated however that if development targets were significantly increased above those suggested, shortfalls in supply may become more problematic, especially in times of stress on the system.

6.38 The EA (2004) has selected representative observation boreholes as drought indicator sites. The Hodhill Farm borehole, near Shirebrook, north of Mansfield has been chosen to be representative of conditions within the Lower Magnesian Limestone aquifer.

6.39 Severn Trent Water has confirmed that during the drought of 2006, Berry Hill covered reservoir on Lindhurst Road, which supplies drinking water to central Mansfield, was down to just 14 per cent capacity. They were concerned that up to

5,000 homes in the area could lose supply if consumption remained high. A plea was issued to customers to use water sensibly as there was a real risk that some areas in and around Mansfield (including Berry Hill) may lose water supply.

6.40 Further schemes have since been undertaken to improve the security of supply across the East Midlands WRZ. To help ensure that they can deliver water to customers when they need it, in their Monitoring Plan 2005 – 2010, Severn Trent Water (2004) state they will invest in three schemes which will improve reliability of supply to 58,800 households by reducing risks of failure in their strategic water supply grid. Although none of these schemes were directly relevant to Mansfield District, within the East Midlands WRZ, Severn Trent Water can move water around depending on demand.

6.41 Whilst it is convenient to treat WRZs as independent entities for purposes of water supply planning, there are in fact raw water and treated water connections between them. Severn Trent Water can therefore also both import to and export water from the East Midlands WRZ depending upon demand.

6.42 It is noted in the draft WRMP prepared by Severn Trent Water and due to be finalised in 2009 that there is already a lot of flexibility in the strategic grid that supplies the East Midlands WRZ. The existing transfer between the East Midlands WRZ and the Severn WRZ, known as the East-West link, is being promoted for greater use in the draft WRMP (Severn Trent Water, 2008).

6.43 Despite this, the predicted deployable output (DO) from the combined Newark/Mansfield/Nottingham groundwater sources decreased slightly from 159.16 (Ml/d) in the 2004 Water Resources Plan to 154 (Ml/d) in the draft WRMP. This slight decrease is due to changes in how DO values have been evaluated. Severn Trent Water has now adopted Aquator as their water resources allocation model. This is in wide use across the industry and allows performance of the water supply system to be simulated in much greater detail and with greater flexibility than was previously possible. The Aquator model has been checked by external consultants and during 2008 a detailed review and update of key parameters and data inputs to the model undertaken (Severn Trent Water, 2008).

6.44 The EA also has a strong role in balancing the supply of water with protection of the environment. Catchment Abstraction Management Strategies (CAMS) outline where the EA considers water is available for abstraction at a local level, where it considers there is a need to reduce current rates of abstraction and its policy on time-limited licences and renewal of licences.

6.45 The Idle and Torne CAMS (Environment Agency, 2007a) covers Mansfield District. Water Resource Management Unit 1 (WRMU1) covers the River Meden catchment upstream of the gauging station at Church Warsop, whereas the River Maun and its tributaries are within WRMU4. The Mansfield groundwater management unit (GWMU) of the Lower Magnesian Limestone extends under WRMU 1 and the headwaters of the River Maun (WRMU4).

6.46 Within the CAMS, the upper reaches of the River Meden and the Mansfield GWMU were both classed as 'water available' under their own resource

assessment, but reclassified to 'no water available' due to the poor resource availability status of the River Idle downstream. This status is fixed through to 2016 to maintain flows in the upper Meden and prevent deterioration of flows in the River Idle (Environment Agency, 2007a).

6.47 The River Maun, which was assessed as part of the River Idle, was classed as 'Over Abstracted'. The Target status for 2010 of 'Over licensed' would require a reduction in actual abstraction from both surface and groundwater sources.

6.48 Parts of the Mansfield District as suffering from particularly low flow conditions as a result of high water abstraction and low inflow (RPS 2008). Although Rainworth Water is not flow gauged it is known to suffer from low flows. In their Monitoring Plan 2005 – 2010, Severn Trent Water (2004) noted that they were required to take action to compensate for the environmental impacts of some abstractions. They plan to take action to replenish the water in two streams that currently dry up in summer, including Rainworth Water. This stream is considered by the EA to be of particular ecological significance and to have significant amenity value because it feeds Rainworth Lakes SSSI.

6.49 The Hills and Holes and the Sookholme Brook SSSI is located to the west of Market Warsop in the vicinity of the River Meden. Natural England has identified the vulnerability of this designated site to damage as a result of abstraction and has produced a 'Views About Management' plan. The SSSI has also been included within the EA Restoring Sustainable Abstraction (RSA) Programme catalogue of work, under which monitoring of the impact of abstraction on the site is underway (Environment Agency 2007a).

6.50 There are also concerns over increasing concentration of nitrates in potable sources of water. Nitrate occurs due to the natural decay of vegetable material in soil. Nitrogenous fertilisers used on arable farmland are a significant source of nitrate in groundwater. Rainfall also washes nitrate from the soil into streams and rivers.

6.51 In 2006, all tests for nitrate undertaken by Severn Trent Water met the 50mg/l standard (Drinking Water Inspectorate, 2007). Analysis by Severn Trent Water indicates that between now and 2035 some sources could become unsuitable for drinking water supply or have their yield being severely reduced in order to maintain acceptable drinking water quality.

6.52 Nitrate levels can be reduced by water treatment or by blending with another, low nitrate, water source. As a consequence, legally binding agreements are in place for necessary improvements. This includes to the Papplewick and Berry Hill supply systems which fed Mansfield. In February 2007 STW announced they had spent £1.7 million to reduce nitrates in water at Berry Hill Drinking Water Inspectorate (2008) and that work will complete on Papplewick before 2010.

6.53 Agricultural land outside of the main built up areas of the district, including between Mansfield and Market Warsop and towards the boundaries of the district, can have a high demand for water for irrigation purposes. This supply is sourced from both surface river and groundwater abstractions which require an EA licence.

Development on agricultural land can therefore offer the opportunity to reduce licensed abstraction for agriculture. In water budgetary terms this may offset to some extent any increase in demand associated with the development.

6.54 Whilst there is expected to be increased pressure on water supply in the future, the size of the East Midlands WRZ means that it is difficult to relate available water supply information to the scale of individual potential growth areas. Severn Trent Water has though confirmed that no significant problems are anticipated in meeting the needs of normal domestic and light industrial development in any of the five potential areas of growth. This is largely because the Triassic Sandstone which provides the area with most of its water has a large storage capacity within the structure of the strata and does not tend to react rapidly to periods of low rainfall. It therefore tends to give a relatively reliable and constant supply of water.

Inadequate water supply delivery infrastructure

6.55 The capacity of the infrastructure used to supply water to potential growth areas, both residential and commercial, could potentially have a significant impact on both the location and timing of development. For example, in order to serve a significant increase in population it may be necessary to undertake significant improvements to the existing water supply infrastructure. This would especially be the case should significant growth occur in primarily rural greenfield areas with insufficient infrastructure present to cater for the new development.

6.56 To help scope the water supply delivery infrastructure implications, Severn Trent Water were provided with the estimated need for housing and employment land for each of the five potential areas for development. In response, for the purposes of this WCS scoping study they provided readily available information about the current water supply infrastructure. However, Severn Trent Water wished it noted that the information provided was for indicative purposes only as it is not possible at this stage to provide detailed analysis of the infrastructure requirements and associated capital costs, due to uncertainty over the exact location type and phasing of any development.

6.57 Whilst Severn Trent Water welcomes being consulted on emerging planning documents, they would normally only identify detailed water supply infrastructure requirements as specific development proposals come forward. A charge would be imposed to carry out any capacity studies and the developer would be expected to contribute towards the cost of any additional infrastructure.

6.58 This is consistent with Ofwat requirements that expenditure on assets is committed in response to a specified need rather than speculatively, but can lead to different perspectives on the issue of available capacity. Severn Trent Water has not expressed concern over the capacity of the current water cycle infrastructure to meet the estimated need for housing and employment land in any of the potential areas of growth. However, they wished it noted that if significantly higher development were to occur in any of the areas then it is likely that the capacity of the current infrastructure will be exceeded.

6.59 An extension to the water supply network would be required for development on greenfield sites such as potential growth areas B – Southern Corridor and D – North of Forest Town. Adjustments would also need to be made to the network for brownfield sites. Significant growth on the margins of the existing supply network are likely to require more significant investment in potable water infrastructure than growth on areas elsewhere within the district which already have infrastructure. However, this is not always the case as any existing infrastructure may not have the capacity to supply significantly more potable water.

6.60 Mains reinforcement may be required in certain locations, particularly if there were to be large scale development. Severn Trent Water has indicated these reinforcements are expected to be most severe in the extreme north-west and south-east of Mansfield. Any development on high ground, such as in the vicinity of Abbott Road and Berry Hill, may also experience lower than normal water pressure which may require local boosters and new mains to alleviate the problem.

6.61 Prospective developers are advised to discuss requirements with Severn Trent Water. The exact location, timing and scale of any significant future development should be submitted to Severn Trent Water as early as possible to allow them to carrying out an assessment, determine any costs and include an appropriate allowance for infrastructure improvements in future AMP submissions.

6.62 The technical scoping of these two water resources and supply issues in relation to the five potential areas for growth is shown in Appendix A (Tables A4-A5) and summarised in Table 6.

6.63 Those areas with a low risk (green) means that they are deemed to:

- Have access to a secure source of potable water
- Be close to a major supply main
- Require little in the way of new supply infrastructure

6.64 Those areas with a medium risk (amber) means they are deemed to require some of the following:

- New infrastructure to either secure a water supply
- Link into a major supply main
- Need some upgrading of existing infrastructure

6.65 Those areas with a high risk (red) means they are deemed to require either:

- A new source
- Major new supply main
- Major upgrade in infrastructure

Table 6: Water supply constraints

Potential growth area	Overall water supply source risk	Overall water supply infrastructure risk	Overall water supply risk
(A) Mansfield Urban Area			
North West	Medium	Medium	Medium
South West	Low	Low	Low
River Corridor	Medium	Low	Medium
East	Medium	Medium	Medium
(B) Southern Corridor			
Southern Corridor	Medium	Medium	Medium
(C) Pleasley Hill Regeneration Area			
North	Low	Medium	Medium
South	Low	Medium	Medium
(D) North of Forest Town			
North	Low	Medium	Medium
River Corridor	Medium	High	High
South	Low	Medium	Medium
(E) Market Warsop			
North & West	Medium	Medium	Medium
South & East	Low	Medium	Medium

6.66 The risk assessment assumes that on brownfield sites the previous development was connected to the water supply network and that this is appropriate for the purposes of new development. If this is not the case, then more major works may be required. This will only become apparent through more detailed studies than were possible for this WCS scoping study.

6.67 Similarly, it is assumed areas within, or on the margins of, current settlements will be able to connect to the current water supply network. Where this not to prove the case then more extensive infrastructure is again likely to be required. This table should therefore only be seen as a general guide to potential constraints.

Waste water collection and treatment scoping

6.68 The two main waste water collection and treatment risks to growth are:

- Inadequate waste water collection infrastructure
- Capacity of sewage treatment works
- Water quality targets

Inadequate waste water collection infrastructure

6.69 The capacity of infrastructure taking waste water from potential growth areas, both residential and commercial, could potentially have a significant impact on both the location and timing of development. For example, in order to serve a significant increase in population it may be necessary to undertake significant improvements to the existing waste water infrastructure network. This would especially be the case should significant growth occur in primarily rural greenfield areas with insufficient infrastructure present to cater for the new development.

6.70 To help scope the waste water collection infrastructure implications, Severn Trent Water were provided with the estimated need for housing and employment land for each of the five potential areas for development. In response, for the purposes of this WCS scoping study they provided readily available information about the current waste water supply network. However, Severn Trent Water wished it noted that the information provided was for indicative purposes only as it is not possible at this stage to provide detailed analysis of the infrastructure requirements and associated capital costs, due to uncertainty over the exact location type and phasing of any development available in a scoping study.

6.71 Large scale developments on the margins of the existing waste water network, such as areas B – Southern Corridor and D – North of Forest Town, may require more significant investment in waste water collection infrastructure than the other potential growth areas within the district which already have infrastructure. However, this is not always the case as any existing infrastructure may not have the capacity or be otherwise unsuitable to receive significantly more waste water.

6.72 Depending on location, significant development in and around Mansfield could also require additional pumping of waste water. This could be achieved through investment in upgrading existing pumps or a new scheme. This is likely only to be determined at the detailed design stage. As with water supply, Severn Trent Water has indicated it would normally only identify detailed waste water collection infrastructure requirements as specific development proposals come forward. A charge would be imposed to carryout any capacity studies and the developer would be expected to contribute towards the cost of any additional infrastructure.

Photograph 3: Maun Valley pumping station

Capacity of sewage treatment works

6.73 Development proposals can place increasing pressures on the capacity of the existing sewage treatment system. This in turn may lead to the need to develop new STWs, or to expand and renew existing works. This situation is reinforced by the introduction of more stringent water quality standards, such as under WFD.

6.74 Capacity is quoted in terms of population equivalents composed of the number of people within the catchment area combined with the estimated output from industrial and commercial premises. The four main sewage treatment works that serve Mansfield District with their population equivalents (EA, 2008) are listed below:

- Mansfield Bath Lane 98,737
- Warsop Church Lane 12,340
- Edwinstowe 19,667
- Rainworth 25,035

6.75 In early July 2005, the EA met with East Midlands Regional Assembly, Severn Trent Water and Anglian Water Services to discuss the possible overall water quality implications of proposed housing growth. It was agreed that the EA would undertake a risk assessment to give an indication of how well existing STWs (over 10,000 population equivalent) could accommodate extra waste water from new development (EA, 2006).

6.76 The purpose of the risk assessment was to determine which works have the capacity to improve quality or increase flow in order to accommodate additional demand caused by potential new growth.

6.77 To achieve this, they categorised large sewage treatment works into risk groupings depending on how difficult it would be to improve the quality of the discharge and how close they are to consented discharge limits. The works were assessed on the grounds of BOD and volume. The overall score for each works was determined by the highest risk in either of the categories.

6.78 The results for the STWs relevant to the potential growth areas in Mansfield District are presented in Appendix A (Table A7). This shows that three of the STWs serving Mansfield have a High overall risk, while Edwinstowe has a Medium overall risk.

6.79 This gives an indication that many of the potential growth areas may have a problem with additional population growth given the current STW capacity. The overall conclusion reached by the EA was that if no new work is undertaken to increase STW capacity, certain areas, including those around Mansfield, are at risk of not having sufficient treatment capacity to cater for new housing development.

6.80 This was only a broad-brush assessment that does not look in detail at the local circumstances of each STW. As such, the EA considered it likely that further work will be necessary to identify specific issues in relation to the potential growth areas.

Water quality targets

6.81 All STWs releasing effluent into a river must have consent to discharge from the EA. The consent sets out minimum standards for the quality of effluent and a maximum limit on volume. These limits are calculated by determining the load of polluting material a river can manage without significant impact on water quality or biodiversity.

6.82 To discharge increased quantities of effluent may require revision of an existing consent. Receiving watercourses that have a poor or marginal water quality, or have insufficient surface water for dilution, may be refused a new consent. Should a STW not be able to achieve the required discharge consent this may restrict its ability to receive increased waste water.

6.83 It has already been noted that in low flow conditions a high percentage of water in present in the rivers of the district is derived from effluent discharges. Mansfield STW is d/s of Sutton Ashfield STW and Edwinstowe STW d/s of Mansfield STW. Skegby STW is also u/s of Warsop STW. It is not surprising therefore that in the context of achieving water quality targets, the EA has highlighted Mansfield as being one area with particular problems which could affect the ability of existing STWs to accept discharges from new development (EA, 2006).

6.84 The most recent available water quality data relevant to Mansfield District is set out in the Appendix (Table A8). Preliminary indications show that although river water chemistry across Mansfield District is generally good, most watercourses are scoring high nutrient levels.

6.85 Elevated levels of these nutrients are of concern because they can cause eutrophication, which harms the water environment. In addition, excess nitrate has to be removed before water can be supplied to consumers, increasing supply costs. Such effects have been attributed to agricultural practices, the high rate of surface runoff into watercourses and discharges, including unsatisfactory intermittent discharges (UIDs).

6.86 At times of heavy storm, some sewers are designed to overflow into watercourses, as are the storm water retention tanks at some of STWs. Severn Trent Water has confirmed that there are approximately 3,900 such intermittent discharges in their area of operation. The EA has identified those they consider to be having an unsatisfactory impact on the watercourses into which they discharge. This includes the storm water retention tank outfall at Mansfield STW. STW is required to carry out works to reduce the impacts of these UIDs during the AMP4 period. The upgrade of the Mansfield UID was though reported as delayed in the publicly available version of the June return (Ofwat, 2009).

6.87 The technical scoping of these three water collection and treatment issues in relation to the five potential areas for growth is shown in Appendix A (Tables A6-A8) and summarised in Table 7. Those areas with an overall low risk (green) means that they are deemed to:

- Have capacity in the collection infrastructure;
- Have capacity at the relevant STW; and
- Be able to achieve current and anticipated water quality targets.

6.88 Those areas with a medium overall risk (amber) means that they are deemed to require at least one of the following:

- Some upgrading of existing collection infrastructure;
- Investment to improve STW capacity; or
- Measures to ensure current and anticipated water quality targets are met.

6.89 Those areas with a high overall risk (red) means that they are deemed to require at least one of the following:

- Major upgrade in waste water collection infrastructure;
- A new STW
- Significant capital or operational expenditure to achieve current and anticipated water quality targets.

Table 7: Waste water treatment and collection constraints

Potential growth area		Treatment works	Waste water collection requirement	Waste water treatment risk	Water quality risk assessment	Overall waste water collection / treatment risk
(A) Mansfield Urban Area						
North West		Mansfield Bath Lane (River Maun)	Medium	High	High	High
South West		Mansfield Bath Lane (River Maun)	Low	High	High	High
River Corridor		Mansfield Bath Lane (River Maun)	Medium	High	High	High
East	**Central Mansfield**	Mansfield Bath Lane (River Maun)	Low	High	High	High
	Forest Town	Edwinstowe (River Maun)	High	Medium	High	High
	Berry Hill	Rainworth (Rainworth Water)	Medium	High	High	High
(B) Southern Corridor						
Southern Corridor		Rainworth (Rainworth Water)	Medium	High	High	High
(C) Pleasley Hill Regeneration Area						
North		Mansfield Bath Lane (River Maun)	Medium	High	High	High
South		Mansfield Bath Lane (River Maun)	High	High	High	High
(D) North of Forest Town						
North		Edwinstowe (River Maun)	High	Medium	High	High
River Corridor		Edwinstowe (River Maun)	High	Medium	High	High
South		Edwinstowe (River Maun)	High	Medium	High	High
(E) Market Warsop						
North & West		Church Warsop (River Meden)	Medium	High	High	High
South & East		Church Warsop (River Meden)	Medium	High	High	High

6.90 The methodology employed in this scoping study has identified the collection and treatment of waste water as imposing a high overall risk of constraint on all five potential growth areas. The southern half of the Pleasley Hill regeneration area has been shown to be the only area where the risk of constraint is high in all three of the factors considered.

6.91 The infrastructure necessary to collect and treat waste water throughout the District therefore has the potential to influence both the location and the timing of development. As the precise location and phasing of development is not yet known, it is not feasible for Severn Trent Water to provide outline costs associated with necessary improvements to the waste water collection and treatment infrastructure to meet growth projections at this time.

6.92 The Mansfield Bath Lane, Church Warsop and Rainworth STWs have been identified as being fully, or near fully, committed to meeting existing developments and as such will be under pressure if new development were to occur. This was mainly on the basis of inadequate flow in the receiving watercourse to enable ever more stringent water quality targets to be met, notably most recently for phosphorous. Tighter controls on the quality of effluent discharged into the environment can mean a STW which had been operating within earlier standards now requires upgrading to achieve the new standards. This can be as a result of existing loadings let alone any higher loadings a result of growth within the catchment.

6.93 The situation for the first two of these STWs is amplified by Sutton in Ashfield STW being upstream of Mansfield STW and Skegby STW on the River Meden and Shirebrook STW, which feeds into the Sookholme Bath, being u/s of the Warsop STW. Although the Edwinstowe works was assessed at medium risk by the EA, its ability to receive increased waste water has historically been reported as limited due to the effects of mining subsidence (Mansfield District Council, 1998), as well as being d/s of both Mansfield STW and Sutton in Ashfield STW.

6.94 Under Ofwat requirements, water companies can only normally improve existing assets or develop new assets in response to a specifically identified economic driver, such as the WFD. They are not normally able to justify expenditure on improving or developing assets in response to potential growth which may or may not happen. This can sometimes make it difficult for water companies to engage as positively as they and others may wish in the growth agenda of planning authorities.

6.95 Severn Trent Water has though stated they intend to provide additional sewers and associated pumping stations and sewage treatment capacity to service new development. This is currently largely as a result of the automatic right of connection to a public sewer where one currently exists granted by Section 106 of the Water Industry Act, 1991. This right of connection is though expected to be removed under the forthcoming proposed Floods and Water Bill, a draft of which was published in spring 2009.

7 CONCLUSIONS

7.1 Table 8 presents the combined results of the scoping of constraints posed by water cycle infrastructure to significant development in the five areas of potential growth.

Table 8: Summary constraints assessment

Potential growth area	Flood risk	Water supply	Waste water	Overall risk
(A) Mansfield Urban Area				
North West				
South West				
River Corridor				
East				
(B) Southern Corridor				
Southern Corridor				
(C) Pleasley Hill Regeneration Area				
North				
South				
(D) North of Forest Town				
North				
River Corridor				
South				
(E) Market Warsop				
North & West				
South & East				

7.2 Table 8 indicates that for most potential growth areas the overall flood risk and water supply constraint has been placed in the amber category. However, many of these areas include Brownfield land and this assessment assumes the previous development was connected to the water supply network and that this network not only still functions but is adequate for future growth. The exceptions are the river corridors, the southern end of the Pleasley Hill Regeneration area and north and west of Market Warsop. These all have at least one or other of the issues in the red category. The issue of waste water has though been universally placed in the red category.

7.3 This scoping analysis indicates that investment in water cycle infrastructure will be needed to enable Mansfield District to accommodate the level of required growth. Detailed costings for the improvements required for each potential growth area cannot be provided within this scoping study. This is due to a number reasons including that Severn Trent Water only provides cost estimates when formally approached by a developer.

7.4 However, the traffic light system adopted provides a general indication of the scale of cost. Potential growth areas shown in red will require a higher degree of investment compared to those in the green category. The high number of areas placed in the amber category for flood risk and water supply indicates that in many cases these issues are not 'show stoppers' to development and could probably be addressed at a local scale through upgrading of infrastructure to allow development to take place.

7.5 The potential costs to be considered include:

- Increasing the capacity of the surface water drainage system;
- Implementation of SUDS and control of runoff measures;
- New water supply pipe lines to connect growth areas to existing trunk mains;
- Upgrading or installation of booster stations to transmit water to the growth areas on the edge of Mansfield and more rural areas of the District;
- Increasing the capacity and connections of the sewer system; and
- Improving the capacity of the sewage treatment works and their ability to treat effluent to comply with water quality standards.

7.6 Whilst action is underway to address some of these issues, when they will be resolved will inevitably have an effect on the timing of growth. Close liaison with all stakeholders will be required to allow the development targets to be met.

Flood risk

7.7 Due to the location of Mansfield District in the headwaters of two catchments, there is little direct risk of river flooding other than in their immediate vicinity. There are corridors alongside the main watercourses that are included within Flood Zones. These must be reviewed with reference to the EA guidance in relation to their intended use, especially where they fall within Flood Zones 3a and 3b, in addition to compliance with the Sequential and Exception Tests required by PPS25.

7.8 The District also contains a number of ordinary watercourses. Development in proximity to these watercourses may have the potential to be at risk of flooding. However, the key flood risk management challenges facing growth in Mansfield District have been shown to be greater surface and sewer flooding as a result of additional development over formerly permeable ground and increased storm frequency as a result of climate change.

7.9 The additional problems of sewer and surface water flooding can be reduced through the reduction in runoff from the developments and from improvements to the existing drainage network. Effective planning and design that includes careful integration and enhancement of green infrastructure can also bring positive environmental and social benefits.

7.10 The flood risk to potential growth presented in this WCS scoping study should only be taken as a guide as at the individual site scale these risks need to be clarified with further modelling or site specific Flood Risk Assessments.

Water resources and supply

7.11 There is little differentiation between the potential growth areas in terms of availability and connection to the water supply network. However, limitations in water resources may pose a problem dependent upon the type and density of development.

7.12 This WCS scoping study has shown that within Mansfield District the five areas of potential growth fall within an area that is currently not over-abstracted. However, the draft WRMP indicates that the East Midlands WRZ will be in supply-demand deficit in 2011/2012, and that the shortfall will become increasingly negative throughout the 25 year plan period. It is also important to take into account the limited availability of water for increased abstraction and the requirement to decrease abstraction noted in the Idle and Thorne CAMS produced by the EA.

7.13 Consultation with Severn Trent Water has indicated that they have no immediate concerns regarding water resource supply in relation to predicted growth levels in Mansfield District as they have measures in place to ensure there will be sufficient headroom within the system. However, delivery of these measures is dependent upon investment made in future AMP programmes.

7.14 The key water supply and distribution challenges facing growth in Mansfield District are:

- The water supply system has been unable to meet customers expectations of service in terms of continuity of supply and pressure in times of water stress;
- Severn Trent Water is likely to have less water available in future as climate change reduces rainfall;
- There is environmental pressure to reduce use of water from some rivers in the District and groundwater sources that serve the district;
- There are quality issues over some of the sources of water serving Mansfield; and
- Severn Trent will have insufficient water available to meet long-term demand without further investment.

7.15 The water supply issues affecting the District highlight the necessity for effective water demand management in new development. This, together with a growing awareness about the implications of climate change, may affect what development is considered viable and sustainable in the long term. Whilst this is expected to in the first instance influence the design and layout of development that occurs, it is increasingly likely to also have a bearing on influencing the location of where development should be permitted.

7.16 The assessment of water supply presented in this WCS scoping study is limited by the detail of information available. It has largely been based upon the draft WRMP 2009 prepared by Severn Trent Water. As this is now nearing finalisation, it is assumed that any changes will be relatively minor. The final conclusions of the WRMP will however need to be reviewed as part of any subsequent stages of the WCS.

7.17 Any development application for significant growth will require a formal submission to Severn Trent Water outlining the water usage requirements in order that the application can be assessed in detail to identify the potential impact upon the water distribution system and any upgrades that may be required.

Waste water collection and treatment

7.18 This scoping study has shown that the collection and treatment of waste water is the major water cycle infrastructure constraint to significant growth in Mansfield District.

7.19 The headroom within the collection and treatment of waste water system is dependent upon three main criteria:

- Infrastructure location and capacity;
- STW capacity; and
- The ability of the receiving watercourse to cope with the discharge.

7.20 Due to the topography of the district, the five potential growth areas are to a greater or lesser degree elevated above existing STWs. As such, most development would be able to connect to the gravity-fed foul water sewers already present within existing developed areas of the district. However, there are capacity restrictions within the waste water infrastructure which may struggle to cope with new development that resulted in significantly increased volumes unless remediation measures are incorporated.

7.21 Despite limited information being made available, the main problems appeared to be associated with the combined sewer systems in Mansfield District when there was an influx of unattenuated storm water resulting in an exceedance of capacity. The combined foul sewers are not designed to carry high volumes of storm water and the SFRA identified this as particularly problematic in the area of Bridge Street in Mansfield Town.

7.22 Despite significant investment in recent years, the four STWs serving Mansfield District will struggle to cope with increased volumes of waste water. To be able to treat additional waste water from significant new development may require additional capital investment by Severn Trent Water. Whilst they have identified the need to upgrade STWs in response to growth, the timing of this investment will be based on funding being made available through Ofwat approval of AMP submissions every five years.

7.23 For AMP submissions to be successful they need to be based on accepted environmental drivers such as increasing legal requirements over environmental performance. The WFD for example now requires rivers to be brought up to good ecological status. In terms of water quality, the rivers in the area are suffering from eutrophication due to nutrient enrichment from both agricultural practices and discharge from STWs, including several upstream on both the River Maun and River Meden. This is not surprising when in times of low flow the water in thee rivers largely comprises treated effluent.

8 RECOMMENDATIONS

8.1 Given the lead-in time associated with the design and construction of water cycle infrastructure, it is essential that the need for any upgraded or new infrastructure be identified in detail at an early stage in the growth agenda.

8.2 To enable Severn Trent Water to upgrade their infrastructure, they should be provided with full details of the location, type, scale, and timing of any significant future growth. This will enable them to identify the critical path, establish the costs involved and prioritise delivery of new or improved assets accordingly. This would also help them include an appropriate allowance for infrastructure improvements in future five-yearly price review rounds to Ofwat.

8.3 To help facilitate this, it is recommended that detailed WCS studies are commissioned for each of the potential growth areas once firmer proposals for growth emerge. These detailed WCS studies should seek to resolve the issues that have been raised in this scoping phase.

8.4 It is imperative new development not only takes into account the risk of flooding from rivers and ordinary watercourses, but also any increased risk to other areas as a result of new development. As such, it will be necessary for development to minimise runoff through the implementation of SUDS, especially where located on greenfield sites.

8.5 The aim should be to ensure that runoff is in line with that which existed prior to any development taking place. The requirement and viability of SUDs will need to be assessed in detail for each of the five potential growth areas, but will be especially required in the low permeability ground condition on the southern half of the Pleasley Hill Regeneration Area.

8.6 It is recommended that local models are developed to increase the accuracy of flood risk predictions should significant growth be brought forward in the vicinity of the River Maun, River Meden, or other watercourses in the district. This will allow more accurate definition of the areas at risk and enable clearer identification of the relationship between potential growth areas and flood zones, including areas at a low risk of fluvial flooding.

8.7 The analysis presented in this scoping study would benefit from construction of models to indicate pressure points within the existing sewer infrastructure. Although limited information was available, there appears to be little or no spare capacity within the current sewerage system (both surface water and combined sewers).

8.8 Severn Trent Water should be encouraged to commission such models either as part of their monitoring of the network or in response to development proposals. The results of any detailed studies should be used to inform more detailed WCS studies.

8.9 Based on the outputs of this modelling, in order to prevent an increase in sewer flooding, the capacity of the sewer network to cope with all but the most extreme forms of weather should be improved, including through separation of foul and surface water drainage. It is therefore recommended that Severn Trent Water investigate the scope and cost effectiveness of separating foul and surface systems with the dual benefit of creating capacity and improving the efficiency of sewage works through treating stronger sewage.

8.10 There is also potential for SUDS to help reduce the growth in sewer flooding problems in the context of climate change, keeping down costs and reducing costs of pumping sewage. It is therefore important that any significant growth incorporates appropriate SUDS to attenuate and balance any surface water runoff. It is important these are integrated into the green infrastructure of the district and that opportunities are taken to ensure they contribute to green infrastructure objectives.

8.11 As extensions to the water supply network would be required for growth on greenfield sites, as well as adjustments required to the network for growth on brownfield sites, Severn Trent Water should be encouraged to provide a schematic of the mains water supply network across Mansfield District, together with a summary of their capacity. Although schematics are available for some areas served by some other water companies, other beneficiaries, such as Mansfield District Council and the construction industry may need to consider becoming partners to help facilitate this to happen.

8.12 Mansfield District Council should discuss long term water supply options with Severn Trent Water and the Environment Agency. This should include making best use of existing water sources through supply integration projects, using supplies from other producers where sustainable and economic, and, where necessary, developing new sources of supply by identifying the most sustainable abstraction or storage solutions. It would be helpful for such discussions to be extended to other local authorities to ensure the growth agenda across the East Midlands can be delivered. To achieve this, more detailed discussion will also be required on achieving water neutrality in new development.

8.13 Similarly, Severn Trent Water should be encouraged to provide a schematic of the sewage collection and treatment network. As this was the main constraint identified in this WCS scoping study, it warrants more detailed investigation and discussion between relevant stakeholders to identify the way forward.

8.14 Severn Trent Water should be encouraged to identify solutions that meet higher standards for sewage treatment where this is the most cost-effective solution. However, catering with growth will need to be considered in the context of the potential loss of the automatic right of connection and achieving more stringent water quality targets, such those imposed by the Water Framework Directive.

8.15 Meeting sewage treatment requirements will also need to be considered in the context of the growth agenda of Ashfield District (which has sewage treatment works upstream of Mansfield District) and Newark and Sherwood District (which has sewage treatment works downstream of Mansfield District).

8.16 Whilst it is anticipated the final versions of documents such as the Water Resources Management Plan will not differ markedly from their current well advanced drafts, it is recommended that the conclusions and recommendations of this study are reviewed during production of any subsequent more detailed WCS studies to take account of emerging policies and plans. Detailed requirements, such as the size and storage capacity of schemes to address sewer flooding, together with sustainability issues and funding issues should be addressed in detailed WCS studies covering each of the potential growth area.

8.17 Recommendations specific to each of the potential growth areas are outlined below.

Mansfield Urban Area

- Identify potential locations within the urban setting or extensions to existing urban patterns that could accommodate significant growth;
- Confirm potable water quality of Berry Hill reservoir following installation of nitrate removal technology;

Southern Corridor

- Identify sustainable drainage scheme options;
- Consider how potential, growth could integrate with improving condition of Rainworth Water (e.g. reedbed); and
- Discuss growth with Newark and Sherwood District Council, especially in relation to impacts on Rainworth STW.

Pleasley Hill Regeneration Area

- Identify sustainable drainage scheme options; and
- Complete a detailed review of water supply and sewage collection options.

North of Forest Town

- Consider how to integrate any potential growth into the green infrastructure, notably Maun Valley Park LNR; and
- Discuss growth with Newark and Sherwood District Council, especially in relation to impacts on Edwinstowe STW.

Market Warsop

- Identify sustainable drainage scheme options;
- Complete a detailed review of water supply and sewage collection options; and
- Consider how to integrate any potential growth into the green infrastructure.

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Appendix A: Technical Scoping Assessment

Table A1: Flooding from a watercourse

Potential growth area	Watercourse	Functional floodplain	Adequate capacity	Overall flood risk from a watercourse
(A) Mansfield Urban Area				
North West	Small private watercourses / upper reaches of tributary of River Meden	No	Yes	Low
South West	Small private watercourses	No	Yes	Low
River Corridor	River Maun / lower reaches Caldwell Brook	Yes	Limited in places	High
East	Small private watercourses / upper reaches Vicar Water	No	Yes	Low
(B) Southern Corridor				
Southern Corridor	Small private watercourses / upper reaches Rainworth Water	Small strip along southern boundary	Limited in eastern end	Medium
(C) Pleasley Hill Regeneration Area				
North	Small private watercourses / River Meden along northern boundary	No	Yes	Low
South	Small private watercourses	No	Limited in eastern end	Medium
(D) North of Forest Town				
North	Small private watercourses	No	Yes	Low
River Corridor	River Maun	Yes	Limited in places	High
South	Small private watercourses	No	Yes	Low
(E) Market Warsop				
North & West	River Meden / Sookholme Bath	Yes (strip along north of Town)	Limited in places	High
South & East	Small private watercourses	No	Yes	Low

Table A2: Flooding from runoff

Potential growth area	Increased runoff rates	Low ground permeability	Concentrated runoff	Overall flood risk from runoff
(A) Mansfield Urban Area				
North West	Urban with large rural wedge (former Debdale Hall Farm)	Small low permeability area in north	No	Medium
South West	Principally urban rural outer edge	Low permeability area in west	Small area in southwest (south of A6014)	Medium
River Corridor	Urban / rural	Artificial channel in places	No (other than Bridge Street area)	Medium
East	Principally Urban / rural outer edge	Small area low permeability around Berry Hill	No	Medium
(B) Southern Corridor				
Southern Corridor	Rural	No	Two areas north of A617	Medium
(C) Pleasley Hill Regeneration Area				
North	Rural / urban	No	Small pockets and along MARR	Medium
South	Rural / urban	Majority low permeability	Area of low permeability in south and along MARR	High
(D) North of Forest Town				
North	Rural	No	No	Low
River Corridor	Rural	Natural bed	No	Low
South	Rural	No	Small area in southeast	Low
(E) Market Warsop				
North & West	Urban / rural	Area of low permeability in north of town	No	Medium
South & East	Rural	Areas of low permeability	No	Medium

Table A3: Failure of water supply

Potential growth area	Failure of water supply	Environmental restrictions	Overall water supply risk
(A) Mansfield Urban Area			
North West	No evidence	Need to protect flow in tributary u/s Hills and Holes and the Sookholme Brook SSSI	Medium
South West	No evidence	No	Low
River Corridor	No evidence	Need to protect flow in River Maun	Medium
East	Berry Hill Reservoir high in nitrates and suffers in drought	Need to protect catchment with low flow including Vicar Water	Medium
(B) Southern Corridor			
Southern Corridor	Berry Hill Reservoir high in nitrates and suffers in drought	Need to protect RainWorth Water and Rainworth Lakes SSSI	Medium
(C) Pleasley Hill Regeneration Area			
North	No evidence	No	Low
South	No evidence	No	Low
(D) North of Forest Town			
North	No evidence	No	Low
River Corridor	No evidence	Need to protect flow in River Meden	Medium
South	No evidence	No	Low
(E) Market Warsop			
North & West	No evidence	Need to protect Hills and Holes and the Sookholme Brook SSSI	Medium
South & East	No evidence	No	Low

Table A4: Inadequate water supply delivery infrastructure

Potential growth area	Greenfield / brownfield	Remoteness	Risk of low pressure	Overall supply infrastructure risk
(A) Mansfield Urban Area				
North West	Mixed (greenfield wedge on former Debdale Hall Farm)	Not remote (Mansfield Woodhouse, parkland, abuts countryside)	No	Medium
South West	Principally brownfield with greenfield pockets / outer edge	Not remote (Ladybrook, outer edge close to Sutton in Ashfield)	No	Low
River Corridor	Principally Brownfield, with greenfield areas	Not remote (through Town centre)	No	Low
East	Principally brownfield, with greenfield pockets / outer edge	Not remote (outer edge abuts countryside)	Localised issues on higher ground (e.g. Berry Hill)	Medium
(B) Southern Corridor				
Southern Corridor	Greenfield / urban edge	Partially (abuts Mansfield, MARR crosses E-W, open countryside south, Rainworth to southeast	No	Medium
(C) Pleasley Hill Regeneration Area				
North	Mixed	Partially	Localised issues on higher ground (e.g. Abbot Road	Medium
South	Greenfield / urban edge	Partially (abuts Ladybrook)	Localised issues on higher ground (e.g. Abbot Road)	Medium
(D) North of Forest Town				
North	Greenfield / urban edge	Partial (open countryside to north and east)	Localised issues on higher ground (Pearfield Farm)	Medium
River Corridor	Greenfield	Principally Surrounded by open countryside	No (valley bottom d/s of Mansfield)	High
South	Greenfield / urban edge	Partial (abuts Forest Town to south)	No	Medium
(E) Market Warsop				
North & West	Mixed	Partial	No	Medium
South & East	Mixed	Partial	No	Medium

Table A5: Waste water collection infrastructure requirement

Potential growth area		Greenfield / brownfield	Proximity to STW	Major new infrastructure required	Overall waste water infrastructure risk
(A) Mansfield Urban Area					
North West		Brownfield with greenfield wedge (former Debdale Hall Farm)	Within 3 km of Mansfield STW	Partly reliant on pumping as some downstream of Mansfield STW	Medium
South West		Principally brownfield with greenfield outer edge / pockets	Within 3 km of Mansfield STW	Upstream of Mansfield STW	Low
River Corridor		Brownfield with greenfield areas, notably Cauldwell Brook	Within 3 km of Mansfield STW	Upstream of Mansfield STW	Medium
East	**Central Mansfield (NW)**	Brownfield	Within 3 km of Mansfield STW	Gravity drain	Low
	Forest Town (NE)	Principally brownfield with greenfield outer edge / pockets	Within 9 km of Edwinstowe STW	Partially reliant on pumping	High
	Berry Hill (SE)	Principally brownfield with greenfield outer edge / pockets	Within 6 km of Rainworth STW	Principally gravity drain	Medium
(B) Southern Corridor					
Southern Corridor		Greenfield	Within 6 km of Rainworth STW	Gravity drain	Medium
(C) Pleasley Hill Regeneration Area					
North		Brownfield with greenfield areas	Within 6 km of Mansfield STW	Gravity drain	Medium
South		Greenfield	Within 6 km of Mansfield STW	Gravity drain	High
(D) North of Forest Town					
North		Greenfield	Within 9 km of Edwinstowe STW	Gravity drain	High
River Corridor		Greenfield	Within 9 km of Edwinstowe STW	Gravity drain	High
South		Greenfield	Within 9 km of Edwinstowe STW	Gravity drain	High
(E) Market Warsop					
North & West		Brownfield with greenfield areas	Within 3 km of Mansfield STW	Gravity drain	Medium
South & East		Brownfield with greenfield areas	Within 3 km of Mansfield STW	Partially gravity drain	Medium

Table A6: Waste water treatment works (EA risk assessment 2005)

Potential growth area		Treatment works	BOD / ammonia	River flow	Overall STW risk
(A) Mansfield Urban Area					
North West		Mansfield Bath Lane (River Maun)	High	Medium	High
South West		Mansfield Bath Lane (River Maun)	High	Medium	High
River Corridor		Mansfield Bath Lane (River Maun)	High	Medium	High
East	**Central Mansfield**	Mansfield Bath Lane (River Maun)	High	Medium	High
	Forest Town	Edwinstowe (River Maun)	Low	Medium	Medium
	Berry Hill	Rainworth (Rainworth Water)	Medium	High	High
(B) Southern Corridor					
Southern Corridor		Rainworth (Rainworth Water)	Medium	High	High
(C) Pleasley Hill Regeneration area					
North		Mansfield Bath Lane (River Maun)	High	Medium	High
South		Mansfield Bath Lane (River Maun)	High	Medium	High
(D) North of Forest Town					
North		Edwinstowe (River Maun)	Low	Medium	Medium
River Corridor		Edwinstowe (River Maun)	Low	Medium	Medium
South		Edwinstowe (River Maun)	Low	Medium	Medium
(E) Market Warsop					
North & West		Church Warsop (River Meden)	Low	High	High
South & East		Church Warsop (River Meden	Low	High	High

Table A7: Water quality risk assessment (based on EA 2007 data)

Potential growth area		Treatment works	Chemistry	Biology	Nutrients	Overall STW risk assessment
(A) Mansfield Urban Area						
North West		Mansfield Bath Lane (River Maun)	U/s: C D/s: B	U/s: D D/s: D	U/s: N3/P5 D/s: N6/P5	High
South West		Mansfield Bath Lane (River Maun)	U/s: C D/s: B	U/s: D D/s: D	U/s: N3/P5 D/s: N6/P5	High
River Corridor		Mansfield Bath Lane (River Maun)	U/s: C D/s: B	U/s: D D/s: D	U/s: N3/P5 D/s: N6/P5	High
East	**Central Mansfield**	Mansfield Bath Lane (River Maun)	U/s: C D/s: B	U/s: D D/s: D	U/s: N3/P5 D/s: N6/P5	High
	Forest Town	Edwinstowe (River Maun)	U/s: B D/s: No data	U/s: B D/s: No data	U/s: N6/P5	High
	Berry Hill	Rainworth (Rainworth Water)	U/s: No data D/s: B	No data	U/s: No data D/s: N/6/P6	High
(B) Southern Corridor						
Southern Corridor		Rainworth (Rainworth Water)	U/s: No data D/s: B	No data	U/s: No data D/s: N/6/P6	High
(C) Pleasley Hill Regeneration area						
North		Mansfield Bath Lane (River Maun)	U/s: C D/s: B	U/s: D D/s: D	U/s: N3/P5 D/s: N6/P5	High
South		Mansfield Bath Lane (River Maun	U/s: C D/s: B	U/s: D D/s: D	U/s: N3/P5 D/s: N6/P5	High
(D) North of Forest Town						
North		Edwinstowe (River Maun)	U/s: B D/s: No data	U/s: B D/s: no data	U/s: N6/P5 D/s: no data	High
River Corridor		Edwinstowe (River Maun)	U/s: B D/s: No data	U/s: B D/s: no data	U/s: N6/P5 D/s: no data	High
South		Edwinstowe (River Maun)	U/s: B D/s: No data	U/s: B D/s: no data	U/s: N6/P5 D/s: no data	High
(E) Market Warsop						
North & West		Church Warsop (River Meden)	U/s: A D/s: A	U/s: B D/s: No data	U/s: N6/P4 D/s: N6/P4	High
South & East		Church Warsop (River Meden)	U/s: A D/s: A	U/s: B D/s: No data	U/s: N6/P4 D/s: N6/P4	High