West Northamptonshire Development Corporation

Water Cycle Strategy

Phase 1 - Outline Study

May 2009

West Northamptonshire Water Cycle Strategy

Phase One Outline

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Halcrow Group Limited

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West Northamptonshire Water Cycle Strategy Phase One Outline

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Contents

1 Executive Summary 1

2 Introduction 5

2.1 Background 5

2.2 West Northamptonshire Growth 6

2.3 Delivering the Growth Agenda 9

3 A Strategic Approach 11

3.1 The Problem 11

3.2 Implications for Development 11

3.3 The Solution 12

3.4 The Project Group 13

3.5 Analytical Approach and Scope of Phase 1 Strategy 13

4 Spatial Distribution of Future Development 16

4.1 Introduction 16

4.2 Scale and Phasing of Growth 17

4.3 Employment 18

4.4 Northampton 19

4.5 Daventry 21

4.6 South Northamptonshire 24

4.7 Development Summary 27

5 Flood Risk Management 28

5.1 Introduction 28

5.2 Catchment Description 29

5.3 Relevant Guidance and Studies 33

5.4 Groundwater Flooding 37

5.5 Evaluation of Development Proposals 38

5.6 Hydrological Analysis 39

5.7 Impact of increased WwTW discharges on flood risk 41

5.8 Northampton 42

5.9 Daventry 63

5.10 South Northamptonshire 70

6 Foul Drainage, Sewage Treatment and Water Quality 89

6.1 Introduction 89

6.2 Sewage Treatment and Water Quality Overview 89

6.3 Northampton 94

6.4 Daventry 99
6.5 Towcester and Silverstone 105
6.6 Brackley 113

7 Water Resources and Water Supply 117
7.1 Introduction 117
7.2 Environment Agency Water Resource Management 117
7.3 CAMS Review 120
7.4 Water Company Planning 123
7.5 Anglian Water Resource Strategy 125
7.6 Water Efficiency Targets 129
7.7 Water Supply Existing Situation 131
7.8 Northampton Supply Strategy 133
7.9 Daventry Supply Strategy 134
7.10 Towcester and Brackley Supply Strategy 137
7.11 Silverstone Supply Strategy 140
7.12 Network Summary 140

8 Groundwater and Sustainable Drainage Systems 141
8.1 Introduction 141
8.2 Geological and Hydrogeological Setting 141
8.3 SuDS for the West Northamptonshire Area 141
8.4 Sustainable Drainage and Planning 142

9 Ecological Constraints and Opportunities 146
9.1 Objectives and Approach 146
9.2 Ecological Features Considered 147
9.3 Ecological Constraints 147
9.4 Sensitive Ecological Features Identified 149
9.5 Potential Impacts of Development 154
9.6 Nature Conservation Threats and Opportunities 155
9.7 Enhancement Opportunities 158
9.8 Recent Projects and Initiatives 160
9.9 Summary and Recommendations 160

10 Developer Guidance 162
10.1 Developer Checklist 162
10.2 Flood Risk 162
10.3 Water Efficiency Measures 162

11 Conclusions and Recommendations 165
11.1 Overview 165

11.2 Northampton *165*
11.3 Daventry *176*
11.4 South Northamptonshire *182*
11.5 Scope for Phase 2 *191*

12 References **194**
12.1 List of documents referenced and status *194*

Appendix A – Population Growth **197**

Appendix B – Catchment Flood Management Plans **213**

Appendix C – PPS 25 **220**

Appendix D – Flood Zone Maps **223**

Appendix E – History of Flooding **224**

Appendix F – Derivation of River Quality Objectives **238**

Appendix G – Derivation of Future Consent Requirements **244**

Appendix H – Geology Maps **246**

Appendix J – Possible Sustainable Drainage Systems **264**

Appendix K **268**

Appendix L – Developer Check List **273**

Figures

Figure 2-1: Milton Keynes and South Midlands Sub-Region 5

Figure 2-2: Strategy Study Area 8

Figure 3-1: The Water Cycle 11

Figure 4-1: Potential development areas for Northampton 20

Figure 4-2: Daventry growth options 23

Figure 4-3: South Northamptonshire Growth Options 26

Figure 5-1. Study area overview showing watercourses 30

Figure 5-2: Northampton Implemention Area Flood Zone Mapping 43

Figure 5-3: Daventry Flood Zone Mapping 65

Figure 5-4: Towcester and Silverstone Flood Zone Mapping 73

Figure 5-5: Brackley Flood Zone Mapping 83

Figure 6-1: Foul treatment works in study area 90

Figure 6-2: Water Company Funding Cycle 92

Figure 6-3: Daventry Existing Sewage Network 100

Figure 6-4: Daventry Sewage Network – Potential Solutions 104

Figure 6-5: Towcester and Silverstone Sewage System 106

Figure 6-6: Towcester and Silverstone Sewage System – Potential Options 112

Figure 6-7: Brackley Sewage System – Potential Option 116

Figure 7-1: Overview of CAMS process stages 118

Figure 7-2: Map of Areas of Relative Water Stress (source: Areas of Water Stress, Final Classification; Environment Agency) 120

Figure 7-3: CAMS Overview for West Northants Study Area 122

Figure7-4: Water company capital funding cycle 125

Figure 7-5: Selected new resource development schemes 127

Figure 7-6: Resource development strategy for Ruthamford resource zone 128

Figure 7-7: Code Level requirements for energy and water efficiency (Source: Code for Sustainable Homes – A Step Change in Sustainable Home Building Practice. Crown Copyright, 2006.) 130

Figure 7-8: Study area existing water supply network 132

Figure 7-9 Proposed Water Supply Infrastructure for Daventry 136

Figure 7-10: Proposed Water Supply Infrastructure for Towcester 138

Figure 7-11: Proposed Water Supply Infrastructure for Brackley 139

Figure 10-1: Typical water usage in unmeasured households (Edwards K, Anglian Water, 1996) 164

Figure H1: 'Daventry – Ecology (solid & drift) 271

Figure H2: Northampton 276

Figure H3: South Hamptonshire 282

Tables

Report

Table 3-1: Planning guidance for study area growth points 10

Table 4-1: Housing Requirements 2001-26, February 2008 13

Table 4-2: Development phasing within the Draft Regional Plan 13

Table 4-3: West Northamptonshire estimated Job Growth 2001-2026 14

Table 5-1. Flood Risk Management Policies from the River Nene CFMP for Policy Units lying within West Northamptonshire. 29

Table 5-2 - Flood Zone definition 32

Table 5-3: Comparison of dry weather flow discharges from WwTW to the 1 in 2 year peak flow in receiving watercourses 44

Table 5-4: Recommendations for clustered potential development areas. 47

Table 5-5: Approximate long term and attenuation storage volumes required for the major development areas in Daventry, for a 100 year event with climate change. 55

Table 5-6: Comparison of dry weather flow discharges from WwTW to the 1 in 2 year peak flow in receiving watercourse. 55

Table 5-7: CSS options for South Northamptonshire Growth - CSS Issues and Options. *Using a housing density of 40 dwellings per hectare 57

Table 5-8: Approximate long term and attenuation storage volumes required for the major development area in Towcester, for a 100 year event with climate change. 61

Table 5-9: Comparison of dry weather flow discharges from WwTW to the 1 in 2 year peak flow in receiving watercourses. 61

Table 5-10: Comparison of dry weather flow discharges from WwTW to the 1 in 2 year peak flow in receiving watercourse. 63

Table 5-11: Approximate long term and attenuation storage volumes required for 1000 properties on one site in Brackley, for a 100 year event with climate change 66

Table 5-12: Comparison of dry weather flow discharges from WwTW to the 1 in 2 year peak flow in receiving watercourse. 66

Table 6-1: Foul treatment works and their respective capacities in study area 69

Table 6-2 Great Billing WwTW Projected Load 73

Table 6-3: Great Billing Consent Forecasts 74

Table 6-4: Great Billing Current Performance against Sanitary Limits 74

Table 6-5: Great Billing Future Consent Requirements 75
Table 6-6: Assessment of Northampton Sewerage Constraints and Opportunities 76
Table 6-7: Whilton WwTW Projected Loads 79
Table 6-8: Whilton WwTW Consent Forecasts 79
Table 6-9: Current Performance against Sanitary Limits 80
Table 6-10: Whilton Future Consent Requirements 81
Table 6-11: Assessment of Daventry Sewerage Constraints and Opportunities 82
Table 6-12: Towcester WwTW Projected Loads 84
Table 6-13: Towcester WwTW Consent Forecasts 86
Table 6-14: Current Performance against Sanitary Limits 86
Table 6-15: Projected Loads for Silverstone WwTW 87
Table 6-16: Silverstone WwTW Consent Forecasts 88
Table 6-17: Current Performance against Sanitary Limits 88
Table 6-18: Towcester Future Consent Requirements 90
Table 6-19 Assessment of Towcester Sewerage Constraints and Opportunities 90
Table 6-20: Brackley WwTW Projected Loads 92
Table 6-21: Overview of Load Measurement Discrepancy 92
Table 6-22: Current Performance against Sanitary Limits (EA vs AWS data) 93
Table 6-22: Brackley Future Consent Requirements 94
Table 6-23 Assessment of Brackley Sewerage Constraints and Opportunities 94
Table 7-1: CAMS resource availability status categories 98
Table 7-2: Northampton water resource and supply sources 113
Table 7-3: Potential for growth of areas around Northampton urban 113
Table7-4: Daventry water resource and supply sources 114
Table 7-5: Daventry Strategic Infrastructure Requirements 114
Table 7-6: Towcster and Brackley water resource and supply sources 116
Table7-7: Towcester and Brackley Strategic Infrastructure Requirements 116
Table 9-1: Nature conservation threats and opportunities for the WCS 134
Table 11-2: Daventry water resource and supply sources 154
Table 11-3: Daventry Strategic Infrastructure Requirements 154
Table 11-4: WCS Contributions for Daventry 156
Table 11-5 Assessment of Towcester Sewerage Constraints and Opportunities 160

Table 11-6: Assessment of Brackley Sewerage Constraints and Opportunities 161

Table 11-7 Towcster and Brackley water resource and supply sources 161

Table 11-8: Towcester and Brackley Strategic Infrastructure Requirements 162

Table 11-9: WCS Contribution for South Northamptonshire 164

Appendix A

Table 1: Future Housing Provision in Daventry, 2008 171

Table 2: Future Housing Provision in South Northamptonshire, 2008 173

Appendix B

Table 1: Policy Units from the River Nene CFMP lying within West Northamptonshire. Source: River Nene Catchment Flood Management Plan, 2008. 185

Appendix E

Table 1: History of flooding. Adapted from the River Nene CFMP and the West Northamptonshire SFRA 196

Appendix F

Table: River Ecosystem Classification 261

Table 0-1: Water Quality Assessments for the Whilton Branch (Daventry), the River Nene (Northampton) and the River Tove (Towcester). 264

Appendix G

Table 1: Water Quality Data Measurements 267

Table 2: summary of the three water quality targets used in the analysis 268

Appendix H

Table H.1: Geological strata outcropping beneath Daventry and their hydrogeological properties 272

Table H2: Soil associations in the Daventry area and their characteristics 274

Table H.3: Geological strata outcropping beneath Northampton and their hydrogeological properties 278

Table H.4: Soil associations in the Northampton area and their characteristics 279

Table H.5: Geological strata outcropping beneath South Northants and their hydrogeological properties 284

Table H.6: Soil associations in the South Northants area and their characteristics 285

Appendix J

Table J1: Possible SuDS Options 288

Appendix K

Table 1: BAP Habitats and Species Relevant to the Study Area (with priority species/habitats in bold, broad habitats in italics) 296

Table 2a: Nature Conservation Opportunities ("Habitat Visioning") Associated with the West Northamptonshire Water Cycle Strategy for Northampton 298

Table 2b: Nature Conservation Opportunities ("Habitat Visioning") Associated with the West Northamptonshire Water Cycle Strategy for Daventry 298

Table 2c: Nature Conservation Opportunities ("Habitat Visioning") Associated with the West Northamptonshire Water Cycle Strategy for South Northamptonshire 299

Table 3: Nature Conservation Values of Features in the Study Area 300

Table 4a: Summary of Pressures, Mitigation and Opportunities for Water and Wetland Nature Conservation for Northampton 304

Table 4b: Summary of Pressures, Mitigation and Opportunities for Water and Wetland Nature Conservation for Daventry 309

Table 4c: Summary of Pressures, Mitigation and Opportunities for Water and Wetland Nature Conservation for South Northamptonshire 313

1 Executive Summary

The emerging East Midlands Regional Plan has set a target of 62,150 new homes to be provided across West Northamptonshire by 2026 (East Midlands Regional Plan, Secretary of State Proposed Changes July 2008). West Northamptonshire includes three local authorities: Daventry District Council, Northampton Borough Council and South Northamptonshire Council. Daventry and South Northamptonshire are to provide 13,500 and 8,250 new dwellings respectively. However, the majority of growth, 40,400, is to be within the Northampton Implementation Area (NIA) that includes small tranches of the other two local authorities' land on the outskirts of Northampton itself. The Joint Core Strategy for West Northamptonshire Issues and Options Paper (2007) has put forward a number of strategic development sites in and around the urban centres of Daventry, Towcester and Brackley for consultation. The Joint Core Strategy is still in its early stages with the emerging strategy due to be produced for consultation by early July 2009. The consultant EDAW in its growth study for Northampton indicated several options for potential growth in the NIA and these are have been used in lieu of the Issues and Options in this study. The outcomes of the EDAW study informed the potential growth options for the Issues and Options Consultation in September 2007. A Planning Brief has provided detail of proposals in the Silverstone Circuit. These areas are to provide the vast majority of the growth in the area, however other potential development areas may come forward in the emerging Core Strategy.

Delivering the right infrastructure is critical to sustainable and economic development, in particular housing. This includes the "hidden infrastructure" associated with the urban water cycle; a fact which has been brought into the spotlight recently through events such as the droughts of 2006 and the extreme flooding events of 2007. This Phase 1 Water Cycle Strategy (WCS) for major growth in West Northamptonshire looks at the challenges of accommodating large scale housing and development in an area of contradictions: the location of a key growth area, Northampton, at a confluence of a major river which is subject to regular fluvial flooding; whilst the location of Northamptonshire in one of the driest areas in England (identified by the Environment Agency as an area of serious water stress) poses entirely different challenges relating to availability of water.

This WCS has been developed under the direction of a stakeholder steering group including Daventry District Council, South Northamptonshire Council, Northampton Borough Council (these three have been represented by the Joint Planning Unit), Anglian Water Services Limited (AWS), the Environment Agency (EA) and West Northamptonshire Development Corporation (WNDC, who commissioned the study). It has assessed the potential impacts and constraints associated the proposed major development areas with regard to key topics of:

flood risk; water resources and supply; foul sewerage; wastewater treatment; water quality and water-related ecology. This WCS also provides guidance on the role of the water cycle infrastructure in achieving sustainable development. It identifies actions and responsibilities to help move forward toward a future vision, as well as addressing potential barriers to achieving this vision.

In Northampton it has been possible to identify which factors drive the preferred location for future development with respect to the water cycle – this is illustrated in the figure on the following page. The key driver has been the foul sewerage network. There are both capacity issues at key locations in the existing sewer system and water quality implications associated with any increased discharge from intermittent storm overflows.

AWS are currently developing a strategy to serve development in Northampton. However, until the location of LDF sites is finalised, these cannot be incorporated.

There may be the opportunity to connect some sites to the existing system within the constraints of capacity and water quality. However, this would require modelling to assess impact. It would be dependant upon the location of the site and size of development. The most straightforward sites to develop would be those which would transfer to Great Billing WwTW via a direct connection to the works (developer would requisition AWS). The south-east quadrant would fall into this category.

Northampton benefits from flood defences and therefore any increase in river flows will reduce the current level of protection. This means there is limited means of differentiating between areas from a flood risk perspective and a policy that all surface water should be attenuated on site is recommended. However, there are some exceptions to the rule and these have driven the identification of priority areas 2 and 3.

There are no long-term insurmountable constraints to the growth proposed in Daventry. However, the current flow and process capacity of the Wastewater Treatment Works (WwTW) at Whilton is a major constraint to any growth prior to the proposed upgrades at the works in the AMP 5 capital investment period 2010-2015.

In South Northamptonshire there are no long term insurmountable constraints to the proposed growth. However, further investigation of flows and discharges at Brackley Wastewater Treatment Works is required to determine the available capacity.

The capacity available on the flow consent at Towcester WwTW will allow for an estimated 1000 dwellings prior to higher flow consent application being required.

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The outline study has identified a number of important issues which need to be addressed in the detailed strategy to ensure that development is sustainable from a water cycle perspective. These include:

- Incorporate in to the Water Cycle Strategy additional information on proposed employment growth.
- Incorporate in to the Water Cycle Strategy final information on the LDF sites in Northampton, Daventry and South Northamptonshire. This is particularly important in Northampton where locating the proposed growth in the LDF will enable strategic infrastructure solutions to be determined for flood risk, foul drainage and the supply network. AWS is currently developing the most sustainable strategic solution for development within Northampton. Depending on the timing of these sites coming forward, LDF allocations may be able to influence this solution.
- If Brackley growth is included in the LDF, then the difference between measured flow and current assessed flow needs to be reconciled to confirm the capacity at the WwTW. In addition, it will be necessary for AWS to estimate the likely future load from the principal trade effluent discharge at Brackley and incorporate the findings in to the phase 2 WCS.
- Investigate further the capacity of the foul drainage networks in Towcester and Brackley.
- Consider possible water quality consent implications for Towcester and Silverstone WwTWs
- Incorporate the conclusions on ongoing consent negotiations at Whilton WwTW and Silverstone WwTW.
- Incorporate the findings of the Level 2 SFRA and sequential test.
- Engage relevant stakeholders to develop an integrated and comprehensive Surface Water Management Plan for Northampton, including common Sustainable Drainage Systems (SuDS) Adoption Strategies for the whole Study Area.
- Develop ecological design criteria for those areas on which development is to take place either as a result of allocation through development planning documents or through the grant of planning permission.

It should be noted that some of the assumptions made with respect to serving areas for sewerage require further investigation before constraints can be evaluated and infrastructure costs compared.

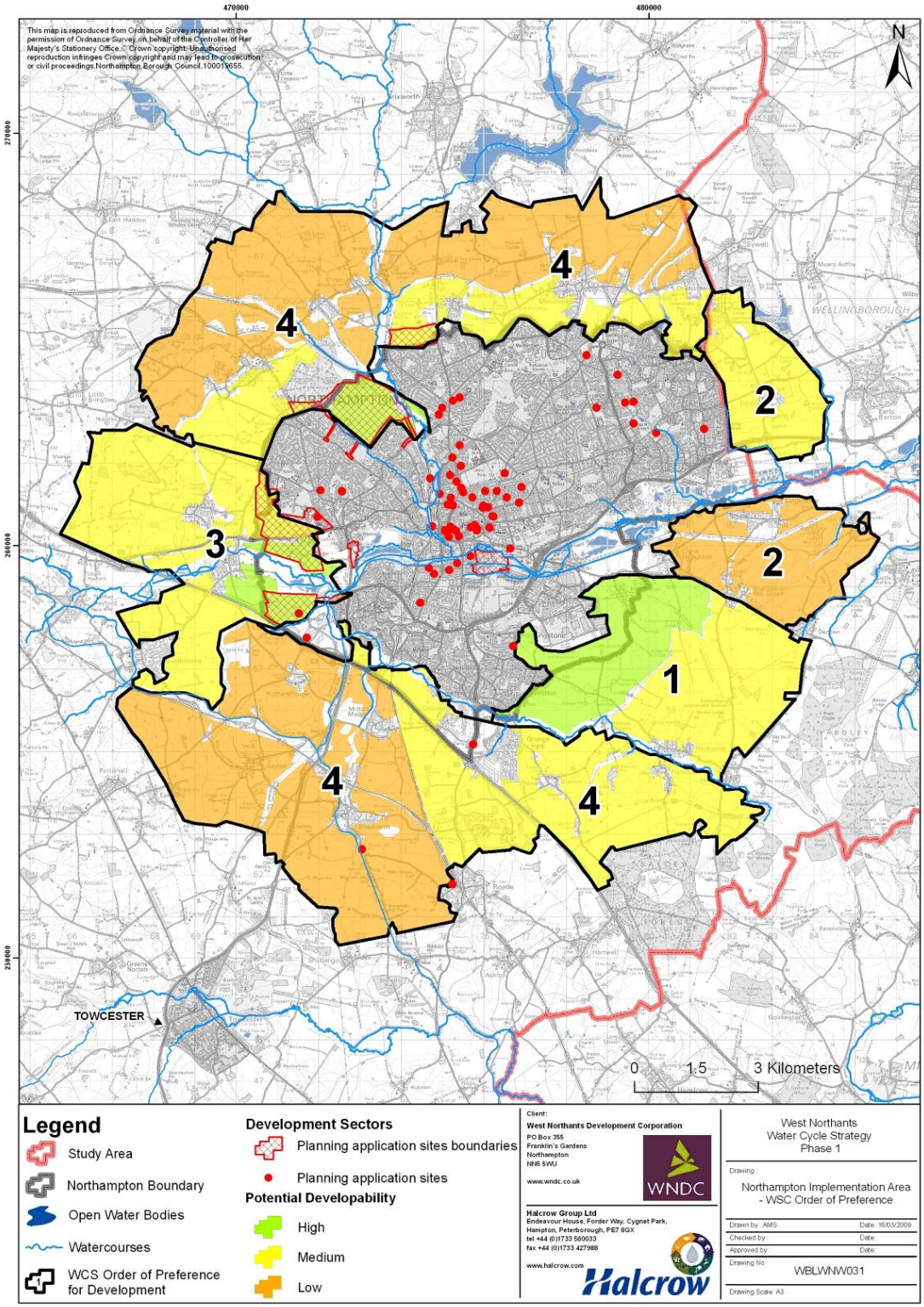

Figure 1-1: NIA development areas in order of preference for the water cycle

2 Introduction

2.1 Background

As a result of the Government's Sustainable Communities Plan (2003) four potential growth areas (or Sub-Regions) have been identified in the south and south east of England. They are: 1) Milton Keynes and South Midlands, 2) London-Stansted-Cambridge-Peterborough, 3) Ashford and 4) the Thames Gateway.

The Milton Keynes and South Midlands Sub-Region is shown in Figure 2-1 below.

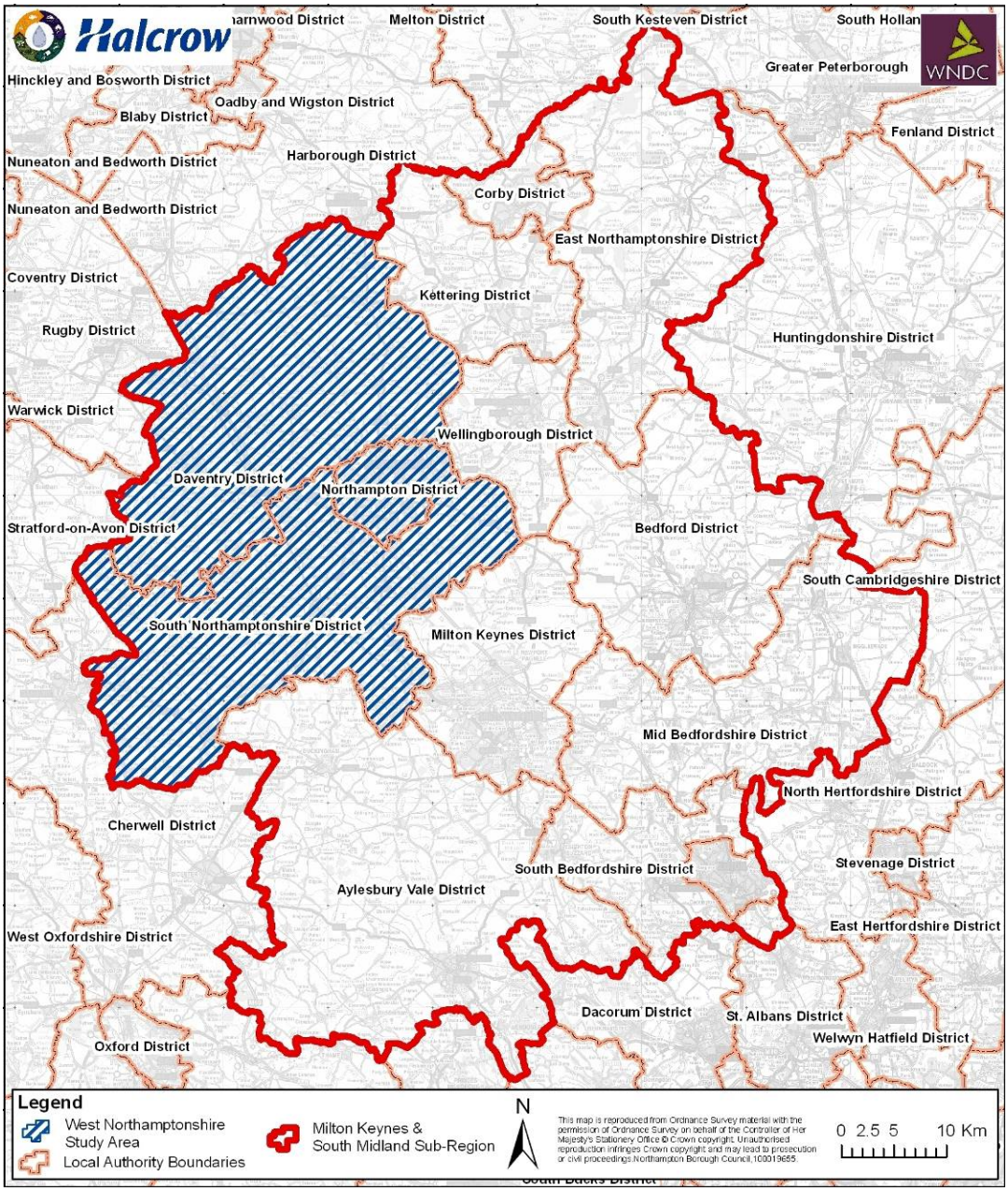

Figure 2-1: Milton Keynes and South Midlands Sub-Region

A Sub-Regional Spatial Strategy was produced for the Milton Keynes and South Midlands (MKSM) Sub-Region (March 2005) which provides a unified strategic approach to planning across the boundaries of three Regional Spatial Strategies (South East, East Midlands and the East of England).

The MKSM Sub-Regional Study covers the following key growth areas and towns (with information as to the status of current WCS work):

- Aylesbury (Phase 2 ongoing)
- Bedford, Kempston and northern Marston Vale (Scoping study complete)
- North Northamptonshire (Corby, Kettering, Wellingborough) (Detailed Strategy)
- Luton and South Beds (Houghton Regis, Dunstable) (Outline Strategy)
- Milton Keynes (Outline Strategy)
- West Northamptonshire (Scoping Study Complete)

Water cycle strategies in other areas have progressed and this progress is shown in the brackets in the list above.

Halcrow Group Ltd (Halcrow) delivered a scoping report to support this Water Cycle Strategy to the Environment Agency in November 2007.

West Northamptonshire Development Corporation (WNDC), an Urban Development Corporation set up to deliver development and infrastructure that enables regeneration and growth,, has commissioned Halcrow to undertake Phase 1 of this Water Cycle Strategy.

2.2 West Northamptonshire Growth

The growth target for West Northamptonshire over the period 2001 to 2021 is set out within the MKSM Sub Regional Study. The draft East Midlands Regional Plan (March 2006) updates the MKSM target and covers the period 2006 to 2026. The draft EMRP following consultation on the Secretary's of State Proposed Changes, is expected to be published early in 2009 and therefore the proposed housing figures may be subject to change[1]. This will be reviewed in Phase 2 of the Water Cycle study. Housing figures are discussed in more detail in Section 4.

[1] The East Midlands Regional Plan was adopted in March 2009. The housing figures have changed marginally, actually going back to the former housing figures i.e. for West Northants 62,125. The consequential changes related to this would affect several parts of the document. This is a change of 25 dwellings across the whole area from the housing figures used in the Outline Phase 1 report. The changes will be incorporated in the level 2 Water Cycle Strategy. The adopted Regional Plan can be found at:

http://www.gos.gov.uk/497296/docs/229865/EMRP

The draft EMRP proposes that Northampton, Daventry and South Northamptonshire are required to provide 62,150 homes between 2001 and 2026. West Northamptonshire Development Corporation, (WNDC), has been set up to take responsibility for delivery of the vast majority of these dwellings.

The main focus for growth, are the three urban centres of Daventry (sub-regional centre), Northampton (Principal Urban Area) and Towcester (rural service centre) as depicted below in Figure 2-2. There is an option of including some growth in Brackley (rural service centre), also shown.

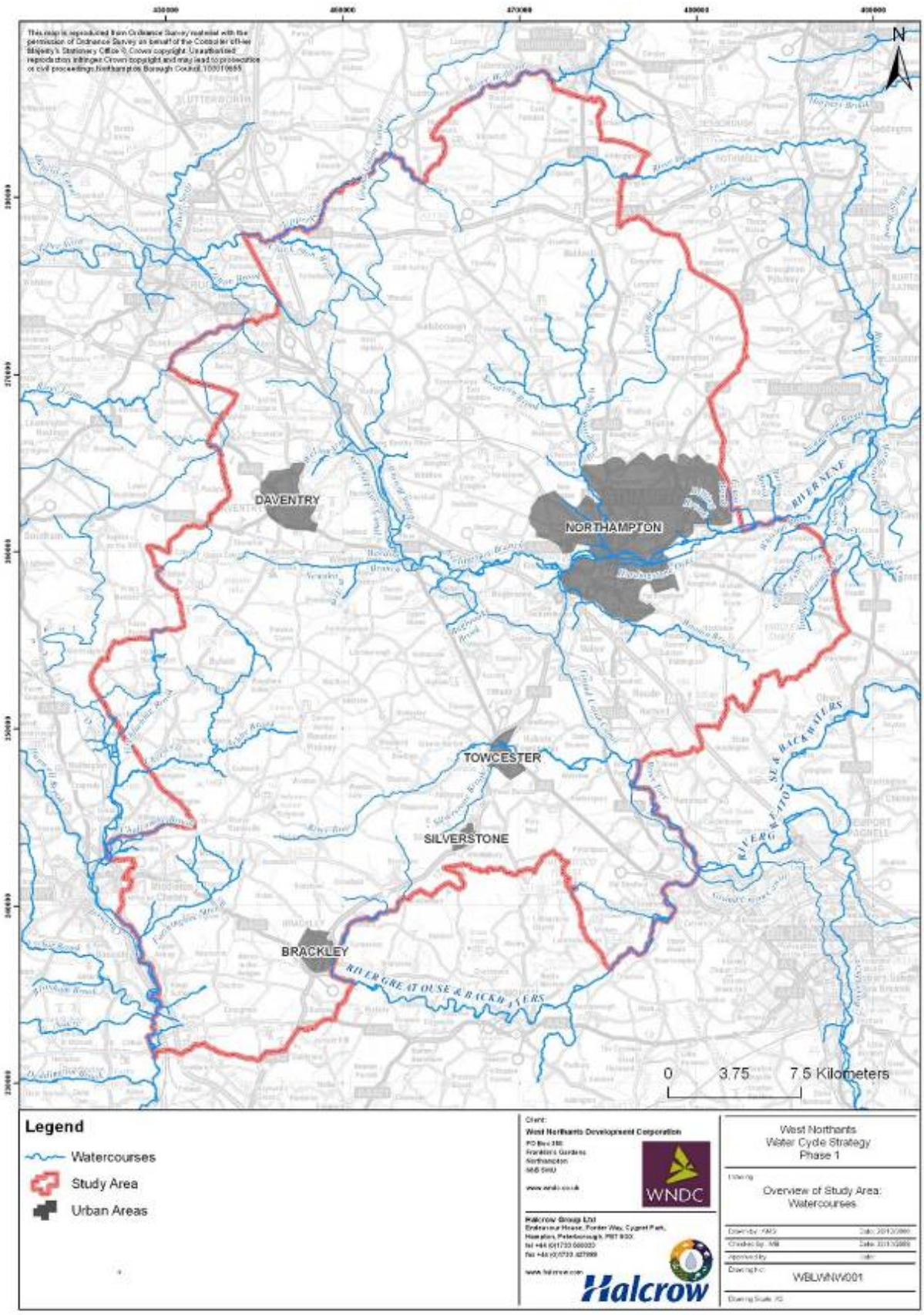

Figure 2-2: Strategy Study Area

2.3 Delivering the Growth Agenda

The policy planning powers for West Northamptonshire rest with the West Northamptonshire Joint Strategic Planning Committee which is serviced by the West Northamptonshire Joint Planning Unit (JPU). West Northamptonshire comprises Daventry District Council and South Northamptonshire Council. The West Northamptonshire Joint Planning Unit is responsible for delivering the Joint Core Strategy that will cover all three authority areas. The outstanding housing requirement in Northampton will be largely provided by growth focused on the perimeter of the urban area.

The West Northamptonshire Development Corporation (WNDC) has been set up by government to work with local authorities and partners to deliver sustainable growth within Northampton, Daventry and Towcester. WNDC is an Urban Development Corporation, set up by the Secretary of State under the provisions of the Local Government Planning and Land Act 1980 (LGPLA) with the power to determine planning applications of a strategic nature. The Act provides that it may do so in a number of different ways including making decisions on planning applications. The Government has granted WNDC powers to make decisions on certain types of planning applications of a strategic nature or those which have a significant impact upon the designated area. In Northampton town centre a wider range of planning applications will be determined by WNDC than in the rest of its urban development area.

WNDC has commissioned Halcrow to prepare Phase 1 of this Water Cycle Strategy. The primary purpose of this study is to assess the implications for water supply and wastewater treatment of planned housing growth up to 2026. This will provide a context for the consideration of current and future planning applications. It can also feed into consideration of longer term growth options being considered by the Joint Planning Unit, as part of work on the ongoing Core Strategy for the three local authorities.

This Water Cycle Strategy focuses on the Core Strategy Issues and Options paper (2007) and aims to provide guidance and recommendations to assist the planning authorities in locating the growth, in relation to water services infrastructure (WSI). With respect to Northampton however, the EDAW potential development schematic (see Figure 4-1) has been used in place of the Issues and Options paper on directive of the JPU. The EDAW study forms part of the evidence base for the Core Strategy. The Joint Core Strategy is still in its early stages with the emerging strategy due to be produced for consultation in early July 2009. Other potential development areas may come forward in the emerging Core Strategy.

"Local Authorities, developers, water companies, the Environment Agency and other relevant public bodies should work together to take water related issues into account at an early stage in the process of identifying land for development and in the phasing and implementation of development, e.g. by undertaking water cycle studies" (Policy 32, draft East Midlands Regional Plan)

3 A Strategic Approach

3.1 The Problem

Figure 3-1 shows the elements that comprise the Water Cycle. Although the methods of dealing with them may change, the basic requirements never will. Rain will fall, clean water will be needed for life, and sewage treatment will be needed for public health.

The effects of climate change upon the water cycle is not yet fully understood, however it is generally accepted that summers will become drier and winters will become wetter. The effects of climate change can only be modelled crudely as no-one yet knows the full impacts, however a WCS should consider the potential implications of climate change.

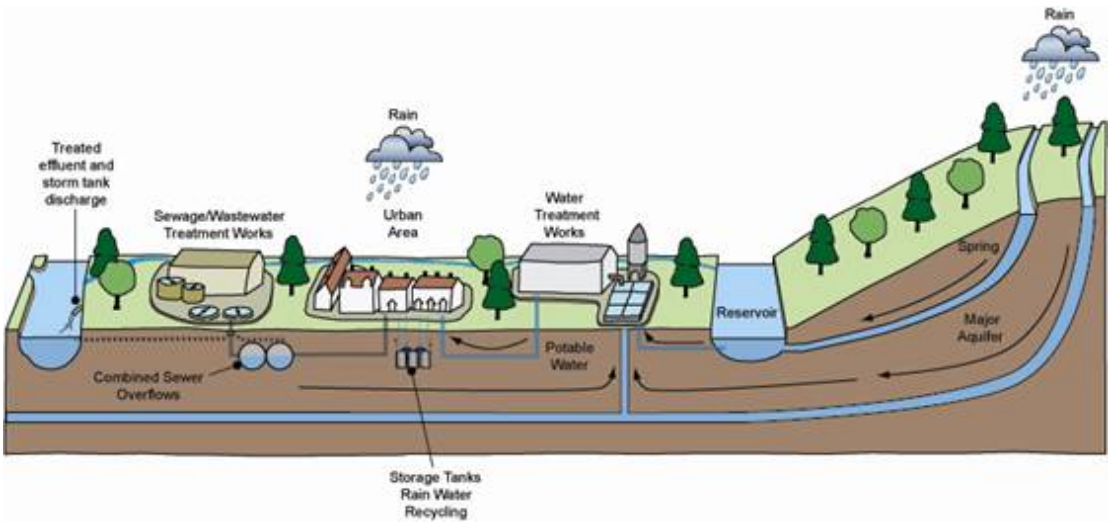

Figure 3-1: The Water Cycle

The Water Framework Directive (which has already been transposed into UK law) will ensure that water quality standards improve significantly between now and 2015. What is acceptable now will not necessarily be so in the future. Defra and the Environment Agency are currently working towards classifying all watercourses in England and Wales to determine what should be classified as 'good' water quality as required by the Water Framework Directive (WFD) with respect to chemical, biological and physical standards. A draft WFD plan is expected in December 2008 with a final plan to be provided in December 2009.

3.2 Implications for Development

The demand for clean water supply and wastewater treatment can be expected to increase in proportion to the number of new homes being built, as can the risk of flooding if houses are built in the wrong place or if drainage is not managed

sustainably. It will not be sustainable to continue to develop new homes, employment land and community infrastructure at the scale proposed in the draft EMRP without due consideration of how to address factors such as flood risk, water resource, water supply and sewerage infrastructure, waste water treatment and water quality and sustainable drainage systems (SuDS).

Stakeholders such as WNDC, Northampton Borough Council, Daventry District Council, South Northamptonshire Council, Anglian Water Services Ltd (AWS), the Environment Agency, Ofwat and developers are called upon to work together to facilitate the approach to considering this range of water services infrastructure.

LDF documents submitted to the Secretary of State must include within their evidence base demonstrable evidence of this strategic approach. An integrated Water Cycle Strategy provides the ideal means by which to address this need and can be undertaken in a phased manner to suit the staged levels of detail required by the planning process.

There has been widespread recognition of the value of Water Cycle Strategies in terms of sustainable water infrastructure planning. Water Cycle Strategies are considered best practice by the Environment Agency, and the Environment Agency, supported by Anglian Water Services and Government Office East of England, has just produced guidance on how to carry out water cycle strategies.

3.3 The Solution

This Phase 1 Water Cycle Strategy for West Northamptonshire breaks the Water Cycle down into its component parts to establish the existing situation and examine the potential impacts of the proposed level of growth on each. The following technical chapters explain the base data that has been used, any assumptions that have been made, the analysis we have undertaken and the outcomes we have derived.

This WCS is based on current data but it should be noted that there are several matters that are outstanding at this stage including:

- the Joint Core Strategy Submission 2 March 2010 (adoption programmed for January 2011);
- the outcomes of the Development Planning Documents detailed in the Local Development Scheme (November 2008, see www.westnorthamptonshirejpu.org); and,
- the overall growth figures are subject to change following the publication of the adopted EMRP expected early in 2009;
- the way in which discharges are regulated, and the quality they need to meet may be subject to change. Achieving the Water Framework Directive objectives and standards are driven through the River Basin Management Plan, which was published in December 2008, and under

consultation until June 2009. The final River Basin Management Plan which will confirm the activities required to achieve the standards will be published in December 2009.

It is recommended that a phase 2 Water Cycle Strategy is undertaken within the next 12 months to build upon the findings of this Phase 1 report. Broad locations of development are expected to be identified within the Joint Core Strategy and are expected to be known towards the end of 2009. The phase 2 WCS will provide the evidence base of the water service infrastructure that is needed and when it is needed to support the submission of the Joint Core Strategy and adoption of the CS that identifies the preferred development areas.

3.4 The Project Group

West Northamptonshire Development Corporation, has taken the lead on the strategic assessment of the Water Cycle in West Northamptonshire. A project steering group was formed comprising the following stakeholders:

- West Northamptonshire Development Corporation
- The Environment Agency
- Anglian Water Services Ltd
- West Northamptonshire Joint Planning Unit (representing NBC, DDC and SNC)

3.5 Analytical Approach and Scope of Phase 1 Strategy

A proposed scope of work for the outline WCS was agreed between Halcrow Group Limited and the Environment Agency for inclusion in the Scoping Study issued in November 2007. This formed the initial scope of work included in WNDC's 'Project Brief for Potential Tenderers' issued in November 2007.

A revision of this scope was agreed between WNDC and Halcrow in October, 2008 which changed the focus of this Water Cycle Strategy away from the council planning application submissions, and toward assessing the growth points for suitable locations to accommodate the outstanding housing requirement.

The Joint Core Strategy has yet to allocate broad site allocations for development but the documents below in Table 3-1 have been used to inform the identification of potential development areas.

Town/City	Council Area	Planning Reference
Northampton	Northampton Borough and parts of Daventry and South Northamptonshire districts to be specified	EDAW site options
Daventry	Daventry District	CSS Issues and Options
Towcester	South Northamptonshire	CSS Issues and Options
Brackley	South Northamptonshire	CSS Issues and Options
Silverstone	South Northamptonshire	Development Brief

Table 3-1: Planning guidance for study area growth points

It is noted that applications have been submitted in Towcester and Daventry which coincide (in part) with the potential development areas. Whilst decisions on the acceptability of these proposals have yet to be made, they provide a level of information which enables more realistic assumptions to be applied in the analysis.

This outline Water Cycle Strategy provides information regarding existing environmental and infrastructure capacities. It provides a comparative assessment of the potential development sectors to identify any potential constraints relating to water services infrastructure which may help to inform the LPAs' selection of sectors for their preferred options. High level mitigation options have been considered to help understand the relative severity of potential constraints and allow comparison of the scale of required infrastructure.

The scope for this Outline Water Cycle Strategy is to;

- Provide an overview of the proposed development areas and growth trajectories within the area.
- Assess existing water services infrastructure including schematics delineating the various regions and catchments.
- Assess the effect upon flood risk and surface water drainage from the potential development areas (on greenfield and brownfield sites), including consideration of the storage and release of any run-off water from the development, based on available existing information.
- Review existing water company planning in relation to future water resource availability and supply infrastructure.
- Assess wastewater treatment, foul drainage and water quality aspects with respect to the potential development areas. High level analysis of impacts on relevant treatment works will be provided. This will include input and liaison with AWS. An indication of required network and treatment works improvements will be provided.

- Undertake an initial high level assessment of environmental and ecological issues associated with the water cycle and its associated infrastructure.
- Provide a WSI summary matrix for the various development area options to inform the preferred options.
- More detailed analysis and infrastructure optioneering will be undertaken within the detailed Phase 2 WCS, once preferred areas have been selected. This will include scheduling and indicative costing of the preferred development areas, and progress the detail of analysis around identified constraints and mitigation options for the preferred areas.

4 Spatial Distribution of Future Development

4.1 Introduction

The following section summarises current information on proposed development in West Northamptonshire, upon which this Water Cycle Strategy has been based.

Key sources of data that have been used in this study consist of the current and emerging RSS8/East Midlands Regional Plan (EMRP), the Milton Keynes South Midlands (MKSM) Sub-Regional Study (SRS), and the Core Strategy Issues and Options Paper (2007). The Joint Core Strategy is still in its early stages with the emerging strategy due to be produced for consultation in early July 2009. Other potential development areas may come forward in the emerging Core Strategy.

Current RSS8 allocations, plus the figures in the emerging East Midlands Regional Plan provide the starting point for the analysis. The figures from the emerging Regional Plan should be used for guidance only, until the final version is complete and published. Updated information on housing completions, applications and likely developments has been supplied by Daventry District Council, Northampton Council, South Northamptonshire Council, the West Northamptonshire Joint Planning Unit and West Northamptonshire Development Corporation (WNDC). We have also analysed the following Plans and Strategies:

- Daventry District Local Plan (Adopted 1997)
- Northampton Borough Local Plan (Adopted 1997)
- South Northamptonshire Local Plan
- Northamptonshire Structure Plan
- Approved Silverstone Circuit Masterplan Development Brief (March 2009)

Note that only the saved policies of the local plans that are still considered relevant by the Secretary of State pending the adoption of the new Core Strategy and Local Development documents apply. However, housing allocations in the Local Plans also provide some information on the location of future housing growth, but these do not extend up to 2026 and may be subject to significant review and amendment as a result of the ongoing work of the Joint Planning Unit.

Pending adoption of the draft Regional Plan, the saved policies in the current Structure Plan for Northampton are also relevant.

For employment, data from the CoPELA Report (2003 and 2006), the Strategic Northamptonshire Economic Action Plan (SNEAP) Annual Monitoring Reports 2006-2007 and information supplied by the Study Partners has been used.

4.2 Scale and Phasing of Growth

The latest housing provision for West Northamptonshire as set out in the draft Regional Plan has been updated within the document 'Completions, and planning permission data' supplied by Study Partners (February 2008) and is provided in Table 4-1 below and Appendix A. The latest housing figures for West Northamptonshire as set out in the Proposed Changes from the Secretary of State were not revised except for adding figures for the period 2021-26 and replacing the figure for the Northampton Implementation Area (NIA) for the period 2001-21 as the original figure had been quashed following a successful High Court challenge in 2006. Apart from these additions the MKSM SRS is unchanged and Part 1 of the Strategy and Part 2 (Northamptonshire) will be reproduced in full in the final version of this RSS. The housing figures will all be revised in a subsequent RSS review and up to date information from the local planning authorities will be used in Stage 2 of the Water Cycle Strategy[2]. The unimplemented planning permissions are listed in Appendix A.

	Northampton Implementation Area	Daventry	South Northamptonshire	Total
Total Housing Requirement	40,375	13,500	8,250	62,125
Completions 2001 - 2008	9,367	2,019	1,873	13,259
Under Construction as at 2008	2,329			2,329
Unimplemented Planning Permissions at 2008	1,797	85	552	2,434
Outstanding Planning applications at 2008	10,734	2,467	3,879	17,080
Pre-Applications at 2008	4,487	2,736	1,350	8,573
Allocated in Local Plan		20	456	476
Remaining Housing Requirement	11,661	6,693	140	8,369

Table 4-1: Housing Requirements 2001-26, February 2008

The Draft Regional Plan recommends the phasing of housing figures for the five-year periods between 2001 and 2026 as provided in Table 4-2:

[2] Housing figures will be updated to reflect the newly adopted Regional Plan in the next phase of the water cycle study.

Council Area	Phasing Periods						
	01/06	06/11	11/16	16/21	Total	21/26	Total
S. Northamptonshire							
Phasing	1,650	1,650	1,650	1,650	6,600	1,650	**8,250**
Annual Average	330	330	330	330		330	
Daventry							
Phasing	2,700	2,700	2,700	2,700	10,800	2,700	**13,500**
Annual Average	540	540	540	540		540	
Northampton NIA							
Phasing	6,500	7,250	8,850	8,900	31,500	8,900	**40,400**
Annual Average	1,300	1,450	1,770	1,780		1,780	
TOTAL							
Phasing	10,850	11,600	13,225	13,225	48,900	13,225	**62,125**
Annual Average	2,170	2,320	2,645	2,645		2,645	

Table 4-2: Development phasing within the Draft Regional Plan

4.3 Employment

The Milton Keynes and South Midlands Strategy indicates that an additional 37,200 jobs in West Northamptonshire (Northampton, Daventry and South Northamptonshire districts) in the period 2001-2021 will be created., as shown in Table 4-3. The draft SNEAP Report extends the total jobs to 61,800 for 2026. It should be noted that SNEAP figures are indicative and subject to change.

Borough/District	Additional Jobs 2001-2021	Actual Job Growth 2001-2005*	Remaining Job Growth
Northampton	27,600	6,000	21,600
Daventry District	6,000	8,000	- 2,000
South Northamptonshire	3,600	2,000	1,600

* Source of actual job growth is the Annual Business Inquiry.

Table 4-3: West Northamptonshire estimated Job Growth 2001-2021

In order to meet land requirements for future business growth, extensions to Brackmills, Pinham and Milton Ham as well as land at Upton and the Town Centres have been deemed suitable.

This report uses the SNEAP Report as a study for consultation which indicates that higher levels of employment will probably materialise along with shift in employment structure. The CoPELA reports 2003 and 2006 are also used to look at quantities of employment land and investigate the future requirements of employment land in the areas of Daventry, South Northamptonshire and Northampton which according to the MKSM aims for large scale employment growth over the next 20 - 30 years.

According to the CoPELA Report 2003 (updated 2006) it is suggested that successful implementation of the MKSM growth targets might require 450-500 hectares of net new employment land in Northamptonshire over the period 2003-2016, equal to approximately 35-40 hectares a year. About half of the requirement is in Northampton with smaller amounts in Daventry and just a few hectares in South Northamptonshire.

The updated CoPELA Report 2006 suggests that to meet the MKSM objectives 2001-2021 some of the emerging employment land supply does need to be brought forward. This will be looked at in a more site specific way in Phase 2 of this Strategy.

4.4 Northampton

4.4.1 Growth

40,400 new dwellings are forecast to be built over the period 2001 – 2026 in the Northampton area, with annual completion rates of between 1,300 and 1,775 dwellings a year over five, five-year plan periods. The latest information available when collating this report had 1,797 dwellings with unimplemented planning permission, 2,329 have construction begun on site and 15,221 with outstanding applications or pre-applications (Table 4-1).

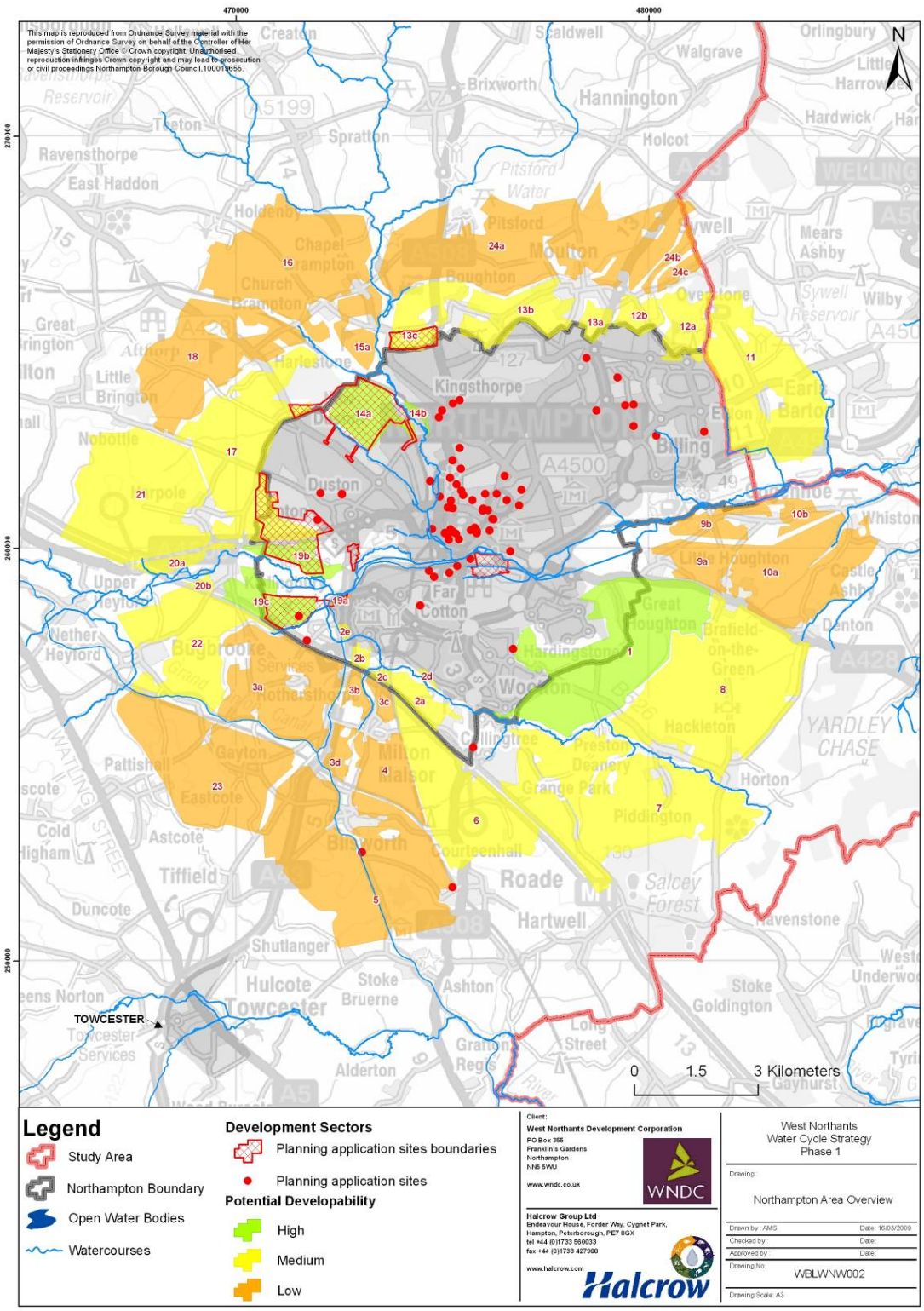

Figure 4-1: Potential development areas for Northampton

The West Northamptonshire Joint Core Strategy is not advanced enough to have identified directions of growth for Northampton. The Northampton Longer Term Growth Options Study (prepared by EDAW et al for Daventry District, Northampton Borough and South Northamptonshire Councils) assessed the potential "developability" of 24 sectors in and around Northampton. For the purposes of the Water Cycle Strategy all 24 sectors have been considered rather than just the four growth options finally recommended by EDAW and included for comments in the Joint Core Strategy Issues and Option Discussion Paper in September 2007.

In Northampton a number of sites have been allocated within the Local Plan. The following sites are the subject of current applications: Dallington Grange (3500 dwellings), Upton Lodge (1784 dwellings), Princess Marina (550 dwellings), Avon/Nunn Mills (1250 dwellings), Ransome Road (800 dwellings, recently granted outline planning permission), Pineham Barns (625 dwellings), Upton Lodge and Grange Park (450 dwellings). These sites are represented in Table 3 in Appendix A and are being examined in detail outside of this Water Cycle Strategy

4.4.2 *Employment*

According to the Northampton Annual Monitoring Review 2006-2007 the amount of land developed for employment, by type totals 11.8ha with no development or regeneration areas currently defined in the LDF. Of the amount of land developed for employment 9% has been on previously developed land. The employment land supply by type is 174.62ha in total, with 0.038ha of employment land lost to residential development.

4.5 Daventry

4.5.1 *Growth*

The emerging RSS indicates that Daventry will deliver 13,500 new dwellings between 2001 and 2026. Currently, 85 dwellings have unimplemented planning permission and 4,703 dwellings have outstanding permission or pre-applications. Applications have been submitted for three development sites, Church Fields, Monksmoor and Danetree, which together comprise 10,150 dwellings. All three sites are subject to on-going appeals for determination by the Secretary of State. Refer to Table 1 in Appendix A for more detail.

An overview of the potential development areas identified within the Core Strategy Issues and Options Paper has been included in Figure 4-2. Note that where a planning application has been submitted that coincides to some extent with a potential development area identified within the Issues and Options paper, this site layout has been included on the figure. However the wider potential development areas have been used in analysis for the purpose of this study.

4.5.2 *Employment*

According to the Daventry Annual Monitoring Report 2006-2007 (revised February 2008) employment supply is equivalent to 6.8 years at the take up rate of 3.75

hectares per annum. However it is not possible to distinguish the type of employment use class in most circumstances. Many planning permissions are various interchangeable mixes of uses classes. The target for the type of employment land available is 120 hectares of industrial land in Daventry. The supply of 25.36 hectares represents 6.8 years supply. The LDF period will run up to 2026 and the need for additional land to be allocated for employment purposes will be considered through the production of the Core Strategy DPD.

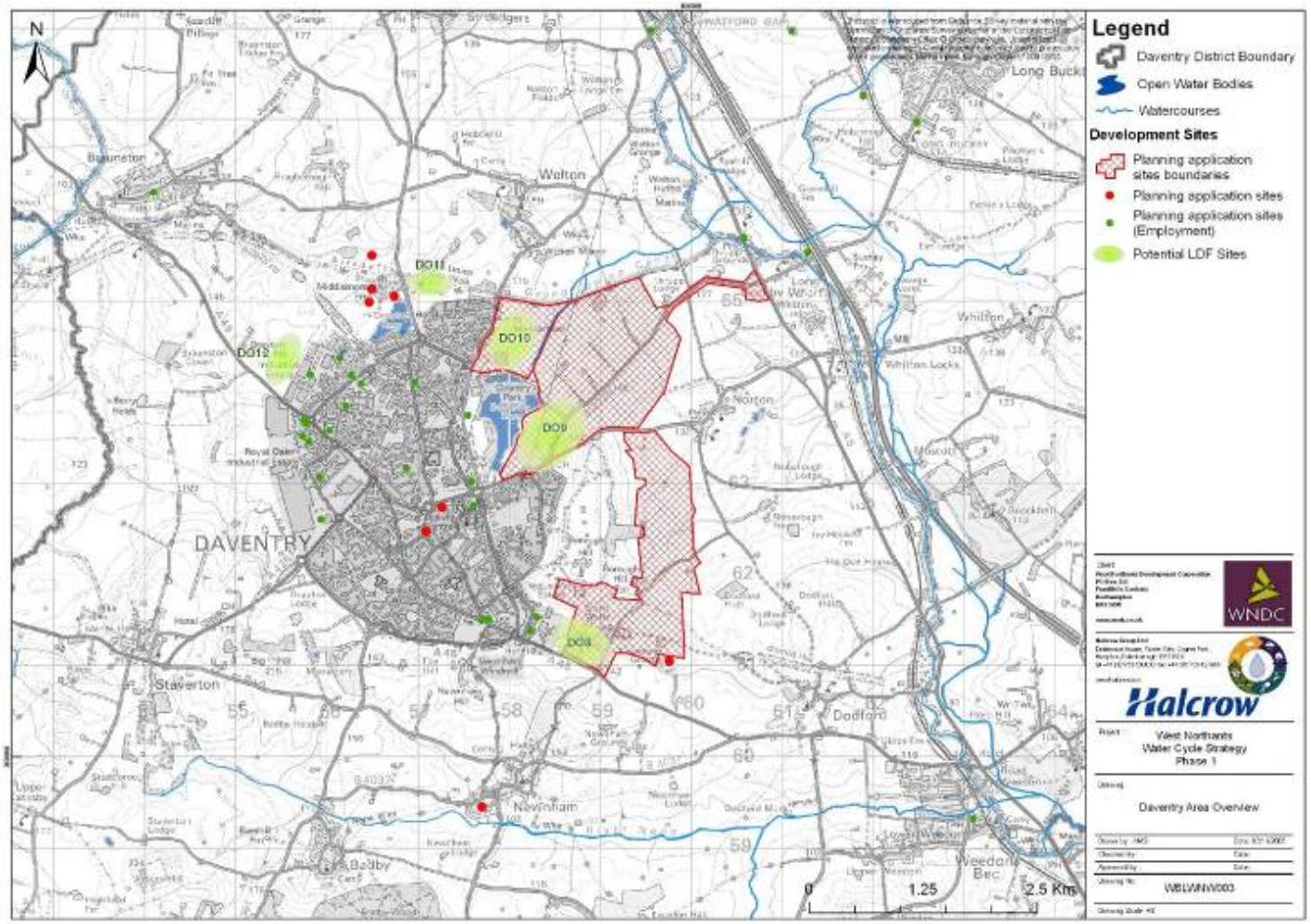

Figure 4-2: Daventry growth options

4.6 South Northamptonshire

4.6.1 Growth

South Northamptonshire is to deliver 8,250 new dwellings over the period 2001 – 2026, with an annual completion rate of 330. Currently, 552 dwellings have unimplemented planning permission and 5,229 dwellings have outstanding permission or pre applications, with an additional 456 allocated in the Local Plan. Table 2 in Appendix A gives details of these.

An overview of the potential development areas identified within the Core Strategy Issues and Options Paper has been included in Figure 4-3. Note that if a planning application has been submitted that coincides with a potential development region identified within the Issues and Options paper, this site layout has been included. Silverstone has been based upon planning application masterplans.

Towester

The principle of significant growth at Towcester is established in the RSS through its designation as a Rural Service Centre. A masterplan is being produced for Towcester that will cover the next 10 to 15 years. A draft will be available in January 2009. The masterplan aims to build on the ideas of the 'Vision for Towcester' document that was published in 2006 and will provide a cohesive framework for the development of the town as a whole. This will bring together plans currently being prepared for the historic Moat Lane area and the Persimmons and Bloor's planning application for 3000 homes to the south of Towcester, known as Towcester Vale. A related masterplan is also proposed for Brackley, work for this is scheduled to begin in early 2009.

The possible options for the growth of Towcester found in the Core Strategy have been influenced by the context for future development as set out in the RSS as well as known existing physical infrastructure constraints.

Brackley

As with Towcester, the RSS designates Brackley as a Rural Service Centre. However, the RSS does not make a specific reference to the needs of Brackley and therefore there is an issue on how much growth should be provided there. Work on a masterplan for Brackley will begin early in 2009. The town centre is considered to be underperforming although the proposed mixed-use development at College Place may help to improve the vitality of the town.

The options for the growth of Brackley distinguished in the Core Strategy have been influenced by the context for future development as set out in the RSS as well as known existing physical infrastructure constraints.

Silverstone

Silverstone Circuit, although in a predominantly rural setting, contains a wide range of high value and high skill enterprises including motorsport businesses, which make an important contribution to the national and local economy. It lies at the centre of a high tech motorsport cluster, which focuses on Silverstone Circuit. Part of the Circuit lies in Aylesbury Vale District Council's area. The Silverstone Circuit Development Brief is intended to provide planning guidance for improvements proposed for the motor racing circuit. These include a new pit and paddock complex to provide up to date motor racing facilities needed attract high level motorsport events to Silverstone. Employment development which will provide funding for the proposed pit and paddock complex is also covered by the brief. Other uses include hotel accommodation, an education campus, an exhibition and conference area and uses related to motor sport and the motor industry.

The Brief is based on adopted Local Plan policies and takes account of planning guidance from the Government. The development brief is now adopted.

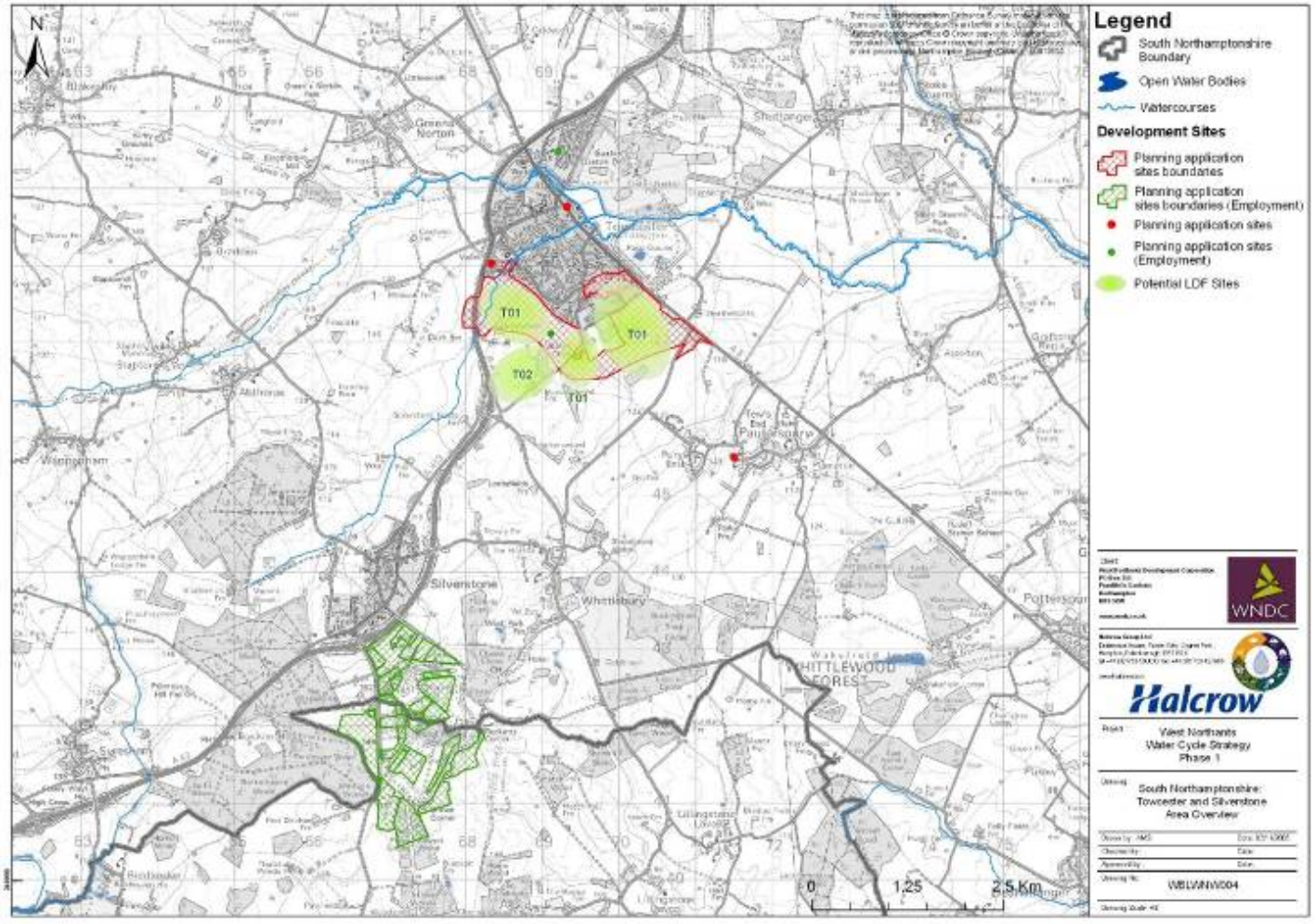

Figure 4-3: South Northamptonshire Growth Options

4.6.2 *Employment*

The Local Plan (1997) makes provision for 35 hectares of land for industrial and commercial development during the Plan period. A further 30ha of employment land is identified as part of the Grange Park development, however this has been taken as been part of Northampton. In the year ending March 2007 a total of 6.12ha (developments completed over 0.4ha) of industrial or commercial space were completed in the District. The Planning Brief for Silverstone incorporates a range of use classes that would supply 3,479 new jobs on approximately 46.78 ha of land.

4.7 Development Summary

It is apparent that a significant element of future housing growth is not currently allocated and does not yet have planning permission. The Water Cycle Strategy aims to provide guidance for selection of the location, form and means of delivery of this future growth. The Core Strategy Issues and Options Report, the background studies which support it and the options developed by EDAW for Northampton consider a number of potential Growth Options to accommodate future growth requirements.

In Phase 2 of the Water Cycle Strategy, future consideration will be given to employment growth, some of which may have significant implications for water supply and quality, as well as supporting growth for schools, hospitals and other community infrastructure.

5 Flood Risk Management

5.1 Introduction

A review of flood risk management options during the early phases of a Water Cycle Strategy is essential to ensure that:

- The risk of flooding from all sources to the development areas is considered and development is steered away from high risk areas (in particular, Flood Risk Zones 2 and 3).
- The potential impact of development proposals on catchment flood response is considered.
- Any flood risk mitigation measures are planned in a strategic, rather than unplanned fashion.
- There is no deterioration to existing communities' standard of protection.

The guidance for Water Cycle Strategy (Halcrow Group Ltd, Anglian Water Services and the Environment Agency, 2008) states that the output of the Outline Water Cycle Study should answer the following question:

"Is there enough land available for development - without increasing flood risk or building vulnerable properties in flood risk areas?"

It also states that a detailed Water Cycle Strategy should establish minimum design standards for new development, identify a timeline of infrastructure requirements and consider the basis for developer contributions to infrastructure.

The Water Cycle Strategy is not intended to replace site-specific flood risk assessments by developers. Instead, it identifies the potential for developers, local planning authorities and the Environment Agency to work together in providing strategic solutions that benefit the catchment as a whole.

The aims and scope of this Outline Water Cycle Strategy are therefore as follows:

- to review the findings of recent studies into flood risk in West Northamptonshire;
- to determine existing flood risk to the proposed development areas from all sources of flooding, in order to aid the local planning authority in selecting preferred areas;
- to identify the potential for strategic solutions to mitigate the effects of development and improve flood risk protection standards in the study area; and

- to identify topics requiring further investigation in the Phase 2 (detailed) Water Cycle Strategy.

Throughout this section, standards of flood protection are referred to according to the probability of flooding occuring in a location in one year. A standard of protection to the 1 in 100 year event means that the location has a 1% chance (1 in 100) of flooding in any year. This does not mean that if the location floods in one year, it will definitely not flood again for the next 99 years, nor that if it has not flooded for the previous 99 years, that it will definitely flood this year.

5.2 Catchment Description

The River Nene, River Great Ouse (including River Tove), River Cherwell and their tributaries all originate within the administrative areas of the West Northamptonshire local planning authorities (LPAs) as shown in Figure 5-1. The principal rivers in the study area drain from west to east with the exception of the River Cherwell, which flows from north to south. The upper reaches of these catchments are classed as being 'flashy' due to the underlying hard rock geology, leading to relatively short catchment response times. The main source of flooding within West Northamptonshire is from rivers and watercourses overtopping their banks.

5.2.1 River Nene and Tributaries

The catchment of the River Nene covers the majority of the Daventry District Council and Northampton Borough Council administrative areas. The River Nene rises on the mainly clay soils of the Northampton Uplands at sources near Badby, Naseby and Yelvertoft and then crosses the gently undulating rural country to the flat plains of Peterborough. The catchment is largely rural and the major land use is agriculture. The main urban areas include:

- Daventry (covered by this Water Cycle Strategy)
- Northampton (covered by this Water Cycle Strategy)
- Wellingborough (covered by the North Northamptonshire Water Cycle Strategy)
- Kettering (covered by the North Northamptonshire Water Cycle Strategy)
- Corby (covered by the North Northamptonshire Water Cycle Strategy)
- Peterborough (covered by the Peterborough Water Cycle Strategy)

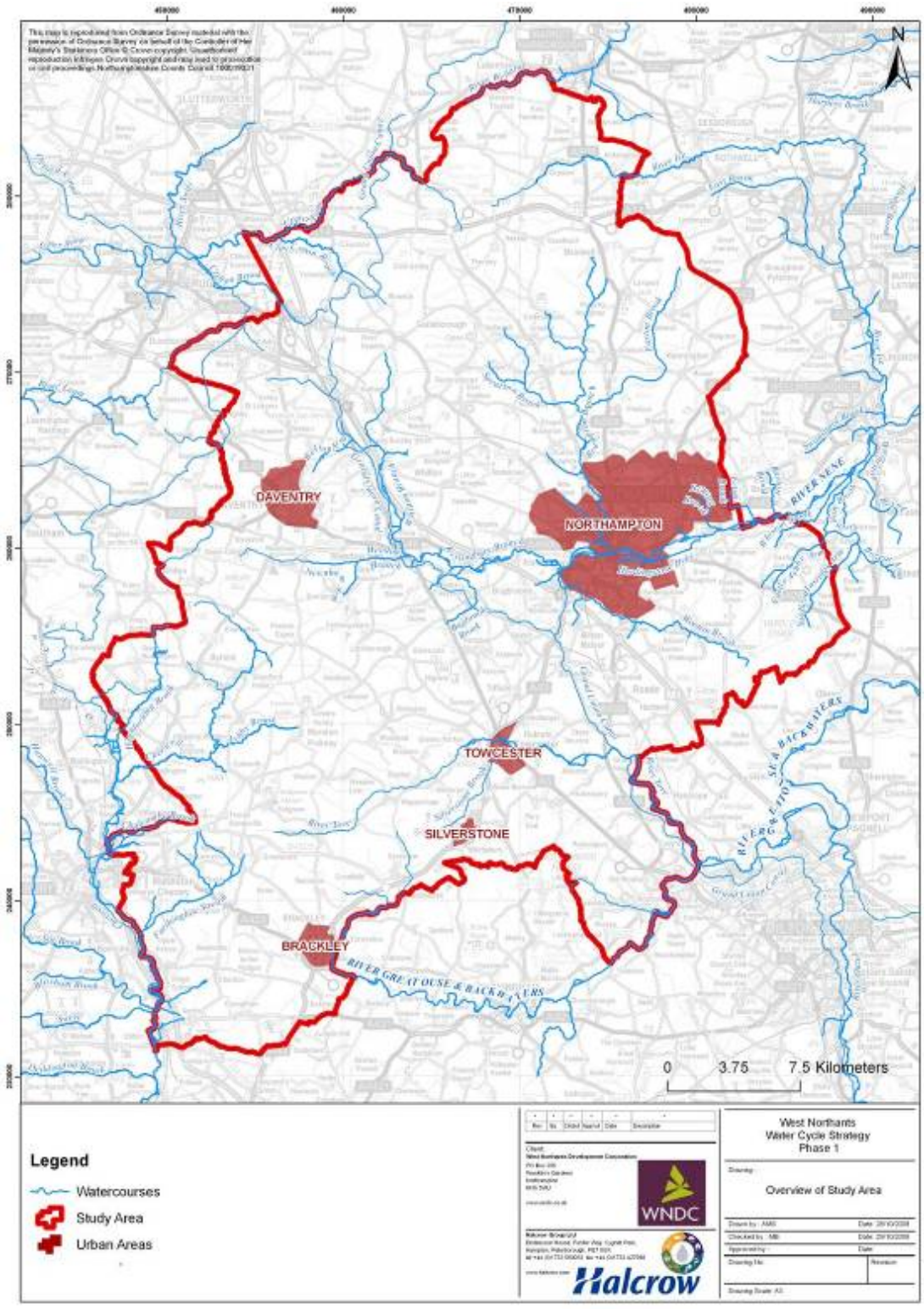

Figure 5-1. Study area overview showing watercourses

Northampton lies at the confluence of the River Nene's principal upper tributaries – the Kislingbury Branch, the Brampton Branch and Wootton Brook (Figure 5-1). The upper catchment is crossed by the Grand Union Canal and its Northampton Arm. The canal is supplied with water from the Daventry and Drayton reservoirs in the upper catchment of the Kislingbury Branch. The Kislingbury Branch is joined by the Weedon Branch. Downstream of the confluence with the Weedon Branch, the Kislingbury Branch has an extensive floodplain and is joined by the Wootton Brook before entering Northampton where it is joined by the Grand Union Canal, immediately upstream of South Bridge, and by the Brampton Branch.

The three main tributaries of the Upper Nene – Wootton Brook, the Kislingbury and Brampton Branches – respond to storm rainfall at approximately the same rate. The watercourses are classified as Main Rivers. For example the flood of April 1998 passed through Northampton in a single peak which arrived about 22 hours after the start of the storm.

In the upper catchment of the Brampton Branch, there are three public water supply reservoirs – Ravensthorpe, Hollowell and Pitsford – owned and operated by Anglian Water Services (AWS). The Nene Catchment Flood Management Plan (CFMP) states that it is to be expected that the AWS reservoirs in the catchment of the Brampton Branch will spill during major flood event such as the one in April 1998. It is probable that these reservoirs would moderate less intense floods if the reservoirs were not full when the flood event started. Using the reservoirs for flood water storage would require the co-operation of Anglian Water Services.

The catchment is crossed by the Grand Union Canal, the Northampton Arm of which may have some effect on how the catchment responds. The canal does not, however, introduce floodwater from other catchments. According to the Nene CFMP, the relatively small British Waterways reservoirs (Daventry and Drayton reservoirs) in the upper reaches of the Kislingbury Branch are unlikely to have a significant influence on how the catchment responds. The wide floodplain in the lower reaches of the Kislingbury Branch tends to moderate flood flow.

Through Northampton, the River Nene is separated from its floodplain by defences. The Northampton Washlands compensate for the effect of upstream development on flow downstream. The Washlands consists of an area of former gravel workings into which flood waters are diverted and stored for controlled release as the flood subsides. This scheme is intended to reduce flood peaks in the Nene downstream of Northampton, not to benefit the town itself.

The flood storage reservoir recently constructed on the Weedon Branch is designed to protect Weedon, but also has some influence in reducing flood risk in the Kislingbury Branch through to Northampton.

The River Nene catchment is underlain by rock formations of mainly Jurassic age with older limestones and mudstones outcropping in the hills to the north and west.

These are overlain in the middle of the catchment by sandstones which are exposed along the valley of the River Nene. Younger limestone rocks cap hills in the centre of the catchment and to the east and west the youngest rocks – mudstones – occur.

The rocks are overlain by the more recent drift deposits, much of which are the result of glaciations which have led to the deposition of till, sands and gravels mostly in the middle of the catchment. On top of the drift deposits are deposits derived from the shifting meanders of the River Nene, comprising river terrace gravels and alluvium. These deposits lie along the river course. In the upper reaches of the catchment, the drift deposits give way to expose the underlying rock.

Much of the underlying rock across the West Northamptonshire gives rise to impermeable clay-based soils with a relatively quick response to rainfall and a high proportion of run-off followed by high river flow.

Groundwater flooding was not identified as a significant factor in the existing Northampton Borough Council Strategic Flood Risk Assessmemt (SFRA) or the West Northamptonshire Level 1 SFRA. The River Nene CFMP notes that the Nene catchment does not have any of the groundwater emergence zones, identified by Defra (2004), in which there is a greater risk of groundwater flooding.

5.2.2 River Great Ouse

The Great Ouse starts in Northamptonshire near Brackley and then passes through Buckingham, Newport Pagnell, Bedford, St Neots, St Ives and Earith before it crosses the Fens and flows into The Wash. The principal tributaries include the rivers: Tove, Ouzel, Ivel, Cam, Lark, Wissey and the Little Ouse.

Of these watercourses only the River Tove, which flows through the centre of Towcester, is situated within the study area. The River Tove is a Main River. Silverstone Brook is also classified as a Main River and has its confluence with Tove in centre of Towcester.

The Great Ouse catchment is largely rural and it supports traditional industries such as manufacturing, tourism, and agriculture. However, research and technology, finance and service sectors are becoming more important.

The main urban areas downstream of the study areas include:

- Milton Keynes, (covered by the Milton Keynes Water Cycle Strategy)
- Bedford, (covered by the Bedford Growth Area Water Cycle Strategy)
- Cambridge (covered by the Cambridge Water Cycle Strategy)

The upper part of the Great Ouse catchment is at a level of typically 70m AOD and spans the southern part of South Northamptonshire administrative area. At this

location soils consist mainly of clays with limestone being the dominant under-lying strata.

5.2.3 *River Cherwell and Tributaries*

The River Cherwell rises at Hellidon to the south east of Daventry, flowing in a southerly direction through parts of Daventry District and South Northamptonshire. Downstream of the administrative area for South Northamptonshire near to Cropredy, the Oxford Canal also follows the Cherwell Valley. Further downstream the River Cherwell then flows through Banbury and parts of industrial Oxfordshire before flowing through Oxford and ultimately flowing into the River Thames to the west of central Oxford. Only a small portion of this catchment falls within the study area.

5.3 Relevant Guidance and Studies

Studies on flood risk management in the relevant catchments are listed below. These have been reviewed as part of the work carried out for this water cycle strategy. It should be noted that much of this work is currently in progress, meaning that only draft reports or indicative findings were available to inform Phase 1 of the Water Cycle Strategy. Phase 2 of this Water Cycle Strategy should include a review of the final outcomes from these studies.

The documents available for this section of the Water Cycle Strategy are:

- Northampton Borough Council Strategic Flood Risk Assessment Stage 2 Report (December 2004)
- West Northamptonshire Strategic Flood Risk Assessment Final Level 1 Report (August 2007)
- Nene Catchment Flood Management Plan Final Report (September 2008)
- Draft Great Ouse Catchment Flood Management Plan, Summary of Draft Plan (February 2007)
- West Northants Water Cycle Strategy Scoping Study (2007)
- Planning Policy Statement 25: Development and Flood Risk

5.3.1 *Northampton Borough Council Strategic Flood Risk Assessment Stage 2, 2004*

The Strategic Flood Risk Assessment covers Northampton Borough Council. In undertaking Phase 2 of the SFRA, Bullen Consultants carried out a general Flood Risk Assessment for the whole of the Borough of Northampton and detailed Flood Risk Assessments for eight specific development areas within the Borough that were identified by the Borough Council as areas within which significant urban development was under active consideration. These eight areas are: Dallington Grange, Upton, Pineham, Swan Valley, Collingtree, Sixfields, Harvey Rees Road and Ransome Road.

5.3.2 *West Northamptonshire Strategic Flood Risk Assessment Level 1*

The Strategic Flood Risk Assessment (SFRA) covers the same study area as this Water Cycle Strategy. The purpose of the SFRA is to provide information on current and future flood risk (taking into account climate change) from all sources to allow decision makers to allocate development and infrastructure in accordance with PPS25.

Level 1 of the West Northamptonshire SFRA was published in August 2007 by Scott Wilson and was updated in January 2009. Level 2 of the SFRA will look in more detail at those areas of high risk where it is likely the PPS25 exception test will be required. The Level 2 SFRA is forthcoming. These documents should be reviewed for the Phase 2 Water Cycle Study.

Recommendations from the Level 1 SFRA are listed below:

- Daventry District Council and South Northamptonshire Council should undertake their Sequential Testing based upon the information presented in the Final Level 1 SFRA and the accompanying mapping and GIS datasets.
- Following the completion of the Sequential Testing, any areas that cannot be located within a low flood risk area (i.e. Flood Zone 1) should then be examined in more detail during a Level 2 assessment. The purpose of a Level 2 assessment is to provide enough information to allow the relevant LPA to either re-apply their Sequential Testing, in light of further information or to apply the Exception Test to the proposed development site. The scope of the Level 2 assessments cannot be set until the Sequential Testing has been undertaken.
- As part of a Level 2 SFRA, to address the issues of functional floodplain and climate change, it may be necessary to define and refine the extent of the floodplain. During the Level 2 SFRA, additional modelling of key watercourses may be required to define the functional floodplain and extent of the floodplain including climate change where no data is available.

5.3.3 *Nene Catchment Flood Management Plan Main Stage Report (2008)*

The Nene Catchment Flood Management Plan (CFMP) covers the catchment of the River Nene, the upper reaches of which are within the Water Cycle Strategy study area. It is a high-level document of strategic policies designed to plan for flood risk management in the catchment over the next 100 years. The final CFMP is expected to be published by the Environment Agency in 2009.

The River Nene CFMP area has been divided into 16 policy units, five of these are within the West Northamptonshire Water Cycle Strategy area. Policy units are based on clearly defined areas of the catchment which have common sources and mechanisms of flooding and common receptors of flooding (people, properties,

environment etc). The scale of flood risk across each policy unit is also similar. One preferred appropriate policy will be applied across the policy unit.

The five policy units within the West Northamptonshire Water Cycle Strategy are described in Table 1 in Appendix B. The draft flood risk management policy selected for each unit is detailed in Table 5-1 below.

Policy Unit	**Policy Choice (draft)**
Upper and Middle Nene catchment	Reduce existing flood risk management actions (accepting that flood risk will increase over time).
River Nene (Weedon to Kislingbury)	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere (which may constitute an overall risk reduction e.g. for habitat inundation).
Wootton	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
Northampton Central	Take further action to sustain the current level of flood risk into the future.
Northampton Outer	Take further action to sustain the current level of flood risk into the future.

Table 5-1. Flood Risk Management Policies from the River Nene CFMP for Policy Units lying within West Northamptonshire.

Actions relating to development are included in Appendix B.

Water Cycle Strategies consider flood risk, wastewater treatment, the sewerage network, water supply and water resources both now and in the future. The Strategies indicate when constraints need to be addressed and what infrastructure is needed and thereby support the strategic approach of CFMPs for the management of flood risk.

5.3.4 *Great Ouse CFMP Catchment Flood Management Plan Main Stage Report Summary (February 2007)*

The Great Ouse CFMP covers the catchment of the Great Ouse and also sets out policy for dealing with increasing flooding in the catchment. The Great Ouse CFMP is still in draft and has been subject to review.

The southern portion of the Water Cycle Strategy study area is covered by this CFMP which includes Brackley and Towcester. The River Tove, which flows through Towcester, is a tributary of the Great Ouse. The Great Ouse CFMP area has been divided into five draft policy units, the Bedford Ouse policy unit falls into the West Northamptonshire Water Cycle Strategy study area. For large areas with significant risk of flooding (e.g. Towcester) the following policy *Take further action to reduce flood risk (now and/or in the future)* has been adopted.

Actions specific to the Bedford Ouse policy unit include:

- River Tove flood risk management study to be undertaken. This study should identify what further actions can be taken to manage flood risk at Towcester. This is a medium priority action over the timescale 2008-2010. The lead partner for this study is the Environment Agency Strategic and Development Planning Team.
- The Bedford Ouse flood risk management study. This study should identify what further actions can be taken to manage flood risk at numerous locations outside the WCS study are but including Brackley, within the WCS study area. This is a high priority action over the timescale 2009-2011. The lead partner for this study is the Environment Agency Strategic and Development Planning Team.

Catchment wide actions are included in Appendix B.

5.3.5 *Preliminary findings from Water Cycle Scoping Study (2007)*

The scoping study identified three preliminary findings relating to flood risk:

- It is critical to the sustainable management of flood risk that all new developments take account of the guidance provided in PPS25. Flood risk mitigation measures will be required on a strategic basis, as well as on individual development sites, to ensure that this guidance is adhered to.
- The draft CFMP for the River Nene recommended a strategic study of flood risk across the whole catchment. (Draft conclusions are presented in Section 5.3.3).
- There is a risk of flood mitigation measures in one area exacerbating flood risk in other parts of the catchment, even if accepted guidance for individual sites is followed. It is therefore recommended that detailed

consideration is given to the cumulative impact of development across the study area.

5.3.6 Planning Policy Statement 25: Development and flood risk

Planning Policy Statement 25 (PPS25) details national planning policy in relation to flood risk. It considers both flood risk to new developments and the potential impact of new development on flood risk. Its aims are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk (refer to Appendix C for summary).

PPS25 advocates a risk based approach using the "Sequential" and "Exception" tests and considering the vulnerability of different types of development to flooding. The Sequential Test requires that for a development to be appropriate there should be no reasonably available sites in areas of lower flood risk. If development is proposed in high flood risk areas but there are no reasonable available sites at lower risk then the Exception Test is applied. This requires that the development provides wider sustainability benefits outweighing flood risk, that developments are on brownfield sites if possible and that the development is safe and does not increase flood risk elsewhere. PPS25 states that it is not acceptable for new development to increase flood flows downstream.

5.4 Groundwater Flooding

5.4.1 Causes and Impacts of Groundwater Flooding

PPS25 states that "groundwater flooding occurs when water levels in the ground rise above surface elevations," however groundwater may also cause harm in other ways, for example when it enters sub-surface structures (such as basements etc). Recent research being carried out for Defra identifies seven types of groundwater flooding event, as follows:

i. rise of typically high groundwater levels to extreme levels in response to prolonged extreme rainfall;
ii. rising groundwater levels in response to reduced groundwater abstraction in an urban area (termed groundwater rebound) or a mining area (termed minewater rebound);
iii. subsidence of the ground surface below the current groundwater level;
iv. rise of groundwater level in aquifers in hydraulic continuity with high in-bank river levels or extreme tidal conditions;
v. rise of groundwater levels due to leaking sewers, drains and water supply mains;
vi. faulty borehole headworks or casings causing upward leakage of groundwater through confining layers driven by artesian heads;
vii. increases in groundwater levels and changed flow paths due to artificial obstructions or pathways, and loss of natural storage and drainage paths.

Of these, only (i), (iv) (v) and (vii) are likely to apply in the West Northamptonshire area, and even these are expected to be limited in extent.

The Defra research also identifies the following impacts observed as a direct result of excess groundwater at or close to surface:

- flooding of basements of buildings below ground level;
- flooding of buried services or other assets below ground level;
- inundation of farmland, roads, commercial, residential and amenity areas;
- flooding of ground floors of buildings above ground level; and
- over flowing (surcharging) of sewers and drains.

Often, effects of groundwater flooding are indistinguishable from effects of fluvial flooding, or are not obviously attributable to groundwater (e.g. surcharge of sewers). As a result the recording of groundwater flooding is often inconsistent. A Defra Study, carried out in 2004, maps groundwater flooding recorded during the most severe recent groundwater flooding episodes (winter 2000/2001 and winter 2003). This study shows no groundwater flooding incidents in the West Northamptonshire area.

5.5 Evaluation of Development Proposals

Several parts of the study area are at risk of flooding. Development upstream of these areas has the potential to exacerbate the existing risk but there is also the opportunity to incorporate flood risk mitigation as part of the development proposals to reduce flood risk to existing properties. It is therefore important to understand where these areas of flood risk are in relation to the potential development areas. The main source of flood risk information for the study area comes from the Environment Agency Flood Zone Maps, included in Appendix D.

PPS25 divides land into four flood zones according to its probability of flooding from rivers or the sea, see Table 5-2.

Flood Zone	Probability
1 (Low Probability)	Less than a 1 in 1000 (<0.1%) annual probability of river or sea flooding in any year.
2 (Medium Probability)	Between 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
3a (High Probability)	A greater than 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
3b (Functional Floodplain)	Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood

Table 5-2 - Flood Zone definition from PPS25

The proposed development areas can be largely split into five geographical areas within the study area: Northampton itself, Daventry, Brackley and Towcester and Silverstone. For the most part the proposed developments are within Flood Zone 1 and are therefore considered to be at low risk. However, there are developments within the higher risk Flood Zones, such as those proposed in west and central Northampton.

Development has the potential to increase flood risk downstream of all these areas as it increases the impermeable area and hence both the rate and volume of run off. There may also be an increase in the volume of water discharged from sewage treatment works. PPS25 requires that there is no increase in flood risk due to development, and development proposals must include measures to ensure that flood risk downstream is not increased. Typically planning requirements are that storage is provided so that the rate and volume of run off from development is equivalent to the greenfield rates. This is typically undertaken on an ad-hoc basis for each individual site; this WCS provides an opportunity to develop a strategic solution for flood risk; one that encompasses all future development. Hydrological analysis has been undertaken to assist with the development of a strategic solution..

5.6 Hydrological Analysis

The objectives of the hydrological analysis were to:

- Determine the drainage pathways for each of the proposed strategic development locations. This is discussed further under the relevant section for each urban area.

- Estimate the magnitude of additional runoff volume from the development areas for the 100 year event

- Consider alternative flood management options to mitigate the impact of additional runoff from the development sites.

PPS25 states that it is not acceptable for new development to increase flood flows downstream. We have therefore not investigated the capacity of the River Nene, River Tove or any tributaries of these rivers downstream of the development areas within the study area, nor their ability to convey additional flood flows.

An analysis of the surface drainage pathways has been undertaken to determine the indicative routes by which runoff would travel away from the proposed development areas. From this information, the waterway that would receive the majority of runoff from a site has been identified. This analysis has already been undertaken for sites in Northampton in the Northampton Borough Council SFRA and for the Towcester Vale site in Towcester. For other areas the analysis was performed using Ordnance Survey mapping, and has been broken down into urban areas.

The estimation of runoff and approximate storage volumes from proposed development areas have been calculated using the method outlined in the Defra/Environment Agency Flood and Coastal Defence Research and Development Programme, "Preliminary rainfall runoff management for developments", (2005). This method provides initial estimates of the increase in peak flow and volume of runoff from developments less than 200 ha, and guidance for the preliminary sizing of stormwater storage volumes required to limit discharge from a development to Greenfield runoff. These figures have been used to provide a basis for evaluating the development in the following sections.

The current standard of design is to attenuate up to the 1 in 100 year return event with provision for climate change. However, for development upstream of Northampton it is necessary to provide attenuation up to a 1 in 200 year standard plus climate change to maintain the standard of protection given by the Northampton flood defences. This is the standard agreed between the Environment Agency Anglian Region and the local Planning Authorities for the purposes of PPS25.

These calculations have assumed that 75% of the whole development area will be impermeable, compared to 0% prior to development. It is expected that the actual impermeable area will be lower so these represent conservative estimates of the storage area. In addition adoption of a sustainable drainage strategy can further reduce the impermeable areas for example through adoption of pervious paved areas. The calculations were performed for units of housing specified by the WNDC and JPU with a housing density of 40 dwellings per hectare. No information was available on other land use types. Therefore runoff calculated is for

the proposed area of housing only which may be a smaller area than the entire proposed development location.

For each site, required storage volumes are broken down into attenuation storage which is provided to reduce the rate of run off to the equivalent predevelopment rate of run off, and long term storage which is provided to reduce the volume of run off to the predevelopment runoff volume. Developers will be required to provide sufficient storage to meet the combined total on the long term and attenuation storage. Where relevant, results of the hydrological analyses will be included in the following sections discussing Daventry, Northampton and South Northamptonshire separately.

Developers should only consider the hydrological results analysis in the outline WCS as indicative. Developers should devise their own strategy and include the appropriate level of detail within outline planning applications.

5.7 Impact of increased WwTW discharges on flood risk

Increased discharges from WwTW due to development may adversely affect flood risk downstream. The potential impacts were assessed for the five treatment works that will receive most of the projected growth in West Northants (Great Billing, Brackley, Towcester, Silverstone and Whilton).

The assessment used the methodology of the recent Environmental Capacity Assessment undertaken by Halcrow Group Limited for Anglian Water Services (Phase 1, December 2008). The study evaluated the potential effects of population growth on flood risk by comparing increases in WwTW discharges to the 1 in 2 year peak flow in the receiving watercourse. This flood event was selected because the 1 in 2 year event is very crudely considered to approximate bank full conditions. Any significant increase in the 1 in 2 year event could therefore result in out of bank flooding. The 1 in 2 year peak flow was estimated using the Flood Estimation Handbook (FEH) statistical method (SC050050) based on catchment descriptors and adjusted using observations of flood flows at nearby gauging stations. The Environmental Capacity Assessment is ongoing. The final outputs from the study will be reviewed in Phase 2 of the Water Cycle Study.

The 1 in 2 year peak flow in the receiving watercourse is compared to the increase in flow to full treatment (FFT) from each WwTW. The estimated flow to full treatment in 2026 is based upon 3 x dry weather flow (3DWF), which is a standard methodology. If the projected growth does not result in exceedance of the consented dry weather flow, there will be no increase in the flow to full treatment.

Great Billing WwTW is taken as discharging into the Ecton Brook due to its proximity to the confluence between Ecton Brook and the River Nene. The results show that the largest percentage increases in flow occur downstream of the Great Billing and Whilton WwTW. However, in all cases, the percentage increase in flow is small.

PPS25 requires that there is no increase in flood risk downstream due to development. Mitigation measures may be required where either (a) there is a quantifiable increase in frequency of spill from storm storage tanks due to additional foul flows, or (b) the receiving watercourse and associated flood risk area is particularly sensitive to changes in flows. Anglian Water should consult with the Environment Agency to identify and agree an appropriate policy for identifying locations where mitigation measures would be beneficial and suitable methods for mitigation. For example, one option for mitigating the increase in flows could be to provide additional storage volume in any flood attenuation facilities near to the WwTW to compensate for increase in flows. To allow further evaluation of options for combining storage in strategic flood attenuation facilities, the approximate volume of compensation storage that could mitigate the increase in flows from each WwTW was estimated in this Water Cycle Strategy. The volume was calculated by multiplying the duration of the 100 year storm hydrograph (estimated using the FEH revitalised rainfall-runoff method with catchment descriptors) by the increase in dry weather flow multiplied by 3. Results are presented for each urban area in the relevant section below.

5.8 Northampton

5.8.1 Existing situation

Northampton is the largest urban area in the study area, and as such is the main focus of the majority of the development; (see Figure 5-2). As there are two major branches of the River Nene, the Kislingbury Arm and the Brampton Arm, flowing through Northampton a large proportion of the town adjacent to the watercourses lies within Flood Zones 2 and 3.

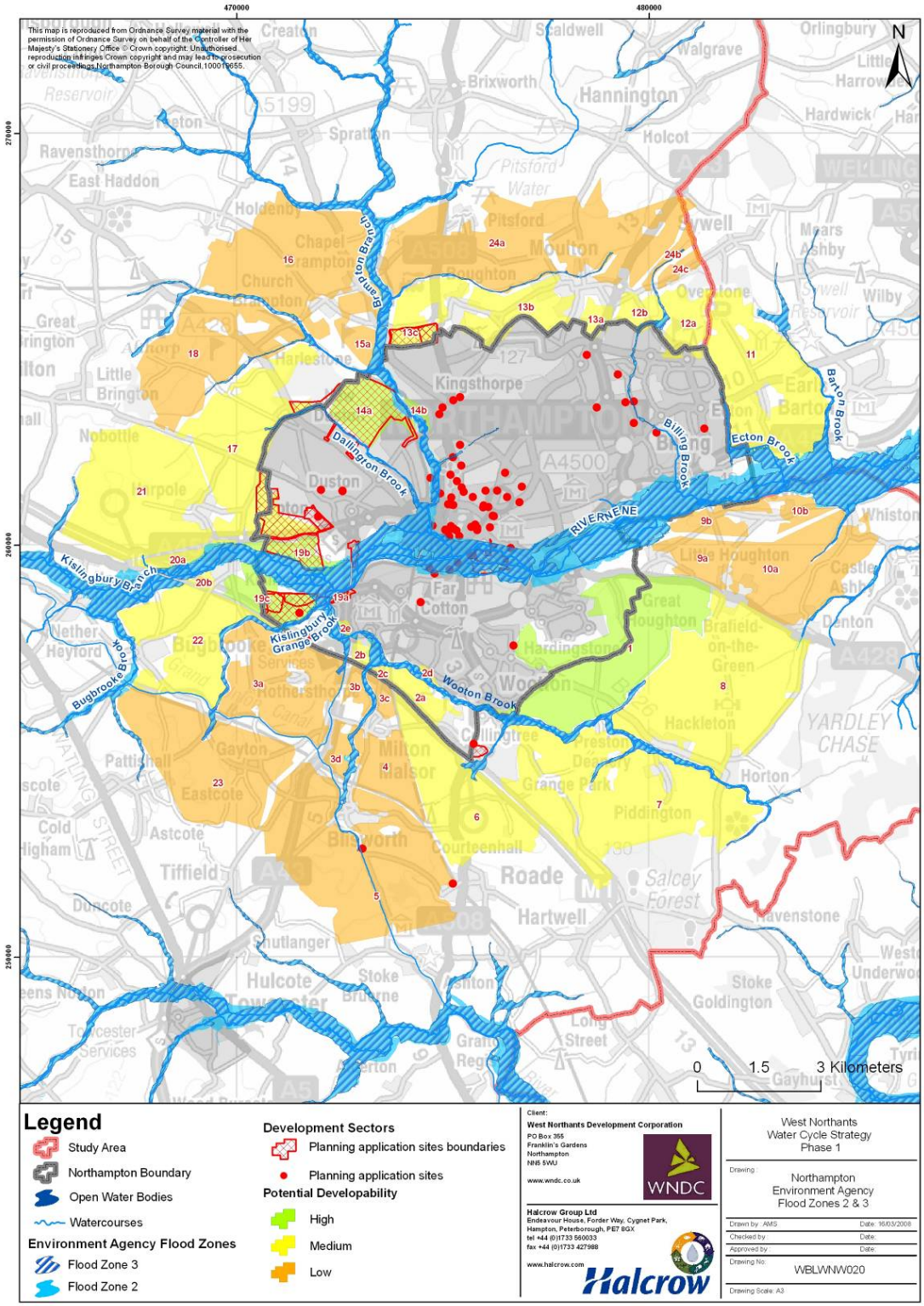

Figure 5-2: Northampton Implementation Area Flood Zone Mapping

5.8.2 *History of flooding*

The River Nene CFMP (2008) and the West Northamptonshire Level 1 SFRA include a history of flooding in Northampton. Flood events from 1847 to 1900 are detailed in Appendix E. The historic record over the last 160 years shows that there

have been many heavy storms that have caused flooding in the River Nene catchment at all times of the year, although with the older written accounts of flooding it has often been difficult to assess which parts of the River Nene catchment were affected. Historical records are mostly sketchy and incomplete, but are useful for providing background information. More recent gauged records and flooding databases are more valuable for estimating flood frequency and severity at different locations. Anglian Water has advised that the DG5 Register (flooding of foul sewers due to lack of capacity as reported to OFWAT) lists a number of properties that have suffered foul water flooding within Northampton. It should be stressed that the DG5 Register only indicates the impact location of the flooding and not the source or cause of the flooding.

Extensive, catchment-wide fluvial floods tend to occur in the River Nene catchment when heavy and prolonged rainfall occurs and falls on an already saturated catchment. In particular, sites along the River Nene from Northampton to Peterborough have been affected by fluvial flooding on a number of occasions, while surface water, sewer and groundwater flooding has been more localised (see Appendix E.

There is some history of surface water flooding in the Wootton Brook catchment, with a recorded event in June 2007.

5.8.3 Current flood protection in Northampton

There are several flood alleviation schemes in place within Northampton.

Northampton flood defence scheme

Northampton suffered extensive flooding in the April 1998 floods. Following this event, a flood defence scheme was carried out in the town to improve the level of flood protection to a 0.5% standard, or 1 in 200 year return period. This is now the agreed local design standard in Northampton and upstream. The scheme cost £6.8 million and involved channel works to improve the capacity of the river, together with works to raise and improve flood walls and embankments.

Weedon flood alleviation scheme

The village of Weedon Bec is situated 7km west of Northampton, at the downstream end of the Newnham Branch of the Nene a short distance above its confluence with the Kislingbury Branch. Weedon Bec has a long history of flooding from the River Nene, the most significant events occurring during March 1947, September 1992 and April 1998. An on-line flood storage reservoir was built 1.5km upstream of the village near to Dodford Mill on the Newnham Branch in 2002-3. The dam was constructed using clay sourced from adjacent fields. The flood storage reservoir has an effective storage capacity of 810,000m^3 and a surface area of 66.6 hectares (Northampton Borough Council SFRA, 2004).

Under normal conditions the stream flows in a culvert beneath the reservoir embankment and the reservoir remains empty. Under flood conditions, the natural inflow to the reservoir exceeds outflow by a significant amount, the reservoir fills and the excess flood water is stored in the reservoir and released in a controlled manner. A large Hydro-Brake flow control device controls flow through the dam to help minimise the upstream storage required. The flow rate can be adjusted between the limits of 8 and 12 m^3/s.

The scheme, which cost £1.2 million, has improved the level of flood protection to a 2% standard (1 in 50 year return period). Although intended specifically for the benefit of Weedon Bec, the retention of flood water in the reservoir will inevitably have a small but real beneficial effect on flood risk in Northampton.

Kislingbury flood alleviation scheme

Kislingbury village is situated on the south bank of the Kislingbury Branch of the Nene, 3km upstream of Duston Mill. Kislingbury has a long history of flooding from the River Nene, the most significant events occurring during March 1947, September 1992 and April 1998. Minor flooding occurred again in 2000. A flood alleviation scheme was carried out in 2003, to improve the level of flood protection to a 0.5% standard. The scheme involved construction of flood defences for 1000m along the south bank of the river. These defences consist of a series of floodwalls and floodbanks and improvement works to the bridge in the village. The scheme cost £1.6 million. The flood defences are, in many places, set well back from the river bank and the area of floodplain protected (and hence the volume of floodplain storage lost) thereby minimised (Northampton Borough Council SFRA, 2004).

Northampton washlands

Northampton Washlands is an on-line flood water storage reservoir provided in the 1970s to cope with increased surface water run-off from the planned expansion of Northampton up to 1981. Situated on the River Nene between Weston Favell Lock and Bedford Road Sluice, it covers an area of some 97 hectares and is contained within clay cored earth embankments.

It provides a storage volume of 2.4 million m^3, and is categorised as a large raised reservoir falling under the Reservoirs Act 1975. The reservoir is normally kept virtually empty. It is managed to maintain the flood risk to Billing Aquadrome, situated downstream of the Washlands site, at the current standard of 12%. Cogenhoe, Barton and Hardwater Mills also benefit (Nene CFMP, 2008). This scheme is intended to reduce flood peaks in the Nene downstream of Northampton, not to benefit the town itself.

Upton Flood Attenuation Area

Between Northampton and Kislingbury, English Partnerships is constructing the Upton Flood Attenuation Area (UFAA) adjacent to the River Nene. The UFAA is designed to provide flood attenuation for developments on the outskirts of Northampton, as well as some "brownfield" development sites within the town. It provides additional storage to compensate for the loss of floodplain due to the new Cross-Valley Link Road currently under construction. It has also been designed to further reduce flood water levels in the River Nene through Northampton. The scheme is being built in three phases, with the first phase having been completed in 2007.

Duston Flood Storage Reservoir

Duston reservoir was built in 1995-7 to provide compensatory storage for the additional storm runoff expected to be generated by large scale urban developments in the area southwest of Northampton, upstream of the town, to a 2% standard (1 in 50 year return period). The embanked, off-line reservoir is situated east of Upton Way, to the south of the Kislingbury Branch of the Nene. The Duston Flood Relief Channel, also embanked, runs along the south side of the reservoir, between the reservoir and the Northampton Arm of the Grand Union Canal. Flow into the Relief Channel is controlled by a weir and sluice at its upstream end.

As originally constructed, Duston reservoir had a storage capacity of 300,000m^3. Inflow to the reservoir is over a 20m weir in the right bank of the Kislingbury Nene. The reservoir is drawn down by discharge to the river through a low level culvert. Under flood conditions the reservoir, when full, discharges to the river over a high level spillway. Original design calculations indicated that inflow to the reservoir would begin at a 10% river flood event (1 in 10 year return period) and that the reservoir would be inundated in a 0.66% event (1 in 150 year return period). The reservoir was observed to be inundated in the Easter 1998 flood, with only the crests of the Relief Channel embankments visible above the water.

Following the Easter 1998 floods, Duston Reservoir was modified in summer 2002 to:

- allow more water into the reservoir in extreme flood events
- allow more rapid release of water from the reservoir, and
- to provide mitigation of the effects of increased runoff from urban development to the same 0.5% (1 in 200 year) standard as the post-1998 flood alleviation scheme.

The construction of a larger reservoir outlet pipe with a 100mm lower invert level has increased the effective capacity of the reservoir to 480,000m^3 and a surface area of 160,000m^2 (West Northamptonshire SFRA, 2007). Reassessment of the

hydrology indicates that inflow to the reservoir occurs at a 1-year return period and total inundation would occur at a 1000 year return period.

The West Northamptonshire SFRA, (2007) states that Duston FSR has spare capacity available to accommodate runoff from future development.

Dallington Flood Storage Reservoir

This off-line reservoir which is owned and operated by the Environment Agency is located on the Dallington Brook 250m upstream of Mill Lane. It has a capacity of about 13,000m^3 and is filled from a side spillway weir in the right bank of the brook. The reservoir is normally kept empty by a low-level culvert through the embankment at the downstream end and spills, when full, back into the brook. There are two small on-line ponds on the brook immediately downstream of the reservoir but these are long established amenity ponds and have no flood storage function (Northampton Borough Council SFRA, 2004).

Dallington flood storage reservoir was built in the 1980s to accommodate the additional impermeable area runoff from upstream urban development by the year 2000 to a 2% (1 in 50 year) standard, but it is understood that not all of the development for which the reservoir was intended has yet materialised and there is therefore some "spare capacity" in the reservoir. The Agency also has a small flood storage reservoir adjacent to Dallington Brook at Tintern Avenue, 1,000m downstream. It is reported that there was no flooding along the Dallington Brook upstream of the Spencer Road Industrial Estate in 1998 (Northampton Borough Council SFRA, 2004).

Wootton Brook

The lower reaches of the Wootton Brook were improved by Anglian Water in the 1980s to allow for urban development within the catchment. A number of small on- and off-line lakes were created or enlarged from the Kislingbury Nene confluence to the A508 road at Collingtree in order to attenuate flood flows in the brook. These lakes are located at Swan Valley, Shelfleys, Collingcroft Close (off-line) and Collingtree Park (Lower and Upper lakes). The water level in these lakes is maintained by weirs at their downstream ends and they are normally full to weir level and the effective volume of flood storage in these lakes is therefore small. The Borough Council have stated that they regard them as amenity lakes and not as flood storage reservoirs.

Delapre Lake and Brackmills

Delapre Lake is an extensive body of water covering an area of about 14ha on the northeastern side of Delapre Park, discharging to Hardingstone Dyke over a weir at its eastern end. The on-line lake receives the inflow from Hardingstone Dyke and all of Delapre Park, including the wooded hillside at the southern edge of the park.

The lake was originally an old gravel pit. Its extensive surface area and small outflow weir indicate that it may have a significant flood peak attenuation capability.

A number of runoff retention lagoons have been constructed in recent years in connection with industrial and commercial development at Brackmills, notably a series of ponds at the Barclaycard and County Council offices, and a single large pond (believed to be the "Brackmills Reservoir" mentioned in Halcrow's May 1998 Report) east of Salthouse Road. They all drain to Hardingstone Dyke.

The Bedford Road Lakes

These linear lakes are the remnants of the old course of the River Nene and an associated flood relief channel, believed to date from the early 1940s, made redundant by the re-routing of the river into a new channel south of Nene Valley Way (A45) about thirty years ago. Flows into the old channels from the Nene are controlled by a sluice just upstream of Bedford Road (A428). Outflow from the old channels returns to the Nene downstream of the Washlands Sluice. The effective flood storage volume available in these old channels is small and, situated downstream of the town, is of little or no benefit in reducing flood risk in Northampton.

Billing and Ecton Brooks

There is a series of linear, on-line ponds along each of these streams. Although these ponds are all believed to have been constructed for amenity purposes rather than flood storage they provide, in aggregate, a certain degree of runoff attenuation, though the effect of this will probably diminish with increasing return period. The water level in the ponds is maintained constant under normal conditions by their outfall weirs. Some of these ponds have become partially silted up but this does not, paradoxically, reduce their flood flow attenuation potential. Both brooks have large on-line lakes upstream of the Borough boundary.

On Billing Brook there are ponds along the brook within the Borough at Thorplands, Billing Arbours, Birds Hill and Little Billing, and on a tributary stream at Lings Wood. The much larger Overstone Park Lake lies just outside the Borough Boundary. Some years ago the embankment forming the lake was overtopped in a flood. Although the embankment was not breached the water was impounded behind the Overstone Park boundary wall which then collapsed, cascading water across Billing Lane. The wall was subsequently rebuilt with pipes through the wall to prevent a repetition.

There are three small off-line ponds along the west (Northampton) bank of Ecton Brook, two upstream and one downstream of Wellingborough Road (A4500). Some 500m upstream of the Borough boundary, Ecton Brook flows through two small lakes, the Upper and Lower Ponds at Overstone Solarium. As with Overstone Park

Lake on the Billing Brook, these will also provide some degree of flood flow attenuation.

5.8.4 *Potential development areas*

The Northampton Longer Term Growth Option Study has identified potential development sectors around the periphery of Northampton. The possible development sectors have been classified in terms of "potential developability" into "high", "medium" or "low" areas (Figure 5-2).

A high level assessment of current flood risks was undertaken using the Environment Agency's Flood Zones. Flood zones 2 and 3 are present along all watercourses. Where part of the development sectors are in flood zone 2 and 3 the developer of these sectors should undertake a flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for these sectors, and the future extent of these flood zones with climate change. Land use within these sectors should be allocated according to the appropriate uses for the flood zones according to PPS25.

Bugbrooke Brook joins the River Nene from the south upstream of Northampton. Area 20b is bounded to the west by Bugbrooke Brook and to the north by the River Nene. There are areas benefitting from defences on the south bank of the River Nene around Bugbrooke Mill and around Kislingbury. There are areas benefitting from defences on the north bank of the River Nene adjacent to sector 20a. The Nene CFMP state that removal of defences in Kislingbury (or ceasing maintenance so the defences fall into disrepair) will see up to 100 properties flooded that are at present defended.

A **small watercourse flows south from Vicarage Farm** to join the River Nene from the north upstream of Upper Heyford. This watercourse marks the western boundary of sector 21. There is an area deemed to be at risk of sewerage flooding, as indicated by Anglian Water in their DG5 register near Harpole (area 21). Any development in this sector must not exacerbate this issue.

The flood risk management policy from the Nene CFMP for the River Nene (Weedon to Kislingbury), which is upstream of the development sectors, is: "take action to increase the frequency of flooding to deliver benefits locally or elsewhere (which may constitute an overall risk reduction e.g. for habitat inundation)."

One of the actions arising from the Nene CFMP for the River Nene (Weedon to Kislingbury) policy unit is to develop a Flood Storage Study to investigate creating/developing flood storage on the River Nene. The lead partner for the study is the Environment Agency Strategic Planning and Development team. The CFMP states that the study should consider the flood defence measures constructed at Upton and should determine the possible location of storage and combination of river restoration and engineered flood storage. Flood storage between Weedon and Kislingbury will provide an opportunity to mitigate future flood risk to downstream Northampton and, depending on the area used for flood water storage, could

mitigate flood risk to sectors 19a, 19b, 19c, 20a and 20b and possibly 21. The timescale for the study is 2008 to 2011. The timing of development and the LDF may provide an opportunity for links between the two strategies.

The spare capacity of Duston flood storage reservoir needs to be investigated to see if the flood storage reservoir could accommodate runoff from future development. If so this could mitigate future flood risk to areas downstream of sector s 19b and 19c and upstream.

To the south of Northampton **Wootton Brook** flows north-west to join the River Nene above Northampton at Upton Mill. Areas of flood zones 2 and 3 along Wootton Brook and its tributaries (including the Kislingbury Grange Book and the watercourse running north from Blisworth through Milton Malsor) are relatively narrow, indicating narrow floodplains. Development areas bordering these watercourses include sector 1, 2a, 2b, 2c, 2d, 2e, 3a, 3b, 3c, 3d, 4, 5, 6, 7, 8, 19a, 19c, 22 and 23. According to the Environment Agency's flood maps there are some areas benefitting from defences in this area around sectors 2d, 2e and 19c and a short length of defences on Wootton Brook near sectors 1 and 7. The Nene CFMP notes that the defences on Wootton Brook are privately maintained. The Nene CFMP states that the Wootton Policy Unit is largely urbanised with insufficient floodplain area to make flood storage effective. Therefore any runoff from development would have to be attenuated on site. The CFMP flood risk management policy selected for the Wootton Brook is to continue with existing and alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from the baseline). Therefore development in this area will be exposed to higher fluvial flood risk in the future as flood risk increases with climate change. An action arising from the CFMP is to undertake an Integrated Urban Drainage Plan for Wootton to investigate the risk from surface water flooding. The lead partner for this study is Anglian Water. Developers must take account of any recommendations from this study. These issues place constraints on development in the Wootton Brook catchment.

The CFMP state that there have been a number of modifications to the channels and floodplains as part of the development of the Wootton catchment. This includes some online storage lakes along the Wootton Brook and other measures linked to specific developments to compensate for their impact in terms of increased surface runoff to the watercourses from paved areas.

The **Brampton Branch of the River Nene** flows south through the town centre. Areas of flood zones 2 and 3 along the Brampton Branch and its tributaries are relatively narrow, indicating narrow floodplains. Development areas bordering these watercourses include sectors 13b, 13c, 14a, 14b, 15a, 16, 17, 24a. According to the Environment Agency's flood maps there are some areas benefitting from defences in this area around sector 15a. The CFMP policy choice for the Northampton Outer policy unit is: "take further action to sustain the current level of flood risk into the future." The CFMP considered flood storage on the Brampton Branch

upstream of Northampton (in the Upper and Middle Nene policy unit which is upstream of the potential development areas), however, this was rejected as it was felt there is a lack of potential for storage in this location. The CFMP notes that the Northampton Outer Policy Unit is heavily urbanised with insufficient space for water to be stored. In urban areas such as Northampton floodplains are often developed leaving little potential for the development of natural floodplain storage. Therefore any runoff from development would have to be attenuated on site which may pose a constraint to development.

The spare capacity of Dallington flood storage reservoir needs to be investigated. The reservoir is located downstream of sector 14a and could be used to contribute to mitigation of runoff from the south western portion of the development area. The development of storage upstream on **Dallington Brook** can reduce the risk posed by flooding in the future to approximately the same level as at present, this should be investigated as part of the Phase 2 Water Cycle Study.

Billing Brook flows south through the Weston Favell/Great Billing area and joins the River Nene at Billing Aquadrome. The floodplain is narrow and areas of flood zones 2 and 3 are therefore of limited width. Development sectors bordering these watercourses include sectors 12a, 12b, 24b and 24c. Sectors 12b and 12a are adjacent to Overstone Country Park. Investigations should be made by developers as to whether runoff could be attenuated in the park. However any attenuation should not increase the risk of failure of the embankment forming the Overstone Park Lake. All other ponds along the brook are downstream of the development areas and so would not provide any opportunity for attenuation of runoff from the development areas.

A review of the capacity of Overstone Park Lake should be undertaken before any development takes place in sectors 12a and 12b. Developers and the Local Development Framework should follow recommendations from the Pitt Review (2007) on flood risk from reservoirs. The recommendation includes: "the Government should provide Local Resilience Forums with the inundation maps for both large and small reservoirs to enable them to assess risks and plan for contingency, warning and evacuation and the outline maps be made available to the public online as part of wider flood risk information." Developers should work with the Local Resilience Forum to implement these recommendations. This may pose a constraint on development sectors 12a and 12b.

The standard of protection of the Billing Brook flood detention pond (operated by Northampton Borough Council) is unknown. The ponds are located downstream of development sectors 12a, 12b, 24b and 24c and would not provide any flood protection to these areas. Development of areas upstream of the Billing Brook flood detention ponds should not compromise the operation of the ponds and therefore reduce their capacity for flood water storage.

Ecton Brook flows south to join the Nene downstream of Northampton and marks the current eastern extension of the town. Ecton Brook marks the western boundary of development sector 11. **Barton Brook** flows south from Sywell Reservoir to join the Nene downstream of Northampton. Barton Brook marks the eastern boundary of development sector 11. The floodplain of Barton Brook is narrow and areas of flood zones 2 and 3 are therefore of limited width. Development from sector 11 will either flow to Ecton Brook or to Barton Brook. There are three small off-line ponds along the west (Northampton) bank of Ecton Brook constructed for amenity purposes. It may be possible to attenuate flows in these ponds or in the Upper and Lower Ponds at Overstone Solarium; this should be investigated by developers. It is unlikely that any flood storage would be feasible upstream of Barton Brook due to the presence of Sywell reservoir and the narrow floodplains. Recommendations from the Pitt Review (2008) on flood risk from reservoirs should be followed for areas downstream of Sywell reservoir. The recommendation includes: "the Government should provide Local Resilience Forums with the inundation maps for both large and small reservoirs to enable them to assess risks and plan for contingency, warning and evacuation and the outline maps be made available to the public online as part of wider flood risk information." Developers should work with the Local Resilience Forum to implement these recommendations. This may pose a constraint on development sector 11 in locations downstream from Sywell reservoir.

The **River Nene** marks the northern boundary of development sectors 9a, 9b and 10b. There are defences along the south bank of the Nene near Cogenhoe. There are areas deemed to be at risk of sewerage flooding, as indicated by Anglian Water in Great Houghton and Cogenhoe. Any development in this area must not exacerbate this issue.

5.8.5 *Impact of increased WwTW discharges on flood risk*

This section aims to quantify the volume of additional effluent discharge from the Great Billing Wastewater Treatment Work (WwTW) due to growth and how this compares to the existing flow in the watercourse during a flood event. This assessment is undertaken to support the principle of PPS25, which requires that development should not increase flood risk.

PPS25 (Annex E)

Any organisation or person proposing development must consider whether that development will not add to and where practicable reduce flood risk.

At all stages of the planning process, the minimum requirements for flood risk assessments are that they should consider and quantify the different types of flooding (whether from natural and human sources such as wastewater treatment works and including joint and cumulative effects) and identify flood risk reduction measures.....;

a

ssessment used the methodology of the recent Environmental Capacity Assessment undertaken by Halcrow Group Limited for Anglian Water Services (Phase 1, December 2008). The study evaluated the potential effects of population growth on flood risk by comparing increases in WwTW discharges to the 1 in 2 year peak flow in the receiving watercourse. This flood event was selected because the 1 in 2 year event is very crudely considered to approximate bank full conditions. Any significant increase in the 1 in 2 year event could therefore result in out of bank flooding. The 1 in 2 year peak flow was estimated using the Flood Estimation Handbook (FEH) statistical method (SC050050) based on catchment descriptors and adjusted using observations of flood flows at nearby gauging stations. The Environmental Capacity Assessment is ongoing. The final outputs from the study will be reviewed in Phase 2 of the Water Cycle Study.

The 1 in 2 year peak flow in the receiving watercourse is compared to the increase in flow to full treatment (FFT) from each WwTW. The estimated flow to full treatment in 2026 is based upon 3 x dry weather flow (3DWF), which is a standard methodology. If the projected growth does not result in exceedance of the consented dry weather flow, there will be no increase in the flow to full treatment.

At this stage, there may be opportunities to meet the PPS25 statements to reduce flood risk where this appropriate. The Water Cycle Strategy mechanism provides an opportunity to reach agreement between all parties in order to facilitate sustainable growth. Sufficient time should be allowed within the detailed study to address this issue and obtain agreement from the Environment Agency, Water Companies and the local planning authority partners of the study. To give this discussion context, the volumes of storage that would be required to mitigate the additional WwTW discharge for the duration of the 1 in 100 year flood event had been calculated using FEH methods (using the critical storm duration for each location and the Re-FEH rainfall runoff method) and are summarised in Table 5-3 below.

WwTW	Receiving watercourse	1 in 2 year peak flow (m^3/s)	Consented FFT* (2008) (m^3/s)	Increase in FFT by 2026 (based on 3xDWF) (m^3/s)	Percentage increase in total flow (%)	Duration of 1 in 100 year hydrograph (hrs)	Storage volume required (m^3)
Great Billing	Ecton Brook	0.44	1.85	0.302	16.3	22.5	24428

Table 5-3: Comparison of flow to full treatment discharges from Great Billing WwTW to the 1 in 2 year peak flow in receiving watercourses and compensation storage volume required due to increase in wastewater treatment effluent discharge.

* consented FFT figure supplied by AWS. All other figures are from calculation.

The base flows for WwTWs may increase as a result of development if mitigation is not provided. Assessment at outline report stage has not determined this issue as insurmountable and thus requiring material change to the proposed spatial plan. However the next phase of the WCS needs to quantify such risks and propose appropriate mitigation measures. These will need to be prescribed in sufficient detail to:

a) Produce outline costs;

b) Identify associated land use linkages to feedback into the spatial planning process, and;

c) Allow later phases of the WCS to determine an implementation mechanism including funding and agreements for delivering the necessary works. If either the Core Strategy allocation sites for development or sites come forward in advance of the WCS then this implementation mechanism needs to be clearly agreed. Developers will be required to submit Flood Risk Assessments in accordance with PPS25 to demonstrate how the development will ensure risk is not increased including discharge to watercourses.

The WCS must consider that any works to WwTWs adjacent to a Main River are highly likely to require a Flood Defence Consent from the Environment Agency. The appropriate Internal Drainage Board will need to be consulted for works to any WwTW sites on IDB main drains.

5.8.6 Known Planning Applications

The development areas that have been examined above are to be considered in conjunction with other evidence and some will be further developed within the Core Strategy as part of the Local Development Framework. These areas will be further examined in the detailed WCS. However, there a number of live planning applications or outline applications for the Northampton Implementation Area. To enable development to progress in a strategic manner before the detailed WCS and core strategy is complete, ten of these planning sites are being examined and an interim strategy devised. These sites are:

- Avon Nunn Mills
- Buckton Fields East
- Buckton Fields
- Dallington Grange
- Grange Park
- Pineham Barns
- Princess Marina
- Ransome Road

- Upton Lodge
- Upton Park

5.8.7 Recommendations

General recommendations for Northampton include:

- It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25. Any new development should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development. Developers should wherever possible incorporate river naturalisation and environmental enhancement into new developments. This will support the actions outlined in the Nene CFMP.

- SFRA Level 2 sequential tests should feed into the Local Development Framework. The Northampton SFRA Level 2 will be prepared.

- When sectors are allocated, a combined flood risk assessment will be required to show that there will be no increase in flood risk from all developments draining into all watercourses. Where multiple sites are within with same minor catchment, a surface water management plan is recommended to identify opportunities for strategic flood risk solutions.

- Where part of the development sectors are in flood zone 2 and 3 the developer of these sectors should undertake a site-specific flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for these sectors, and the future extent of these flood zones with climate change. Land use within these sectors should be allocated according to the appropriate uses for the flood zones according to PPS25.

- Where large urban extensions contain elements of flood zone 3 it should be incorporated into the scheme through not building in those areas and the land fulfilling an open space requirement.

- Post-development flows and volumes should be restricted to pre-development levels.

- Areas benefitting from defences should be investigated by developers more closely in relation to potential development sectors.

- The developers must take account of any recommendations from the River Nene CFMP for the River Nene (Weedon to Kislingbury),

Wootton, Northampton Central and Northampton Outer policy units, and any subsequent studies arising from the CFMP.

- Anglian Water should consult with the Environment Agency to identify an appropriate policy to mitigate the increased flows from the Great Billing WwTW.

- Developers should take account of the West Northants SFRA Level 2 that will be prepared.

- It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

- A further consideration is that if any development takes place within Flood Zone 3, where some of the proposed developments partially lie, the land 'lost' to the development from the flood plain must have its capacity replaced elsewhere. The most feasible option to do this would be to relocate any property that is currently planned to be built within Flood Zone 3 to another location within the proposed development area. While this would create higher density development, it would leave the areas of Flood Zone 3 as greenfield, therefore not impacting upon floodplain storage.

Where possible, development areas should seek to combine to provide strategic flood risk management solutions. Recommendations for clustered potential development areas are given in the following Table 5-4.

Table 5-4: Recommendations for clustered potential development areas.

Potential Development sector number	Flood risk (fluvial, sewerage, surface water)	Flood defences	Future flood risk	Recommendations
19a, 19b, 19c, 20a, 20b, 21	Fluvial flood risk to areas adjacent to the River Nene. Area of DG5 near Harpole	Defences around Bugbrooke Mill and Kislingbury. Duston flood storage reservoir which may have spare capacity. Upton flood attenuation area scheme in progress. CFMP recommends Flood Storage Study to investigate creating/developing flood storage on the River Nene.	Draft CFMP policy is to increase flooding in the area between Wootton and Kislingbury to deliver benefits locally or elsewhere. Therefore increased flood storage upstream of potential development areas in Northampton could benefit the development areas bordering the Nene to the west of Northampton.	The LDF should take account of recommendations arising from the Flood Storage Study if the timing of the study allows. The capacity of Duston Flood Storage Reservoir should be investigated by developers before any planning application is made. If using existing storage is not possible then on site attenuation must be provided. Any development in this area must not exacerbate flooding from sewers near Harpole.
1, 2a, 2b, 2c, 2d,	Fluvial flood risk to areas	No formal flood defences. Any	Future flood risk is likely to	Largely urbanised area with

Potential Development sector number	Flood risk (fluvial, sewerage, surface water)	Flood defences	Future flood risk	Recommendations
2e, 3a, 3b, 3c, 3d, 4, 5, 6, 7, 8, 19a, 19c, 22 and 23	adjacent to Wootton Brook and its tributaries (including the Kislingbury Grange Brook and the watercourse running north from Blisworth through Milton Malsor). Recorded surface water flooding event in Wotton Brook catchment. Integrated Urban Drainage Plan was recommended in the CFMP to investigate flooding from surface water.	defences privately owned.	increase with cimate change. The draft CFMP policy is to continue with existing and alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from the baseline).	insufficient floodplain area to make flood storage effective. Therefore any runoff from development would have to be attenuated on site. Developers should take account of recommendations and conclusions from the Integrated Urban Drainage Plan for Wootton. Surface water flooding problem should not be exacerbated by new development. New development must not reduce the capacity of online storage lakes created as part of previous development.
13b, 13c, 14a, 14b, 15a, 16, 17,	Fluvial flood risk to areas adjacent to Brampton Branch of	Dallington flood storage reservoir, which may have spare	Future flood risk should remain at current levels as the draft CFMP policy is to take further	The capacity of Dallington and Flood Storage Reservoir should be investigated by developers

Potential Development sector number	Flood risk (fluvial, sewerage, surface water)	Flood defences	Future flood risk	Recommendations
24a	River Nene, Dallington Brook.	capacity. Small flood storage reservoir adjacent to Dallington Brook at Tintern Avenue.	action to sustain the current level of flood risk into the future.	before any planning application is made. Developers should investigate the potential for storage upstream on Dallington Brook. If using existing storage is not possible then on site attenuation must be provided.
12a, 12b, 24b and 24c	Fluvial flood risk to areas adjacent to Billing Brook	Billing Brook flood detention pond (standard of protection unknown). Amenity ponds along Billing Brook.	Future flood risk should remain at current levels as the draft CFMP policy is to take further action to sustain the current level of flood risk into the future.	A review of the capacity of Overstone Park Lake should be undertaken before any development takes place in areas 12a and 12b. Developers should investigate whether runoff could be attenuated in Overstone park or upstream. This should not increase the risk of failure of the embankment forming the

Potential Development sector number	Flood risk (fluvial, sewerage, surface water)	Flood defences	Future flood risk	Recommendations
				Overstone Park Lake. If using existing storage is not possible then on site attenuation must be provided. Recommendations from the Pitt Review (2007) on flood risk from reservoirs should be followed. Developers should work with the Local Resilience Forum to implement these recommendations. This may pose a constraint on development areas 12a and 12b. Developers should investigate whether runoff could be attenuated in amenity ponds along Billing Brook. Development of areas upstream of Billing Brook flood detention

Potential Development sector number	Flood risk (fluvial, sewerage, surface water)	Flood defences	Future flood risk	Recommendations
				ponds should not compromise the operation of the ponds and therefore reduce their capacity for flood water storage. If using existing storage on Billing Brook is not possible then on site attenuation must be provided.
11	Fluvial flood risk to areas adjacent to Ecton Brook and Barton Brook.	No formal flood defences. Sywell reservoir located upstream on Barton Brook. Amenity ponds along Ecton Brook.	Future flood risk should remain at current levels as the draft CFMP policy is to take further action to sustain the current level of flood risk into the future.	Developers should investigate whether it may be possible to attenuate flows in the offline ponds on Ecton Brook or in the Upper and Lower Ponds at Overstone Solarium. If using existing storage is not possible then on site attenuation must be provided. Recommendations from the Pitt Review (2007) on flood risk

Potential Development sector number	Flood risk (fluvial, sewerage, surface water)	Flood defences	Future flood risk	Recommendations
				from reservoirs should be followed. Developers should work with the Local Resilience Forum to implement these recommendations for Sywell reservoir. This may pose a constraint on development area 11 in locations downstream of Sywell reservoir.
9a, 9b and 10b	Fluvial flood risk to areas adjacent to River Nene. Areas of DG5 near Great Houghton and Cogenhoe.	Flood defences along the south bank of the Nene near Cogenhoe.	Future flood risk should remain at current levels as the draft CFMP policy is to take further action to sustain the current level of flood risk into the future.	Any development in this area must not exacerbate the sewer flooding issues near Houghton and Cogenhoe.

5.9 Daventry

5.9.1 *Existing situation*

Daventry is located in the west of the study area, close to the Kislingbury arm of the Nene. The emerging RSS indicates that Daventry will deliver 13,500 new dwellings between 2001 and 2026. Applications have been submitted for three sites in to the north and east of Daventry, which are subject to appeals to the Secretary of State.

Daventry is, for the most part, located in Flood Zone 1 (less than 1 in 1000 chance of flooding). However, a small area immediately south and north of Daventry reservoir is classified as Flood Zone 3 (high risk). The south eastern boundary of DO9, Churchfields, is located adjacent to the southern portion of Flood Zone 3 and both Churchfields and D10, Monksmoor, are adjacent to the northern portion of Flood Zone 3 (Figure 5-3). These sites are subject to appeals to the Secretary of State.

5.9.2 *Potential Development Areas*

There are five potential development areas in Daventry as outlined in the Joint Core Strategy Issues and Options paper. Three of these areas (Churchfields, land to the east of Daventry and north of the A45 and Monksmoor) are covered by current planning applications. These three sites are also discussed below. Other areas may come forward in the emerging Core Strategy.

The draft CFMP flood risk management policy for the Upper and Middle Nene (which includes Daventry) is to reduce existing flood risk management actions (accepting that flood risk will increase over time).

5.9.3 *Churchfields (DO9)*

The application for housing at Church Fields proposes 4000 properties and covers 246 hectares. The northern flanks of Borough Hill border the southern boundary of the planned development, therefore creating a flow path for rainfall run off into this area from the south. Further run-off would drain to the west into Daventry reservoir, to the north into the Grand Union Canal and to the east in the direction of the village of Norton. The northwest boundary of the proposed development falls within Flood Zones 3 and 2 – high and medium flood risk. This boundary is also within a modelled flood extent from a breach of Daventry Reservoir.

Increased run off from the Church Fields development could increase risk of flooding to the village of Norton approximately 1km to the east. Run off flowing west would enter Daventry Reservoir, potentially increasing the reservoir discharge and risk of dam break through overtopping. Both would increase the flooding to the Monksmoor site although it should be noted that the watercourse and dam break inundation area are in proposed open spaces. If increased discharge to the reservoir is proposed, then a review of reservoir capacity would need to be undertaken before any development takes place. Detailed Flood Risk Assessments should examine all aspects of flood risk for the site.

5.9.4 *Land to the east of Daventry and the north of the A45 (DO8)*

The proposed site lies to the south and east of Borough Hill, within Flood Zone 1. A total of 5150 properties are proposed in this location. Rainfall run off would flow down the hill, entering the site from the west and north. The south of the site would also receive run off from the south, flowing down Newnham Hill. This would create ponding in this area, which the Danetree Village masterplan states, is to be used for both employment and residential uses.

This development will significantly reduce the amount of permeable land available for rainfall run off to infiltrate, even with the green space the Danetree Village masterplan has incorporated into the development. The predominant runoff pathway is to the east, due to the presence of a watercourse in the south of the site as well as Borough Hill lying immediately to the west of the development. Unmitigated, this will increase flood risk to areas to the east of the development, particularly to the village of Dodford which lies downstream on the watercourse.

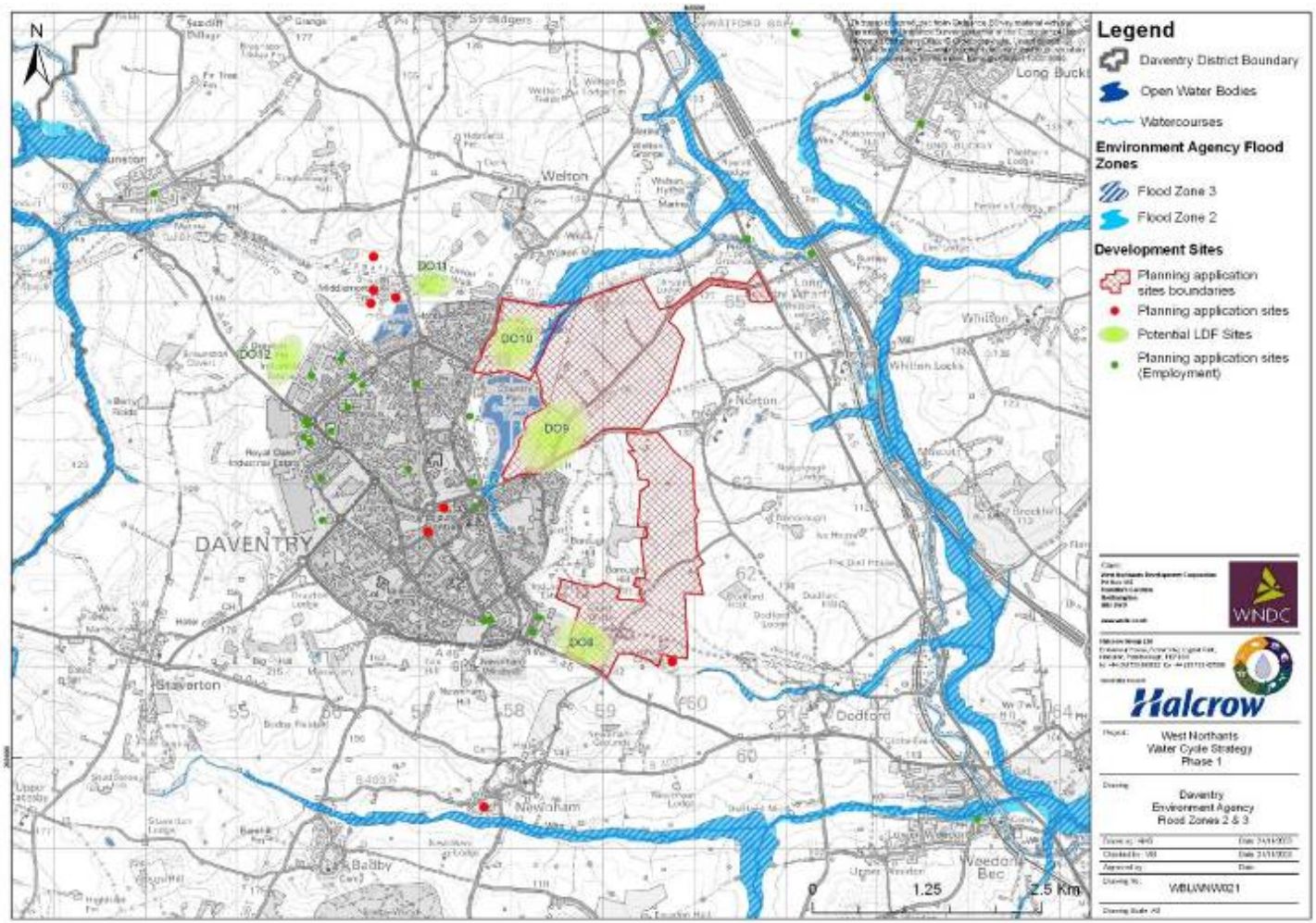

Figure 5-3: Daventry Flood Zone Mapping

5.9.5 Monksmoor (DO10)

D10, Monksmoor, is smaller than DO8 and Churchfields (DO9), comprising 1000 properties, which would cover 32.04 hectares. It is located to the north on a square of land between Daventry Reservoir and the Grand Union Canal. The land is predominantly flat, and lower than surrounding land, creating a natural ponding area for run off in certain parts of the site. Only a proportion of the site area is proposed for built development in the current appeal application. A small watercourse flows north from the reservoir to the canal in the centre of the site. It is this watercourse that is responsible for the area of Flood Zone 3 present on the development site. The eastern boundary of the site lies within Flood Zones 2 and 3. Approximately half the site also lies within the modelled flood extent of the dam breach, as discussed below.

Other risks of flooding are the potential for blockage of a culvert/siphon under the canal and canal bank failure.

A dam break analysis carried out by HR Wallingford and Hyder Consulting modelled a worst-case scenario breach of Daventry Reservoir. The modelled flood extent falls within the northwest boundary of Church Fields and approximately half the area of Monksmoor. Further work confirms the dam is in acceptable condition. However, for the purposes of flood risk the specific FRA has assumed that the dam will fail and the inundation map matches the proposed open spaces. If increased discharge to the reservoir is proposed, then a review of reservoir capacity would need to be undertaken before any development takes place.

Hydrological analysis has been undertaken for the three sites with current planning applications to calculate approximate storage volumes for the major development areas for the 1 in 100 year flows. Table 5-5 below indicates approximate storage volumes to attenuate runoff from development up to the 1 in 100 year flow to greenfield rates. The largest volume requirement is for Church Fields.

It should be noted that the standard of protection at the development sites is 1 in 200 years. Volumes given below are for the 1 in 100 year flows, following the Defra/Environment Agency's guidance (Preliminary rainfall runoff management for developments, 2005). Attenuation storage volumes for the 1 in 200 year flows are therefore likely to be greater and a detailed site specific Flood Risk Assessment (FRA) should be applied by the developers to determine attenuation volumes required to store the 1 in 200 year flows.

Site	Total proposed properties	Area of development (ha)	Long term storage (m^3)	Attenuation Storage (m^3), (100 year)
Daventry				
Church Fields,	4000	161.52*	22,900	57,100
Land to E of Daventry and N of A45	5150	143.93*	20,400	50,900
Monksmoor,	1000	34.02	4800	12,000

Table 5-5: Approximate long term and attenuation storage volumes required for the major development areas in Daventry, for a 100 year event with climate change.

Areas of development were calculated from the planning applications (as of November 2008) and a Percentage Impermeable Area (PIMP) of 75%. *Takes into account area of open space in planning application.

DO11 and DO12 are areas highlighted by the West Northamptonshire Joint Core Strategy as being areas of potential growth. DO11 is located north of Daventry and east of the A361 and DO12 is located north of Daventry east of the A45. Neither of these areas is located within Flood Zone 2 or 3, therefore they can be considered to be a low risk of fluvial (river) flooding.

5.9.6 *Impact of increased WwTW discharges on flood risk*

This section aims to quantify the volume of additional effluent discharge from the Whilton Wastewater Treatment Works (WwTW) due to growth and how this compares to the existing flow in the watercourse during a flood event. This assessment is undertaken to support the principle of PPS25, which requires that development should not increase flood risk.

> PPS25 (Annex E)
>
> Any organisation or person proposing development must consider whether that development will not add to and where practicable reduce flood risk.
>
> At all stages of the planning process, the minimum requirements for flood risk assessments are that they should consider and quantify the different types of flooding (whether from natural and human sources [such as wastewater treatment works] and including joint and cumulative effects) and identify flood risk reduction measures.....;

The assessment used the methodology of the recent Environmental Capacity Assessment undertaken by Halcrow Group Limited for Anglian Water Services (Phase 1, December 2008). The study evaluated the potential effects of population growth on flood risk by comparing increases in WwTW discharges to the 1 in 2 year peak flow in the receiving watercourse. This flood event was selected because the 1 in 2 year event is very crudely considered to approximate bank full conditions. Any significant increase in the 1 in 2 year event could therefore result in out of bank

flooding. The 1 in 2 year peak flow was estimated using the Flood Estimation Handbook (FEH) statistical method (SC050050) based on catchment descriptors and adjusted using observations of flood flows at nearby gauging stations. The Environmental Capacity Assessment is ongoing. The final outputs from the study will be reviewed in Phase 2 of the Water Cycle Study.

The 1 in 2 year peak flow in the receiving watercourse is compared to the increase in flow to full treatment (FFT) from each WwTW. The estimated flow to full treatment in 2026 is based upon 3 x dry weather flow (3DWF), which is a standard methodology. If the projected growth does not result in exceedance of the consented dry weather flow, there will be no increase in the flow to full treatment.

At this stage, there may be opportunities to meet the PPS25 statements to reduce flood risk where this appropriate. The Water Cycle Strategy mechanism provides an opportunity to reach agreement between all parties in order to facilitate sustainable growth. Sufficient time should be allowed within the detailed study to address this issue and obtain agreement from the Environment Agency, Water Companies and the local planning authority partners of the study. To give this discussion context, the volumes of storage that would be required to mitigate the additional WwTW discharge for the duration of the 1 in 100 year flood event had been calculated using FEH methods (using the critical storm duration for each location and the Re-FEH rainfall runoff method) and are summarised in the Table 5-6 below.

WwTW	Receiving watercourse	1 in 2 year peak flow (m^3/s)	Consented FFT* (2008) (m^3/s)	Increase in FFT by 2026 (based on 3xDWF) (m^3/s)	Percentage increase in total flow (%)	Duration of 1 in 100 year hydrograph (hrs)	Storage volume required (m^3)
Whilton	Whilton Brook	9.34	0.2	0.109	53.8	35.5	13897

Table 5-6: Comparison of flow to full treatment discharges from Whilton WwTW to the 1 in 2 year peak flow in receiving watercourse and compensation storage volume required due to increase in wastewater treatment effluent discharge.

* consented FFT figure supplied by AWS. All other figures are from calculation.

The base flows for WwTWs may increase as a result of development if mitigation is not provided. Assessment at outline report stage has not determined this issue as insurmountable and thus requiring material change to the proposed spatial plan. However the next phase of the WCS needs to quantify such risks and propose appropriate mitigation measures. These will need to be prescribed in sufficient detail to:

a) Produce outline costs;

b) Identify associated land use linkages to feedback into the spatial planning process, and;

c) Allow later phases of the WCS to determine an implementation mechanism including funding and agreements for delivering the necessary works. If either the Core Strategy allocation sites for development or sites come forward in advance of the WCS then this implementation mechanism needs to be clearly agreed. Developers will be required to submit Flood Risk Assessments in accordance with PPS25 to demonstrate how the development will ensure risk is not increased including discharge to watercourses.

The WCS must consider that any works to WwTWs adjacent to a Main River are highly likely to require a Flood Defence Consent from the Environment Agency. The appropriate Internal Drainage Board will need to be consulted for works to any WwTW sites on IDB main drains.

5.9.7 *Recommendations*

There are five potential development areas in Daventry as outlined in the Joint Core Strategy Issues and Options paper. Due to the different runoff routes of the five development areas a strategic solution for flood risk management does not exist for these areas. Rather runoff should be managed on site by site basis and site specific flood risk assessments would be required. Post-development flows and volumes should be restricted to pre-development levels.

The developer of the Churchfields area should undertake a study analysing the impact of runoff from the site to Daventry reservoir, the Grand Union Canal and to the village of Norton.

Flood risk to the village of Norton must not be increased as a result of developing areas D1 and D2.

Flood risk to the village of Dodford must not be increased as a result of developing area D2.

A review of reservoir capacity should be undertaken before any development takes place in the Churchfields and Monksmoor areas.

The developers should undertake a study to show that there will be no increase in flood risk from development areas draining into the River Nene or other watercourses.

It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25. Any new development

should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development. Developers should incorporate river naturalisation and environmental enhancement into new developments. This will support the actions outlined in the Nene CFMP.

As part of the development sites Church Fields and Monksmoor are in flood zone 2 and 3 the developer of these sites should undertake a site specific flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for these sites, and the future extent of these flood zones with climate change. Land use within these sites should be allocated according to the appropriate uses for the flood zones according to PPS25.

The developers must take account of any recommendations from the River Nene CFMP for the Upper and Middle Nene catchment policy unit and any subsequent studies.

The increase in flows from foul sewerage treatment at Whilton WwTW needs to be managed. A preferred mitigation solution would be to introduce a strategic storage site near to the works themselves.

It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

A further consideration is that if any development takes place within Flood Zone 3, where some of the proposed developments partially lie, the land 'lost' to the development from the flood plain must have its capacity replaced elsewhere. The most feasible option to do this would be to relocate any property that is currently planned to be built within Flood Zone 3 to another location within the proposed development area. While this would create higher density development, it would leave the areas of Flood Zone 3 as greenfield, therefore not impacting upon floodplain storage.

5.10 South Northamptonshire

Towcester, Silverstone and Brackley are located in the catchment of the River Great Ouse. Development in these locations will therefore not drain into the River Nene.

The West Northamptonshire Joint Core Strategy Issues and Options Report (September 2007) proposed three potential growth scenarios for Towcester and Brackley which are outlined in Table 5-7 below.

Growth option	No. of houses in Towcester	No. of houses in Brackley	No. of houses in outlying villages	Area required for housing in Towcester*	Area required for housing in Brackley*	Area required for housing in villages*
SN01 - growth	4000	0	0	100	0	0

only at Towcester						
SN02 - concentrate growth in Towcester, remainder in Brackely	3000	1000	0	75	25	0
SN03 - concentrate growth in Towcester, some in Brackley, some in outlying villages	3000	500	500	75	12.5	12.5

Table 5-7: CSS options for South Northamptonshire Growth - CSS Issues and Options. **Using a housing density of 40 dwellings per hectare*

5.10.1 Existing situation in Towcester

Towcester is located in the south of the study area, in the district of South Northamptonshire, with the River Tove flowing east through the centre of the town. The River Tove is a tributary of the River Great Ouse. Most of the centre of the town is designated as Flood Zone 3, with some areas of Flood Zone 2 towards the south west of the town (Figure 5-4). The Environment Agency, in accordance with the action plan of the Great Ouse CFMP, is to develop a flood risk management study for the River Tove to identify what further actions can be taken to manage flood risk at Towcester.

There are two potential development areas in Towcester, one of which (Towcester Vale), is covered by current planning applications. Hydrological analysis has been undertaken to calculate approximate storage volumes for the major development areas. The calculations were performed for the built up area of the potential development area, excluding any open space. Therefore runoff calculated is for the proposed area of housing only which may be a smaller area than the entire proposed development location. Results are presented in Table 5-8.

5.10.2 History of flooding in Towcester

In Towcester there have also been several significant flood events. An event in 1947 affected the River Tove, Silverstone Brook and Wood Burcote Brook. The 1968 event affected Silverstone and Wood Burcote Brooks and Silverstone Brook. As a result of this event Silverstone Brook from the head of the designated Main River to the confluence with the River Tove, (i.e. through the built up area of Towcester) was improved. The Easter 1998 event caused extensive flooding on Watling Street and surrounding areas from the Tove.

After extremely heavy and prolonged rainfall on 20 July 2007, the catchment of the Upper Ouse and Tove became saturated. In July, the Environment Agency recorded that 101.8mm of rain fell on Towcester. The average rainfall for July is 50.3mm. Towcester initially flooded from surface water on 20 July, this overwhelmed the existing drainage system. No properties were flooded.

5.10.3 Current flood protection in Towcester

Towcester has a recently constructed Flood Alleviation Scheme on the River Tove which has a 1 in 50 year standard of protection.

The Towcester Flood Storage Reservoir is an impounding reservoir with a capacity of 105,000 m^3.

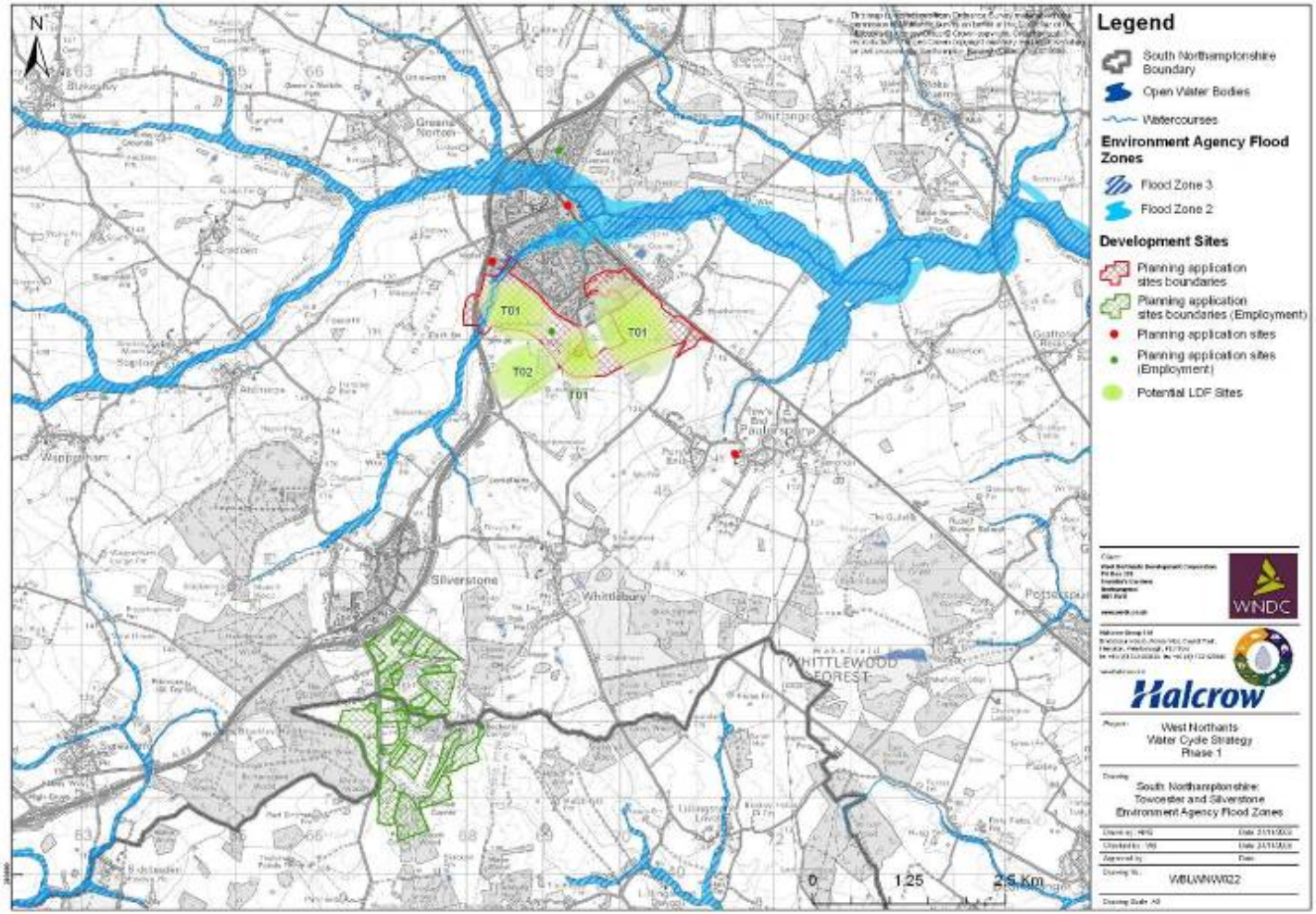

Figure 5-4: Towcester and Silverstone Flood Zone Mapping

5.10.4 Potential Development Areas in Towcester

The proposed location of Towcester Vale (SN1, T01) borders the south of the town surrounding the village of Wood Burcote in its extent. 3000 properties are proposed. 20.6 hectares of employment land will also be provided in Towcester Vale. The land slopes gently westwards, allowing rainfall run off to flow downhill into the small watercourse (Silverstone Brook) that runs close to the western boundary of the site. This watercourse is responsible for this area of the site being classed as Flood Zone 3. The rest of the area is classified as Flood Zone 1 (low risk of flooding). The east of the site is primarily flat with a small watercourse (Wood Burcote Brook) running northwards, although this is not classed as within a Flood Zone. However this watercourse is known to flood and therefore must be considered as a source of flood risk. Rainfall is likely to flow into this watercourse, being the natural drainage feature on the site. The northern portion of SN1 falls within an area of DG5 (flooding of foul sewers due to lack of capacity as reported to OFWAT), which AWS has indicated as being at risk of foul water flooding. It should be stressed that the DG5 Register only indicates the impact location of the flooding and not the source/cause.

A flood risk assessment for the site, submitted as part of the outline planning application, was undertaken in 2007 by URS for Persimmon Homes. This states that the risk of flooding from groundwater at the site is low. The study concluded that development of this site using on site attenuation would not increase either the existing surface water runoff or volume from the site, and therefore would not increase flood risk elsewhere. However if the proposed development for the site differs from that proposed in the flood risk assessment the assessment of runoff volumes should be recalculated.

Outline planning applications have been submitted for Towcester Vale. If planning permission is not granted or revised permission is sought, any new developer would have to undertake their own new flood risk assessment in line with PPS25.

Level 1 of the West Northamptonshire SFRA was published in August 2007 by Scott Wilson. It was updated in January 2009. Level 2 of the SFRA will look in more detail at those areas of high risk where it is likely the PPS25 exception test will be required. The Level 2 SFRA is forthcoming. These documents should be reviewed for the Phase 2 Water Cycle Study.

Table 5-8 indicates approximate storage volumes for Towcester Vale area to attenuate runoff from development to greenfield rates.

Site	Total proposed properties	Area of development (ha)	Long term storage (m^3)	Attenuation Storage (m^3), (100 year)
Towcester				
Towcester Vale	3000	152.3*	21600	53800

Table 5-8: Approximate long term and attenuation storage volumes required for the major development area in Towcester, for a 100 year event with climate change.

Areas of development were calculated from the planning applications and a Percentage Impermeable Area (PIMP) of 75%. *takes into account area 50 hectares of open space as outlined in planning application.

TO2 is highlighted by the West Northamptonshire Joint Core Strategy as being an area of potential growth. TO2 is located south west of Towcester and could be considered as an extended area of the SN1 development area.

There are no watercourses in the potential development area and TO2 is not located within Flood Zone 2 or 3, therefore the area can be considered to be a low risk of fluvial (river) flooding.

5.10.5 Impact of increased WwTW discharges on flood risk

This section aims to quantify the volume of additional effluent discharge from the Towcester Wastewater Treatment Works (WwTW) due to growth and how this compares to the existing flow in the watercourse during a flood event. This assessment is undertaken to support the principle of PPS25, which requires that development should not increase flood risk.

> PPS25 (Annex E)
>
> Any organisation or person proposing development must consider whether that development will not add to and where practicable reduce flood risk.
>
> At all stages of the planning process, the minimum requirements for flood risk assessments are that they should consider and quantify the different types of flooding (whether from natural and human sources [such as wastewater treatment works] and including joint and cumulative effects) and identify flood risk reduction measures.....;

The assessment used the methodology of the recent Environmental Capacity Assessment undertaken by Halcrow Group Limited for Anglian Water Services (Phase 1, December 2008). The study evaluated the potential effects of population growth on flood risk by comparing increases in WwTW discharges to the 1 in 2 year peak flow in the receiving watercourse. This flood event was selected because the 1 in 2 year event is very crudely considered to approximate bank full conditions. Any significant increase in the 1 in 2 year event could therefore result in out of bank flooding. The 1 in 2 year peak flow was estimated using the Flood Estimation Handbook (FEH) statistical method (SC050050) based on catchment descriptors and adjusted using observations of flood flows at nearby gauging stations. The Environmental Capacity Assessment is ongoing. The final outputs from the study will be reviewed in Phase 2 of the Water Cycle Study.

The 1 in 2 year peak flow in the receiving watercourse is compared to the increase in flow to full treatment (FFT) from each WwTW. The estimated flow to full treatment in 2026 is based upon 3 x dry weather flow (3DWF), which is a standard methodology. If the projected growth does not result in exceedance of the consented dry weather flow, there will be no increase in the flow to full treatment.

At this stage, there may be opportunities to meet the PPS25 statements to reduce flood risk where this appropriate. The Water Cycle Strategy mechanism provides an opportunity to reach agreement between all parties in order to facilitate sustainable growth. Sufficient time should be allowed within the detailed study to address this issue and obtain agreement from the Environment Agency, Water Companies and the local planning authority partners of the study. To give this discussion context, the volumes of storage that would be required to mitigate the additional WwTW discharge for the duration of the 1 in 100 year flood event had been calculated using FEH methods (using the critical storm duration for each location and the Re-FEH rainfall runoff method) and are summarised in Table 5-9 below.

WwTW	Receiving watercourse	1 in 2 year peak flow (m^3/s)	Consented FFT* (2008) (m^3/s)	Increase in FFT by 2026 (based on 3xDWF) (m^3/s)	Percentage increase in total flow (%)	Duration of 1 in 100 year hydrograph (hrs)	Storage volume required (m^3)
Towcester	River Tove	14.40	0.09	0.028	32.6	52	5172

Table 5-9: Comparison of flow to full treatment discharges from Towcester WwTW to the 1 in 2 year peak flow in receiving watercourses and compensation storage volume required due to increase in wastewater treatment effluent discharge.

* consented FFT figure supplied by AWS. All other figures are from calculation.

The base flows for WwTWs may increase as a result of development if mitigation is not provided. Assessment at outline report stage has not determined this issue as insurmountable and thus requiring material change to the proposed spatial plan. However the next phase of the WCS needs to quantify such risks and propose appropriate mitigation measures. These will need to be prescribed in sufficient detail to:

a) Produce outline costs;

b) Identify associated land use linkages to feedback into the spatial planning process, and;

c) Allow later phases of the WCS to determine an implementation mechanism including funding and agreements for delivering the necessary works. If either the Core Strategy allocation sites for development or sites come forward in advance of the WCS then this implementation mechanism needs to be clearly agreed. Developers will be required to submit Flood Risk Assessments in accordance with PPS25 to demonstrate how the development will ensure risk is not increased including discharge to watercourses.

The WCS must consider that any works to WwTWs adjacent to a Main River are highly likely to require a Flood Defence Consent from the Environment Agency. The appropriate Internal Drainage Board will need to be consulted for works to any WwTW sites on IDB main drains.

5.10.6 *Recommendations for Towcester*

The developer of the Towcester Vale site should follow the recommendations made by the URS (2007) Flood Risk Assessment for the site. If a revised planning application is made for the Towcester vale site, the developer is required to undertake their own Flood Risk Assessment for the site.

It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25. Any new development should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development, unless an exception test supported by the Core Strategy Sustainability Appraisal can provide evidence otherwise. Developers should incorporate river naturalisation and environmental enhancement into new developments wherever possible. This will support the actions outlined in the Great Ouse CFMP.

Identify opportunities to reduce runoff from landuse by future de-intensification. This will support the actions outlined in the Great Ouse CFMP.

Part of the development site SN1, (TO1) is in flood zone 2 and 3 the developer of this site should undertake a flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for the sites, and the future extent of these flood zones with climate change. Land use within the site should be allocated according to the appropriate uses for the flood zones according to PPS25.

Post-development flows and volumes should be restricted to pre-development levels.

The developers must take account of any recommendations from the Great Ouse CFMP and the planned River Tove flood risk management study.

Anglian Water should consult with the Environment Agency to identify an appropriate policy to mitigate the increased flows from the Towcester WwTW.

It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

A further consideration is that if any development takes place within Flood Zone 3, where some of the proposed developments partially lie, the land 'lost' to the development from the flood plain must have its capacity replaced elsewhere. The most feasible option to do this would be to relocate any property that is currently planned to be built within Flood Zone 3 to another location within the proposed

development area. While this would create higher density development, it would leave the areas of Flood Zone 3 as greenfield, therefore not impacting upon floodplain storage.

5.10.7 *Existing situation in Silverstone*

The town of Silverstone and Silverstone Circuit are both located in Flood Zone 1 and are therefore considered to be at low risk of fluvial flooding (see Figure 4).

Whilst there is no mapping of flood risk in Silverstone itself this does not mean that flooding does not exist. The Environment Agency only undertakes flood risk mapping for watercourses with a catchment greater than 3km^2. There are properties on Church Lane within the village of Silverstone at risk of flooding and it is known that this area is subject to frequent flooding. There have also been also other incidents of flooding in the village, in particular in Little London and the Graham Hill areas.

Silverstone Circuit is located on a plateau that is a watershed at the head of several water catchments. The streams to the north, north west and north east of the site area drain towards the north, through and around Silverstone village, to join the River Tove. The streams to the east, south east and south west drain the southern section of the site and eventually drain to the River Great Ouse. These watercourses flow across predominately rural land.

The site is within PPS25 Flood Zone 1 which identifies a low probability of flooding from fluvial sources. Rainfall runoff has the potential to cause localised flooding on the site. Retention ponds already exist on the Circuit to control and manage the run off from the site and to reduce flood risk at lower points of the area in particular Silverstone Village.

5.10.8 *Potential development in Silverstone*

Potential development options for Silverstone Circuit are given in the Approved Silverstone Circuit Masterplan Development Brief (March 2009). Most of the development options are confined to the boundary of the circuit. Runoff from development areas to the north, north west and north east of the circuit would drain towards the north. Runoff from development areas to the east, south east and south west drain the south.

Development areas G2 (an extension to the existing Advanced Technology Park) and H1 (a hotel) are located within the area of South Northamptonshire Council. Runoff from these areas would drain to the small watercourse running under Dadford road and to the existing pond along Dadford Road.

Runoff from areas developed on currently open ground (e.g. development areas H2 and K, to the west of the Silverstone access road) should be restricted to Greenfield rates.

5.10.9 *Impact of increased WwTW discharges on flood risk in Silverstone*

This section aims to quantify the volume of additional effluent discharge from the Silverstone Wastewater Treatment Works (WwTW) due to growth and how this compares to the existing flow in the watercourse during a flood event. This assessment is undertaken to support the principle of PPS25, which requires that development should not increase flood risk.

> PPS25 (Annex E)
>
> Any organisation or person proposing development must consider whether that development will not add to and where practicable reduce flood risk.
>
> At all stages of the planning process, the minimum requirements for flood risk assessments are that they should consider and quantify the different types of flooding (whether from natural and human sources [such as wastewater treatment works] and including joint and cumulative effects) and identify flood risk reduction measures.....;

The assessment used the methodology of the recent Environmental Capacity Assessment undertaken by Halcrow Group Limited for Anglian Water Services (Phase 1, December 2008). The study evaluated the potential effects of population growth on flood risk by comparing increases in WwTW discharges to the 1 in 2 year peak flow in the receiving watercourse. This flood event was selected because the 1 in 2 year event is very crudely considered to approximate bank full conditions. Any significant increase in the 1 in 2 year event could therefore result in out of bank flooding. The 1 in 2 year peak flow was estimated using the Flood Estimation Handbook (FEH) statistical method (SC050050) based on catchment descriptors and adjusted using observations of flood flows at nearby gauging stations. The Environmental Capacity Assessment is ongoing. The final outputs from the study will be reviewed in Phase 2 of the Water Cycle Study.

The 1 in 2 year peak flow in the receiving watercourse is compared to the increase in flow to full treatment (FFT) from each WwTW. The estimated flow to full treatment in 2026 is based upon 3 x dry weather flow (3DWF), which is a standard methodology. If the projected growth does not result in exceedance of the consented dry weather flow, there will be no increase in the flow to full treatment.

At this stage, there may be opportunities to meet the PPS25 statements to reduce flood risk where this appropriate. The Water Cycle Strategy mechanism provides an opportunity to reach agreement between all parties in order to facilitate sustainable growth. Sufficient time should be allowed within the detailed study to address this issue and obtain agreement from the Environment Agency, Water Companies and the local planning authority partners of the study. To give this discussion context, the volumes of storage that would be required to mitigate the additional WwTW discharge for the duration of the 1 in 100 year flood event had been calculated using FEH methods (using the critical storm duration for each location and the Re-FEH rainfall runoff method) and are summarised in Table 5-10 below.

WwTW	Receiving watercourse	1 in 2 year peak flow (m^3/s)	Consented FFT* (2008) (m^3/s)	Increase in FFT by 2026 (based on 3xDWF) (m^3/s)	Percentage increase in total flow (%)	Duration of 1 in 100 year hydrograph (hrs)	Storage volume required (m^3)
Silverstone	Silverstone Brook	2.97	0.014	0.0	0	22	0

Table 5-10: Comparison of flow to full treatment discharges from Silverstone WwTW to the 1 in 2 year peak flow in receiving watercourse and compensation storage volume required due to increase in wastewater treatment effluent discharge.

* consented FFT figure supplied by AWS. All other figures are from calculation.

The base flows for WwTWs may increase as a result of development if mitigation is not provided. Assessment at outline report stage has not determined this issue as insurmountable and thus requiring material change to the proposed spatial plan. However the next phase of the WCS needs to quantify such risks and propose appropriate mitigation measures. These will need to be prescribed in sufficient detail to:

a) Produce outline costs;

b) Identify associated land use linkages to feedback into the spatial planning process, and;

c) Allow later phases of the WCS to determine an implementation mechanism including funding and agreements for delivering the necessary works. If either the Core Strategy allocation sites for development or sites come forward in advance of the WCS then this implementation mechanism needs to be clearly agreed. Developers will be required to submit Flood Risk Assessments in accordance with PPS25 to demonstrate how the development will ensure risk is not increased including discharge to watercourses.

The WCS must consider that any works to WwTWs adjacent to a Main River are highly likely to require a Flood Defence Consent from the Environment Agency. The appropriate Internal Drainage Board will need to be consulted for works to any WwTW sites on IDB main drains.

5.10.10 Recommendations for Silverstone

It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25. Any new development should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development, unless an exception test supported by the Core Strategy Sustainability Appraisal can provide evidence otherwise. Developers should incorporate river naturalisation and environmental enhancement into new developments wherever possible. This will support the actions outlined in the Great Ouse CFMP.

The developer of this site should undertake a flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for the site, and the future extent of these flood zones with climate change. Land use within the site should be allocated according to the appropriate uses for the flood zones according to PPS25.

A surface water drainage strategy should be produced for the circuit. This should identify the current situation and proposals to deal with future development.

The developers should undertake a study to show that there will be no increase in flood risk from all developments draining into the existing watercourses.

Post-development flows and volumes should be restricted to pre-development levels and should be managed on a site basis unless attenuation can be provided on a strategic basis. Attenuation for areas G2 and H1 could be provided on a strategic basis and this should be investigated by the developers.

In view of the flooding situation in the village of Silverstone, a recommendation for improved management in terms of surface water drainage to reduce flood risk is advised.

Opportunities to reduce runoff from landuse by future de-intensification should be identified. This will support the actions outlined in the Great Ouse CFMP.

It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

A further consideration is that if any development takes place within Flood Zone 3, the land 'lost' to the development from the flood plain must have its capacity replaced elsewhere. The most feasible option to do this would be to relocate any property that is currently planned to be built within Flood Zone 3 to another location within the proposed development area. While this would create higher density development, it would leave the areas of Flood Zone 3 as greenfield, therefore not impacting upon floodplain storage.

5.10.11 *Existing situation in Brackley*

Brackley is bounded on the south and east sides by tributaries of the River Great Ouse. Development areas in the town centre are in Flood Zone 1 and therefore are considered to be at low risk of flooding from rivers (Figure 5-5). However surface water flooding did occur in the town in summer 2007.

5.10.12 *History of flooding in Brackley*

After extremely heavy and prolonged rainfall on 20 July 2007, the catchment of the Upper Ouse and Tove became saturated. In July, 131.6mm of rain fell on Brackley with 70mm of rain falling on 20 July alone. The average rainfall for July is 36.2mm.

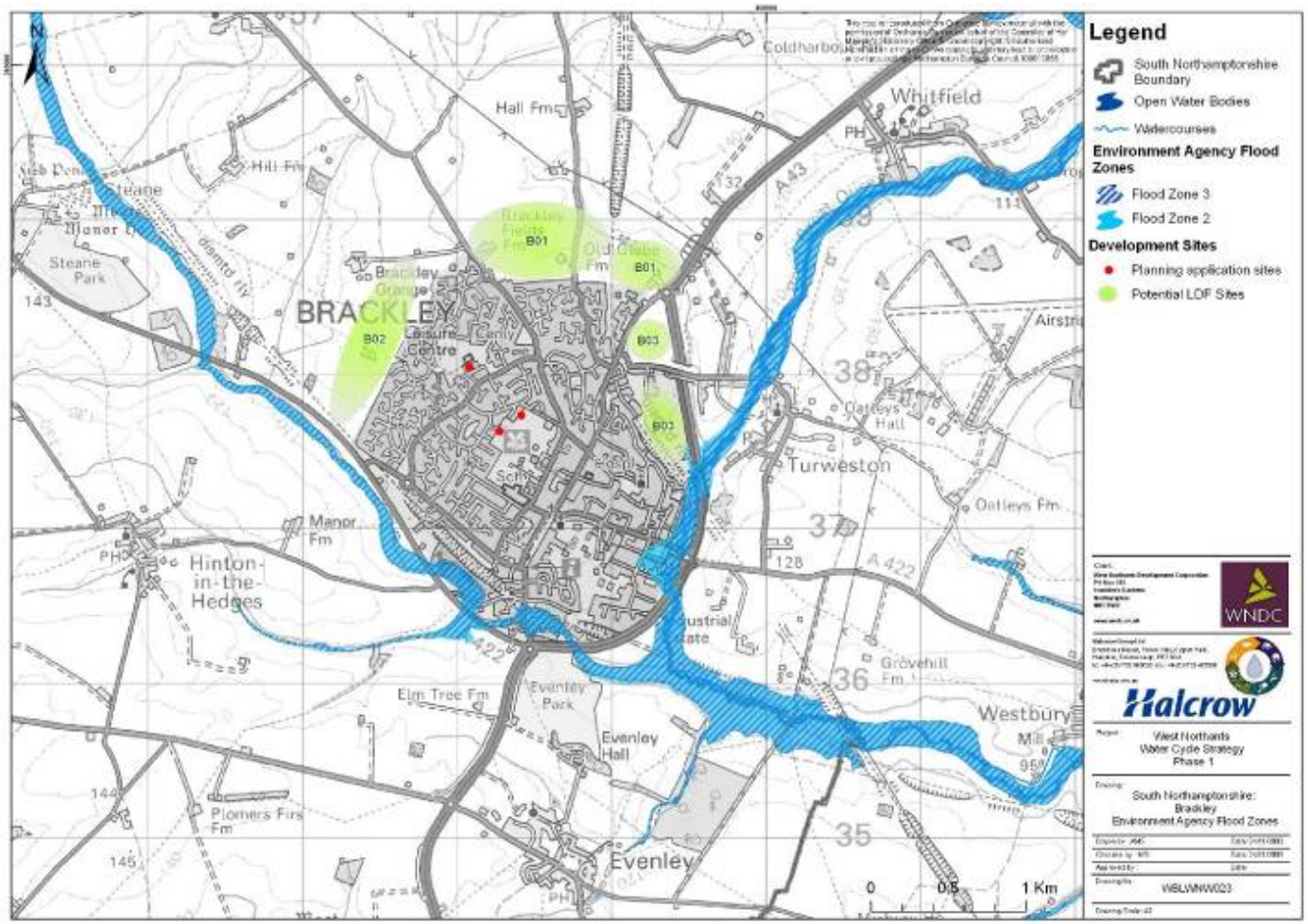

Figure 5-5: Brackley Flood Zone Mapping

Brackley initially flooded from surface water on 20 July, this overwhelmed the existing drainage system. Flood water spread throughout the low-lying areas of the village, most of which had already seen some flooding from surface water. 14 properties were flooded.

Channel clearance has been carried out since the flood event. The Environment Agency has an annual maintenance programme in place on the River Great Ouse which involves vegetation and debris removal.

5.10.13 Potential development areas in Brackley

There are three possible development areas in Brackley (5-5):

- BO1: Growth is located to the north of Brackley. The potential development area is located in Flood Zone 1 and is therefore considered to be at low risk of flooding. Runoff from this area would flow south east into the small watercourse running past Old Glebe Farm and alongside the A43. Runoff from this area should not exacerbate flood risk to Old Glebe Farm or the A43.

- BO2: Growth is located to the west of Brackley. The potential development area is located in Flood Zone 1 and is therefore considered to be at low risk of flooding. Runoff from this area would flow to the west and south west towards the small watercourse running south past Hill Farm and towards the tributary of the Great Ouse.

- BO3: Growth is located to the east of Brackley. The majority of the site is located in Flood Zone 1 and is therefore considered to be at low risk of flooding. The south eastern area of the site is adjacent to an area of Flood Zone 2. Runoff from this area would flow south east into the small watercourse running alongside the A43. This is the same watercourse that would receive runoff from development area BO1.

Table 5-11 indicates approximate storage volumes for 1000 properties in Brackley to attenuate runoff from development to greenfield rates. This is scenario SN02 (see Table 5-7). No attempt has been made to allocate these properties between potential development areas in Brackley so the figure quoted below should be taken as being for 1000 properties on one 25 hectare site with a housing density of 40 properties per hectare.

Site	Total proposed properties	Area of development (ha)	Long term storage (m^3)	Attenuation Storage (m^3), (100 year)
Brackley	1000	25	3,500	8,800

Table 5-11: Approximate long term and attenuation storage volumes required for 1000 properties on one site in Brackley, for a 100 year event with climate change.

Areas of development were calculated using a housing density of 40 dwellings per hectare. The calculations assume a housing density of 40 dwellings per hectare and a Percentage Impermeable Area (PIMP) of 75%.

5.10.14 *Impact of increased WwTW discharges on flood risk in Brackley*

This section aims to quantify the volume of additional effluent discharge from the Brackley Wastewater Treatment Works (WwTW) due to growth and how this compares to the existing flow in the watercourse during a flood event. This assessment is undertaken to support the principle of PPS25, which requires that development should not increase flood risk.

> PPS25 (Annex E)
>
> Any organisation or person proposing development must consider whether that development will not add to and where practicable reduce flood risk.
>
> At all stages of the planning process, the minimum requirements for flood risk assessments are that they should consider and quantify the different types of flooding (whether from natural and human sources [such as wastewater treatment works] and including joint and cumulative effects) and identify flood risk reduction measures.....;

The assessment used the methodology of the recent Environmental Capacity Assessment undertaken by Halcrow Group Limited for Anglian Water Services (Phase 1, December 2008). The study evaluated the potential effects of population growth on flood risk by comparing increases in WwTW discharges to the 1 in 2 year peak flow in the receiving watercourse. This flood event was selected because the 1 in 2 year event is very crudely considered to approximate bank full conditions. Any significant increase in the 1 in 2 year event could therefore result in out of bank flooding. The 1 in 2 year peak flow was estimated using the Flood Estimation Handbook (FEH) statistical method (SC050050) based on catchment descriptors and adjusted using observations of flood flows at nearby gauging stations. The Environmental Capacity Assessment is ongoing. The final outputs from the study will be reviewed in Phase 2 of the Water Cycle Study.

The 1 in 2 year peak flow in the receiving watercourse is compared to the increase in flow to full treatment (FFT) from each WwTW. The estimated flow to full treatment in 2026 is based upon 3 x dry weather flow (3DWF), which is a standard methodology. If the projected growth does not result in exceedance of the consented dry weather flow, there will be no increase in the flow to full treatment.

At this stage, there may be opportunities to meet the PPS25 statements to reduce flood risk where this appropriate. The Water Cycle Strategy mechanism provides an opportunity to reach agreement between all parties in order to facilitate sustainable growth. Sufficient time should be allowed within the detailed study to address this issue and obtain agreement from the Environment Agency, Water Companies and the local planning authority partners of the study. To give this discussion context, the volumes of storage that would be required to mitigate the additional WwTW

discharge for the duration of the 1 in 100 year flood event had been calculated using FEH methods (using the critical storm duration for each location and the Re-FEH rainfall runoff method) and are summarised in Table 5-12 below.

WwTW	Receiving watercourse	1 in 2 year peak flow (m^3/s)	Consented FFT* (2008) (m^3/s)	Increase in FFT by 2026 (based on 3xDWF) (m^3/s)	Percentage increase in total flow (%)	Duration of 1 in 100 year hydrograph (hrs)	Storage volume required (m^3)
Brackley	River Great Ouse	6.58	0.15	0.0	0	45	0

Table 5-12: Comparison of flow to full treatment discharges from Brackley WwTW to the 1 in 2 year peak flow in receiving watercourse and compensation storage volume required due to increase in wastewater treatment effluent discharge.

* consented FFT figure supplied by AWS. All other figures are from calculation.

The base flows for WwTWs may increase as a result of development if mitigation is not provided. Assessment at outline report stage has not determined this issue as insurmountable and thus requiring material change to the proposed spatial plan. However the next phase of the WCS needs to quantify such risks and propose appropriate mitigation measures. These will need to be prescribed in sufficient detail to:

a) Produce outline costs;

b) Identify associated land use linkages to feedback into the spatial planning process, and;

c) Allow later phases of the WCS to determine an implementation mechanism including funding and agreements for delivering the necessary works. If either the Core Strategy allocation sites for development or sites come forward in advance of the WCS then this implementation mechanism needs to be clearly agreed. Developers will be required to submit Flood Risk Assessments in accordance with PPS25 to demonstrate how the development will ensure risk is not increased including discharge to watercourses.

The WCS must consider that any works to WwTWs adjacent to a Main River are highly likely to require a Flood Defence Consent from the Environment Agency. The appropriate Internal Drainage Board will need to be consulted for works to any WwTW sites on IDB main drains.

5.10.15 Recommendations for Brackley

Due to the different runoff routes of the potential development areas BO2 and BO1 and BO3, a strategic solution for flood risk management does not exist for all sites. Rather runoff from BO2 should be managed on a site basis and site specific flood risk assessments are recommended.

Runoff from BO1 and BO3 would enter the same receiving watercourse (a tributary of the Great Ouse running past Old Glebe Farm). Attenuation ponds may be possible on this watercourse and this should be investigated further as part of a Phase 2 Water Cycle Study. Any development in this location should not enhance flood risk downstream (e.g. any development in area BO1 must not increase flood risk to area BO3).

All three sites will require a flood risk assessment to deal with surface water drainage. The sites are greater than 1ha so the Environment Agency will be required to comment on the flood risk assessment regardless of whether part of the site is in flood zone 2 or 3.

As part of the development site BO3 is adjacent to an area of flood zone 2 the developer of this site should undertake a flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for the site, and the future extent of these flood zones with climate change. Land use within the site should be allocated according to the appropriate uses for the flood zones according to PPS25.

It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25. Any new development should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development, unless an exception test supported by the Core Strategy Sustainability Appraisal can provide evidence otherwise. This will support the actions outlined in the Great Ouse CFMP.

Opportunities to reduce runoff from landuse by future de-intensification should be identified. This will support the actions outlined in the Great Ouse CFMP.

Post-development flows and volumes should be restricted to pre-development levels. Developers should undertake a study to show that there will be no increase in flood risk from developments draining into the Great Ouse or its tributaries.

The developers must take account of any recommendations from the Great Ouse CFMP and the planned Bedford Ouse flood risk management study.

It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

A further consideration is that if any development takes place within Flood Zone 3, where some of the proposed developments partially lie, the land 'lost' to the

development from the flood plain must have its capacity replaced elsewhere. The most feasible option to do this would be to relocate any property that is currently planned to be built within Flood Zone 3 to another location within the proposed development area. While this would create higher density development, it would leave the areas of Flood Zone 3 as greenfield, therefore not impacting upon floodplain storage.

6 Foul Drainage, Sewage Treatment and Water Quality

6.1 Introduction

Anglian Water Services Limited (AWS) is responsible for the operation and maintenance of the existing foul drainage network and wastewater treatment facilities within the areas of Northampton Borough, South Northamptonshire district and Daventry district.

AWS is also responsible for surface water drainage from roofs, driveways and hard standings relating to properties where connection is directly into the public sewer system, or if the surface water system has been adopted by AWS.

For new developments, the developer may choose to offer the surface water system for adoption by the water company, in which case agreement must be reached regarding the relevant design standards (Sewers for Adoption, 6th Edition, March 2006).

This section of the report discusses the existing sewerage and wastewater treatment infrastructure and its impact on water quality in the growth areas of Northampton, Towcester, Silverstone, Brackley and Daventry and the impacts of the flows from these growth areas.

6.2 Sewage Treatment and Water Quality Overview

Foul drainage from the study area is treated at the treatment works, operated by AWS, and indicated on the Figure 6-1 and Table 6-1. The indicative population in this table is derived from National Statistics data for the connected parishes.

Treatment Works	Approx. Population served	Treatment Works	Approx. Population served
Ashton	5200	Litchborough	500
Blakesley	900	Newnham(Northants)	1400
Brackley	21800	Norton(Northants)	400
Brington	500	Preston Capes	100
Brixworth	5400	Quinton	200
Bugbrooke	7900	Ravensthorpe	700
Creaton	700	Stoke Bruerne	600
East Haddon	700	Silverstone	2000
Everdon	400	Tiffield	400
Gayton(Northants)	500	Towcester	7900
Great Billing	315400	Wappenham	1200
Greens Norton	1700	Watford	200
Hackleton	2000	Weedon	3000
Hollowell	1500	Welton(Northants)	700
Long Buckby	5500	Whilton(Daventry)	24000

Table 6-1: Foul treatment works and their respective capacities in study area

Figure 6-1: Anglian Water operated wastewater treatment works in study area

6.2.1 *Background*

Smaller works have not been considered in this Phase 1 Strategy, and at this stage only the five that will receive most of the projected growth (Great Billing, Brackley, Towcester, Silverstone and Whilton) have been looked at in detail.

The quantity of treated effluent discharged from each treatment works and its quality is specified by the legal discharge consent, issued by the Environment Agency above a population equivalent of 250, under the Water Resources Act 1992.

The consent is based upon the dry weather flow (DWF) of the treated effluent, and normally stipulates limits for the concentration of biochemical oxygen demand (BOD), total suspended solids (TSS) and ammoniacal nitrogen. Some works which discharge to sensitive watercourses also have limits relating to phosphorus and total nitrogen, consented under the Urban Waste Water Treatment Directive (UWWTD) or the Habitats Directive. Compliance with these standards is measured on an annual average basis.

Development within the catchment will inevitably result in an increased flow to the receiving treatment works, and a point will be reached when the consented flow to the watercourse is exceeded. When this occurs, a modification or a variation of the consent will be required, normally resulting in a tightening of the consented quality parameters to ensure river quality does not deteriorate

For the purpose of this report, it has been assumed that a load equivalent consent will apply, which is defined as a reduction in pollutant concentrations proportionate to the increase in consented flow to ensure that the overall load of pollutants in the discharge does not increase. These consents will need to be agreed with the Environment Agency.

Any improvements to the treatment works will be programmed into AWS's capital programme, which runs in five year Asset Management Plan (AMP) cycles. We are currently in the AMP4 period (2005-2010) and AWS is in the process of preparing for the next submission to OFWAT, to determine it's regional capital expenditure for AMP5 (2010-2015). Figure 6-2 below illustrates the AMP planning cycle to 2015. This funding cycle and its associated constraints may have implications for the phasing of development.

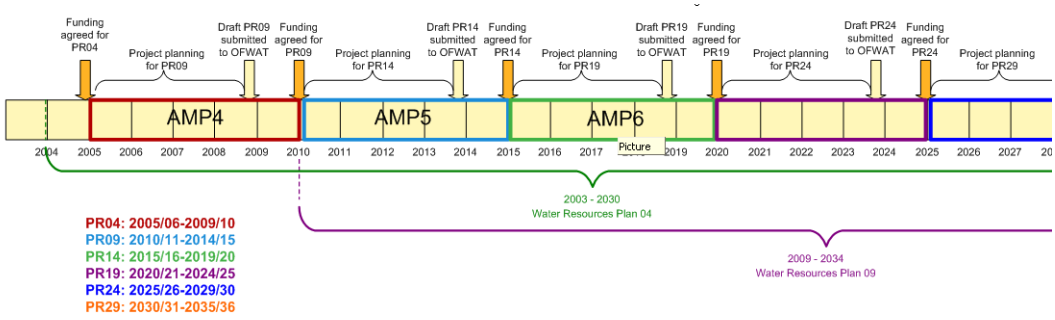

Figure 6-2: Water Company Funding Cycle

6.2.2 *Population projections*

AWS has provided population data, based upon its customer billing system, to determine a baseline population served by each treatment works (data used in this report is the 2006). Growth projections provided by West Northamptonshire Development Corporation (WNDC) have been used to estimate 5-yearly increases in the number of properties served:

The estimated future load for each treatment works has been calculated and is tabulated in the works description below. It has been assumed that the occupancy rate of new properties is 2.1 persons per dwelling and that there is no change in the occupancy of existing properties. This will give a worst-case situation since in reality there will be a level of internal migration within the catchment thus reducing occupancy in existing properties. AWS makes an allowance for this in it's supply demand forecasting.

OFWAT values have been used for per-capita water consumption (NB this is 142 l/c.d for metered households in 2008). All new dwellings are assumed to be served by a metered supply and a separate sewerage system with 100% of supplied water going to drain. The stated flow to full treatment is the consented value until such time as this is exceeded, when a calculated value based upon 3PG + I + 3E (three times the foul flow plus an allowance for infiltration) is used.

To relate this theoretical demand to the present pollutant load at the WwTW, AWS has provided data relating to the measured flow and sample data for each works. This measured value has been compared with the load determined from the present connected population (see above) and the two sets of data reconciled to arrive at the load projections tabulated below.

6.2.3 *Areas of uncertainty*

There are a number of assumptions and uncertainties at this stage relating to the assessment of the wastewater treatment which could affect the extent and the timing of improvements required:

- It has been generally assumed that trade effluent discharges (flow of liquor from a manufacturing process as opposed to waste water from offices, etc.) at each works will remain at the current level, with the exception of Brackley, where the future trade load has the potential to have a significant effect. In general, new trade discharges are dealt with on an individual basis by the water companies, since the strength and nature of these discharges may have a significant impact upon local treatment requirements. It should be noted that AWS have no obligation under the Water Industry Act 1991 to accept trade discharge flows.
- It is normally assumed that infiltration will be equivalent to about 45 litres per head per day, but the true level can vary significantly from this

due to the characteristics of the sewerage system. The risk of underestimating the present flow to a treatment works due to infiltration has been minimised by reconciling the measured and calculated loads.

- It is assumed that the current legal consent or its load equivalent will protect downstream water quality to existing legislation. However, should legislation or statutory water quality objectives change (e.g. under the Water Framework Directive) then the extent and timing of works improvements would need to be re-evaluated.
- Additionally, the methods of calculating dry weather flow and flow to full treatment are based on current practice. There is always the possibility that these methods may be superseded before the year 2026.
- The water quality modelling only included an assessment of the consents required at the WwTW to meet the required water quality standards. For this assessment the modelling did not seek to identify broader catchment management measures to achieve the water quality standards. Therefore, where the modelling states that a water quality standard cannot be achieved, this means the standard cannot be met purely by tightening the WwTW consent. For the phase 2 WCS the modelling will need to be re-examined to identify all sources of pollution within the catchment, and hence different options to achieve the water quality standards. The modelling scope and methodology will need to be agreed in partnership with Anglian Water and the Environment Agency.

6.2.4 *Water Framework Directive Standards and River Basin Management Plans*

In England, River Basin Management Plans (RBMP) implement a Programme of Measures as actions to achieve 'good status' (ecological, chemical and physical) in designated water bodies by 2015.

River Basin Management Plans identify water bodies and appraise their baseline condition (2008). Standards for 'good' status of water bodies will be assessed under UKTAG[3] Water Framework Directive guidance. Where water bodies do not meet the required standard the Programme of Measures will identify action needed to achieve it.

The timetable to prepare and implement the River Basin Management Plans is:

- **2008** (September) draft RBMPs completed
- **2008** (December - June 2009) consult on draft River Basin Management Plans, which includes overview of status and programmes of measures

[3] UKTAG guidance is available from **www.wfduk.org/**

- **2009** (December) first River Basin Management Plans, including the setting of environmental objectives for each body of water and summaries of programmes of measures
- **2015** meet Directive objectives for first River Basin Management Plans

For the purposes of this study, we have assumed that the WFD 'good' ecological status chemical standards will be required for all river reaches. No works of those considered have been identified as requiring WFD driven consent changes in AMP 5.

There are two exemptions to achieving good ecological status in the first round of River Basin Management Plans (up to 2015), which are if the action needed involves disproportionate cost, or is technically infeasible within the period of the plan, the River Basin Management Plan may set alternative objectives for the period up to 2015 and define activities that will achieve good ecological status by 2021 (the end of the second planning period. The final RBMP is to be complete by 2027 and all waterbodies must achieve good ecological status by the end of this plan period.

6.2.5 *River Quality Objective*

Water quality summary data for the two most recent assessment rounds for each of the river reaches within the Growth Areas are reported in Appendix F. For River Quality Objectives RQOs, three chemical measures are used for trend monitoring – Biological Oxygen Demand (BOD), Dissolved Oxygen (DO) and ammonia, with the final classification being based on the worst of these measures. The table indicates in each case which of these measures resulted in the classification for each river reach. For more information regarding derivation of River Quality Objectives and some discussion on those waterways at risk from the potential development, please refer to Appendix F.

6.2.6 *Assessment of Future Consent Requirements*

Indicative water quality consents were calculated for Brackley, Great Billing, Silverstone, Towcester and Whilton WwTW to assess the indicative consents required to meet water quality standards with additional growth. The modelling methodology focuses on WwTW consents, and does not take into account any broader catchment management or upstream improvements in river quality, which could potentially be used to help meet required water quality standards. The indicative consents were analysed for two time periods, 2016 and 2026. For the methodology applied for this, please refer to Appendix G.

6.3 Northampton

6.3.1 *Existing Sewerage System*

Northampton wastewater is treated at Great Billing WwTW, located 6km east of the town centre, on the north bank of the River Nene. The sewerage network transfers to the WwTW via two 1500mm diameter sewers from the town centre. Within the catchment area there are a number of sewage pump stations (SPS) and

intermittent sewer overflows (which spill to watercourses during storm conditions). The majority (approximately 85%) of the network operates using separate foul and surface water sewers.

6.3.2 Sewage Treatment (Great Billing WwTW)

Based on flow consent headroom, Great Billing WwTW currently has little or no capacity for accommodating new connections. AWS is currently negotiating a revised flow consent. Based on growth data, the treatment process can cope with flows until about 2016. Between 2016 and 2026 additional capacity will have to be added to cope with the increased flow rates, which will be dependant on the rate of the developments in the area and flows from the new sludge treatment centre.

The treatment works is situated in Great Billing and serves Northampton and surrounding villages. The load on the treatment works is projected to increase in accordance with the following Table 6-2:

Year		**2008**	**2011**	**2016**	**2021**	**2026**
Population Equivalent		384923	400148	418786	437423	456061
Projected Load On Treatment Works						
BOD - p.c. cons. 0.065 kg/h/d	kg/d	25020	26010	27221	28433	29644
PG+I+E (DWF)	m3/d	55978	59258	63260	67274	71185
Peak flow to treatment (3DWF)	m3/d	159804	159804	165439	175804	185860

Table 6-2 Great Billing WwTW Projected Load*

*figures given are based on Halcrow calculations using AW data source

It should be noted that the stated population equivalent includes the projected load from a sludge treatment facility, and is consequently higher than the present load from the catchment. The effluent is discharged into the River Nene via Ecton Brook; the legal consent standards for this discharge are:

- 25mg/l TSS: 13mg/l BOD: 5mg/l ammonia for a DWF of 61620m^3/d. Full treatment must be provided for flows up to 159804m^3/d.
- Flows in excess of the consented FFT receive settlement prior to discharge.
- The treatment works must also meet a standard of 1 mg/l or 80% removal of phosphorus, measured as an annual average, which is achieved by chemical precipitation.

The flow recorded at the works is significantly greater than would be expected from the population served. AWS is investigating whether excessive infiltration in the sewer system is causing this. However even if infiltration can be reduced, the level of growth in Northampton is such that a revised consent will be required probably in approximately 5 years, which is currently being agreed. Based upon load equivalent calculations the indicative future consents would be those identified in Table 6-3

Year	Current	2008	2011	2016	2021	2026
	Consent		Load Equivalent			
Consented DWF (m3/d)*	61620	55978	59258	63260	67274	71185
SS Limit (mg/l)	25	25	25	24	23	22
BOD Limit (mg/l)	13	13	13	13	12	11
Ammonia limit (mg/l)*	5	5	5	5	5	4

Table 6-3: Great Billing Consent Forecasts

* It is anticipated that under the flow compliance scheme ammonia limit will now be changing to 4mg/l and consented Dry Weather Flow increasing 83 215 m^3/d. These new limits will need to be confirmed by AWS in advance of any further analysis.

Current performance against the sanitary limits is satisfactory.

The treatment works will accommodate an estimated load of 420000p.e, according to Anglian Water design Guidelines, the limiting factor being the aeration lanes. On this basis, the works is capable of accommodating the projected growth until the year 2016 before improvements are required. However, improvements to the sludge treatment centre, which takes imported sludge as well as the on-site production, are currently underway, and the resultant increased liquor load could influence the timing of improvements (although the anticipated increase has been incorporated in the load projection).

Likely improvements required to accommodate the projected growth may be summarised as follows:

- Improvements to sludge treatment plant (ongoing)
- Sludge liquor pre-treatment or amended operational practice to improve primary settlement tank performance.
- Additional treatment capacity to be provided (expected to be required post 2015).
- Public realm options at Beckett's Park may benefit from improvements to the CSO and should be considered at the detail stage.

There is ample space for development at Great Billing WwTW, any extension to the works could be accommodated on the existing site. Great Billing WwTW is located in Flood Zone 3 (1% annual probability of flooding) for Billing Brook and Flood Zone 2 (0.1% annual probability of flooding) for the River Nene.

6.3.3 Future Consent Requirements (Great Billing WwTW)

The ammonia consents will need to be tightened to 2mg/l to meet the WFD by 2026, but the BOD consent will not need to be changed to meet WFD. Current UWWTD consent limit for phosphorus is 1.0mg/l, or 80% removal as an annual average, and the modelling indicates that this is satisfactory to meet no deterioration

of downstream water quality with growth. Neither the 'high' nor 'good' ecological status under WFD could be achieved for phosphate without improving upstream river quality.

Gt Billing WwTW	BOD	Ammonia	Phosphate
No deterioration	BOD consent tightened to 13mg/l by 2016, no further tightening required by 2026	Ammonia consent does not need tightening	Current discharge is sufficient
RQO	No tightening required	No tightening required	
WFD	No tightening required	No tightening required	Not achievable by improving effluent quality alone due to high level of phosphate in receiving watercourse

Table 6-4: Great Billing Future Consent Requirements*

* It is anticipated that under the flow compliance scheme ammonia limit will now be changing to 4mg/l and consented Dry Weather Flow increasing 83 215 m^3/d. These new limits will need to be confirmed by AWS in advance of any further analysis.

6.3.4 *Network Upgrades Required*

A partially verified hydraulic model of the existing sewer network in Northampton is available. Discussions with AWS have revealed that certain key sections of the existing network are at capacity, therefore upgrades or new infrastructure will be necessary in order to cope with the additional flows.

AWS is currently developing a strategic sewerage solution for priority sites in the Great Billing catchment. This work is expected to be complete in May 2009. Water quality issues will be considered using urban pollution modelling (UPM).

The following table provides an overview of the possible constraints, and solutions to developing the various urban extension areas identified in Table 6-6 below.

Region	Sectors	Planning Guidance

Region	Sectors	Planning Guidance
South East	1, 7, 8, 9a, 9b, 10a, 10b	These sectors would transfer to Great Billing works probably by a new direct connection. Sector 7 may have some growth directed to Hackleton WwTW based upon detailed analysis.
North East	11, 12a, 12b, 24b, 24c	These sectors would be expected to either require upgrades through the town to existing sewers or a new strategic main linking them to the Great Billing WwTWs.
North – North East	13a, 13b, 24a	These sectors may be able to be linked strategically to the east into the North East option.
North West	13c, 14a, 14b, 15a, 16, 17, 18	These sectors may be serviced by upgrades to the sewer network to Great Billing. This would pose significant cost and disruption due to the urban nature of the environment work is required. AWS are preparing a scheme that assesses options for this area. This will depend upon which sectors emerge and in what order.
South West	2a, 2b, 2c, 2d, 2e, 3b, 3c, 3d, 4, 19a, 19b, 19c, 20a, 20b, 23	These sectors are expected to require upgrading of existing urban infrastructure to support. This would be costly and disruptive. These sectors could be strategically developed in conjunction with a preliminary scheme under consideration by AWS to address growth in this area of the town.
South – South West 1	5	This sector could also connect into the AWS scheme being developed to service priority sites. There may be potential to transfer flows to Towcester WwTW.
South – South West 2	6	This sector may be served by linking into a strategic solution to accommodate priority sites in the south east depending on timescale. It is likely to involve significant sewerage infrastructure upgrades.

Table 6-5: Assessment of Northampton Sewerage Constraints and Opportunities

6.4 Daventry

6.4.1 *Existing Sewerage System*

Daventry foul and surface water collection networks operate as separate systems, except for two small sections of combined sewer to the south and east of town near pump stations. The foul sewage the network collects is treated at Whilton Wastewater Treatment Works (WwTW). Figure 6-3 shows an overview of the system.

Within the sewerage network there is approximately 7km of trunk sewer up to 1375mm diameter. Flows from the sub-catchment areas are carried via 900mm mains into the trunk sewer. There are a number of box culverts providing storage for the storm water, including a section from the Royal Oak industrial estate.

AWS has developed an initial design to serve priority sites in Daventry. This involves connection into the existing trunk main transferring to Whilton WwTW. The scheme would be triggered by developer requisition.

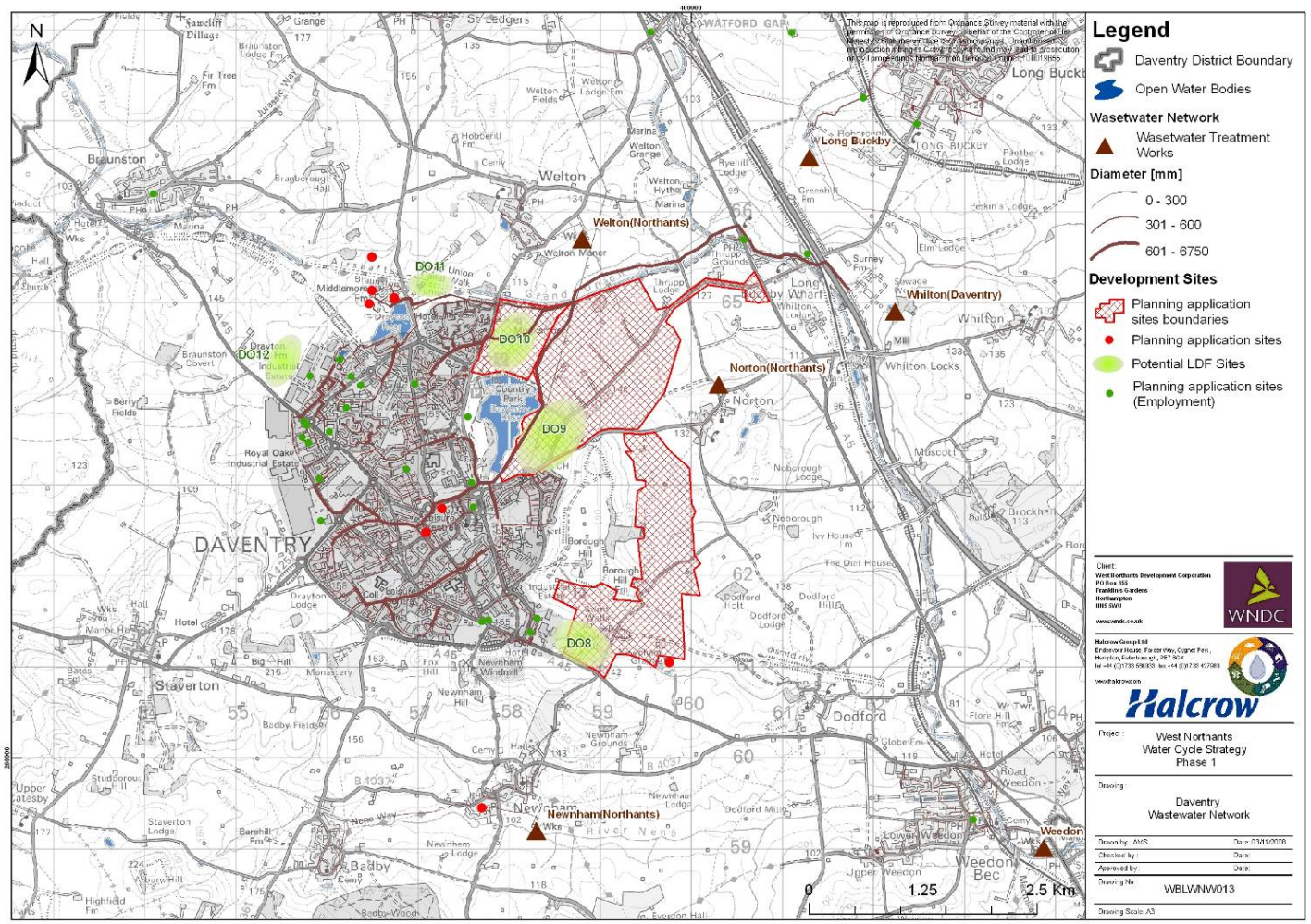

Figure 6-3: Daventry Existing Sewage Network

6.4.2 Sewage Treatment (Whilton WwTWs)

The Whilton treatment works serves the town of Daventry in Northants. The population projection due to growth is estimated Table 6-6 below:

Year		**2008**	**2011**	**2016**	**2021**	**2026**
Projected population equivalent		36637	41887	47137	52387	57637
Projected Load On Treatment Works:						
BOD - p.c. cons. 0.065	Kg/d	2381	2723	3064	3405	3746
PG+I+E (DWF)	M3/d	6019	6963	7882	8817	9755
Peak flow to treatment	M3/d	17453	17856	20140	22471	24814

Table 6-6: Whilton WwTW Projected Loads

*figures given are based on Halcrow calculations using AW data source

The effluent is discharged into a tributary of the River Nene and into the canal in winter. The legal consent standards for this discharge are:

- 25mg/l SS: 12mg/l BOD: 5mg/l ammonia (summer), 25mg/l SS: 12mg/l BOD: 8mg/l ammonia (winter), for a DWF of 4000 m^3/d. Full treatment must be provided for flows up to 17453 m^3/d, which is approximately 4.6 X DWF, against a more normal 3 X DWF
- Flows in excess of the consented FFT receive storm-water settlement prior to discharge.
- The treatment works must also meet a standard of 2 mg/l or 80% removal of phosphorus, measured as an annual average, which is achieved by chemical precipitation in the primary settlement tanks.

The works is operating to discharge consent capacity and therefore currently cannot accommodate any additional flows without consent modification. There are plans to expand the WwTW and funding is expected during the AMP5 cycle with construction potentially starting before 2015.

AWS has agreed future quality parameters for increasing cDWF figures expected to allow for growth up to 2026 as follows:

- 24 mg/l SS: 12 mg/l BOD: 2 mg/l ammonia (year round) at consented DWF 9828 m3/d (expected 2011)_
- 22 mg/l TSS: 11 mg/l BOD: 2 mg/l ammonia at consented DWF 11 060 m3/d (expected 2017)

It has been agreed that increasing cDWF to 13 422 m3/d (expected 2026) will not result in any further tightening.

Likely improvements required to accommodate the projected growth, and their timing may be summarised as follows:

- Improvements to inlet work (screens, etc.) to accommodate the increased hydraulic load during the period 2016-2021.
- Additional storm tank capacity to provide the required 2 hours retention at 3 X dry weather flow during the period 2016-2021.
- Provision of additional treatment capacity to meet the anticipated future limit on ammoniacal nitrogen. Precise timing will be dependent upon the future consent conditions, but it is likely that this work will be required during the period 2011-2012.
- Provision of suitable treatment capacity to meet the anticipated future limit on BOD and suspended solids. Again, the type of process and the precise timing will be dependent upon the revised consent conditions, but the work will be required before 2016.

There is ample space for development at Whilton WwTW, any extension to the works could be accommodated on the existing site. Whilton WwTW is not located in a flood risk zone, as defined by Flood Zones.

6.4.3 *Future Consent Requirements (Whilton WwTW)*

WFD targets could not be met by reductions in discharges from wastewater treatment works alone, because upstream quality is worse than either the 'high' or 'good' ecological target.

6.4.4 *Network Upgrades (Required Daventry)*

Initial calculations by AWS have indicated that the existing sewerage infrastructure within Daventry is approaching capacity, and considering that the population is likely to almost double in size by 2021, detailed modelling of relevant existing infrastructure and proposed options should be undertaken be undertaken when all LDF site allocations have been located..

Due to planning pressures, AWS has identified an outline solution to service the proposed development sites along the eastern part of the town (see Figure 6-4).

Site	Comments
D08	This site will require designated new infrastructure. Its distance from Whilton WwTW would imply that it would be unsustainable to develop on its own; however it may be integrated into a combined strategy if D09 is developed also. Reinforcement of the trunk sewer to Whilton WwTW would be required.
D010/D09	These sites are both located near the existing trunk sewer to Whilton WwTW and hence are conveniently located with respect to cost and practicality. Reinforcement of the trunk sewer to Whilton WwTW would be required.
D11	This site is not too distant from the existing trunk sewer to Whilton WwTWs. This would pose little constraint. Reinforcement of the trunk sewer to Whilton WwTW would be required.
D12	The distance from this site to the trunk main to Whilton makes it less practical and sustainable for development. If D11 was developed, a strategic solution may make it viable, however it is not recommended to develop this site, if D11 is not also being developed.

Table 6-9: Assessment of Daventry Sewerage Constraints and Opportunities for the five potential development areas outlined in the Joint Core Strategy Issues and Options paper. Other sites may come forward in the emerging Core Strategy.

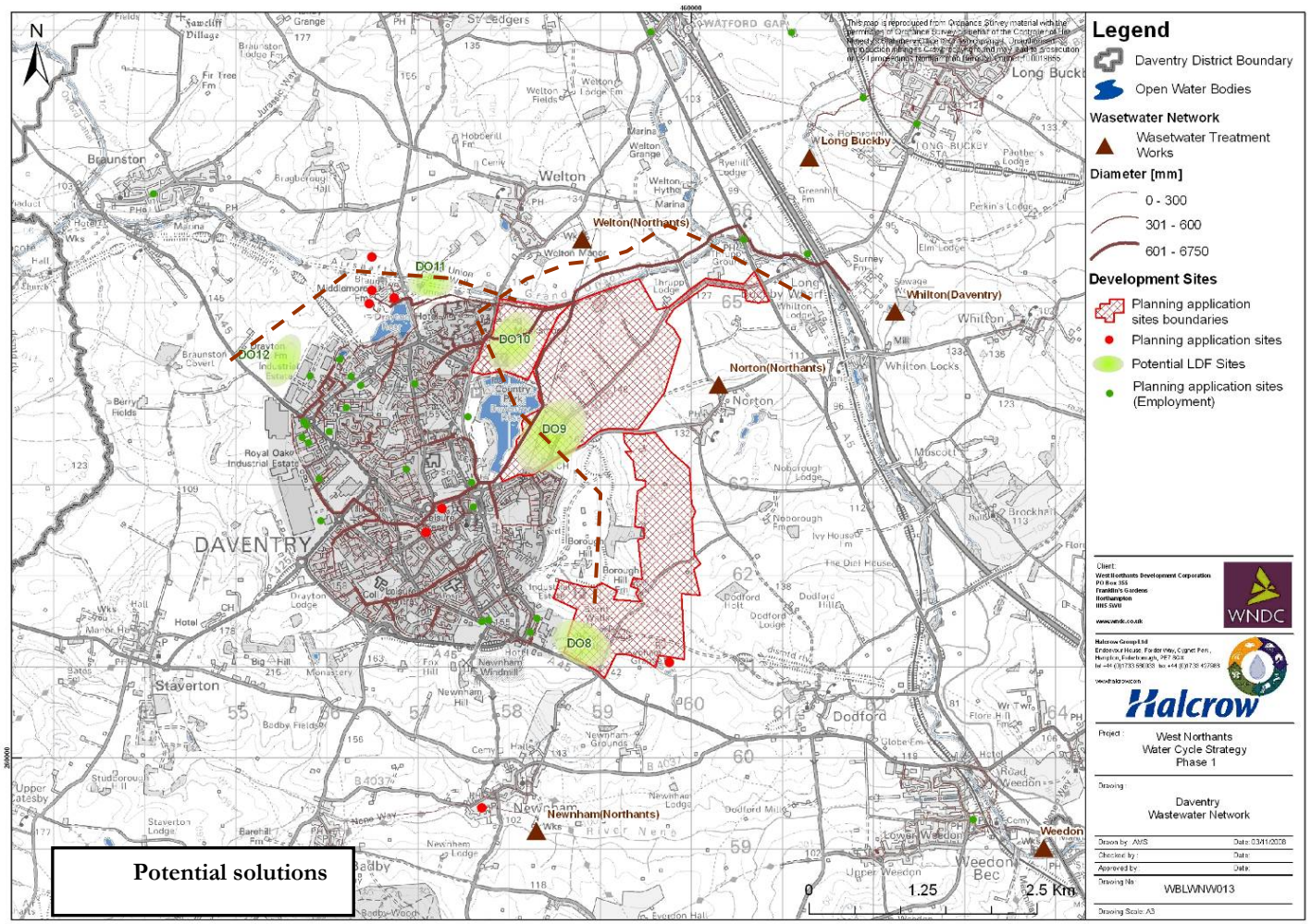

Figure 6-4: Daventry Sewage Network – Potential Solutions

6.5 Towcester and Silverstone

6.5.1 Existing Sewerage System

Towcester is served by Towcester WwTW. The majority of the sewerage network operates using separate foul and surface water sewers. Silverstone is serviced by Silverstone WwTW. The flow is influenced by activities at the Silverstone Racing Circuit, and during Grand Prix events this additional flow is diverted to holding tanks and conveyed to larger treatment works for treatment. Figure 6-5 below provides an overview of the two systems.

Definitive existing capacity information of the existing network was unavailable at the time of writing. If capacity is not available within this network, then it will be necessary to provide direct conveyance from the southern proposed development to the works, either by gravity or by pumping.

6.5.2 Sewage Treatment (Towcester WwTW)

The treatment works is situated to the East of Towcester and serves the parishes of Towcester, Grafton Regis and Paulersbury. The population projection to accommodate the anticipated growth within the catchment are summarised in Table 6-12:

YEAR		**2008**	**2011**	**2016**	**2021**	**2026**
Projected population equivalent		11436	13537	15639	17739	19840
Projected Load On Treatment Works*						
BOD - p.c. cons. 0.065 kg/h/d	kg/d	728	864	1001	1137	1274
PG+I+E (DWF)	m3/d	2212	2613	3016	3420	3821
Peak flow to treatment (3DWF)	m3/d	7321	7321	7670	8693	9708

Table 6-10: Towcester WwTW Projected Loads

*figures given are based on Halcrow calculations using AWS data source

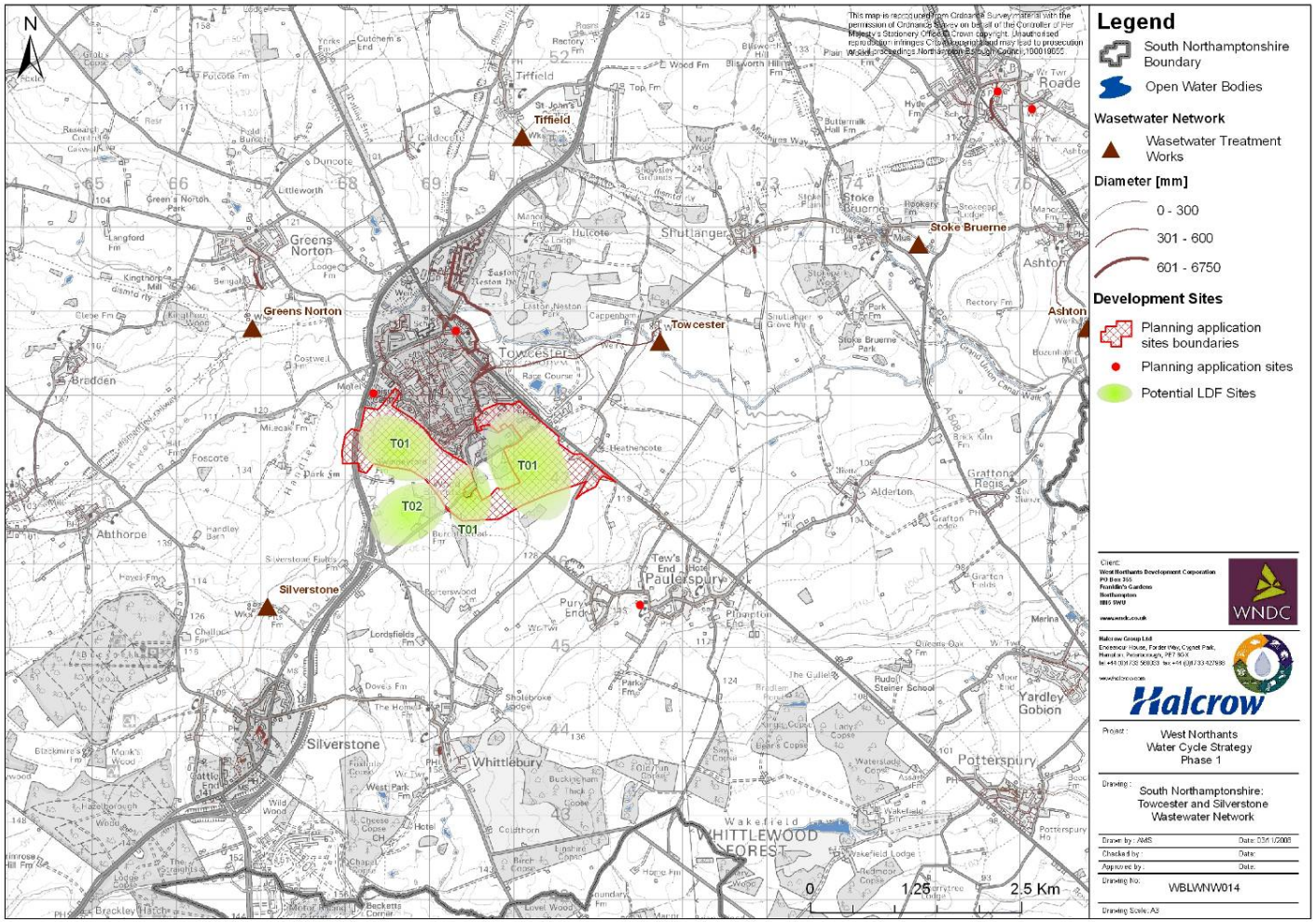

Figure 6-5: Towcester and Silverstone Sewage System

The effluent is discharged into the River Tove, a tributary of the River Great Ouse. The legal consent standards for this discharge are:

- 30mg/l TSS: 15mg/l BOD: 5mg/l ammonia for a DWF of 2800 m3/d. Full treatment must be provided for flows up to 7321 m3/d (84.7 l/sec). This equates to approximately 3 X DWF.
- Flows in excess of the consented flow to full treatment receive settlement prior to discharge. It is understood that the consent for storm water discharge is descriptive, subject to a minimum settlement time equivalent to 2 hours at 3 X DWF.
- The treatment works must also meet an UWWTD standard of 80% removal of phosphorus (or 2 mg/l) as an annual average, which is achieved by chemical precipitation, and 30% removal of total nitrogen, which is achieved by process control.

Flow data suggest that the treatment works is currently flow compliant, but, if the proposed development takes place at the assumed rate, a revised consent will be required at or around the year 2011. A load equivalent consent, to accommodate the projected flow of 3821 m^3/d in the year 2026 would be 22mg/l SS: 11mg/l BOD: 4mg/l ammonia. AWS does not expect to require consent revision until post 2015.

	Legal		**Load Equivalent**			
	Consent	**2008**	**2011**	**2016**	**2021**	**2026**
Consented DWF (m3/d)	2800	2212	2613	3016	3420	3821
SS Limit (mg/l)	30	30	30	28	25	22
BOD Limit (mg/l)	15	15	15	14	12	11
Ammonia limit (mg/l)	5	5	5	5	4	4

Table 6-11: Towcester WwTW Consent Forecasts

Current performance against the sanitary limits is satisfactory.

The treatment works comprises a trickling filter plant followed by a nitrifying, submerged aerated filter, and has an estimated capacity of 12000 population equivalent. On this basis, the works is almost fully loaded now, but, with careful operation will be able to accommodate the projected load until the period 2011 - 2016. This is in agreement with AWS's estimation that the works will accommodate the flow from an additional 4000 population equivalent.

Improvements required to accommodate the projected growth will be significant, due to the present limited headroom and the high level of growth in relation to the present catchment size:

- A doubling of treatment capacity, provided by duplicating the existing treatment units or by providing a parallel treatment stream.
- A suitable tertiary process to meet the future BOD and suspended solids limit.

There is ample space for development at Towcester WwTW, any extension to the works could be accommodated on the existing site. Towcester WwTW is located in Flood Zone 2 for the River Tove. Flood Zone 3 abuts the south side of the site.

6.5.3 Sewage Treatment (Silverstone WwTW)

The Silverstone WwTW serves the parishes of Silverstone and Whittlebury in Northants. According to the core strategy for West Northamptonshire, no new properties are planned within the catchment, other than existing commitments, etc. and on this basis the population projection due to growth is estimated in Table 6-15.

Year		**2008**	**2011**	**2016**	**2021**	**2026**
Projected population equivalent		2326	2372	2418	2464	2471
Projected Load On Treatment Works*:						
BOD - p.c. cons. 0.065	Kg/d	151	154	157	160	161
PG+I+E (DWF)	M3/d	428	436	444	453	454
Peak flow to treatment	M3/d	1170	1170	1170	1170	1170

Table 6-12: Projected Loads for Silverstone WwTW

NB figures given are based on Halcrow calculations using AWS data source

The core strategy does, however discuss options for development of the motor racing circuit, and these would lead to an increase in the waste water discharge from this facility.

The effluent is discharged into a tributary of the River Tove, which is a tributary of the River Great Ouse. The legal consent standards for this discharge are:

- 40mg/l TSS: 20mg/l BOD: 15mg/l ammoniacal nitrogen, for a DWF of 480 m^3/d. Full treatment must be provided for flows up to 1170 m^3/d which is equivalent to the "normal" 3PG + I + 3E.
- Flows in excess of the consented flow to full treatment receive storm-water settlement prior to discharge. The settled storm tank effluent must meet a standard of 200 mg/l suspended solids if discharge to the watercourse occurs.

The measured flow is appreciably higher than the calculated value (above), and consequently the works is not compliant with its consented dry weather flow, and a

revised consent is currently being negotiated. The discrepancy in the flow data is thought to be due to the following additional flow to the treatment works:

- Flow from the motor racing circuit – although flows associated with the British Grand Prix are stored in holding tanks for removal by tanker to larger works for treatment, other events at the circuit, which occur at most weekends during summer months and which are understood to attract up to 15000 people, produce a foul flow which is drained directly to the works.
- Flow from a nearby golf course and country club was diverted to the treatment works approximately 3 years ago.

Since there is no permanent population associated with the flow from these sources, it is difficult to assess the load equivalent of these discharges, and consequently the stated population equivalent served by the treatment works does not include this additional load. Furthermore, since the load from these sources does not follow normal diurnal flow patterns, including it with the permanent base load would be misleading.

The following table indicates the likely future consent conditions, based upon load equivalent calculations

Consent Data:			**Load Equivalent**			
	Legal consent	2008	2011	2016	2021	2026
Consented DWF (m3/d)	480	633	644	655	666	668
SS Limit (mg/l)	40	30	30	29	29	29
BOD Limit (mg/l)	20	15	15	15	14	14
Ammonia limit (mg/l)	15	11	11	11	11	11

Table 6-13: Silverstone WwTW Consent Forecasts

NB figures given are based on Halcrow calculations using AWS data source

Current performance against the sanitary limits is satisfactory.

It is understood that current negotiations between AWS and the Environment Agency are based upon the assumption that the existing sanitary limits will be unchanged as a result of the dry weather flow amendment. If this situation prevails, the existing treatment facilities will be adequate for present and future flows. However, the Environment Agency will clearly model the potential impact of this increased flow on the watercourse, and if tighter consent conditions are found to be necessary, the treatment works is likely to require the following improvements to remain compliant:

- Improvements to inlet work (screens, storm water separation.) to accommodate the increased hydraulic load during the period 2011-2016
- Additional trickling filter capacity or the provision of nitrifying filter to meet the anticipated future consent standards. Timing will be dependent upon the future consent conditions, but it is unlikely that this work will be required prior to 2016.
- Additional storm tank capacity to provide 2 hours retention at 3 X dry weather flow. This requirement is likely to replace the present, numeric storm water consent (200 mg/l suspended solids) when the consent is revised.

Silverstone WwTW is surrounded by farm land; therefore there should be ample space for development. Silverstone WwTW is not located in a flood zone but flood zones have not been mapped for minor watercourse to the north of the site.

6.5.4 *Future Consents Requirements (Silverstone and Towcester WwTW)*

There was no Environment Agency sampling point upstream of Silverstone WwTW. For the purposes of the outline WCS the upstream quality for BOD and ammonia was assumed to be 25% of the RE class, in this case RE4. Further analysis of the upstream quality estimates will be required in the detailed WCS to confirm the required consents at Silverstone WwTW. The predicted growth up to 2026 would not exceed the current consented DWF. Therefore no tightening of consents would be required to meet the no deterioration or RQO standard for BOD or ammonia. It is not possible to set a WwTW consent to achieve 'good' ecological status under the WFD for BOD or ammonia, because assumed upstream quality is worse than the WFD targets. Phosphate discharges from Silverstone can be set to ensure compliance with 'good' ecological status under the WFD[4]. Phosphate consent would need to be set to 1mg/l as an annual average to achieve compliance with the WFD (currently discharge is 6.2mg/l).

At Towcester, marginal tightening of the consents would be needed for BOD and ammonia to ensure no deterioration of current planned water quality. Current phosphate consent would not need to be tightened to achieve no deterioration of downstream quality. However, the WFD targets for phosphate cannot be met without improving upstream water quality.

[4] Assumed upstream quality is 0.0093mg/l as a mean, this needs to be clarified in the detailed WCS to confirm the required phosphate consent

Towcester WwTW	BOD	Ammonia	Phosphate
No deterioration	*BOD consent tightened to 14mg/l by 2016, and to 12mg/l by 2026*	*Ammonia consent tightened by 2026 to 4mg/l*	*Current discharge is sufficient*
RQO	*No tightening required*	*No tightening required*	
WFD	*No tightening required*	*No tightening required*	*Not achievable by tightening effluent quality alone*

Table 6-14: Towcester Future Consent Requirements

6.5.5 *Network Upgrades Required (Silverstone and Towcester)*

The following Table 6-19 identifies the associated constraints and opportunities with developing the sites identified within the Core Strategy Issues and Options paper for Towcester. Potential solutions are illustrated in Figure 6-6.

Site	Comments
T01	The most likely strategy to serve this site is via connection to the trunk main flowing to Towcester WwTW. This concentration of growth is an efficient way to develop the area.
T02	This site may be served by connection into a strategic solution to Towcester WwTW in the event that T01 is developed. If T01 is not developed, an alternative solution may be to direct the site toward Silverstone WwTW.

Table 6-15 Assessment of Towcester Sewerage Constraints and Opportunities

The developers of the Silverstone race track development will need to provide a solution to the satisfaction of the planning authorities. Silverstone WwTW is the current likely option and reinforcement of existing sewers would be required to service it.

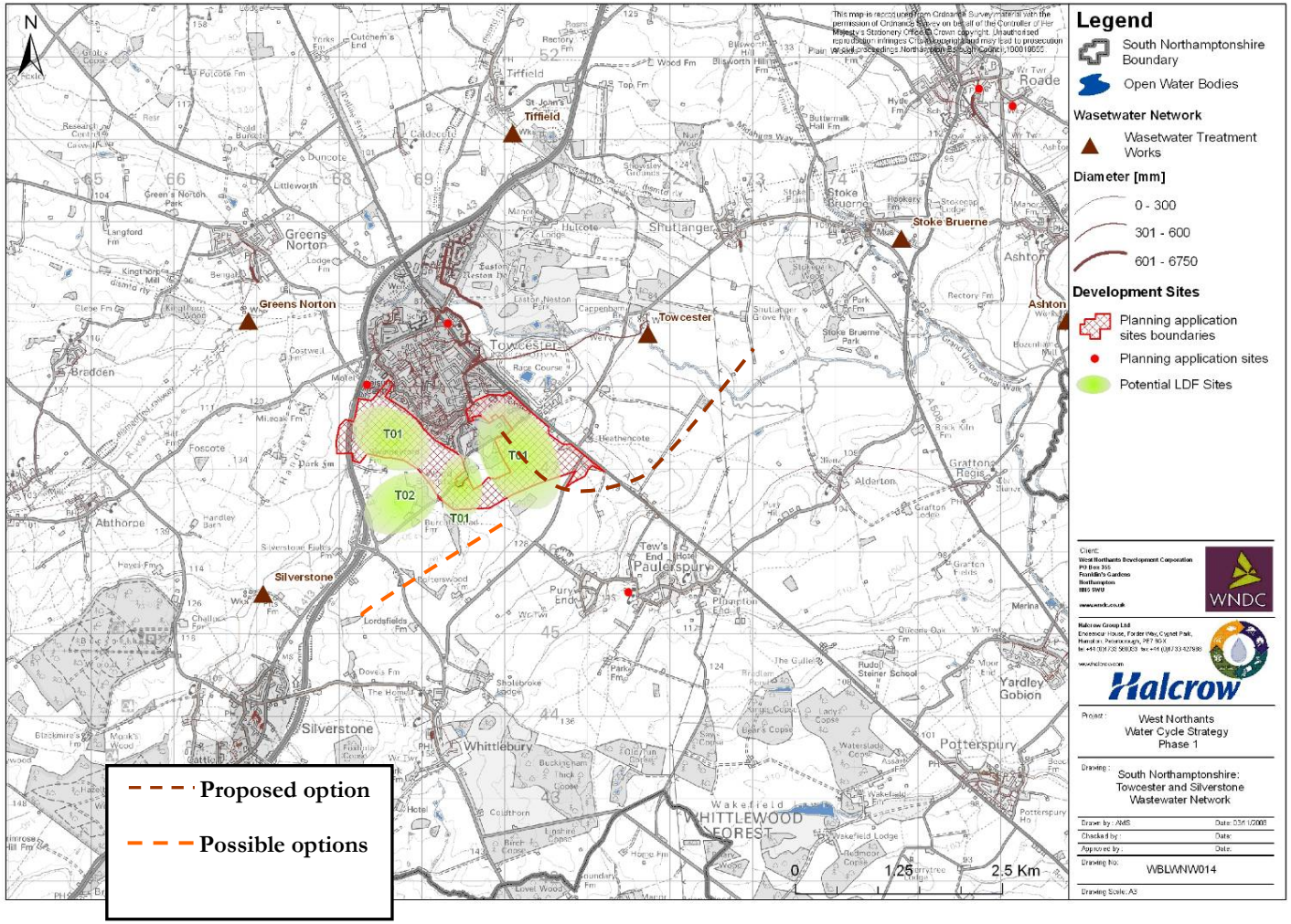

Figure 6-6: Towcester and Silverstone Sewage System – Potential Options

6.6 Brackley

6.6.1 Existing Wastewater System

Brackley wastewater is treated at Brackley WwTW to the east of the town. There is understood to be capacity in the existing sewer system to accommodate the dwelling numbers proposed although some upgrades may be required. In terms of minimising cost and disruption caused by sewer upgrades, the sites further from the WwTW would be less favoured.

6.6.2 Wastewater Treatment (Brackley WwTW)

The treatment works serves the town of Brackley and the villages of Turweston and Hinton in the Hedges in Northants, an estimated population of 12130. Trade effluents, principally from a poultry processing plant increase the connected load to approximately 21800 population equivalent. According to the core strategy for West Northamptonshire, approximately 1000 additional properties could be provided at Brackley by the year 2026. For the purpose of this report, it has been assumed that 1000 new dwellings will be provided, and on this basis the population projection due to growth is estimated as follows:

Year		**2008**	**2011**	**2016**	**2021**	**2026**
Projected population equivalent		21858	22208	22791	23374	23666
Projected Load On Treatment Works:*						
BOD - p.c. cons. 0.065	kg/d	1421	1444	1481	1519	1538
PG+I+E (DWF)	m3/d	3665	3730	3820	3923	3971
Peak flow to treatment	m3/d	12853	12853	12853	12853	12853

Table 6-16: Brackley WwTW Projected Loads

NB figures given are based on Halcrow calculations using AWS data source

However, the current assessed load is contradicted by the measured load, based upon the treatment works flow meter and crude sewage composite samples, which are as follows:

	2006	**2007**	**2008**
Measured DWF	4877	5025	5323
Population Equivalent (BOD)	37171	30613	32290
Population Equivalent (TSS)	23268	18645	20274
Population Equivalent (Ammonia)	36421	23626	31871
Population Equivalent (Average)	32287	24295	28145

Table 6-17: Overview of Load Measurement Discrepancy

This is a discrepancy of almost 30%, and it will be necessary to reconcile this data to confirm the true current load. Since the discrepancy between the measured and calculated flow is also approximately 30%, reconciling the flow data may also reconcile the measured and calculated load.

For the purpose of this report, AWS's calculated data, which is based upon population statistics and measured trade effluent flow and load will be assumed to be correct, but the discrepancy between these two sets of data must be reconciled, since the higher, measured values would significantly reduce the available treatment and consented headroom.

The effluent is discharged into a tributary of the River Great Ouse. The legal consent standards for this discharge are:

- 25mg/l SS: 12mg/l BOD: 5mg/l ammoniacal nitrogen for a DWF of 5151 m^3/d. Full treatment must be provided for flows up to 12853 m^3/d, which is equivalent to the "normal" 3PG + I + 3E.
- The treatment effluent must also meet a standard of 2 mg/l or 80% removal of phosphorus, measured as an annual average, which is achieved by chemical precipitation in the primary settlement tanks.
- Flows in excess of the consented FFT receive storm-water settlement prior to discharge. The settled storm tank effluent must meet a standard of 200 mg/l suspended solids if discharge to the watercourse occurs.

The measured flow exceeds its consented dry weather flow, and a revised consent has been agreed with the EA of 6320 m^3/d. There is no associated tightening of sanitary consents.

Current performance against the sanitary limits is satisfactory.

The works has no available headroom on the basis of the consented flow, and a revised consent will be required before the treatment works can accommodate the projected growth.

However, although the principal trade effluent discharge is currently equivalent to a load from 9600 population, the load from this source has exceeded 20000 population equivalent in recent years, and it is understood that this load was within the trader's discharge consent. It will therefore be necessary for AWS to estimate the likely, future load from this source to determine the need for a future increase in treatment capacity.

Brackley WwTW is not located in a Flood Zone but Flood Zone 2 and 3 for the River Great Ouse is approximately 100 m away from the site.

6.6.3 *Future Consent Requirements (Brackley WwTW)*

As discussed in the wastewater section there were some discrepancies in the current DWF arriving at Brackley WwTW, by up to 30%. Using the values from AWS's calculated data the future DWF will not exceed the current consented DWF. As a result no tightening of the consent is required to achieve no deterioration, RQO or WFD. The WFD targets for 'good' ecological status could not be met for phosphate without setting a consent which is beyond current Best Available Technology (BAT).

Preliminary analysis suggests the assumptions of DWF will have a significant impact on the future consent requirements, and should be clarified in the detailed WCS.

Brackley WwTW	BOD	Ammonia	Phosphate
No deterioration	No tightening required	No tightening required	Current discharge is sufficient to ensure no deterioration
RQO	No tightening required	No tightening required	
WFD	No tightening required	No tightening required	Not achievable by tightening effluent quality alone

Table 6-18: Brackley Future Consent Requirements

6.6.4 *Network Upgrades Required*

The following Table 6-23 identifies the associated constraints and opportunities with developing the sites identified within the Core Strategy Issues and Options paper for Towcester.

Site	Comments
B01	This site is a significant distance from Brackley WwTW. It would not be a sustainable or cost efficient site to develop in isolation, however if B03 was developed also a strategic solution may service both sites.
B02	This site is on the opposite side of the town to Brackley WwTW. It is not a practical, cost effective, or sustainable site to

	develop in isolation. It is not very appropriate for a combined strategy either. This site is not recommended
B03	These sites are closest to Brackley WwTW and may connect into the trunk main with no major constraint.

Table 6-19 Assessment of Brackley Sewerage Constraints and Opportunities

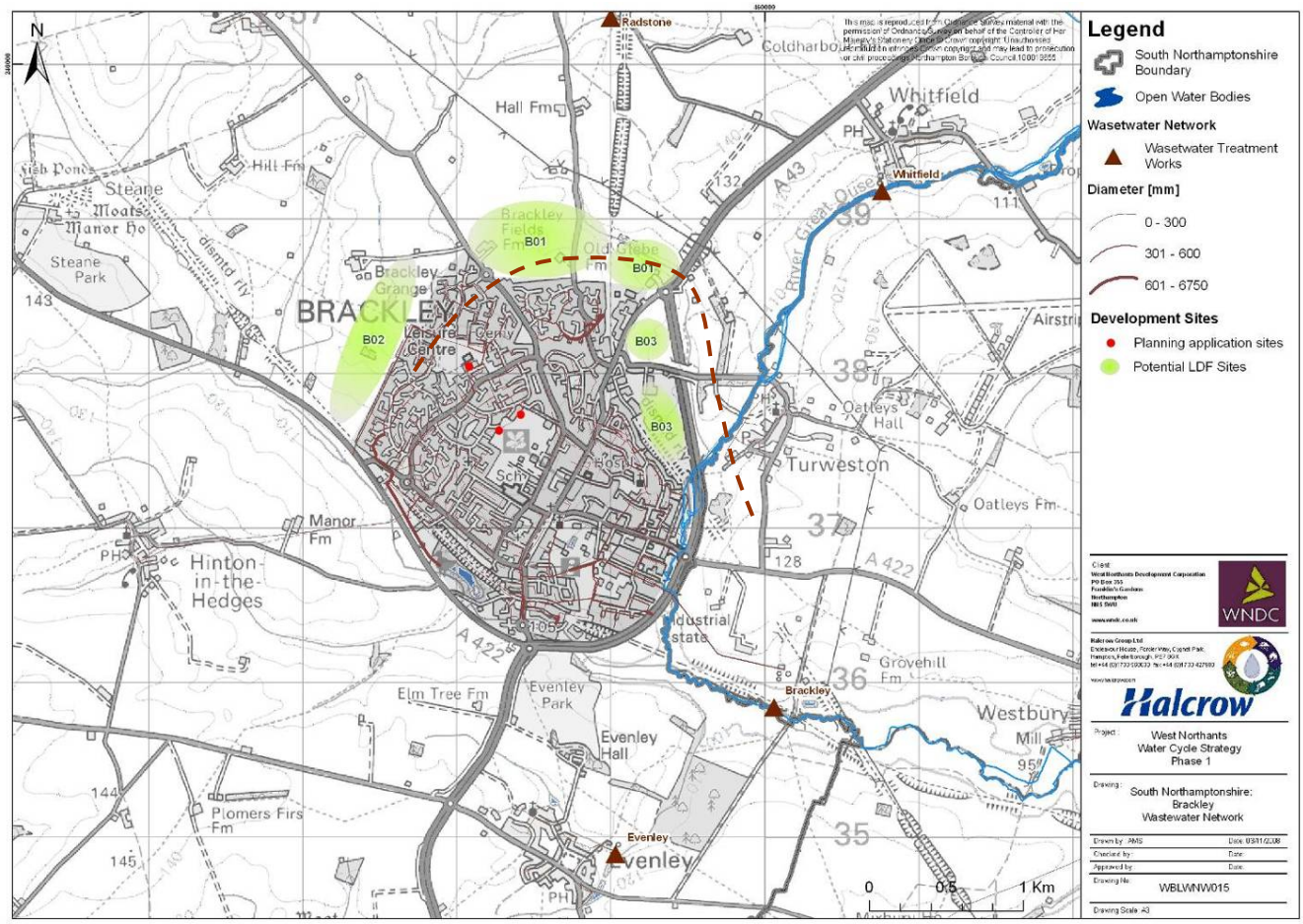

Figure 6-7: Brackley Sewage System – Potential Option

7 Water Resources and Water Supply

7.1 Introduction

This Water Cycle Strategy (WCS) has collated the latest information on water resource planning and supply infrastructure from the Environment Agency, and Anglian Water Services (AWS) in order to identify any significant constraints to the proposed LDF growth. Based upon this desktop review, a summary of available water within the study area has been provided in light of AWS planning for proposed core strategy growth.

The existing network infrastructure will be assessed with respect to the proposed growth and LDF development options, and where required high level outline strategies to supply the potential development sites proposed.

Information resources applied for this analysis include:

- AWS draft Water Resource Management Plan (2008)
- Strategic Direction Statement 2010 – 2035
- Planning for drought in the Anglian Water region
- Catchment Abstractions Management Strategies (CAMS, Environment Agency)
- Liaison with AWS
- AWS infrastructure database

7.2 Environment Agency Water Resource Management

The Environment Agency manages water resources at a local level through Catchment Abstraction Management Strategies (CAMS), which are prepared on a 6 yearly cycle.

The CAMS process has changed and will become a 'live strategy' called the Future CAMS, in order to feed into the WFD. The figure below gives the overview of the three stages that will be adopted. The CAMS products will be more customer focused. Customers can be within the Environment Agency and external such as current and future abstraction licence holders. The future CAMS process has been divided into three stages which are;

- Stage 1: Resource Assessment Management (RAM) (Blue in Figure 7-1 below)
- Stage 2: Licensing strategy (Green in Figure 7-1 below)

- Stage 3: Measures appraisals process (Purple in Figure 7-1 below)

The first two are the main CAMS processes; the third stage is where CAMS links with other Water Resource activities.

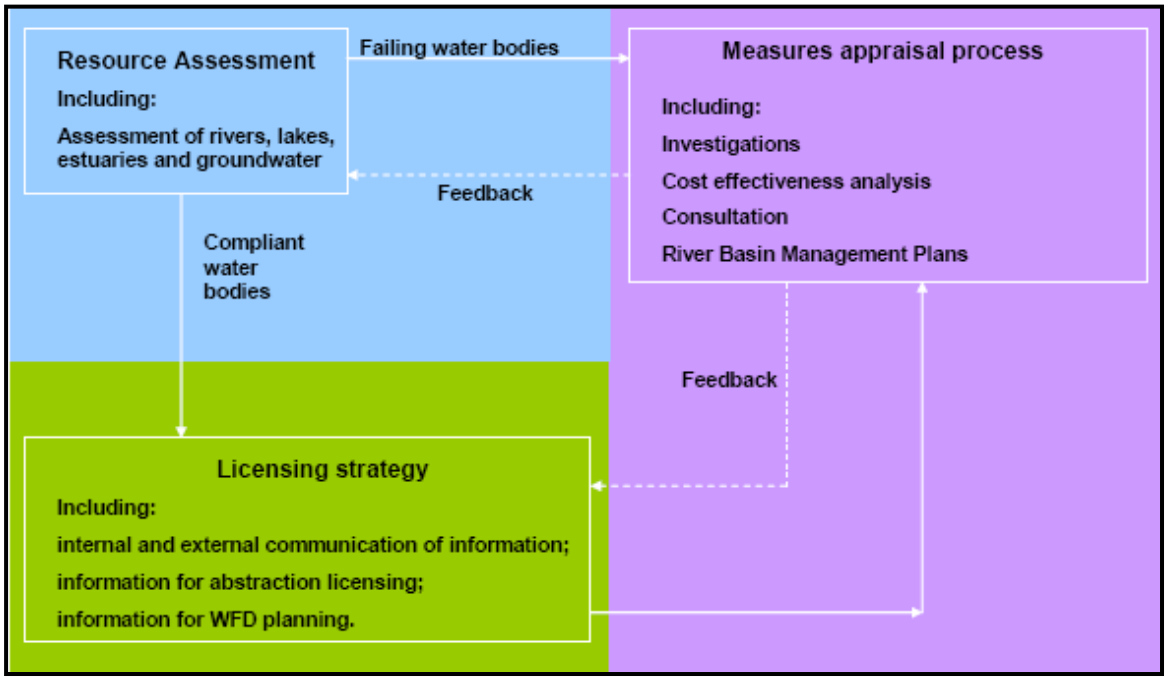

Figure 7-1: Overview of CAMS process stages

Within the CAMS, the Environment Agency's assessment of the availability of water resources is based on a classification system which states the perceived resource availability status, indicating:

- The relative balance between the environmental requirements for water and how much is licensed for abstraction;
- Whether water is available for further abstraction;
- Areas where abstraction needs to be reduced.

The categories of resource availability status are shown in Table 7-1. The classification is based on an assessment of a river system's ecological sensitivity to abstraction-related flow reduction. Figure 7-2 provides an overview of the resource availability status classifications for the UK.

Indicative Resource Availability Status	Licence Availability
Water available	Water is likely to be available at all flows including low flows. Restrictions may apply.
No water available	No water is available for further licensing at low flows. Water may be available at high flows with appropriate restrictions.
Over-licensed	Current actual abstraction is such that no water is available at low flows. If existing licences were used to their full allocation they could cause unacceptable environmental damage at low flows. Water may be available at high flows with appropriate restrictions.
Over-abstracted	Existing abstraction is causing unacceptable damage to the environment at low flows. Water may still be available at high flows with appropriate restrictions.

Table 7-1: CAMS resource availability status categories

This classification can be used to help assess the potential for additional water resource abstraction opportunities. Figure 7-2 shows the Environment Agency's assessment of relative water stress throughout England, and it can be seen that there is a great deal of pressure on water resources in the Aylesbury area, and the whole south east of England. The effects of climate change are likely to further reduce supply and could also actually increase demand.

Aspirational water efficiency targets are provided in the Code for Sustainable Homes (CSH), and will soon be enforceable through the Building Regulations. As of April, 2007 all housing built on English Partnership's will need to meet Code Level 3 (105l/p/d), and the same applies for housing funded through the Housing Corporation beyond April, 2008 to CSH level 2. The Water Act 2003 places a requirement on Local Planning Authorities to take steps wherever practicable to encourage the conservation of water.

The Environment Agency recommends that, due to the specific pressures faced, the region should adopt the following measures:

- Efficient use of water in all new homes with water efficiency set at 105 litres pre head per day (i.e. level 3/4 for water within Code for Sustainable Homes) or better;
- That all growth point plans liaise with water companies to ensure that company have the water resources and associated environmental infrastructure (such as new resources and adequate distribution) now, and in the future, to meet planned development;

- All new buildings, including flats, must be metered;
- Whenever possible developments should consider the benefits of rainwater harvesting and water recycling in new developments;
- Use of low water use landscaping and gardens; and
- Local authorities to follow their duties, as noted in the Water Act 2003 (part 3 sections 81 & 83), that 'the relevant authority must, where appropriate, take steps to encourage the conservation of water'.

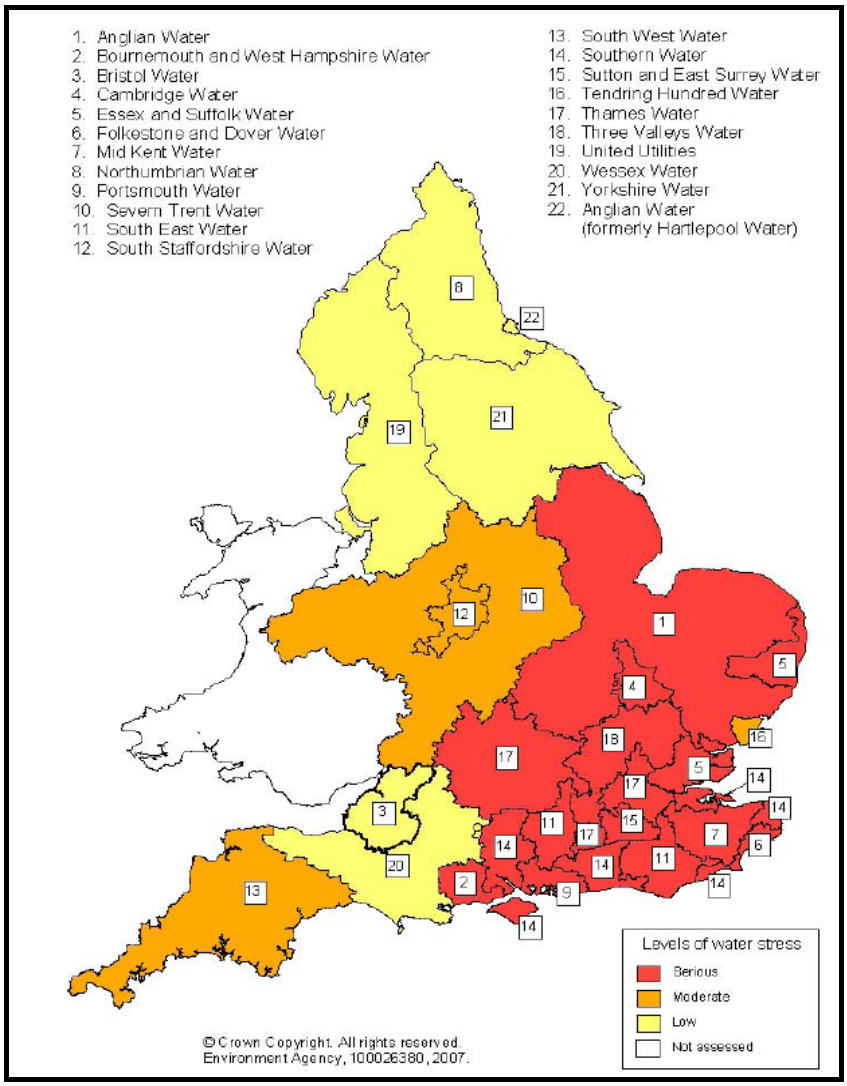

Figure 7-2: Map of Areas of Relative Water Stress (source: Areas of Water Stress, Final Classification; Environment Agency)

7.3 CAMS Review

Northampton and Daventry fall within the Nene CAMS, whilst South Northamptonshire comes under the Upper Ouse and Bedford Ouse CAMS. Neighbouring CAMS areas; Warwickshire and Avon and Cherwell have also been

reviewed. Whilst there is no current abstraction from these CAMS into the study area it is worthwhile noting their status for completeness.

Within the CAMS, the Environment Agency's assessment of the availability of water resources is based on a classification system which states the resource availability status, including:

- The relative balance between the environmental requirements for water and how much is licensed for abstraction
- Whether water is available for further abstraction
- Areas where abstraction needs to be reduced

Assessment has been carried out for each Water Resource Management Unit (WRMU) within the EA CAMS areas to provide an indication of water availability, the abstraction level, licence status and strategy. A nationwide indication of relative water stress is provided in Figure 7-2, while Figure 7-3 provides an overview of CAMS regions and water stress for the West Northamptonshire study area.

7.3.1 *Nene CAMS*

The Nene CAMS region consists of 3 WRMUs which have been assessed under the management strategy published in March 2005. This has subsequently been reviewed annually. All WRMUs are currently classified as over licensed.

If all licence holders abstracted the whole volume they are permitted, the minimum required river flows established by the EA (River Flow Objectives) would not be satisfied for:

- WRMU 1 – 82% of the year
- WRMU2 – 70% of the year
- WRMU 3 – 90% of the year

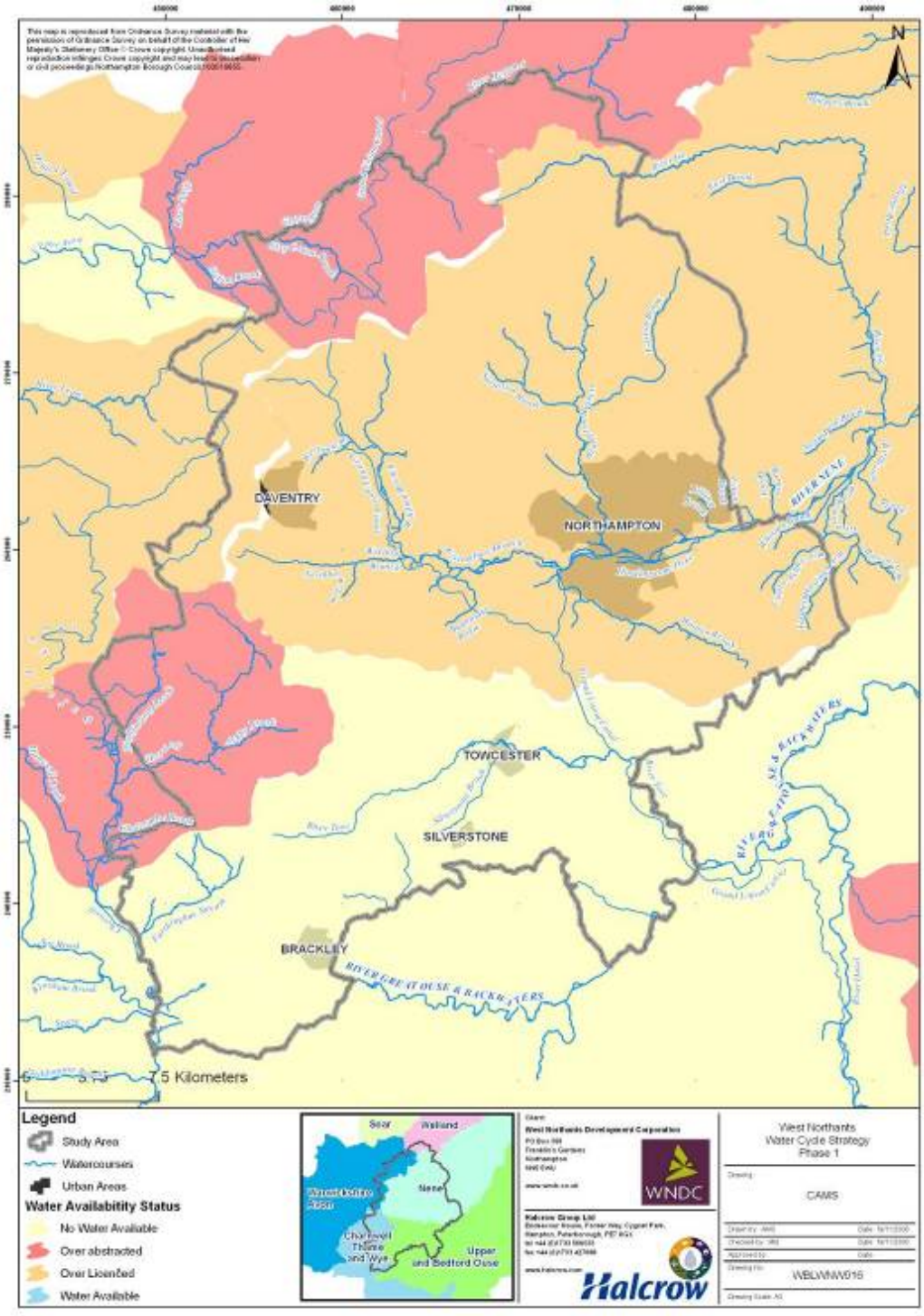

Figure 7-3: CAMS Overview for West Northants Study Area

The Nene CAMS identifies abstraction by AWS for public water supply as the main use of water within the catchment comprising of approximately 92% of total abstractions.

The most relevant AWS abstraction license within the Nene CAMS is to the west of Peterborough and is used to fill Rutland Water (located in the neighbouring Welland CAMS) where water is also transferred under the abstraction licence (at Stamford)..

AWS have three reservoirs within the Nene catchment (to the north of Northampton, Ravensthorpe and Hollowell), which between them account for most of the remaining water abstracted by the company. The reservoir to the west of Huntingdon is located within the Upper Ouse and Bedford Ouse CAMS. In addition AWS have an abstraction licence from Duston, located within the Nene catchment.

This implies that the resource availability is 'over-abstracted', despite actual current abstractions mean that river flow objectives are satisfied 100% of the year for WRMUs 1 and 2, and 71% for WRMU 3.

7.3.2 *Welland CAMS*

The Welland CAMS region consists of 4 WRMUs which have been assessed under the management strategy published in April 2007. The strategy is reviewed annually and was last reviewed in April 2008. The current status of each WRMU is as follows:

- WRMU 1 – over abstracted 73% of the time
- WRMU2 – over abstracted (Rutland water lies within this WRMU)
- WRMU 3 – over abstracted 75% of the time (abstraction at Stamford for AWS lies within this WRMU)
- WRMU 4 – currently over licensed

7.3.3 *The Upper Ouse and Bedford Ouse CAMS*

The Upper Ouse and Bedford Ouse CAMS region consists of 10 WRMUs which have been assessed under the management strategy published in March 2005. This has subsequently been reviewed in June 2007. Only a small area of this CAMS relates to the Ruthamford supply zone although the abstraction and transfer of water from source to the west of Huntingdon to South Northamptonshire with in the WNWCS area.

The key WRMU for AWS abstraction falls in the group of units (1-4).The resource availability status for all these units is "No Water Available"

7.4 Water Company Planning

As the appointed water company, Anglian Water has a responsibility to provide sufficient quantity and quality of water to meet the needs of its customers, whilst also minimising their impacts on the environment. This responsibility applies to

new customers as well, and population growth as well as changing demands within the existing customer base must therefore be comprehensively planned for.

All water companies have a duty to produce water resources plans covering the next 25 years. These plans set out how companies intend to provide sufficient water to meet their customers' needs. Although not previously compulsory, companies have prepared 25 year water resource management plans on a voluntary basis, and shared these with the Government and regulators, since 1999. On 1 April 2007 these plans became compulsory under changes to the Water Industry Act 1991, and this year for the first time they are also subject to public consultation before they are finalised.

Information regarding the strategic water resources for West Northamptonshire has been obtained from AWS' newly prepared draft Water Resources Management Plan (dWRMP) 2008, which is currently undergoing public consultation. The final documents are to be submitted in Spring 2009 and it should be noted that the strategies and conclusions may vary from the draft to the final submission. AWS typically undertake a yearly review of their water resource plans as part of the June Return process. As this WCS coincides with the preparation of AWS' new WRMP, the information used for the WCS is the most comprehensive and up-to-date possible. This also means; however, that the information remains subject to change pending the outcomes of the consultation.

Whilst strategic plans for meeting future demand over a 25 year period are set out in the WRMP, detailed design of schemes is not undertaken until works have been granted funding by Ofwat.

Any improvements to the water services infrastructure needs to be programmed into a water company's capital programme, which runs in five year Asset Management Plan (AMP) cycles. We are currently in the AMP4 period (2005-2010) and water companies are in the process of preparing for its next submission to Ofwat, to determine its allowable capital expenditure for AMP5 (2010-2015). Figure 7-4 illustrates the AMP planning cycle to 2015. This funding cycle and its associated constraints can have implications for the phasing of development, and it is important that water companies are involved in the planning process to ensure that infrastructure can be provided in time.

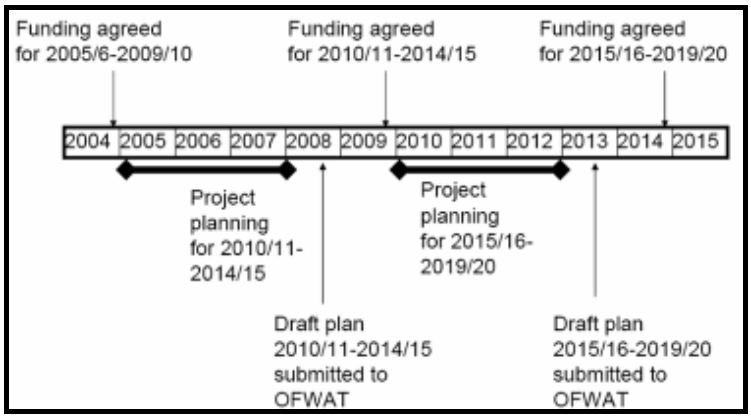

Figure 7-4: Water company capital funding cycle

7.5 Anglian Water Resource Strategy

7.5.1 Company Strategic Overview

AWS adopts a twin track approach for water resource management via both demand management and water resource development. A number of demand management proposals have been outlined within the dWRMP including:

- Targeted customer metering,
- Targeted leakage control,
- Pressure reduction,
- Domestic water audits, and
- Encouraging water efficient devices.

It is noted that many aspects of demand management relies on customer behaviour, and whilst AWS can influence these habits, it is ultimately outside of their control to enforce them. It is therefore essential to the success of demand reduction measures that other bodies also promote the importance of being water smart. This includes Local Authorities (through both planning policy and public education), the Environment Agency, and local press. When this does occur achievements can be made in reducing water demand. AWS currently meter approximately 60% of household properties. This is hoped to be increased to 80% by 2016 and 90% in targeted areas such as North Northamptonshire.

AWS has identified within its Strategic Direction Statement (SDS) that the main risk to supply faced over the next 25 years is climate change. The assumptions made by AWS within its draft WRMP 08 have been closely aligned with recommendations provided by UK Climate Impact Programme (UK CIP). The combined effect of increased rainfall in the winter months and reduction of rain in the summer months, with higher temperatures will act to decrease the winter recharge season.

Within the draft WRMP08 AWS have made a number of assumptions for their baseline data and for calculations over the planning period for their demand forecast. These include the following:

- The deployable output for the Ruthamford Group is 230,000 Ml/yr. This is expected to remain unaltered unless licences are altered by the Environment Agency. Impacts of climate change are included in AWS' calculation of deployable output and forecast demand.
- Dry year baseline forecasts are based on "policy growth" projections. This is a combination of the ONS population trend predictions redistributed geographically by the new build property targets published in the RSSs and LDFs.
- An increase in exports to Three Valleys Water Company (91Mld Average to 109Mld –peak output) to their maximum licensed peak flow per day
- The population served will increase by up to 18 per cent or some 850,000 people between 2010 and 2035.
- Assumed a decline in measured water consumption to 129 l/h/d by 2030.
- Water consumption by metered customers will decline as a result of the planned continued promotion of water efficiency.
- Increase in the number metered customers from the current level of 60 per cent to 90 per cent by 2035 in baseline forecasts.
- Decline in measured water consumption for new homes (CSH) from 138 to 127 l/h/d over the plan period to 2035.
- Commercial demand is expected to remain steady over the planning period at about 110 Ml/d.

AWS have published a report referred to as AWS' Strategic Direction Statement 2010-2035, which outlines the direction AWS will be required to take to meet key requirements in their business and align with the regions needs. Key challenges affecting water supply and resources are identified within the document as:

- Housing Population and economic growth
- Climate change
- Effects of environmental pressures
- Provision of water supply

7.5.2 *Drought Measures*

The main drought measures are the potential to reduce the MRF's at Duston Mill intake to the reservoir to the north of Northampton and the Offord intake to the reservoir to the west of Huntingdon. These measures would be sought to allow for increase abstraction during a winter low flow period. Further details are given in the Environmental Monitoring Plan, Appendix 2.

In terms of groundwater, on a local scale replacement / satellite boreholes would be used if required, to sustain source reliable outputs and hence deployable outputs from the Greensand aquifer source works. Intra zone transfers would be used to balance supplies with demands using existing or new trunk mains.

7.5.3 *Future Water Resource Strategy*

The deployable output for the Ruthamford Group is 230,000 Ml/yr. This is expected to remain unaltered unless licences are altered by the EA.

The study area falls over a number of AWS Planning Zones (PZ), including Daventry, Northampton, Wellingborough, Ravensthorpe and Corby and Buckingham. AWS's draft WRMP 08 predicts that the Daventry and Northampton PZs will be in a deficit of 18Ml/day and 12 Ml/day respectively by 2035 for a dry year peak flow scenario. Ravensthorpe and Buckingham both have a minor surplus for a dry year average flow scenario.

Ruthamford was identified by AWS as having a surplus of available supply against target headroom during AMP4 and AMP5 (owing to significant investment to increase output from the Rutland Water Treatment Works during the AMP 4 period). AWS' draft WRMP 08 predicts a deficit for this WRZ by the end of AMP 6 (i.e. around 2020). Figure 7-6 below is taken from AWS' draft WRMP 08 which depicts the company's resource development strategy to ensure security of supply. Figure 7-5 below indicates the schemes relevant to the Ruthamford Water Resource Zone to support new and existing customers.

PZ	Selected option	Period
ALL	Integrated enhanced metering in Ruthamford WRZ	AMP5
	Uprating of Bedford Ouse WTW	AMP5
	Recommission Pulloxhill WTW	AMP6
	Recommissioning of Foxcote reservoir WTW	AMP6
	Peterborough discharge re-use	AMP7
	Bedford Ouse WTW Phase 2 extensions	AMP9

Figure 7-5: Selected new resource development schemes. Data provided by Anglian Water.

The schemes will supply water to more than one planning zone, and may be further extended by the enhancement of trunk mains and local water distribution which will facilitate the supply to new and existing customers. The schemes are identified in Figure 7-6 below.

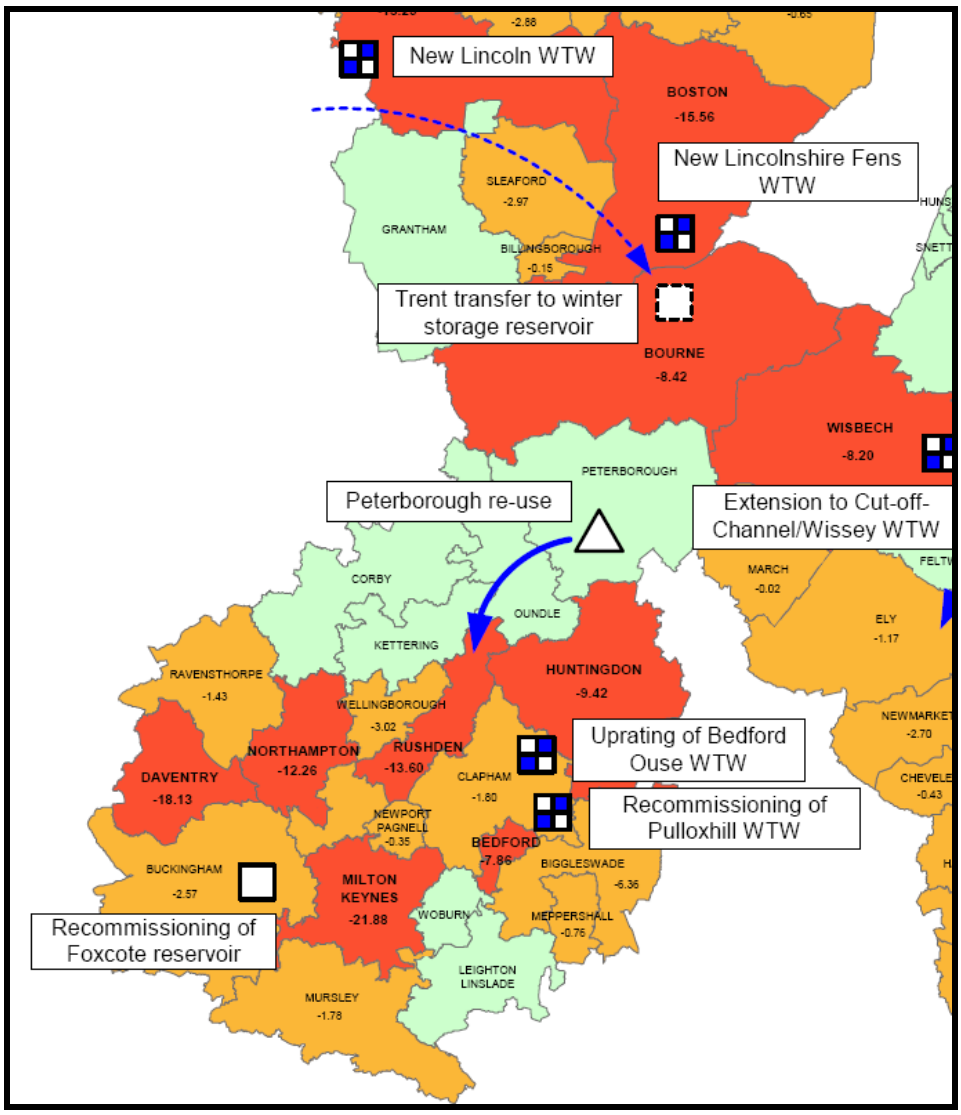

Figure 7-6: Resource development strategy for Ruthamford resource zone

In the longer term, AWS is considering the strategic development of the River Trent via a new winter storage reservoir in the Lincolnshire Fens WRZ as a potential solution to provide additional resources to Ruthamford WRZ as well as adjacent water companies (such as Three Valleys Water (TVW) who rely on bulk supplies from the region. This would require a new reservoir for the next planning period. There is some contention as TVW has already considered and included the bulk supply they would receive from Ruthamford (west of Huntingdon) in their 25 year plans. Detailed investigation is ongoing by AWS into this long term strategy as there

are a number of issues to be considered, including water resource availability in the Lower River Witham.

In conclusion, AWS' strategic infrastructure and resource strategic planning within the Ruthamford Water Resource Zone will support the proposed growth within the study area until 2035. It should be noted that iterative reassessment of this will be undertaken as standard in water company planning, to incorporate latest changes to the social, environmental, and legislative aspects of water resource availability.

7.6 Water Efficiency Targets

7.6.1 National Policy

The Government's new water strategy for England, Future Water was published February 2008. Future Water outlines a strategic and integrated approach to the sustainable management of Britain's water resources to 2030, for the public water supply as well as for the provision of healthy ecosystems and the services they provide.

The Vision by 2030 includes the following measures:

- Reduced per capita consumption of water through cost effective measures, to an average of 130 litres per person per day (l/p/d) by 2030 or possibly even 120 litres per person per day depending on new technological developments and innovation
- Amend the Building Regulations to include a requirement for a minimum standard of water efficiency in new homes. The requirement will be in the form of a calculated whole building performance standard set at 125 litres per day (l/p/d).
- In areas of serious water stress it is believed that near universal metering will be needed by 2030.

In response to the Strategy, the Environment Agency have stated that in water stressed areas, such as West Northamptonshire the introduction of universal metering needs to be undertaken earlier. The Environment Agency would like to see the majority of households in areas where water is scarce to be metered by 2015 with the remainder in water scarce areas being metered by 2020. The Environment Agency also wishes to promote the metering of all new properties, including flats.

7.6.2 Code for Sustainable Homes (CSH)

The Code for Sustainable Homes introduces a step-change in sustainable development and forms a basis for future developments to the Building Regulations. As of May, 2008 the Government has made it mandatory that all new homes have a rating against the Code for Sustainable Homes. The Code measures the sustainability of a new home against nine categories of sustainable design, rating the

'whole home' as a complete package. The Code uses a 1 to 6 star rating system to communicate the overall sustainability performance of a new home. The Code sets minimum standards for energy and water use at each level.

A minimum requirement for each of the nine included categories is necessary to achieve the base rating of Level 1. Beyond this, threshold values must be attained for both 'Water' and 'Energy' to achieve higher code levels. Hence to achieve for example Code Level 3, the requirements for both carbon and water efficiency must be achieved in addition to the minimum points system requirement. Points may be awarded in the other sustainability categories for initiatives and measures implemented beyond the base level requirement for Code Level 1.

Figure 7-7 defines the Carbon and Water Efficiency requirements for each Code Level rating. This assumes the basic entry requirements are met for the other six categories.

Achieving a sustainability rating

	Minimum Standards				
	Energy		Water		
Code Level	Standard (Percentage better than Part L[1] 2006)	Points Awarded	Standard (litres per person per day)	Points Awarded	Other Points[4] Required
1(★)	10	1.2	120	1.5	33.3
2(★★)	18	3.5	120	1.5	43.0
3(★★★)	25	5.8	105	4.5	46.7
4(★★★★)	44	9.4	105	4.5	54.1
5(★★★★★)	100[2]	16.4	80	7.5	60.1
6(★★★★★★)	A zero carbon home[3]	17.6	80	7.5	64.9

Notes
1. Building Regulations: Approved Document L (2006) – 'Conservation of Fuel and Power.'
2. Zero emissions in relation to Building Regulations issues (i.e. zero emissions from heating, hot water, ventilation and lighting).
3. A completely zero carbon home (i.e. zero net emissions of carbon dioxide (CO_2) from all energy use in the home).
4. All points in this document are rounded to one decimal place.

Figure 7-7: Code Level requirements for energy and water efficiency (Source: Code for Sustainable Homes – A Step Change in Sustainable Home Building Practice. Crown Copyright, 2006.)

All new social housing already has to be built to CSH level 3 as a minimum and seek to achieve level 4 if possible, and the Water Act 2003 places a requirement on LPAs

to take steps wherever practicable to encourage the conservation of water. It should be noted that to attain Code Level 3, a home must satisfy the criteria for carbon AND water efficiency. The reduction in use of heated water can therefore contribute towards achieving higher targets for both carbon and water efficiency.

The Environment Agency recommends that measures are adopted to allow the efficient use of water in all new homes with water efficiency set at 105 litres pre head per day (i.e. level 3/4 for water within Code for Sustainable Homes) or better.

7.6.3 *Regional Policy*

Under the Water Act 2003, (Part 3 sections 81 & 83), relevant authorities must, where appropriate, take steps to encourage the conservation of water'. The West Northamptonshire Area is covered by the East Midlands Regional Spatial Strategy (RSS8) and the emerging East Midlands Regional Plan which will guide policy until 2026. The Secretary's of State Proposed Changes published in July 2008 sets targets for water efficiency (Policy 32) as follows:

"Promote improvements in water efficiency in new development and in regeneration to achieve a regional target of 25% (equivalent to an average saving of about 35 litres per person per day);

The strategy also recognises the potential needs of expansion of the treatment work sat Rutland Water and a new reservoir on the lower River Witham to allow for future demand.

7.7 Water Supply Existing Situation

The existing potable water supply network for the study area is operated and maintained by Anglian Water Services Ltd (AWS), and is located within the Ruthamford Water Resource Zone. The three main sources in this resource zone are Water Treatment Works and associated reservoirs located to the north of Northampton, in Rutland and to the west of Huntingdon. The first of these has been recently upgraded (AMP4) for pumps to Harpole Water Reservoir and meets some of the planned growth in Ruthamford.

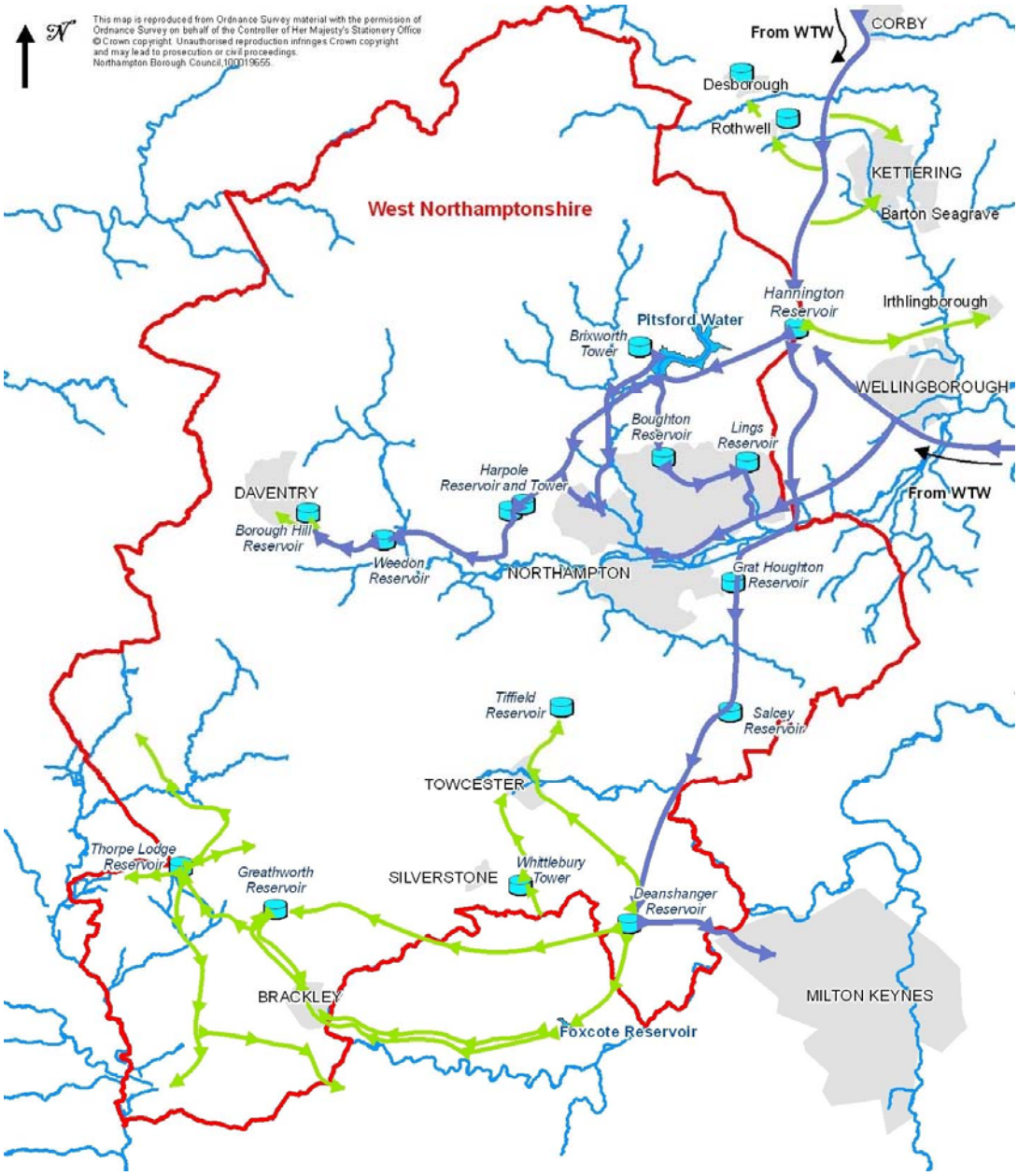

Figure 7-8: Study area existing water supply network

7.7.1 Planned and Current Upgrades

A number of major strategic capacity constraints to support the proposed growth within the Ruthamford Water Resource Zone (which includes our study area) were identified as part of PR09 planning. It should be noted that this water resource zone will be home to major growth within the Milton Keynes and South Midlands Sub Regional Strategy, and it is supplied by the three major sources in the area. The longer term water resource planning will need to integrate all growth and supply sources within this relatively large demand region.

The following works were implemented to meet the current growth by Anglian Water Services in the current AMP4 period. These upgrades to make additional water available from the WTW in Rutland are under way and on track for completion by the end of the AMP4 period (2010);

- Increasing transfer capacity at the WTW; (due for completion in March 2010). Includes duplication of the existing major transfer from WTW to Beanfield Reservoir and Beanfield to a reservoir to the west of Wellingborough.
- Increase supply from WTW to north of Northampton to Daventry and part of Northampton by increased transfer of water from Rutland via a reservoir to the west of Wellingborough .
- Upgrade of the transfer mains from WTW north of Northampton to Harpole Reservoir, including an increase in supply to Northampton through Harlstone Road;
- Increasing available storage capacity at Rutland Water by working within Habitat Directive conditions and requirements;
- Increasing pump capacities at relevant stations to support the increased flows (transfer pumps to Harpole Reservoir have been upgraded, Boughton and Brixworth to be upgraded);
- Upgrade Weedon Water Booster capacity to increase supply to Borough Hill reservoir and into Daventry South.

The additional resource made available from the works in Rutland is made available at a reservoir to the west of Wellingborough. Additional works are required in AMP 5 to transfer this water to the specific growth areas, e.g. Daventry.

Anglian Water Services (AWS) have undertaken modelling of individual sites within the study area in their planning processes. They were able to provide their outcomes for the purposes of this project. It should be noted that, as the extent and exact location of the growth has not been confirmed, sites have been assessed individually to determine the offsite works required. For the purposes of strategic transfers, a level of growth appropriate for the design horizon, typically 20 years has been assumed. The growth assumptions were comparable with those required for this project.

7.8 Northampton Supply Strategy

7.8.1 System Overview

Table 7-2 provides a summary of the major supply reservoirs and treatment works in the Northampton zone.

Water Treatment Works Source	Reservoirs/Towers
Northampton	Boughton
	Harpole
	Brixworth Tower
Rutland	West of Wellingborough (From Beansfield)
	Harpole
Huntingdon	Great Houghton
	Lings

Table 7-2: Northampton water resource and supply sources

7.8.2 *Infrastructure requirements to meet growth*

Northampton growth planning is at a less progressed stage, and the following assessment in Table 7-3 of the potential to accommodate growth accommodation around Northampton have been provided by AWS.

Urban Extension Area	***Constraints and Opportunities for Growth***
*East / South East (Sectors 11, 9a, 9b, 10a, 10b, 1, 8, 7 on **Figure 4-1**)*	*Few constraints since they are close to large diameter strategic mains and storage points. There is some capacity in the network that can supply Wooton without need for offsite reinforcements. Offsite reinforcements maybe required from reservoir west of Wellingborough to Wilby Valve to Great Houghton in the future, the extent dependent on the level of growth.*
South of the M1 (includes sectors 4, 5, 6, 22, 3a, 3b, 3c, 3d, 23)	*Significant offsite reinforcements required, including upgrades from nearest connection point at Salcey Reservoir. There is a potential to cross the M1 motorway. Only small pockets could be accommodated by the existing network.*
*North areas (Sectors 12a, 12b, 13a, 13b, 13c, 2a, 2b, 24c on **Figure 4-1**)*	*Currently supplied by various systems and only small areas could be accommodated, and may require significant local reinforcement from the reservoir to the west of Wellingborough.*
North - North/East areas (14a, 14b, 19c, 19b, 20a, 20b, 21, 15, 15a, 16, 17, 18,	*Significant local offsite reinforcements and pump upgrades are likely to be required. This is dependent on the scale of growth within Daventry and Northampton and an integrated strategy cannot be proposed at this stage.*

Table 7-3: Potential for growth of areas around Northampton urban

7.9 Daventry Supply Strategy

7.9.1 *System Overview*

The following Table 7-4 provides a summary of the major supply reservoirs in the Daventry zone as can be seen in Figure 7-8.

Water Treatment Works Source	*Reservoirs*
north of Northampton and Rutland	*Harpole*
	Weedon
	Borough Hill

Table 7-4: Daventry water resource and supply sources

7.9.2 *Infrastructure requirements to meet growth*

There are five potential development areas in Daventry as outlined in the Joint Core Strategy Issues and Options paper. Three of these areas (Churchfields, land to the east of Daventry and north of the A45 and Monksmoor) are covered by current planning applications which are subject to appeals to the Secretary of State. Other sites may come forward in the emerging Core Strategy.

For the three areas covered by planning appeals, upgrades to the strategic network will be required (Table 7-5). This includes reinforcement of the trunk main between Harpole and Weedon Reservoir in AMP 5. Further reinforcement of the trunk mains between Weedon Reservoir and Daventry may be required in the future, dependent on the level of growth. Additional storage is required at Weedon Reservoir and potentially Borough Hill Reservoir. Local offsite mains will also be required for the individual sites.

Due to close proximity of Monksmoor Farm and Churchfields developments there may be scope to consider a combined servicing approach for these areas. The strategy is currently being reviewed and may change when final review is complete.

Growth area	*Network Requirements*
Monksmoor Farm	*Local reinforcement 2 km main*
Churchfields	*Local reinforcement 2 km main*
Danetree	*Local reinforcement 1 km main*

Table 7-5: Daventry Strategic Infrastructure Requirements

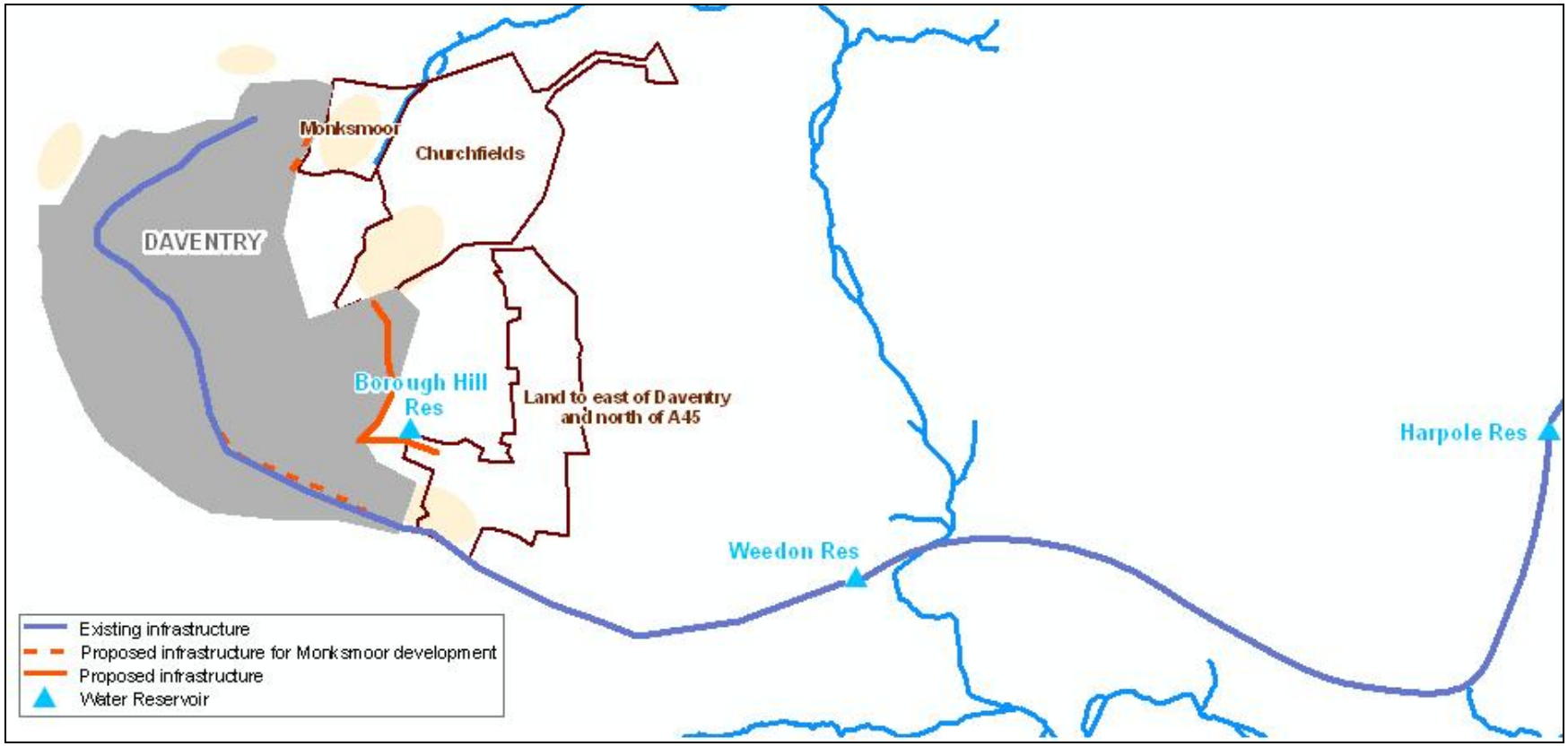

Figure 7-9 Proposed Water Supply Infrastructure for Daventry

7.10 Towcester and Brackley Supply Strategy

7.10.1 System Overview

The following Table 7-6 provides a summary of the major supply reservoirs in the Towcester zone as can be seen in Figure 7-8.

Water Treatment Works Source	Reservoirs
west of Huntingdon	*Great Houghton*
Rutland	*west of Wellingborough*
West of Huntingdon and Rutland	*Salcey*
	west of Milton Keynes
	Foxcote
	Greatworth
	Tiffield

Table 7-6: Towcester and Brackley water resource and supply sources

7.10.2 Infrastructure requirements to meet growth

The following Table 7-7 provides an overview of the reinforcements required to support growth in Towcester and Brackley and further illustrated in Figures 7-10 and 7-11 respectively. The other developments around the areas stated below would require local reinforcements from the mains proposed.

Area	*Growth area*	*WTW Requirements*	*Network Requirements*
Brackley	*Radstone Fields (including surrounding areas)*	*None*	*Local reinforcement 3km long*
Towcester	*Land South of Towcester (including surrounding areas)*	*Pumps upgrade at reservoir west of Milton Keynes*	*A new dedicated main 8 km long with a pumping station There is a potential to phase the delivery*

Table 7-7: Towcester and Brackley Strategic Infrastructure Requirements

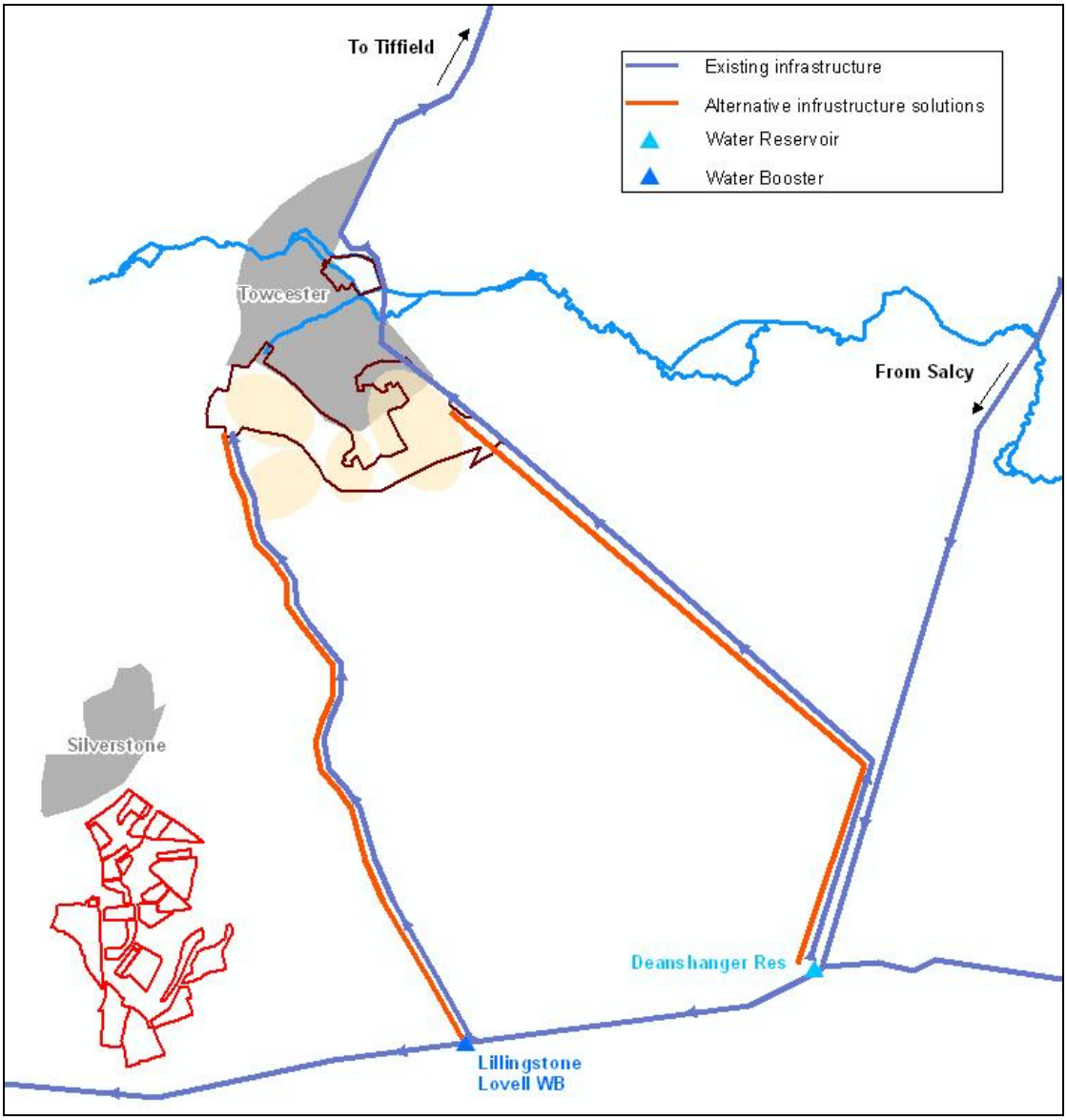

Figure 7-10: Proposed Water Supply Infrastructure for Towcester

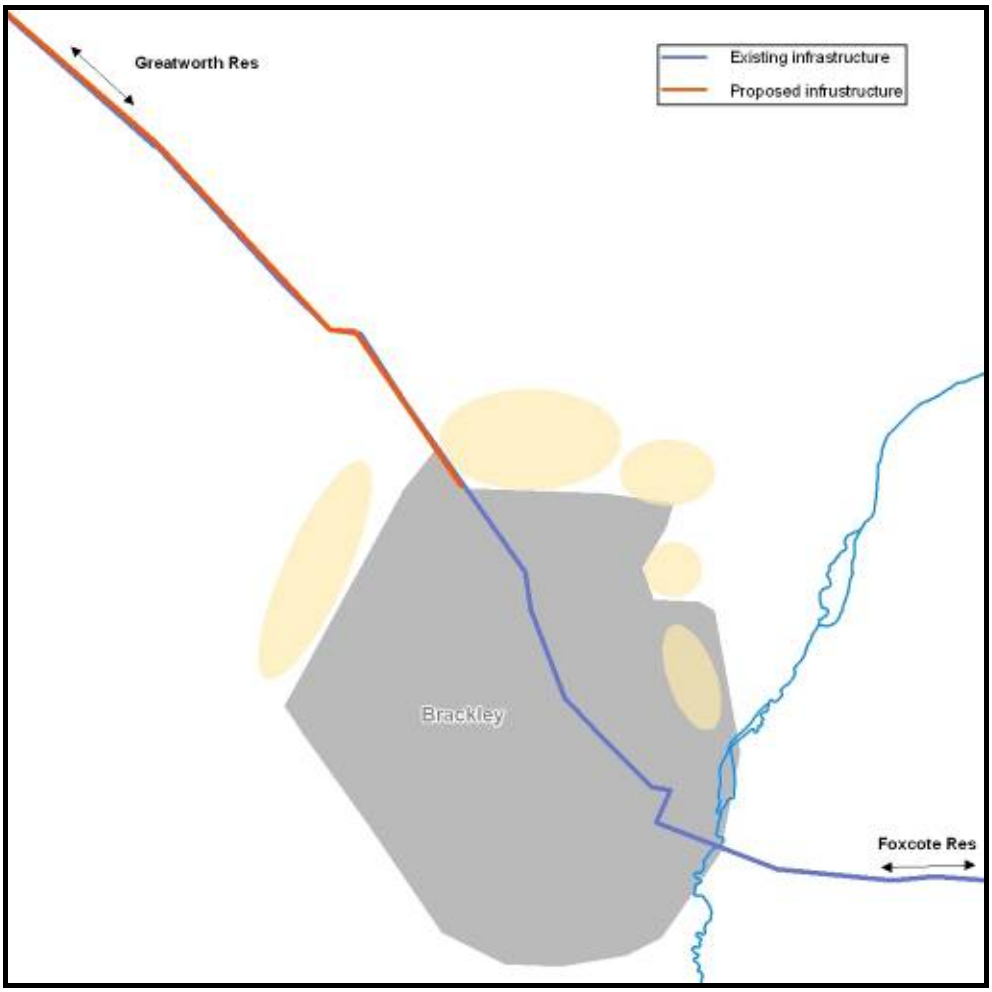

Figure 7-11: Proposed Water Supply Infrastructure for Brackley

7.11 Silverstone Supply Strategy

Silverstone is fed via Dadford booster which is off the trunk main between Deanshanger and Greatworth Reservoirs. To support the proposed development at the race circuit, approximately 700m reinforcement and upgrade of pumps.

7.12 Network Summary

AWS's provision for improvements and upgrades is dependent on the growth. Anglian Water is aware of the planned growth and infrastructure strategy to supply the planned growth is at an advanced stage and some of the work is already being carried out in the current AMP4 period.

For the planned growth in the study area detailed in the CSS, local reinforcements will be required. This has already been identified by AWS and they will be able to provide the infrastructure when the proposed growth occurs.

8 Groundwater and Sustainable Drainage Systems

8.1 Introduction

This Water Cycle Strategy aims to provide a high level indication of what SuDS may be suitable based upon underlying geology, source protection zones, and aquifer characteristics. Detailed site geological surveys should be undertaken by developers as required, as a part of planning application process to define the most suitable SuDS options.

Where the geology does not permit infiltration then the volume of detention storage required at a local or strategic site will increase as no runoff can be lost to ground. This is also the case when numerous small scale source control elements are not used, e.g. permeable paved driveways/paths, as the major attenuation elements then need to store the full volume of runoff.

8.2 Geological and Hydrogeological Setting

The geological and hydrogeological setting provides a background both for an evaluation of the potential for groundwater flooding and for an understanding of the role of infiltration drainage either as part of SuDS systems, or within the overall natural water cycle.

A review of the geological and hydrogeological setting in the study area has been undertaken and is contained in Appendix H.

8.3 SuDS for the West Northamptonshire Area

It is likely that SuDS systems for large scale drainage within new development in West Northamptonshire will be dependent on surface based systems, with discharge to existing watercourses and incorporating ponds or similar detention areas for storage and flow attenuation. Space will need to be allowed for these features during the planning process.

However, there is a possibility that there will be potential for some large infiltration schemes, particularly around the Upton Lodge and Grange Farm development areas in Northampton. There also appears to be some localised potential for infiltration schemes in South Northamptonshire. Again, space will need to be allowed for these features in the planning process.

Site investigations should identify these potential areas that could be used for infiltration, both large scale and localised. There is potential across the developments

in Northampton and South Northamptonshire but the actual groundwater levels in Northampton will also influence the possibility of these schemes.

Adopting the stormwater management train approach, described in Section 8.4, may allow the identification and development of prevention or source control techniques that limit the requirement for disposal into water courses, hence reducing the need for additional, downstream flood control measures.

This prevention/control strategy should be adopted at the earliest possible stage in the planning process. The recognition of the benefits of SuDS for groundwater resource protection, ecological enhancement and flood management is important for regional spatial planning.

8.4 Sustainable Drainage and Planning

For sustainable drainage to be most effective it is necessary to have a series of elements in series with the runoff passing through them. This is known as the treatment train. Therefore whilst it is often necessary to have ponds or wetlands to store large volumes of runoff SuDS elements should be introduced at house or street level to provide source control. The smaller scale elements are most typically a soakaway. However it should be noted that soakaways are only normally designed to attenuate runoff for up to 1 in 10 year events. Building Regulations require an assessment to be made to determine if soakaways can be utilised. An overall site strategy will be required and this may show them to be unnecessary.

8.4.1 Choosing the Right SuDS

The ideal SuDS option for a development site will vary in each situation, depending upon:

- the goals of the local planning authority and the developer,
- the geological and topographical characteristics of the site, and
- the requirements of the Environment Agency (EA).

SuDS solutions may be selected and implemented to achieve many environmental objectives including:

- Pollution control arising from surface water runoff;
- Reducing pollutant infiltration into groundwater;
- Maintaining recharge to groundwater;
- Reduce construction;
- Providing natural amenity and green spaces within development;
- Maintaining or restoring natural flow regimes of a receiving watercourse.

8.4.2 *Flood Risk Mitigation*

One of the primary applications of SuDS with respect to PPS25 is mitigation against flood risk. This may be achieved through attenuation or filtration ponds, wetlands, or through a number of smaller scale infiltration and site specific SuDS such as porous pavements, green roofs, or rainwater harvesting.

The Code for Sustainable Homes requires that peak run-off rates and annual volumes of run-off are no greater than the previous conditions for the development site. The majority of Daventry's strategic growth sites are on greenfield and brownfield sites, hence careful planning of flood risk mitigation will be required within the planning process.

It is the developer's responsibility to undertake the analysis required to provide the evidence base to prove that flood risk will not be exacerbated as a result of their development. This should be included within the planning application.

8.4.3 *SuDS in design*

To maximise the benefits of SuDS these should be integrated into the strategy and be an essential feature of any development process.

The cost effectiveness of SuDS benefits enormously from integration into design at the earliest possible stage.

Adoption of the "stormwater management train" concept will allow identification of the most appropriate approach at an early stage. This hierarchical concept comprises, in order of preference:

Prevention	application at individual sites, e.g. use of rainwater harvesting, management to prevent accumulation of pollutants.
Source Control	e.g. through permeable pavements, green roofs etc.
Site Control	management of water from several sub catchments - e.g. by routing water from roofs, pavements etc. to swales or small infiltration ponds.
Regional Control	management of water from a number of sites, e.g. by routing to larger infiltration ponds or wetlands.

(After CIRIA 2004)

Thus a wide range of systems may be incorporated from small scale (e.g. at the level of a single dwelling) to more regional management (e.g. infiltration ponds serving larger areas). The appropriate system is dependant on the scale of the development

and hydrogeological and other environmental constraints, and the selection of the SuDS system should be an integral part of the planning process.

SuDS design will incorporate measures to manage and attenuate stormwater run-off and mitigate potential flood risk from drainage, prevent pollutants reaching natural water systems and provide opportunities for development of biodiversity and amenity features.Appendix J shows the various SuDS techniques and gives commentary on each.

Failure to manage and maintain SuDS sufficiently can lead to increased risk of flooding and cause deterioration in water quality. Therefore, it is essential that maintenance and management processes are considered at an early stage of design, and should be allowed for in any strategic development.

8.4.4 *SuDS Maintenance and Adoption*

Currently, no standard framework exists for adoption and maintenance of SuDS infrastructure, however in the DEFRA publication 'Making Space for Water' it is advised that a long term adoption strategy is crucial for the success of SuDS measures. This implies the involvement of a "durable, accountable organisations that can be expected to have the financial capacity to meet their responsibilities in the longer term." We recommend supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

The planning, design, construction and initial maintenance of SuDS are the responsibility of the developer. The 'Interim Code of Practice for Sustainable Drainage Systems' developed by the National SuDS Working Group (2004) states that an adopting authority will require the SuDS to be developed to an appropriate standard, and that they are in an acceptable condition at handover. A developer must also provide comprehensive owners manual, covering annual maintenance tasks as well as long-term remedial solutions.

The current arrangements with regards to adoption of drainage are:

- The local water company will adopt SuDS elements that are in compliance with Sewers for Adoption (SFA) 6th Edition where the storage capacity does not exceed that required to attenuate storms any larger than a 1 in 30 year storm. The key clauses are:
    a) Part 1 – General
    b) Clause 1.14 covers flow attenuation and details the design parameters to be achieved. It also excludes any above ground items.
    c) Clause 1.19 which relates to Sustainable Drainage Systems (SuDS)

d) Part 2 – Design

e) Clause 2.13 Hydraulic Design - Surface Water on Site

f) Clause 2.14 Hydraulic Design – Protection Against Flooding, which relates to sewer flow capacity and defines the 1 in 30 year no flood level of protection.

g) Clause 2.15 Control of Surface Water Discharges, which relates to PPS25 and the need to provide a sustainable solution.

- The Highway Authority will adopt engineered grassed channels that are similar to swales and vegetated wetlands, so long as both are in accordance with the provisions of DMRB.

Refer to geological map for distribution, some deposits described here may occur outside the study area.

9 Ecological Constraints and Opportunities

9.1 Objectives and Approach

9.1.1 Objectives

The primary objective of the ecological appraisal undertaken to support the West Northamptonshire Water Cycle Strategy (WNWCS) is to identify and summarise nature conservation issues, in terms of constraints and opportunities, related to potential development locations in and around Northampton, Daventry, Towcester, Silverstone (Motor racing circuit) and Brackley (as discussed in section 4). It is intended that the output could be used as part of a decision support toolbox, to aid in the evaluation of development proposals within Northamptonshire and considers;

- Physical impact of development upon ecological features.
- Drainage and flood defence associated with new developments.
- Water resources exploitation and protection associated with water supply for an increased population, as discussed in section 7.
- Water quality protection, in particular associated with wastewater treatment and disposal, as discussed in section 6.

Elements of the ecological appraisal have been included throughout this report where appropriate. Further information is included within Appendix K. At the outline stage the WCS has assessed the impacts of development on water-based and riparian ecology only.

This appraisal aims to provide low level site-specific guidance for those involved in the possible development and expansion of the potential development locations, by highlighting the possible impacts that future planned development(s) may have on water and wetland ecologically sensitive sites and species in and around these five development locations.

9.1.2 Approach

The approach to ecological appraisal for the WNWCS makes use of the River Basin Biodiversity (RBB) Framework concept including compiling information on existing nature conservation features, objectives and targets (e.g., Biodiversity Action Plan (BAP) targets, designated sites and protected species). The use of GIS to display information is a key feature of this approach.

9.1.3 *Information Sources*

The information within this study has been collated from a number of sources, namely;

- Northamptonshire Biodiversity Record Centre
- Published and web-based information on ecological features from Natural England, Northamptonshire County Council, MAGIC, and the Environment Agency
- Environment Agency regional sources

9.2 Ecological Features Considered

The following features within the study area have been considered:

- Main rivers. This includes the River Nene south of Northampton and its tributaries such as Brampton Branch with runs north to south through Northampton, the Grand Union Canal which runs south of Northampton and north east of Daventry and the River Tove running through Towcester.
- Tributaries downstream of sewage treatment works at Whilton, Great Billing, and in Towcester.
- Standing open waters and wetlands in the vicinity of potential development sites.
- Designated sites featuring notable water and wetland features.
- BAP habitats (water and wetland) and protected and notable species.

9.3 Ecological Constraints

The full list of ecological constraints considered is drawn from the *River Basin Biodiversity Framework* model and also informed by the approach taken for other Phase 1 WCSs.

9.3.1 *Overview of the Study Area*

There are five major development locations within the study area, all of which are situated in West Northamptonshire. These locations are; Northampton, Daventry, Towcester, Silverstone (motor racing circuit only) and Brackley (*please note that the southern half of the Silverstone Motor Racing Circuit lies within the county of Buckinghamshire*). A number of possible development options have been proposed in and around each of these development locations.

Natural England's Natural Area profile for the *West Anglian Plain* identifies features and contributions to biodiversity. No "Prime Biodiversity Areas" are identified within Northamptonshire; however there are a number of important and relevant habitats within the study area. These include:

- the large, slow-flowing River Ouse and River Nene (and a small stretch of the River Welland)
- a multitude of smaller watercourses including small drains, marshes and wetlands which support a number of protected birds
- lowland meadows occur on the seasonally flooded (winter and spring) alluvium
- an extensive series of old flooded gravel pits, clay pits and reservoirs, many of which have swamp vegetation or reed beds along their margins

9.3.2 Designated Sites Considered

The following types of water and wetland designated sites of nature conservation importance have been considered in this study;

- International Sites of Nature Conservation Importance - Special Protection Areas (SPAs), potential Special Protection Areas (pSPAs), Special Areas of Conservation (SACs), and Ramsar Sites
- National Sites of Nature Conservation Importance - Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs)
- Local Sites of Nature Conservation Importance - Local Nature Reserves (LNRs), Country Wildlife Sites (CWSs)

9.3.3 BAP Habitats Considered

The following BAP Habitats from the Northamptonshire LBAP have been considered in this study;

- Broad habitats - Fen, marsh and swamp, Rivers and Streams, Standing Open Water and Canals
- Local habitats - Quarries and Gullets, Wet and Marshy Grassland
- Priority Habitats - Reedbeds, Wet Woodland

9.3.4 Protected and Notable Species Considered

Protected and notable species that are aquatic or primarily associated with water or wetland habitats and relevant to the study area include the otter (*Lutra lutra*); water vole (*Arvicola terrestris*); great crested newt (*Triturus cristatus*); white-clawed crayfish (*Austropotamobius pallipes*); bullhead (*Cottus gobio*); eel (*Anguilla anguilla*); common toad (*Bufo bufo*); a range of aquatic and water-associated birds including the great crested grebe (*Podiceps cristatus*), cormorant *(Phalacrocorax carbo)* and the kingfisher (*Alcedo atthis*), and aquatic invertebrates such as dragonflies and damselflies (e.g., ruddy darter *Sympetrum sanguineum*).

With regard to bats, only those species which use water sites as their main feeding areas have been considered in this study, i.e. Daubenton's bat *(Myotis daubentoni)*.

9.3.5 *Fisheries*

The River Nene from Northampton and downstream is designated as a cyprinid river under the EC Freshwater Fisheries Directive. Most of the reaches for which water quality data are available are at their target River Ecosystem (RE) Classifications of 2 or 3, indicating that they are of good to fair quality and can support either all fish species (RE2) or high class coarse fish populations (RE3).

9.4 Sensitive Ecological Features Identified

This section highlights the sensitive ecological features (sites and species) identified within each of the study locations.

Sensitive water or wetland sites within approximately 1km of each of the development locations are considered. This 1km distance has been increased where applicable to consider particularly sensitive designated sites. The following sensitive water/wetland sites were identified;

Northampton;

a) Pitsford Water SSSI (SP780708)

b) Upper Nene Valley Gravel Pits SSSI/pSPA5 (SP966717)

c) Bugbrooke Meadows SSSI (SP672586)

d) Sywell Reservoir and Country Park CWS (830655)

e) Barnes Meadow LNR (785600)

f) Nobottle Wood (BAP Wet Woodland) (675635)

Daventry;

g) Daventry Reservoir and Country Park LNR (SP580640)

h) Drayton Reservoir CWS (SP570646)

[5] Please note that the term Upper Nene Gravel Pits includes the Northampton Washlands, both are treated as the same proposed Special Protection Area.

i) Braunston Marsh CWS (SP7066)

j) Badby Woods (BAP Wet Woodland) (SP560580)

Towcester;

k) Kingsthorne Wood BAP Wet Woodland (SP660490)

l) BAP Floodplain Grazing Marsh (SP705485)

Silverstone (Motor Racing Circuit only);

m) Syresham Marshy Meadows SSSI (SP638426/SP645422)

n) Several areas of BAP Wet Woodland Habitat

Brackley;

o) One un-designated nature reserve (St James Fishing Lake) featuring standing open water (SP580367).

A brief overview of these sites, giving consideration to their proximity to the five development locations is provided below. Site locations are shown on Figures 9.1, 9.2 and 9.3 in Appendix K. Protected and notable species recorded in and around each of the development locations are listed at the end of each location section. This species data was obtained from the Northampton Biodiversity Record Centre. It should be noted that this data is spatially and temporally limited and therefore follow-up surveys would be required to confirm site-specific species constraints.

Northampton

North, There are a number of potential development options to the north of Northampton. To the north of the town lies Pitsford Water SSSI, fed from Faxton Brook and other water courses flowing south westwards. The reservoir discharges into the Brampton Brook or branch of the Nene which flows southward to Northampton where it joins the main course of the river. The reservoir is the largest water body in Northamptonshire and serves as a major site for passing and wintering waterfowl. Negative impacts could occur as a result of increased run-off or discharge, reduced water quality, or low water levels as a result of over abstraction.

North East; There are a number of potential development options to the north east of Northampton. There are a number of areas of standing open water in the area north of the town. One notable site to the north east of the town is Sywell Reservoir and Country Park CWS, a tranquil area dedicated to preserving wildlife habitats. The waters and banks of the Edwardian reservoir provide habitat for water birds. Development to the north east of Northampton should therefore give careful consideration to possible negative impacts on these sites which could occur as a result of, for example, reduced water quality from increased surface run-off.

East/South East; There are a number of sensitive water/wetland sites to the east of Northampton, which include a number of BAP standing water habitats. However, the most notable site to the east of Northampton is the Upper Nene Valley Gravel Pits SSSI/pSPA, which is considered to be of exceptional significance for the variety and quality of breeding birds associated with the opens water and marginal habitats. It is also nationally important for its rare example of wet floodplain woodland. The gravel pits offer an extensive series of shallow and deep waters which occur in association with a wide range of marginal features. These would be sensitive to changes in water levels which may occur if flows were to increase (due to new additional surface runoff and/or wastewater discharge) water along the River Nene and Grand Union Canal which flow through the town.

South/South West/West; Barnes Meadow LNR is situated to the south of the town centre. A large area of BAP floodplain grazing marsh is situated on the town's south west urban fringe. Bugbrooke Meadows SSSI is situated approximately 3km away from the town's western urban fringe. The site contains a group of low lying meadows alongside the River Nene which have escaped drainage and improvement. They tend to flood in winter and often remain wet well in to the growing season. As a result they support a range of damp grassland communities which are remarkably diverse and rich in species. These sites may be adversely affected if increased flows in the River Nene were to occur as a result of development.

North West; A large area of wet woodland (Nobottle Wood) is situated some 3km from the town, and is fed by a tributary of the River Nene. Wet woodlands occur on poorly-drained or seasonally wet soils, therefore reductions in water levels in the future could have an adverse effect on the site.

Protected and Notable BAP Species

Data requests have confirmed that the following protected and notable species have been recorded within Northampton and its urban fringes;

- Freshwater crayfish *Austropotamobius pallipes*

- Common toad *Bufo bufo*
- Daubenton's bat *Myotis daubentoni*
- Great crested newt *Triturus cristatus*
- Otter *Lutra lutra*
- Spined loach *Cobitis taenia*
- Water vole *Arvicola terrestris*
- Kingfisher *Alcedo atthis*
- Reed bunting *Emberiza schoeniclus*
- Water rail *Rallus aquaticus*

Daventry

There are five potential development areas in Daventry as outlined in the Joint Core Strategy Issues and Options paper. These three sites are also discussed below. Other sites may come forward in the emerging Core Strategy.

D011 (North of Daventry); Drayton Reservoir CWS is a popular fishing reservoir on the northern fringe of the town. The reservoir is predominantly stocked with carp, perch, tench and roach. Its owners, British Waterways, say that the reservoir is arguably the best match fishery of its type in England, although as a stocked fishery its nature conservation value is more questionable.

D010/D011 (North East of Daventry); Development to the north of the town could have a negative impact on the Daventry Reservoir and Country Park LNR which is located on the town's northern urban fringe. The Park is centred around the reservoir which is used to provide water for the Grand Union Canal.

D09/D08 (East and South East of Daventry); No sensitive water or wetland sites were identified to the east of Daventry.

D012 (North West of Daventry); Braunston Marsh CWS lies approximately 2.5km north west of the town's urban fringe. The site could suffer if development resulted in modification of the local hydrological regime.

Protected and Notable BAP Species

Data requests have confirmed that the following protected and notable species have been recorded within Daventry and its urban fringes;

- Freshwater Crayfish *Austropotamobius pallipes*
- Common toad *Bufo bufo*
- Water vole *Arvicola terrestris*
- Otter *Lutra lutra*
- Great crested newt *Triturus cristatus*
- Great crested grebe *Podiceps cristatus*
- Mute swan *Cygnus olor*
- Cormorant *Phalacrocorax carbo*
- Kingfisher Alcedo atthis

Towcester

T01 / T02 – No sensitive water or wetland sites were identified in these areas.

Protected and Notable BAP Species

Data requests have confirmed that the following protected and notable species have been recorded within Towcester and its urban fringes;

- Water vole *Arvicola terrestris*

Silverstone (motor racing circuit only)

North/North East; A small area of BAP wet woodland habitat was identified immediately north of the motor racing circuit, and a larger area of BAP wet woodland habitat was identified to the north east of the motor racing circuit. The integrity of these sites could be compromised if potential development modified the local hydrological regime and caused water level changes at these wet woodland sites.

East/South East; No sensitive water or wetland sites were identified directly adjacent to these areas.

South/South West; Areas of BAP wet woodland habitat were identified adjacent to the south and south west of the motor racing circuit. Streysham Marshy Meadows SSSI can also be found approximately 3km to the south west of the circuit. The integrity of these sites could be compromised if potential development resulted in

modification the local hydrological regime leading to water level changes at these sites.

West/North West; No sensitive water or wetland sites were identified directly adjacent to these areas. However, there is a risk that the integrity of BAP wet woodland habitats situated further to the west of the motor racing circuit could be compromised if potential development modified the local hydrological regime.

Protected and Notable BAP Species

Data requests have confirmed that the following protected and notable species have been recorded at the Silverstone motor racing circuit and within its urban fringes; (*Please note that the southern part of the motor racing circuit lies within the county of Buckinghamshire. Species data was not requested for this county, therefore the list below pertains only to the county of Northamptonshire)*

- Common toad *Bufo bufo*
- Water vole *Arvicola terrestris*
- Great crested newt *Triturus cristatus*
- Otter *Lutra lutra*
- Reed bunting *Emberiza schoeniclus*
- Snipe *Gallinago gallinago*

Brackley

No sensitive water or wetland sites of the designations considered in this study were identified in or around Brackley.

Protected and Notable BAP Species

Data requests have confirmed that the following protected and notable species have been recorded within Brackley and its urban fringes;

- Water Vole *Arvicola terrestris*
- Freshwater crayfish *Austropotamobius pallipes*

9.5 Potential Impacts of Development

There is currently insufficient information concerning future public water supply demands to permit accurate predictions of the likely impact of future developments

on the identified sites and species. If additional water supplies were required and sourced from Rutland and Pitsford Reservoirs, this increased abstraction may reduce water levels, which may in turn have a negative impact on water birds reliant on the habitat provided by the reservoirs' deep waters. If any additional water supplies were to be conveyed via the River Nene then ecological impacts resulting from increased flows along the river would need to be addressed. For example increased flows could adversely affect otters, water voles, and kingfishers, which rely on river bank habitats.

It is therefore recommended that Phase 2 studies consider future inter-regional supplies and their resultant ecological effects on sensitive sites, as well as the impact of works for the strategic distribution of water. These studies should focus on the needs of individual sites.

9.6 Nature Conservation Threats and Opportunities

This appraisal, based on the approach outlined under the River Basin Biodiversity Framework concept developed by Halcrow, Natural England and the Environment Agency in 2005, aims to distinguish between critical, important and desirable contributions to water and wetland nature conservation.

In respect of the WNWCS, realistic contributions to nature conservation value have been identified as follows:

- "**Critical**" contributions relate to the preservation of existing international/national interests:
- "**Important**" contributions will protect existing regional/county interests whilst further promoting international/national interests;
- **"Desirable"** contributions will protect local interests and further contribute to regional/county and local value.

WNWCS contributions (nature conservation threats and opportunities) for the five potential development locations are outlined in Table 9.1. The level of negative impact (*high, medium, low, none*) or positive contribution from enhancements (*probable, tentative, none*) likely in each development location is also shown in the Table (see key below). Significance criteria are shown in Table 1, Appendix K.

Negative impact	Positive contribution
H= High	Y = Probable
M = Medium	(Y) = Tentative

L = Low	
N = None	N = None

Table 9-1: Nature conservation threats and opportunities for the WCS

Development Locations	Northampton	Daventry	Towcester	Silverstone (Motor Racing Circuit)	Brackley
CRITICAL					
Threat to integrity of statutory designated sites (SACs, SPAs, pSPAs, SSSIs, NNRs)	H	N	N	M	N
Threat to extent and quality of standing open waters	H	L	L	N	L
Threat to preserving extent and quality of floodplain grazing marsh	H	N	N	M	N
Threat to preserving extent and quality of rivers and streams	H	M	M	L	M
Threat to river water quality and (cyprinid) fisheries	H	H	M	L	L
Threat to otters and their habitats	H	M	L	M	L
Threat to water voles and their habitats	M	M	M	M	M
Threat to great crested newts and their habitats	H	M	L	M	L

Development Locations	Northampton	Daventry	Towcester	Silverstone (Motor Racing Circuit)	Brackley
Threat to bat habitats and breeding bird habitats	M	L	L	M	L
Threat to freshwater crayfish and their habitats	M	M	L	L	M
IMPORTANT					
Threat to integrity of LNRs and CWSs	H	H	N	N	N
Threat to Local BAP habitats	M	M	H	H	N
Threat to Local BAP species	M	M	L	M	M
Potential to increase linkages between designated sites	Y	(Y)	(Y)	Y	N
Potential to enhance quality and extent of standing open waters	Y	(Y)	N	N	N
Potential to enhance extent and quality of floodplain grazing marsh	Y	N	Y	N	N
Potential to enhance otter habitats	Y	(Y)	Y	N	N
Potential to enhance fisheries habitats/	Y	Y	Y	N	N

Development Locations	Northampton	Daventry	Towcester	Silverstone (Motor Racing Circuit)	Brackley
river water quality					
Potential to enhance water vole and otter habitats	Y	(Y)	Y	N	N
Potential to enhance great crested newt habitats and bat habitats	Y	(Y)	N	N	N
DESIRABLE					
Potential to improve water quality and river corridors for invertebrates and bats that feed on them	Y	Y	Y	N	Y
Maintain minor known populations of LBAP species (e.g., palmate newt)	(Y)	(Y)	(Y)	(Y)	(Y)

9.7 Enhancement Opportunities

There may be opportunities to enhance the value of some of the ecological features identified within the study area. These opportunities are outlined below;

Certain designated sites could be connected/linked (using corridors) to enhance their ecological value (by increasing their overall size and stability). For example, Barnes Meadow LNR lies close to the Upper Nene Valley Gravel Pits SSSI/pSPA and there may be potential to link habitats between these two sites.

Areas of floodplain could be expanded which would enhanced opportunities for establishing BAP habitats such as reedbeds, which are relatively rare in

Northamptonshire and have in the past been the focus of successful habitat creation schemes (e.g. Great Billing Sewage Treatment Works at SP817617).

There may be opportunities to improve and enhance existing areas of standing open water by creating/increasing shallow shelving margins to create a range of water depths and thus increase habitat diversity within these existing habitats (e.g. Upper Nene Valley Gravel Pits SSSI/pSPA). The creation of such habitat would be of benefit to the great crested grebe which build nests among reeds and vegetation fringing shallow lakes and disused gravel pits, and the water rail which favours swampy pond margins

Opportunities may exist to increase riparian vegetation along the River Nene and Grand Union Canal which flow through Northampton. Such measures would improve the physical habitat for the Daubenton's bat, which has a strong association with riparian and open water sites for feeding, and also relies on linear features such as riverside scrub when flying between feeding sites.

New habitats for water voles may also be created by using SuDS in new development allocation areas to address issues of run-off, particularly in Northampton and Daventry.

There are opportunities to include wetlands and ponds in drainage systems (SuDS) for developments in the allocation areas upstream of or adjacent to the River Nene and its Brampton branch.

Developments in all areas present opportunities to increase habitat extent and quality and increases in water quality, through the inclusion of SuDS wetlands/ponds, and also through high-level treatment of waters (especially for phosphates) prior to discharge. This would be potentially beneficial for fisheries as well as for biodiversity.

9.7.1 *Water Quality*

Improved infrastructure for sewage treatment presents an opportunity to improve receiving water quality.

Water quality data indicate that phosphates in the period 2002-2006 are very high to excessively high (see section 6), and nitrates are also an issue. The Nene is a designated Sensitive Area for eutrophication. Biological water quality downstream of Whilton WwTW to the east of Daventry is good (grade B), as is water quality downstream of Great Billing WwTW in Northampton. In Towcester, biological water quality in the River Tove downstream of the WwTW has been grade A or B since 2002. Additional discharges from sewage associated with new commercial and residential developments need to avoid any degradation in water quality as this could

adversely affect species which require clean waters, but upgraded infrastructure presents the opportunity to actually improve receiving water quality if future discharge standards are improved.

Furthermore, additional wastewater discharges of high water quality have the potential to improve the linkages between downstream rivers and their floodplains and riparian wetlands (by providing additional flow).

Additionally, high-level treatment of wastewater before it is discharged presents the opportunity to establish wetland treatment systems as functional components of wastewater treatment works, providing a habitat resource as well as improved effluent quality.

9.8 Recent Projects and Initiatives

This appraisal has also considered recent projects aimed at improved water and wetland habitats within the WCS study area. One important project, undertaken by the Wildlife Trust, for improving the Upper Nene Valley Gravel Pits and other wetland habitats along the Nene valley in Northampton (including Barnes Meadow) has included clearing ditches to balance water levels and digging scrapes to provide feeding areas for wading birds[6].

No projects aimed at enhancing water and wetlands have been identified for Daventry Towcester, Silverstone motor racing circuit or Brackley.

9.9 Summary and Recommendations

This appraisal has identified the sensitive water and wetland sites and protected/notable species in or close to each of the five potential development locations (Northampton, Daventry, Towcester, Silverstone motor racing circuit, and Brackley) in West Northamptonshire. Several SSSIs, pSPAs, LNRs, CWSs and BAP Habitats have been identified, along with a number of associated notable a number of notable and protected species. Nature conservation threats and opportunities for the WNWCS are summarized in Table 9.1.

Potential development sites have been initially assessed to establish the risks (but also the opportunities) that they present to existing water and wetland nature conservation features in the area, associated with changes in surface drainage, hydrology and municipal wastewater discharge.

[6] http://www.wildlifebcnp.org.uk/whats-new-story209.htm

Due to a lack of information regarding future public water supply requirements, it has not been possible to provide accurate predictions of the effects that developments are likely to have on the sites and species identified. It is therefore vital that future water supply to the five development locations and resulting ecological effects on sites and species be fully investigated in Phase 2 of this study to allow robust conclusions on ecological impacts to be made.

Consideration should be given in Phase 2 of this study to the crucial links between green infrastructure provision, reducing flood risk, and the protection and enhancement of biodiversity character, particularly in relation to Northampton and Daventry.

Consideration of the wider environmental issues resulting from the proposals, with a particular focus on resource efficiency, mitigating and adapting to climate change, sustainable construction, and minimising waste streams arising from construction is not in scope of this report. However, consideration should be given to these issues in Phase 2 of this study, with particular reference made to other studies such as Green Riverside Park.

10 Developer Guidance

10.1 Developer Checklist

The key tool for assessing whether developments comply with the principles of this Water Cycle Strategy is the Developer Checklist. This summarises best practice with respect to the Water Cycle, bringing together Environment Agency guidance and the recommendations of this Strategy into a simple checklist which guides Developers in the assumptions to make and the data to be provided. The Checklist is included in Appendix L of this report.

It is recommended that Developers' proposals are assessed against the information available within this Strategy.

10.2 Flood Risk

Natural England has adopted Accessible Greenspace Standards and the strategic proposals for numerous flood storage reservoirs can be used to contribute towards this goal. There are definite opportunities for using storage reservoirs for such multifunctional purposes. One possibility is to use a third of the higher surface area for amenity and leisure activities although details will need to be finalised as part of a more detailed design. Developers for larger sites (> 100 ha) should be required to ensure that 25% of balancing facilities are designed for multi-functional use to meet this guidance. However caution must be applied to the consideration of such areas for formal play areas such as sports pitches which may not be suitable for such multi-function areas.

10.3 Water Efficiency Measures

10.3.1 Introduction

Developers should be encouraged to utilise the measures below to reduce potable water consumption and help to maximise the use of limited water resources. This will enable more homes to be supplied from available resources without compromising the standard of service for existing customers.

10.3.2 Water efficient appliances

Water efficient appliances should comprise: low flush and dual flush toilets, self closing and spray taps, efficient low flow shower heads (rather than power showers), low usage white goods and waterless urinals for public facilities. In addition pipe design should include lagging to minimise wastage associated with waiting for taps to run hot or cold.

Modern dishwashers and washing machines use around half the amount of water of 10-year-old appliances. Out of all household water usage, washing machines and

dishwashers use 14 per cent and 7.7 per cent respectively. Having new efficient appliances can cut their combined usage by half, equating to a 10% saving on domestic consumption. Many modern dishwashers use only 16 litres to wash 12 place settings; a saving of 60% over the equivalent amount washed by hand (the machine must be run full, on a water efficient setting, to achieve these results).

Specialist tap fittings to regulate flow can save up to 80 per cent of water and energy used with standard taps. Spray or aerating inserts can be retrofitted to existing and new taps, and existing shower heads can be replaced with water-saving versions. Installing a displacement device in the toilet cistern can save up to 10% of the total water usage in the house.

10.3.3 Rainwater harvesting

Rainwater harvesting refers to the collection of surface runoff from the roofs of houses. This does not offer very significant savings in water consumption, but is a useful component of the complete water efficiency toolkit as it combines reducing runoff with reducing water usage. Rainwater collected can be used to supply toilets and washing machines, and also for garden irrigation. Further information can be found on the UK Rainwater Harvesting Association website (**www.ukrha.org**).

10.3.4 Greywater recycling

Greywater recycling refers to the re-use of water from sinks, baths, showers and washing machines. This pre-used, or "grey", water can be collected separately from household sewage. It can then be filtered and used to irrigate gardens, or filtered, disinfected and used for flushing toilets (greywater systems cannot be used to supplement potable supply).

Although greywater systems are often opposed on the grounds of hygiene, it is important to remember that only a minimal percentage (3%) of domestic water consumption is actually used for drinking and cooking purposes. The remainder therefore undergoes expensive, energy-intensive treatment processes to meet the EU Drinking Water Directive unnecessarily.

In a typical household, toilet flushing accounts for around 35% of all use (see Figure 10-1). This is comparable to the amount used for bathing, showering and hand basins. There is a strong case for using this "greywater" (i.e. water used for washing) for toilet flushing, which does not require water of potable quality.

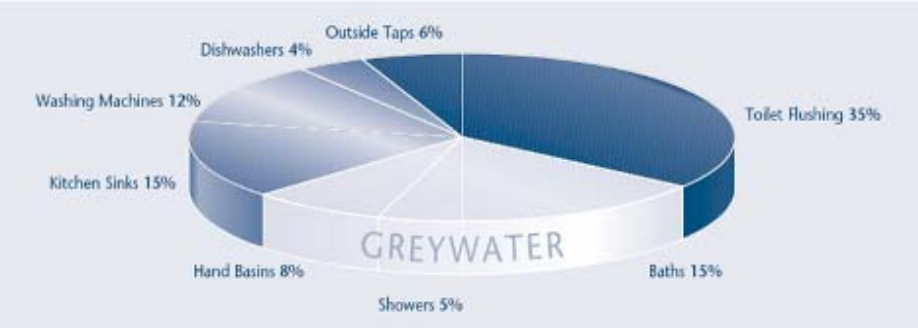

Figure 10-1: Typical water usage in unmeasured households (Edwards K, Anglian Water, 1996)

Reusing greywater significantly reduces domestic water usage. In a system where greywater is used, up to 18,000 litres of treated water per person can be saved each year.

The full benefit of greywater recycling can only be realised through a new build system. With larger developments there may be opportunities to integrate larger scale greywater recycling systems from the outset, which will reduce water consumption and also reduce the impact of wastewater discharges on the environment.

11 Conclusions and Recommendations

11.1 Overview

The Phase 1 Water Cycle Strategy has considered the achievability of the proposed level of growth for West Northamptonshire in terms of the water cycle, with specific reference to the Joint Core Strategy Issues and Options Discussion Paper options and the development areas identified by EDAW on behalf of the JPU. The following aspects have been investigated:

- Flood risk management
- Foul drainage, sewage treatment and water quality
- Water Resources and Supply
- Groundwater and use of sustainable drainage systems
- Ecological constraints and opportunities
- Guidance for developments

Each of these aspects has been considered in detail and conclusions are summarised by local authority in the following sections.

11.2 Northampton

40,400 new dwellings are forecast to be built over the period 2001 – 2026 in the Northampton area, with annual completion rates of between 1,300 and 1,775 dwellings a year over five, five-year plan periods. Potential development sectors have been identified by EDAW and this has resulted in an assessment of the capacity of the water services in Northampton peripheries and the affect of development. The results of which have been illustrated using a Red-Amber-Green system in Table 11-1 below. It should be noted that water resource has not been included in Table 11-1 below as it is not location specific.

Table 11-1 Assessment of the capacity of the water services in Northampton and the affect of development.

	North / West	North / East	South / West	South / East
Flood Risk	*Sectors 14a, 14b, 15e, 16, 17, 18* in the north-northwest part of this quadrant will drain into the Brampton branch of the River Nene. There is potential storage from Dallington Reservoir or the AWS reservoirs upstream. Opportunity exists for developers to fund investigations into strategic mitigative options.	*Sectors 13a, 13b, 13c, 24a* in the north-northeast part of this quadrant will drain into the Brampton branch of the River Nene. There is potential storage from Dallington Reservoir or the AWS reservoirs upstream. Opportunity exists for developers to fund investigations into strategic mitigative options.	*Sectors 2a, 2b, 2c, 2d, 3a, 3b, 3c, 3d, 4, 5, 22, 23* drain into the Wootton Brook catchment. Any development would increase the flood risk and the area is known to suffer from surface water flooding that exacerbates the situation. Locations for a strategic storage area have not been identified and developments would need to rely on local attenuation.	*Sectors 1, 6, 7, 8* drain into the Wootton Brook catchment. Any development would increase the flood risk and the area is known to suffer from surface water flooding that exacerbates the situation. Locations for a strategic storage area have not been identified and developments would need to rely on local attenuation.
	Sectors 19a, 19b, 19c, 20a, 20b, 21 A cluster of sectors immediately north of the River Nene. Runoff would flow in to the river. There is potential for upstream storage that would protect these sectors; this presents an opportunity for developers to investigate a sound strategic flood risk	*Sectors 12a, 12b, 24b, 24c* in the centre of this quadrant drain into Billing Brook and do not impact on the flood zones. Opportunity exists for developers to investigate mitigative options that may include a capacity review of Overstone Park Lake.		

	North / West	North / East	South / West	South / East
	solution.	*Sector 11* with appropriate on site mitigation incurs no unacceptable increase in flood risk although site based mitigation would be required.		*Sectors 9a, 9b, 10a, 10b* immediately south of the River Nene incur no unacceptable increase in flood risk. However, sewer flooding on existing developments would require some investigation.
Wastewater	*Sectors 13c, 14a, 14b, 15a, 16, 17, 18* These sectors may be serviced by upgrades to the sewer network to Great Billing. This would pose significant cost and disruption due to the urban nature of the environment work is required. AWS are preparing a scheme that assesses options for this area. This will depend upon which sectors emerge and in what order.	*Sectors 11, 12a, 12b, 24b, 24c* These sectors would require a new strategic main linking them to the Great Billing WwTWs.	*Sectors 2a, 2b, 2c, 2d, 2e, 3b, 3c, 3d, 4, 19a, 19b, 19c, 20a, 20b, 23* These sectors would require upgrading of existing urban infrastructure to support. This would be costly and disruptive. These sectors could be strategically developed in conjunction with a preliminary scheme under consideration by AWS to address growth in this area of the town.	*Sectors 1, 7, 8, 9a, 9b, 10a, 10b* These sectors have an obvious and simple solution of new designated infrastructure to Great Billing works. *Sector 7* may have some growth directed to Hackleton WwTW based upon detailed analysis.
		Sectors 13a, 13b, 24a These sectors may be linked strategically to the east into the North East option.	*Sector 5* This sector could also connect into the AWS scheme being developed to address growth in this area of the town. Some load may be diverted to Towcester WwTWs.	

	North / West	North / East	South / West	South / East
			Sector 6 This sector may connect into the south east option, however this would be costly and unsustainable with the amount of infrastructure required. It could also be strategically integrated into the AWS plan being developed to address growth in this area of the town. This depends on when the sector emerges.	
Water Supply	*Sectors 14a, 14b, 19c, 19b, 20a, 20b, 21, 15, 15a, 16, 17, 18* Significant local offsite reinforcements and pump upgrades are likely to be required. This is dependent on the scale of growth within Daventry and Northampton and an integrated strategy cannot be proposed at this stage	*Sectors 12a, 12b, 13a, 13b, 13c, 2a, 2b, 24c* Currently supplied by various systems and only small areas could be accommodated, and may require significant local reinforcement from reservoir to west of Wellingborough.	*Sectors 4, 5, 6, 22, 3a, 3b, 3c, 3d, 23* Significant offsite reinforcements required, including upgrades from nearest connection point at Salcey Reservoir. There is a potential to cross the M1 motorway. Only small pockets could be accommodated by the existing network.	*Sectors 11, 9a, 9b, 10a, 10b, 1, 8, 7* Few constraints since they are close to large diameter strategic mains and storage points. There is some capacity in the network that can supply Wooton without need for offsite reinforcements. Offsite reinforcements maybe required from reservoir to west of Wellingborough to Wilby Valve to Great Houghton in the future, the extent dependent on the level of growth.

	North / West	North / East	South / West	South / East
Ecology	*NorthWest* A large area of wet woodland (Nobottle Wood) is situated some 3km from the town, and is fed by a tributary of the Brampton Branch of the River Nene. Wet woodlands occur on poorly-drained or seasonally wet soils, therefore reductions in water levels in the future could have an adverse effect on the site.	*NorthEast* There are a number of potential development options to the north east of Northampton. There are a number of areas of standing open water in the area north of the town. One notable site to the north east of the town is Sywell Reservoir and Country Park CWS, a tranquil area dedicated to preserving wildlife habitats. The waters and banks of the Edwardian reservoir provide habitat for water birds. Development to the north east of Northampton should therefore give careful consideration to possible negative impacts on these sites which could occur as a result of, for example, reduced water quality from increased surface run-off. .	*South/South West/West* Barnes Meadow LNR is situated to the south of the town centre. A large area of BAP floodplain grazing marsh is situated on the town's south west urban fringe. Bugbrooke Meadows SSSI is situated approximately 3km away from the town's western urban fringe. The site contains a group of low lying meadows alongside the River Nene which have escaped drainage and improvement. They tend to flood in winter and often remain wet well in to the growing season. As a result they support a range of damp grassland communities which are remarkably diverse and rich in species. These sites may be adversely affected if increased flows in the River Nene were to occur as a result of development.	*East/South East* There are a number of sensitive water/wetland sites to the east of Northampton, which include a number of BAP standing water habitats. However, the most notable site to the east of Northampton is the Upper Nene Valley Gravel Pits SSSI and potential SPA (pSPA), which is considered to be of exceptional significance for the variety and quality of breeding birds associated with the opens water and marginal habitats. It is also nationally important for its rare example of wet floodplain woodland. The gravel pits offer an extensive series of shallow and deep waters which occur in association with a wide range of marginal features. These would be sensitive to changes in water levels which may occur if flows were to increase (due to new additional surface runoff and/or wastewater discharge) water along the

	North / West	North / East	South / West	South / East
	North There are a number of potential development options to the north of Northampton. To the north of the town lies Pitsford Reservoir SSSI, which is fed from the Faxton Brookand other water courses flowing south westwards. The reservoir discharges into the Brampton Brook or branch of the Nene which flows southward to Northampton where it joins the main course of the river. The reservoir is the largest water body in Northamptonshire and serves as a major site for passing and wintering waterfowl. Negative impacts could occur as a result of increased run-off or discharge, reduced water quality, or low water levels as a result of over abstraction.			River Nene and Grand Union Canal which flow through the town.

It has been possible to identify which factors drive the preferred location for future development with respect to the water cycle – this is illustrated in Figure 11-1 below. The key driver has been the foul sewerage network; this indicates that future growth should be in the south east quadrant, priority area 1. Northampton benefits from flood defences and therefore any increase in river flows will reduce the current level of protection. This means there is limited means of differentiating between sectors from a flood risk perspective and a policy that all surface water should be attenuated on site is recommended. However, there are some exceptions to the rule and these have driven the identification of priority areas 2 and 3.

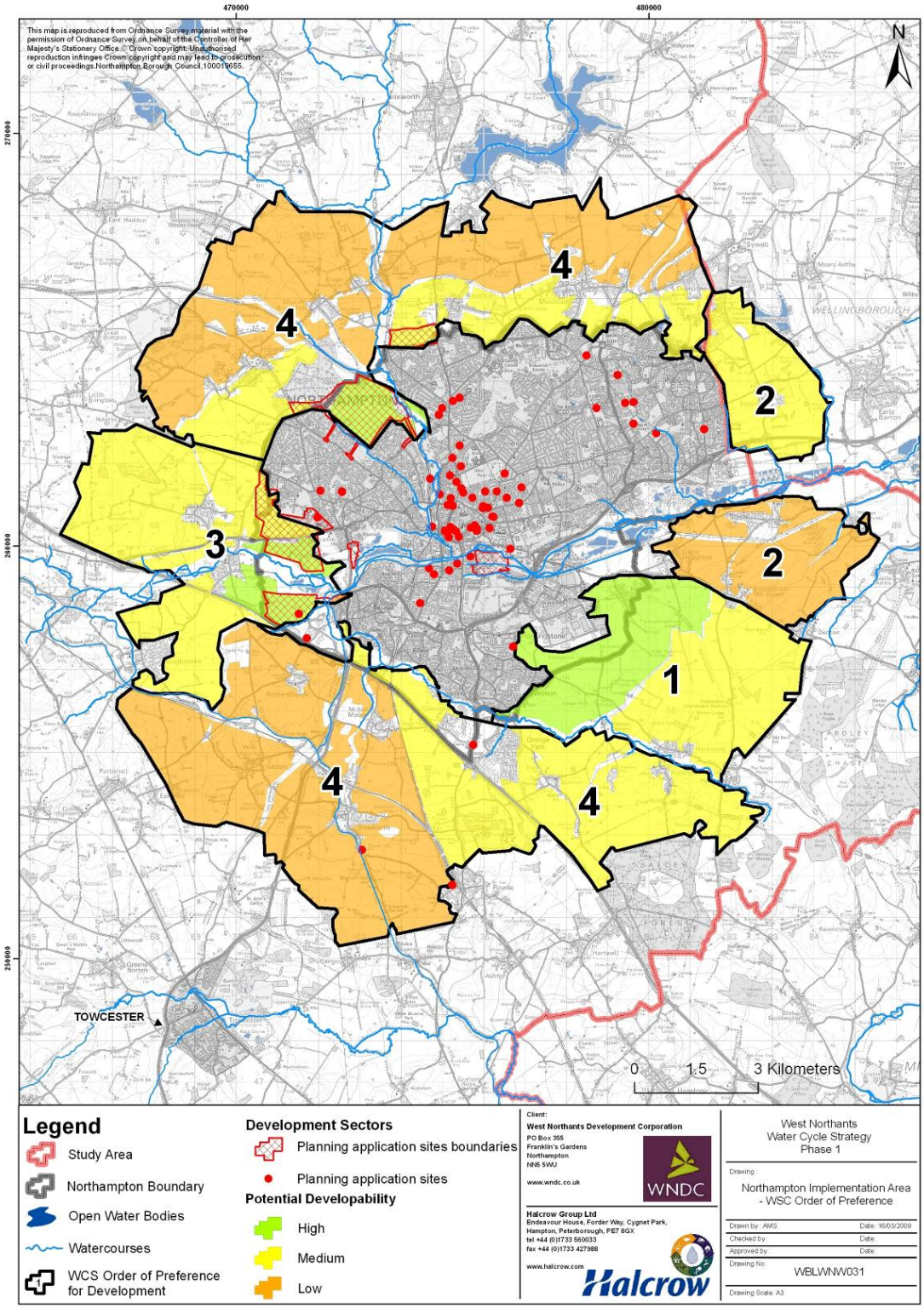

Figure 11-1: NIA development sectors in order of preference for the water cycle

It should be noted that some of the assumptions made with respect to serving areas for sewerage require further investigation before constraints can be evaluated and infrastructure costs compared.

11.2.1 Flood Risk Management

The two main branches of the River Nene, Kislingbury and Brampton, meet in the urban centre of Northampton. Consequently, a large proportion of the city lies within flood zones 2 and 3 and there are several flood alleviation schemes in place. The standard of protection given by the Northampton flood defences is 1 in 200 years. This is the standard agreed between the Environment Agency and Local Planning Authorities for the purposes of PPS25 and attenuation up to a 1 in 200 year standard plus climate change must be provided to maintain this standard of protection. Areas benefiting from defences should be investigated by developers more closely in relation to potential development sectors.

There has been no recorded groundwater flooding events in Northampton. Due to the geological and hydrogeological setting, groundwater flooding is considered low risk.

Potential development areas can be clustered together to consider strategic flood risk management activities that would provide a strategic solution to benefit a group of development areas. When sectors are allocated, a combined flood risk assessment will be required to show that there will be no increase in flood risk from all developments draining into all watercourses. Where multiple sites are within the same minor catchment, a surface water management plan is recommended to identify opportunities for strategic flood risk solutions. Post-development flows and volumes should be restricted to pre-development levels.

SFRA Level 2 sequential tests for surface water runoff should feed into the Local Development Framework. The Northampton SFRA Level 2 will be prepared.

Where part of the development sectors are in flood zone 2 and 3 the developer of these sectors should undertake a site-specific flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for these sectors, and the future extent of these flood zones with climate change. Land use within these sectors should be allocated according to the appropriate uses for the flood zones according to PPS25. Where large urban extensions have elements of flood zone 3 it should be incorporated into the scheme through not building in those areas and the land fulfilling an open space requirement.

Developers should wherever possible incorporate river naturalisation and environmental enhancement into new developments. This will support the actions outlined in the Nene CFMP. The developers must take account of any recommendations from the River Nene

CFMP for the River Nene (Weedon to Kislingbury), Wootton, Northampton Central and Northampton Outer policy units, and any subsequent studies arising from the CFMP.

It is likely that SuDS for large scale drainage within new development in West Northamptonshire will be dependent on surface based systems, with discharge to existing watercourses and incorporating ponds or similar detention areas for storage and flow attenuation. Space will need to be allowed for these features during the planning process. Detailed site geological surveys should be undertaken by developers as required, as a part of planning application process to define the most suitable SuDS options. It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

However, there is a possibility that there will be potential for some large infiltration schemes, particularly around the Upton Lodge and Grange Farm development areas in Northampton. Again, space will need to be allowed for these features in the planning process.

11.2.2 *Foul Drainage, Sewage Treatment and Water Quality*

Northampton sewage is treated at Great Billing WwTW, located 6km east of the town centre, on the north bank of the River Nene. The sewerage network supplies the WwTW via two 1500mm diameter sewers from the town centre. Within the catchment area there are a number of sewage pumping stations (SPS) and overflows. The majority (approximately 85%) of the network operates using separate foul and surface water sewers.

Based on flow consent headroom, Great Billing WwTW currently has little or no capacity for accommodating new development. AWS is currently negotiating a revised flow consent. Based on growth data, the treatment process can cope with flows until about 2016. At some point post 2015 additional capacity will have to be added to cope with the increased flow rates, which will be dependant on the rate of the developments in the area and flows from the new sludge treatment centre.

Likely improvements required to accommodate the projected growth may be summarised as follows:

- Improvements to sludge treatment plant (2011)
- Sludge liquor pre-treatment or amended operational practice to improve primary settlement tank performance.
- Additional treatment capacity to be provided (this should not be required until after 2016)

It is anticipated that under the flow compliance scheme ammonia limit will now be changing to 4mg/l and consented Dry Weather Flow increasing 83 215 m^3/d. These new limits will

need to be confirmed by AWS in advance of any further analysis. Current UWWTD consent limit for phosphorus is 1.0mg/l, or 80% removal as an annual average, and the modelling indicates that this is satisfactory to meet no deterioration of downstream water quality with growth. Neither the 'high' nor 'good' ecological status under WFD could be achieved for phosphate without improving upstream river quality.

11.2.3 Water Resource and Water Supply

Northampton is within the Nene Catchment Abstraction Management Strategy (CAMS) with the water resource availability considered to be stressed. However, there is no current water resource abstraction from this CAMS area into the study area. The study area is supplied by the AWS' Ruthamford Water Resource Zone. There is capacity in this Water Resource Zone that will be able to meet the planned growth in the study area.

AWS has recently prepared the draft Water Resources Management Plan (WRMP) 2008, which is currently undergoing public consultation. This details a strategy to supply water to new and existing customers that aligns with the planned level of growth.

It is recommended that, due to the specific pressures faced, the region should adopt the following measures:

- Efficient use of water in all new homes with water efficiency set at 105 litres per head per day (i.e. level 3/4 for water within Code for Sustainable Homes) or better;
- That all growth point plans liaise with water companies to ensure that companies have the water resources and associated environmental infrastructure (such as new resources and adequate distribution) now, and in the future, to meet planned development;
- All new buildings, including flats, must be metered;
- Whenever possible developments should consider the benefits of rainwater harvesting and water recycling in new developments;
- Use of low water use landscaping and gardens; and
- Local authorities to follow their duties, as noted in the Water Act 2003 (part 3 sections 81 and 83), that 'the relevant authority must, where appropriate, take steps to encourage the conservation of water'.
- Universal metering by 2020 with the majority metered by 2015.

11.2.4 Ecological Constraints and Opportunities

The following sensitive water/wetland sites were identified in Northampton:

- Pitsford Water SSSI (SP780708)
- Upper Nene Valley Gravel Pits SSSI/pSPA (SP966717)

- Bugbrooke Meadows SSSI (SP672586)
- Sywell Reservoir and Country park CWS (830655)
- Bames Meadow LNR (785600)
- Nobottle Wood (BAP Wet Woodland) (675635)

Data requests have confirmed that the following protected and notable species have been recorded within Northampton and its urban fringes:

- Freshwater crayfish *Austropotamobius pallipes*
- Common toad *Bufo bufo*
- Daubenton's bat *Myotis daubentoni*
- Great crested newt *Triturus cristatus*
- Otter *Lutra lutra*
- Spined loach *Cobitis taenia*
- Water vole *Arvicola terrestris*
- Kingfisher *Alcedo atthis*
- Reed bunting *Emberiza schoeniclus*
- Water rail *Rallus aquaticus*

Follow-up surveys will be required to confirm site-specific species constraints.

11.3 Daventry

The Draft Regional Spatial Strategy (2008) indicates that Daventry District will deliver 13,500 new dwellings between 2001 and 2026.

There are five potential development areas in Daventry as outlined in the Joint Core Strategy Issues and Options paper. Three of these areas (Churchfields, land to the east of Daventry and north of the A45 and Monksmoor) are covered by current planning applications. All three sites are subject to on-going appeals for determination by the Secretary of State. Other areas may come forward in the emerging Core Strategy.

There are no insurmountable constraints to the growth proposed in Daventry, however, the capacity of the WwTW at Whilton is a major constraint to future growth prior to extension of the treatment works (planned for AMP5)..

11.3.1 Flood Risk Management

The majority of Daventry sits in Flood Zone 1 and has low flood risk. Two sites, Churchfields and Monksmoor, encroach on the Flood Zones 2 and 3 and would be further

affected by a breach of the Daventry Reservoir dam. There are no records of groundwater flooding and it is considered low risk for Daventry.

The CFMP flood risk management policy for the Upper and Middle Nene (which includes Daventry) is to reduce existing flood risk management actions thereby accepting that flood risk will increase over time.

Due to the different runoff routes of the five development areas in Daventry a strategic solution for flood risk management does not exist for these sites. Rather, runoff should be managed on site by site basis and site specific flood risk assessments would be required.

It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25. Any new development should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development. Developers should incorporate river naturalisation and environmental enhancement into new developments. This will support the actions outlined in the Nene CFMP.

Post-development flows and volumes should be restricted to pre-development levels. The developers should undertake a study to show that there will be no increase in flood risk from all development areas draining into the River Nene, Daventry Reservoir or other watercourses.

As part of the development sites Churchfields and Monkmoor are in flood zone 2 and 3 the developer of these sites should undertake a site specific flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for these sites, and the future extent of these flood zones with climate change. Land use within these sites should be allocated according to the appropriate uses for the flood zones according to PPS25.

A review of reservoir capacity should be undertaken before any development takes place in the Churchfields and Monksmoor areas.

The developer of the Churchfields area should undertake a study analysing the impact of runoff from the site to Daventry reservoir, the Grand Union Canal and to the village of Norton.

It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

11.3.2 *Foul Drainage, Sewage Treatment and Water Quality*

Daventry foul and storm sewer collection networks operate as separate systems, except for two small sections of combined sewer to the south and east of town near pump stations. The foul sewage the network collects is treated at Whilton Sewage Treatment Works (WwTW) to

the east of the town. Development sites considered can be connected to the exuisting trunk main to transfer wastewater to Whilton WwTW.

The works is operating to discharge consent capacity and therefore currently cannot accommodate any additional flows without consent modification. AWS is currently in negotiations with EA to increase the flow consent. There are plans to expand the WwTW. Funding is expected during AMP5 and construction could potentially start before 2015.

11.3.3 *Water Resources and Water Supply*

The following Table 11-2 provides a summary of the major supply reservoirs in the Daventry zone.

Water Treatment Works Source	***Reservoirs***
North of Northampton and Rutland	*Harpole*
	Weedon
	Borough Hill

Table 11-2: Daventry water resource and supply sources

For the three growth areas provided in Table 11-3 below, reinforcement of the existing trunk mains between Harpole and Weedon (Dodford) Reservoir will be required in AMP5. However further reinforcement may be required in the future (dependent on the level of growth).

Due to close proximity of Monksmoor Farm and Churchfields developments, there may be scope to consider a combined servicing approach for these areas.

Growth area	***WTW Requirements***	***Network Requirements***
Monksmoor Farm	*Upgrade storage at Weedon (Dodford) and Borough Hill Reservoir*	*Local reinforcement 2 km main*
Long Buckby Road	*Upgrade storage at Weedon (Dodford) and Borough Hill Reservoir*	*Local reinforcement 2 km main*
Danetree	*Upgrade storage at Weedon (Dodford) and Borough Hill Reservoir*	*Local reinforcement 1 km main*

Table 11-3: Daventry Strategic Infrastructure Requirements

11.3.4 *Ecological Constraints and Opportunities*

The following sensitive water/wetland sites were identified in Daventry:

- Daventry Reservoir and Country Park LNR (SP580640)

- Drayton Reservoir CWS (SP570646)
- Braunston Marsh CWS (SP7066)
- Badby Woods (BAP Wet Woodland) (SP560580)

Data requests have confirmed that the following protected and notable species have been recorded within Daventry and its urban fringes;

- Freshwater crayfish *Austropotamobius pallipes*
- Common toad *Bufo bufo*
- Water vole *Arvicola terrestris*
- Otter *Lutra lutra*
- Great crested newt *Triturus cristatus*
- Great crested grebe *Podiceps cristatus*
- Mute swan *Cygnus olor*
- Cormorant *Phalacrocorax carbo*
- Kingfisher *Alcedo atthis*

A brief overview of these sites, giving consideration to their proximity to the five development locations is provided below:

D011 (North of Daventry) - Drayton Reservoir CWS is a popular fishing reservoir on the northern fringe of the town. The reservoir is predominantly stocked with carp, perch, tench and roach. Its owners, British Waterways, say that the reservoir is arguably the best match fishery of its type in England, although as a stocked fishery its nature conservation value is more questionable.

D010/D011 (North East of Daventry) - Development to the north of the town could have a negative impact on the Daventry Reservoir and Country Park LNR which is located on the town's northern urban fringe. The Park is centred around the reservoir which is used to provide water for the Grand Union Canal.

D09/D08 (East and South East of Daventry) - No sensitive water or wetland sites were identified to the east of Daventry.

D012 (North West of Daventry) - Braunston Marsh CWS lies approximately 2.5km north west of the town's urban fringe. The site could suffer if development resulted in modification of the local hydrological regime.

In respect of the WCS, realistic contributions to nature conservation value have been identified as follows:

- **"Critical"** contributions relate to the preservation of existing international/national interests:
- "Important" contributions will protect existing regional/county interests whilst further promoting international/national interests;
- **"Desirable"** contributions will protect local interests and further contribute to regional/county and local value.

WCS contributions (nature conservation threats and opportunities) for Daventry are outlined in Table 11.4 below. The level of negative impact (high, medium, low, none) or positive contribution from enhancements (probable, tentative, none) likely in Daventry is also shown in the table (see key below). Significance criteria are shown in Table 1, Appendix K.

Negative impact	Positive contribution
H= High	Y = Probable
M = Medium	(Y) = Tentative
L = Low	
N = None	N = None

Key to Table 11-4

Development Locations	*Daventry*
CRITICAL	
Threat to integrity of statutory designated sites (SACs, SPAs, pSPAs, SSSIs, NNRs)	N
Threat to extent and quality of standing open waters	L
Threat to preserving extent and quality of floodplain grazing marsh	N
Threat to preserving extent and quality of rivers and streams	M
Threat to river water quality and (cyprinid) fisheries	H
Threat to otters and their habitats	M
Threat to water voles and their habitats	M

Development Locations	*Daventry*
Threat to great crested newts and their habitats	M
Threat to bat habitats and breeding bird habitats	L
Threat to freshwater crayfish and their habitats	M
IMPORTANT	
Threat to integrity of LNRs and CWSs	H
Threat to Local BAP habitats	M
Threat to Local BAP species	M
Potential to increase linkages between designated sites	(Y)
Potential to enhance quality and extent of standing open waters	(Y)
Potential to enhance extent and quality of floodplain grazing marsh	N
Potential to enhance otter habitats	(Y)
Potential to enhance fisheries habitats/ river water quality	Y
Potential to enhance water vole and otter habitats	(Y)
Potential to enhance great crested newt habitats and bat habitats	(Y)
DESIRABLE	
Potential to improve water quality and river corridors for invertebrates and bats that feed on them	Y
Maintain minor known populations of LBAP species (e.g., palmate newt)	(Y)

Table 11-4: WCS Contributions for Daventry

11.4 South Northamptonshire

South Northamptonshire is to deliver 8,250 new dwellings over the period 2006 – 2026, with an annual completion rate of 330. The majority of this growth will be provided in Towcester and /or Brackley. Brackley is being considered for a maximum growth of 1000 dwellings. Potential development sites have been identified within the Core Strategy Issues and Options Paper. Towcester Vale is a live planning application for 3500 dwellings to the south of Towcester; this coincides with a potential development region identified within the Issues and Options paper, so the site layout have been incorporated into the WCS. The Silverstone Circuit Development Brief is intended to provide planning guidance for improvements proposed for the motor racing circuit and this has also been considered within this WCS.

There is no insurmountable technical constraint to the proposed growth in South Northamptonshire.

11.4.1 Flood Risk Management

Towcester

Towcester is located in the south of the study area, in the district of South Northamptonshire, with the River Tove flowing east through the centre of the town. The River Tove is a tributary of the River Great Ouse. Most of the centre of the town is designated as Flood Zone 3, with some areas of Flood Zone 2 towards the south west of the town. The Environment Agency, in accordance with the action plan of the Great Ouse CFMP, is to develop a flood risk management study for the River Tove to identify what further actions can be taken to manage flood risk at Towcester.

Level 1 of the West Northamptonshire SFRA was published in August 2007 by Scott Wilson and was updated in January 2009. Level 2 of the SFRA will look in more detail at those areas of high risk where it is likely the PPS25 exception test will be required. The Level 2 SFRA is forthcoming. These documents will be reviewed for the Phase 2 Water Cycle Study.

The proposed location of Towcester Vale (site TO1) borders the south of the town surrounding the village of Wood Burcote in its extent. 3000 properties are proposed, along with 20.6 hectares of employment land. Silverstone Brook and Wood Burcote Brook flow through the area. A portion of the site lies in Flood Zone 3; the rest of the area is classified as Flood Zone 1 (low risk of flooding). The northern portion of the site falls within an area of DG5, which AWS has indicated as being at risk of foul water flooding.

Outline planning applications have been submitted for Towcester Vale. A flood risk assessment for the site, submitted as part of the outline planning application, was undertaken in 2007 by URS for Persimmon Homes. However if planning permission has not been

granted or revised permission is sought, any new developer would be required to undertake their own new flood risk assessment in line with PPS25.

Site TO2 could be seen as a southerly extension of this site and offers the potential for a single attenuation pond for both sites. It is in Flood Zone 1 and considered at low risk from flooding.

Part of the development site SN1, (TO1) is in flood zone 2 and 3 the developer of this site should undertake a flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for the sites, and the future extent of these flood zones with climate change. Land use within the site should be allocated according to the appropriate uses for the flood zones according to PPS25.

It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25. Any new development should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development, unless an exception test supported by the Core Strategy Sustainability Appraisal can provide evidence otherwise. Developers should incorporate river naturalisation and environmental enhancement into new developments wherever possible. This will support the actions outlined in the Great Ouse CFMP.

Post-development flows and volumes should be restricted to pre-development levels.

Silverstone

The site is within PPS25 Flood Zone 1 which identifies a low probability of flooding from fluvial sources. However, whilst there is no mapping of flood risk in Silverstone itself this does not mean that flooding does not exist. Rainfall runoff has the potential to cause localised flooding on the site. Retention ponds already exist on the Circuit to control and manage the run off from the site and to reduce flood risk at lower points of the area in particular Silverstone Village.

It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25.

A surface water drainage strategy should be produced for the circuit which should identify the current situation and proposals to deal with future development. In view of the flooding situation in the village of Silverstone, a recommendation for improved management of surface water drainage to reduce flood risk is advised. Opportunities to reduce runoff from landuse by future de-intensification should also be identified. This will support the actions outlined in the Great Ouse CFMP.

The developers should undertake a study to show that there will be no increase in flood risk from all developments draining into the existing watercourses. Post-development flows and volumes should be restricted to pre-development levels and should be managed on a site basis unless attenuation can be provided on a strategic basis. Attenuation for areas G2 and H1 could be provided on a strategic basis and this should be investigated by the developers.

It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

Brackley

Brackley is bounded on the south and east sides by tributaries of the River Great Ouse. Development areas in the town centre are in Flood Zone 1 and therefore are considered to be at low risk of flooding from rivers.

Runoff from B01 and B03 would enter the same receiving watercourse (a tributary of the Great Ouse running past Old Glebe Farm). Therefore there is potential for a strategic solution that benefits both areas. Attenuation ponds may be possible on this watercourse and this should be investigated further as part of a Phase 2 Water Cycle Study. Any development in this location should not enhance flood risk downstream (e.g. any development in area B01 must not increase flood risk to area B03).

As part of the development site B03 is adjacent to an area of flood zone 2 the developer of this site should undertake a flood risk assessment to establish the extent of the flood zones 2, 3a and 3b for the site, and the future extent of these flood zones with climate change. Land use within the site should be allocated according to the appropriate uses for the flood zones according to PPS25. It is recommended that the Core Strategy includes policies for no inappropriate development in the floodplain using methods in PPS25. Any new development should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development, unless an exception test supported by the Core Strategy Sustainability Appraisal can provide evidence otherwise. This will support the actions outlined in the Great Ouse CFMP.

All three sites will require a flood risk assessment to deal with surface water drainage. The sites are greater than 1ha so the Environment Agency will be required to comment on the flood risk assessment regardless of whether part of the site is in flood zone 2 or 3.

Opportunities to reduce runoff from landuse by future de-intensification should be identified. This will support the actions outlined in the Great Ouse CFMP.

Post-development flows and volumes should be restricted to pre-development levels. Developers should undertake a study to show that there will be no increase in flood risk from developments draining into the Great Ouse or its tributaries.

The developers must take account of any recommendations from the Great Ouse CFMP and the planned Bedford Ouse flood risk management study.

It is recommended that supplementary Planning Guidance or similar is investigated to identify how SuDS can be adopted.

11.4.2 Foul Drainage, Sewage Treatment and Water Quality

Towcester and Silverstone

Towcester sewage is treated at Towcester WwTW. The majority of the sewage network operates using separate foul and surface water sewers. Silverstone is serviced by Silverstone WwTW. Information on the capacity within the existing network had not been made available by AWS during these investigations, therefore interrogation of the existing network model is required before concluding any upgrade options. If capacity is not available within this network, then it will be necessary to provide direct conveyance from the southern proposed development to the works, either by gravity or by pumping.

Flow data suggest that Towcester treatment works is currently flow compliant, but, if the proposed development takes place at the assumed rate, a revised consent will be required at or around the year 2011; this will require infrastructure investment. AWS do not expect flow revision to be required until after 2015.

It is understood that current negotiations between AWS and the Environment Agency on the consent for Silverstone WwTW are based upon the assumption that the existing sanitary limits will be unchanged as a result of the dry weather flow amendment. If this situation prevails, the existing treatment facilities will be adequate for present and future flows. However, the Environment Agency will clearly model the potential impact of this increased flow on the watercourse, and if tighter consent conditions are found to be necessary, the treatment works will require infrastructure improvements.

The following Table 11-5 identifies the associated constraints and opportunities with regard to foul drainage for developing the sites identified within the Core Strategy Issues and Options paper for Towcester.

Site	Comments
T01	The most likely strategy to serve this site is via connection to the trunk main flowing to Towcester WwTW. This concentration of growth is an efficient way to develop the area.
T02	This site may be served by connection into a strategic solution to Towcester WwTW in the event that T01 is developed. If T01 is not developed, an alternative solution may be to direct the

	site toward Silverstone WwTW.

Table 11-5 Assessment of Towcester Sewerage Constraints and Opportunities

The developers of the Silverstone circuit will need to provide a solution to the satisfaction of the planning authorities. Silverstone WwTW is the current likely option and reinforcement of existing sewers would be required to service it.

Brackley

The works has no available headroom on the basis of the consented flow, and a revised consent will be required before the treatment works can accommodate the projected growth.

However, although the principal trade effluent discharge is currently equivalent to a load from a population of 9,600, the load from this source has exceeded 20,000 population equivalent in recent years, and it is understood that this load was within the trader's discharge consent. It will therefore be necessary for AWS to estimate the likely, future load from this source to determine the need for a future increase in treatment capacity.

The following Table 11-6 identifies the associated constraints and opportunities with regard to foul drainage for developing the sites identified within the Core Strategy Issues and Options paper for Brackley.

Site	Comments
B01	This site is a significant distance from Brackley WwTW. It would not be a sustainable or cost efficient site to develop in isolation, however if B03 was developed also a strategic solution may service both sites.
B02	This site is on the opposite side of the town to Brackley WwTW. It is not a practical, cost effective, or sustainable site to develop in isolation. It is not very appropriate for a combined strategy either. This site is not recommended.
B03	These sites are closest to Brackley WwTW and may connect into the trunk main with no major constraint.

Table 11-6: Assessment of Brackley Sewerage Constraints and Opportunities

11.4.3 Water Resource and Water Supply

Towcester and Brackley

The following Table 11-7 provides a summary of the major supply reservoirs works in the Towcester zone.

Water Treatment Works Source	Reservoirs

West of Huntingdon	*Great Houghton*
Rutland	*Hannington*
West of Huntingdon and Rutland	*Salcey*
	Deanshanger
	Foxcote
	Greatworth
	Tiffield

Table 11-7: Towcester and Brackley water resource and supply sources

The following Table 11-8 provides an overview of the reinforcements required to support growth to Towcester and Brackley.

Area	*Growth area*	*WTW Requirements*	*Network Requirements*
Brackley	*Radstone Fields (including surrounding areas)*	*None*	*Local reinforcement 3km long*
Towcester	*Land South of Towcester (including surrounding areas)*	*Pumps upgrade at Deanshanger*	*A new dedicated main 8 km long with a pumping station There is a potential to phase the delivery*

Table 11-8: Towcester and Brackley Strategic Infrastructure Requirements

Silverstone

Silverstone is supplied from Wittlebe Reservoir which is fed ultimately from water treatment works west of Huntingdon and in Rutland. To support the proposed development at the race circuit, approximately 700m of upgrade is required.

11.4.4 *Ecological Constraints and Opportunities*

The following sensitive water/wetland sites were identified in South Northamptonshire:

Towcester :

- Kingsthorne Wood BAP Wet Woodland (SP660490)
- BAP Floodplain Grazing Marsh (SP705485)

Silverstone (Motor Racing Circuit only):

- Syresham Marshy Meadows SSSI (SP638426/SP645422)
- Several areas of BAP Wet Woodland Habitat

Brackley:

- One un-designated nature reserve (St James Fishing Lake) featuring standing open water (SP580367).

Data requests have confirmed that the following protected and notable species have been recorded within South Northamptonshire:

Towcester

- Water vole *Arvicola terrestris*

Silverstone

- Common toad *Bufo bufo*
- Water vole *Arvicola terrestris*
- Great crested newt *Triturus cristatus*
- Otter *Lutra lutra*
- Reed bunting *Emberiza schoeniclus*
- Snipe *Gallinago gallinago*

Brackley

- Water vole *Arvicola terrestris*
- Freshwater crayfish *Austropotamobius pallipes*

A brief overview of these sites, giving consideration to their proximity to the five development locations is provided below:

Towcester

T01 / T02 – No sensitive water or wetland sites were identified in these areas.

Silverstone (motor racing circuit only)

North/North East: A small area of BAP wet woodland habitat was identified immediately north of the motor racing circuit, and a larger area of BAP wet woodland habitat was identified to the north east of the motor racing circuit. The integrity of these sites could be

compromised if potential development modified the local hydrological regime and caused water level changes at these wet woodland sites.

East/South East: No sensitive water or wetland sites were identified directly adjacent to these areas.

South/South West: Areas of BAP wet woodland habitat were identified adjacent to the south and south west of the motor racing circuit. Streysham Marshy Meadows SSSI can also be found approximately 3km to the south west of the circuit. The integrity of these sites could be compromised if potential development resulted in modification the local hydrological regime leading to water level changes at these sites.

West/North West: No sensitive water or wetland sites were identified directly adjacent to these areas. However, there is a risk that the integrity of BAP wet woodland habitats situated further to the west of the motor racing circuit could be compromised if potential development modified the local hydrological regime.

Brackley

B01/B02/B03: No sensitive water or wetland sites of the designations considered in this study were identified in or around Brackley.

In respect of the WNWCS, realistic contributions to nature conservation value have been identified as follows:

- **"Critical"** contributions relate to the preservation of existing international/national interests:
- "Important" contributions will protect existing regional/county interests whilst further promoting international/national interests;
- **"Desirable"** contributions will protect local interests and further contribute to regional/county and local value.

WNWCS contributions (nature conservation threats and opportunities) for the five potential development locations are outlined in Table 11.9 below. The level of negative impact (high, medium, low, none) or positive contribution from enhancements (probable, tentative, none) likely in each development location is also shown in the table (see key below). Significance criteria are shown in Table 1, Appendix K.

H= High	Y = Probable
M = Medium	(Y) = Tentative
L = Low	
N = None	N = None

Key to table 11-9

Development Locations	*Towcester*	*Silverstone (Motor Racing Circuit)*	*Brackley*
CRITICAL			
Threat to integrity of statutory designated sites (SACs, SPAs, pSPAs, SSSIs, NNRs)	N	M	N
Threat to extent and quality of standing open waters	**L**	**N**	**L**
Threat to preserving extent and quality of floodplain grazing marsh	**N**	**M**	**N**
Threat to preserving extent and quality of rivers and streams	**M**	**L**	**M**
Threat to river water quality and (cyprinid) fisheries	**M**	**L**	**L**
Threat to otters and their habitats	**L**	**M**	**L**
Threat to water voles and their habitats	**M**	**M**	**M**
Threat to great crested newts and their habitats	**L**	**M**	**L**
Threat to bat habitats and breeding bird habitats	**L**	**M**	**L**
Threat to freshwater crayfish and their habitats	**L**	**L**	**M**
IMPORTANT			
Threat to integrity of LNRs, CWSs	**N**	**N**	**N**

Development Locations	*Towcester*	*Silverstone (Motor Racing Circuit)*	*Brackley*
Threat to Local BAP habitats	**H**	**H**	**N**
Threat to Local BAP species	**L**	**M**	**M**
Potential to increase linkages between designated sites	**(Y)**	**Y**	**N**
Potential to enhance quality and extent of standing open waters	**N**	**N**	**N**
Potential to enhance extent and quality of floodplain grazing marsh	**Y**	**N**	**N**
Potential to enhance otter habitats	**Y**	**N**	**N**
Potential to enhance fisheries habitats/ river water quality	**Y**	**N**	**N**
Potential to enhance water vole and otter habitats	**Y**	**N**	**N**
Potential to enhance great crested newt habitats and bat habitats	**N**	**N**	**N**
DESIRABLE			
Potential to improve water quality and river corridors for invertebrates and bats that feed on them	**Y**	**N**	**Y**
Maintain minor known populations of LBAP species (e.g., palmate newt)	**(Y)**	**(Y)**	**(Y)**

Table 11-9: WCS Contribution for South Northamptonshire

11.5 Scope for Phase 2

Based upon the findings of this Phase 1 Outline Water Cycle Strategy, the following scope for Phase 2 has emerged:

- Review the findings of the Phase 1 WCS in light of any new information available at the time of commencement.
- Incorporate into the Water Cycle Strategy additional information on proposed employment growth.
- Incorporate into the Water Cycle Strategy additional information on the LDF sites in Northampton, Daventry and South Northamptonshire. This is particularly important in Northampton where locating the proposed growth in the LDF will enable strategic infrastructure solutions to be determined for flood risk, foul drainage and the supply network.
- Where possible, optimise the strategic water cycle solution for Northampton through incorporation of the interim strategy.
- Undertake detailed analysis for Daventry, Northampton and South Northamptonshire including programme (timeline of infrastructure requirements) and indicative costs based upon latest planning information.
- Undertake detailed cost benefit analysis of the aspirational water efficiency scenarios outlined in the Phase 1 WCS, including advice on how the suggested consumption targets could be achieved in existing properties, and whether this would be the most sustainable approach.
- If Brackley growth is included in the LDF, then the difference between measured flow and current assessed flow needs to be reconciled to confirm the capacity at the WwTW. In addition, it will be necessary for AWS to estimate the likely future load from the principal trade effluent discharge at Brackley and incorporate the findings into the Phase 2 WCS.
- Investigate further the capacity of the foul drainage networks in Towcester and Brackley.
- Incorporate the conclusions on ongoing consent negotiations at Whilton WwTW and Silverstone WwTW.
- Incorporate the findings of the West Northamptonshire Level 2 SFRA and sequential test.
- Incorporate the findings of the final River Nene Catchment Flood Management Plan and the final River Great Ouse Catchment Flood Management Plan.
- Engage relevant stakeholders to develop an integrated and comprehensive Surface Water Management Plan for Northampton, including common SuDS Adoption Strategies for the whole Study Area.
- Develop ecological design criteria for the sites yet to obtain planning permission in Northampton, Daventry and Silverstone, to maximise the appropriate water / wetland ecological benefits through relevant design of surface water and grey water management infrastructure.
- Develop a schedule of tasks and activities for developers and relevant stakeholders to implement the Phase 2 WCS.

- Determine the basis for a financial mechanism for developer contribution.
- Consideration of the crucial links between green infrastructure provision, reducing flood risk, and the protection and enhancement of biodiversity character, particularly in relation to Northampton and Daventry.
- Consideration of the wider environmental issues resulting from the proposals, with a particular focus on resource efficiency, mitigating and adapting to climate change, sustainable construction, and minimising waste streams arising from construction. Ensure reference to other studies such as Green Riverside Park.

It is recommended that the Phase 2 Water Cycle Strategy for Northampton and South Northamptonshire does not commence until development sites have been identified in the Core Strategy.

12 References

12.1 List of documents referenced and status

No	Document name	Current status (April 2009)	Status of document used in WCS report
1	Draft East Midlands Regional Plan (March 2006)	(See 2)	Superseded (see 2)
2	East Midlands Regional Plan (2009)	Adopted 12 March 2009	Adopted in March 2009. Footnote inserted in section 2.2 of report: "The East Midlands Regional Plan was adopted in March 2009. The housing figures have changed marginally, actually going back to the former housing figures i.e. for West Northants 62,125. The consequential changes related to this would affect several parts of the document. This is a change of 25 dwellings across the whole area from the housing figures used in the Outline Phase 1 report. The changes will be incorporated in the level 2 Water Cycle Strategy. The adopted Regional Plan can be found at: **http://www.gos.gov.uk/497296/docs/229865/EMRP**
3	Core Strategy Issues and Options paper (September 2007)	Current	Current
4	Northampton Longer Term Growth Options Study by EDAW (March 2007)	Current	Current
5	Daventry District Local Plan Adopted 1997	Current (Joint Core Strategy at issues and options stage)	Current (Joint Core Strategy at issues and options stage)
6	Northampton Borough Local Plan Adopted June 1997	Current (Received Gov direction 27/09/07 extending "saved policies" until adoption of LDF)	Current (Received Gov direction 27/09/07 extending "saved policies" until adoption of LDF)
7	South Northamptonshire Local Plan Adopted October 1997	Current	Current
8	Northamptonshire Structure Plan (2001)	Current - 8 policies "saved" by gov direction from 28/09/07 – 12/03/09	Current - 8 policies "saved" by gov direction from 28/09/07 – 12/03/09
9	Approved Silverstone Circuit Masterplan Development Brief	Adopted	Adopted

No	Document name	Current status (April 2009)	Status of document used in WCS report
	March 2009		
10	CoPELA Report (employment data) 2003, updated 2006	Revised in December 2003 and July 2006	Revised in December 2003 and July 2006
11	Strategic Northamptonshire Economic Action Plan (SNEAP)	Final Report to the Project Board 31st January 2008.	Strategic Northamptonshire Economic Action Plan (SNEAP) Annual Monitoring Reports 2006-2007
12	Milton Keynes and South Midlands Strategy (March 2005)	Adopted March 17 2005. Currently being reviewed to reflect adoption of East Midlands RSS in March 2009.	Adopted March 17 2005. Currently being reviewed to reflect adoption of East Midlands RSS in March 2009.
13	Northampton Annual Monitoring Review 2006-2007	Current (latest available review 2007-08)	Current (latest available review 2007-08)
14	Daventry Annual Monitoring Report 2006-2007 (revised February 2008)	Current (latest available review 2007-08)	Current (latest available review 2007-08)
15	Towcester masterplan	Not currently available	Not available at time of writing. Report notes this is due in January 2009. Is it available now?
16	Brackley masterplan	Not yet available	Not available at time of writing. Report notes work on this is due to start in early 2009.
17	Urban Capacity Study published in January 2005 (for Daventry housing figures – mentioned in Appendix A)	Current	Current
18	Northampton Borough Council Strategic Flood Risk Assessment Stage 2, December 2004	Current	Current
19	West Northamptonshire Strategic Flood Risk Assessment Level 1 (August 2007)	Current	Current. Level 2 SFRA pending
20	Nene Catchment Flood Management Plan Main Stage Report (2008)	Draft	Draft. Final CFMP expected to be published in 2009.
21	Great Ouse CFMP Catchment Flood Management Plan Main Stage Report Summary (February 2007)	Draft	Draft. Still in draft and been subject to review.

No	Document name	Current status (April 2009)	Status of document used in WCS report
22	Preliminary rainfall runoff management for developments", (Defra and Environment Agency, 2005	Current	Current
23	Environmental Capacity Assessment undertaken by Halcrow Group Limited for Anglian Water Services (Phase 1, December 2008).	Ongoing	Ongoing.
24	Sewers for Adoption, 6th Edition, March 2006	Current	Current
25	AWS draft Water Resource Management Plan (2008)	Draft - undergoing public consultation (Final due to be submitted to DEFRA in April 2009)	Draft - undergoing public consultation (Final due to be submitted to DEFRA in April 2009)
26	Strategic Direction Statement 2010 – 2035	Current	Current
27	Planning for drought in the Anglian Water region	Current	Current
28	Catchment Abstractions Management Strategies (CAMS, Environment Agency)	Current	Current
29	Annual Monitoring Reports 2006-2007	Annual Monitoring Reports 2007-2008	Annual Monitoring Reports 2006-2007

Appendix A – Population Growth

A1 Introduction

This Appendix gives details of population growth and housing trajectory from the relevant Annual Monitoring reports, as background to more specific allocation of future housing growth.

A2 Daventry

The opportunity presented by the Milton Keynes and South Midland Strategy has been firmly grasped by Daventry District Council as a means of securing for current and future residents the benefits of investment and growth. As part of this, the Council has ambitious plans for the future of the town and its hinterland.

A trajectory for housing development in Daventry based on past rates of housing completions and conversions, commitments and urban housing capacity figures compares the expected provision of housing in Daventry with the RSS8 requirements.

Based on a review of past building rates it is possible to predict the windfall development rate that is likely to occur within Daventry Town between 2006 and 2026. These are sites that have not been specifically identified in the local plan process. This will assist the formulation of the housing trajectories into future build rates for smaller sites. It is predicated that an average windfall completion rate for the Town over the remaining 15 years of the Plan is 18 dwellings per annum. Outside the town, it is envisaged that 91 dwellings will come forward per annum. These figures are subject to change.

The projected figures include assessments of housing capacity from an Urban Capacity Study published in January 2005. This study estimated the housing capacity within Daventry Town up to 2021 was 175 dwellings, reduced to 116 to avoid double counting windfalls on previously developed land. This estimate has been rebased to April 2005 for the purposes of this trajectory meaning that the housing capacity within Daventry Town over the housing trajectory is 108 dwellings.

To enable a robust projection of future build rates it is important to ascertain in general terms the likely time period when committed developments will be completed. The forthcoming LDF will contain new housing allocations to meet the strategic requirements. The Council have attempted to inform the trajectory by assuming that development on the new LDF allocations in the town and urban extensions will begin to contribute towards completions during 2009/10.

For the purposes of this trajectory, in advance of the DPD that provides for site specific allocations, it is estimated that around 540 dwellings per annum will come forward however these figures are subject to change.

In 2005, Daventry District had an estimated population of 75,900. The table below shows the resident population has increased by 3,800 since 2001, which is relatively strong compared to other benchmark areas. Based on the 2005 estimate, the population density of the District was 1.14 persons per hectare.

Population change (000's)

	2001	**2005**	**% Increase**
Daventry	72.1	75.9	5%
Northamptonshire	630.5	651.8	3.3%
England	49,181.4	50,431.7	2.5%

Source*: Mid Year Population Estimates, NOMIS, ONS*

The Government has identified Daventry as a location for major growth over the next 20 years and the population is projected to grow considerably.

A housing trajectory for the District has been prepared charting progress towards meeting the housing supply. It shows the housing completions from 2001, and the anticipated future completions from 2006 to 2021 as set out below. Whilst the Government examines densities on all completed sites, developments of 10 or more dwellings are also looked at.

The trajectory data updates Table 1 to 2008. Land comprises of the following;

- Current applications;
- Unimplemented Planning permission since 2006. This allows the issues and options completions to be updated;
- Pre-applications; and
- Allocated sites from the Local Plan

Table 1: Future Housing Provision in Daventry, 2008

DAVENTRY						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2019**	**2020-2026**	**Total**
D1	Rigiflex site	Unimplemented planning permission since '06	34			34
D2	Land At Holcot Road	Unimplemented planning permission since '06	14			14
D3	Shaw & Upton and The Limes	Unimplemented planning permission since '06	24			24
D4	Land to rear of heart of England	Unimplemented planning permission since '06	13			13
Sub Total						**85**
D5	Middlemore site 5a&b	Outstanding App as Mar '08	99			99
D6	Middlemore Sites 7/8/9	Outstanding App as Mar '08	190	88	278	556
D7	Buckton Fields	Outstanding App as Mar '08	625	625		1250
D18	Buckton Fields East	Outstanding App as Mar '08	250	250		500
D8	Middlemore Site 4	Outstanding App as Mar '08	62			62
Sub Total						**2467**
D9	Badbury Road	Pre-app Stage		200		200
D10	Town Centre	Pre-app stage	200	300		500
D11	Brookfield Farm	Pre-app stage		1000	1000	2000
D12	Middlemore Site 6a&b	Pre-app Stage	36			36
D13	Middlemore sites 3a,b,c	Allocated in Local Plan	20			20
Sub Total						**2756**

DAVENTRY						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2019**	**2020-2026**	**Total**
D14	Churchfields	Subject to appeal to the Secretary of State	800	1000	2200	4000
D15	Land East of Deventry /North A45 road (Danetree)	Subject to appeal to the Secretary of State	800	1000	3350	5150
D16	Monks more farm	Subject to appeal to the Secretary of State	500	500		1000
D17	Land off North Street	Application withdrawn (WNDC Monitoring Table Jan 2008)	59			59
Sub Total						**10,209**
Total						**15,517**

A3 ***South Northamptonshire;***

The estimated population in the middle of 2003 was 82,600 and 33,400 households. It is expected that this is to grow over the coming years and by 2031 the population is projected to grow to 91,900, however, this increase does not account for any expansion as a result of the proposed Milton Keynes and South Midlands Development. The population is spread over a wide geographic area of 63,156 hectares and is the fastest growing in the county with an increase of 22.3% since 1991. There are only two main towns: Brackley, with a population of 13,500 and Towcester with 9,200.

District	***2004 estimate***	***2011 projection***	***2021 projection***	***2031 projection***
South Northamptonshire	82,600	87,000	90,500	91,900

Source: *2004 estimate- Office for National Statistics Projected population – Northamptonshire Observatory, 2004*

The first four years of the plan period have yielded more than the 330 dwellings per annum required by the Regional Spatial Strategy. This represents a continuation of the existing and historic rate of completions since 2001, where an average of 306 dwellings has been completed per year. As all but a few local plan allocations have now been completed, it is expected that the completion rate will fall below the annual requirement for the next two years as the new Local Development Framework is prepared. However it is expected that there will be a small over provision in five years time. The proposed development in the villages together with anticipated windfall growth will then ensure that the required rate is

achieved. Housing at Towcester is expected to come forward in the second half of the plan period and from that date will comprise the bulk of new development in the District.

Completions on windfall sites have always made a significant contribution to the housing supply in South Northamptonshire. An assessment of the last 10 years windfall show that on average 42% (244) of new homes were built on windfall sites, of these 48% (119) were in the rural areas, this represents an average of 28% of all housing completions in the District. South Northamptonshire is a predominately rural district with at least 76 settlements which can accommodate small scale infill development. It is likely that the trend of developing in the rural areas will continue.

For the purposes of this trajectory, in advance of the DPD that provides for site specific allocations, it is estimated that around 330 dwellings per annum will come forward however these figures are subject to change.

Table 2: Future Housing Provision in South Northamptonshire, 2008

SOUTH NORTHAMPTONSHIRE						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2019**	**2020-2026**	**Total**
S1	Brackley College Place	Unimplemented Planning Permission since '06	51			51
S2	Brackley Buckingham rd	Unimplemented Planning Permission since '06	62			62
S3	Brackley town farm high street	Unimplemented Planning Permission since '06	13			13
S4	Cogenhoe r/o 20 St Peters Road	Unimplemented Planning Permission since '06	8			8
S5	Brackley House Brackley	Unimplemented Planning Permission since '06	22			22
S6	Deanshanger Site 6 Elementis	Unimplemented Planning Permission since '06	11			11
S7	Litchborough Farthingstone Road	Unimplemented Planning Permission since '06	14			14

SOUTH NORTHAMPTONSHIRE						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2019**	**2020-2026**	**Total**
S8	Old Stratford off Towcester Road	Unimplemented Planning Permission since '06	9			9
S9	Chestnut Close Milton Malsor	Unimplemented Planning Permission since '06	16			16
S10	Cross Yard Hartwell	Unimplemented Planning Permission since '06	40			40
S11	Elementis 9 Deanshanger	Unimplemented Planning Permission	26			26
S12	Brackley Springfield Way - BH2	Unimplemented Planning Permission since '06	55			55
S13	Towcester East of Green Lane - TH2	Unimplemented Planning Permission since '06	35			35
S14	Silverstone	Approved in Principle	190			190
Sub Total			**552**			**552**
S15	Towcester Vale	Outstanding Apps as Mar '08	1500	1500		3000
S16	Deanshanger Elementis - RH1(A)	Outstanding Apps as Mar '08	22			22
S17	Roade Walkerpack	Outstanding Apps as Mar '08	37			37
S18	Towcester Moat Lane	Outstanding Apps as Mar '08	25			25
S19	Paulerspury Grafton Hunt Kennels	Outstanding Apps as Mar '08	15			15
S20	Norwood farm	Outstanding Apps as Mar '08		780		780
S21	Silverstone high street	completed		36		36
Sub Total			**1,599**	**2,316**		**3,915**

SOUTH NORTHAMPTONSHIRE						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2019**	**2020-2026**	**Total**
S22	The Leys Road	Pre Application		100		100
S23	Radstone Fields. N. Brackley	Pre Application	600	650		1250
Sub Total			**600**	**750**		**1,350**
S24	Brackley Daniaud Court - BH1(D)	Allocated in Local plan			56	56
S25	Brackley Stuart Road - BH1(E)	Allocated in Local plan			100	100
S26	Wootton fields	Allocated in Local Plan			300	300
Sub Total					**456**	**456**
Total						**5,817**

A4 ***Northampton;***

Northampton has consistently grown at nearly twice the national rate and over the next twenty years or so Northampton will continue to grow, from a population of 200,000 to around 300,000, presenting exciting opportunities for investment and development.

The population estimates and projections for Northampton

District	**2004 estimate**	**2011 projection**	**2021 projection**	**2031 projection**
Northampton	**194,800**	**218,500**	**242,200**	**292,00**

Source: *2004 estimate- Office for National Statistics Projected population – Northamptonshire Observatory, 2004*

This years housing trajectory shows that although the Borough exceeded its annual built rate for the second year running, the housing growth requirements set out in the adopted RSS8 and emerging East Midlands Regional Plan are unlikely to be met within the plan period. It is forecast that further sustainable urban extensions will be required to meet growth requirements.

Projected completions are based on 50 dwellings or more, with planning permissions, approved planning briefs and draft master plans and proposed urban extensions (either with

permissions or allocated in the adopted Local Plan). The trajectory includes Grange Park, which is a site currently under development within the administrative boundary of South Northamptonshire.

Large developments in the urban extensions of Dallington Grange and South West District are expected to be completed by 2021, netting a total of 9,061 dwellings, 3,500 and 5,561 respectively. If the projected growth figure of 40,375 is adopted, then there will be a shortfall in the projected developments likely to take place within the plan period. It is considered likely that further urban extensions will be required to meet the projected growth requirements of 2026.

The information in the table below has been updated following a review of Northampton Borough Council's Annual Monitoring 2006 – 2007. The information below is correct at the time of print (31st March 2007), unless otherwise indicated.

Table 3 Future Housing Provision in Northampton, 2008

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N1	Shelfley's Site	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	72			72
N2	Derby Rd	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	12			12
N3	Duke Street	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	18			18
N4	Craven St	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	12			12
N5	Upton Way Site E	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	49			49
N6	St Giles St	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.		39		39

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N7	East Park Parade	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.		10		10
N8	St Michaels Rd 2	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	20			20
N9	Balmoral Rd	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.		20		20
N10	52 56 Hazelwood Rd	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	14			14
N11	Artizan Rd	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	10			10
N12	Duke Street	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	10			10
N13	Regent Street (N/2004/1120)	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	15			15
N14	St Andrews Rd	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	24			24
N15	Lorne Rd	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	10			10
N16	Semilong Road	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.		29		29
N17	Booth rise	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	12			12
N18	Grange Road	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented	66			66
N19	Freeschool Street	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented		97		97

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N20	Northampton post office, St Giles St (07/0086/FULW NN)	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented	12			12
N21	Harborough Rd	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	10			10
N22	High St	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.		16		16
N23	Wellingbourgh rd (N/2002/1414)	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.	81			81
N24	St George's Street	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented		67		67
N25	Cliftonville Rd	Unimplemented planning Permission since '06	14			14
N26	Upton Way site A	According to current planning applications this site has unimplemented planning permission	14			14
N27	East of Upton Way	Unimplemented planning Permission since '06	Check figures			90
N28	Tonmead Road	Unimplemented planning permission Since '06		13		13
N29	Peveril Road	Unimplemented planning permission Since '06	21			21
N30	Kingsthorp high street	Unimplemented planning permission Since '06	10			10
N31	Bective rd (WN/2006/0028)	According to NBC's AMR 2007 as of 31st March 2007 this site remains unimplemented.		100	55	155
N32	St Katherines Terrace (N/2006/0066)	Unimplemented planning Permission since '06	19			19

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N33	Wootton (if this is site C it has been built out, needs checking)	Unimplemented planning Permission since '06	28			28
N37	Dunster Street	According NBC planning permission has now been approved (30/1/08)		10		10
N38	Emmanuel school (WN/2006/0029)	Approved by committee Sept 08	109			109
N39	St Gregory's lower school	According to NBC development proposals have been approved in principle.	20	49		69
N40	St Andrews Rd	According to NBC's AMR 2007 planning permission lapses on 25/11/08	40			40
N41	British Timken	Outline planning permission granted 19th April 2007. According to NBC's AMR 2007 this site is now under construction.	280	200		480
Sub Total						**1797**
N42	South Bridge West	According to NBC's AMR this site is now under construction.	34			34
N43	Upton Way Site D1	According to NBC's AMR 2007 this site is now under construction	79 (completed)	166	100	345
N44	Mill lane	According to NBC's AMR 2007 this site is now under construction	9 (completed)	15		24
N45	Billing Lane	According to NBC's AMR 2007 this site is now under construction	10 (completed)			162
N46	St Crispin area G	According to NBC's AMR 2007 this site is now under construction	135 (completed)			160

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N47	South Bridge East East (planning app N/1999/1166)	According to NBC's AMR 2007 this site is now under construction	134 (completed as at 31st March 2008)			367
N48	4-5 Cheyne Walk	According to NBC's AMR 2007 this site is now under construction	24			24
N49	Talavera Way (N/2004/0814)	According to NBC's AMR 2007 this site is now under construction	138 (completed)			149
N50	Berrywood Rd (N/2004/1542, N/2005/0144, N/2005/1298)	According to NBC's AMR 2007 this site is now under construction	179 (completed)			295
N51	Upton Way Site B	According to NBC's AMR 2007 this site is now under construction	204			204
N52	Upton Way Site C	According to NBC's AMR 2007 this site is now under construction	25 (completed)			30
N53	Upton Way Site D2	According to NBC's AMR 2007 this site is now under construction	49 (completed)	81	38	165
N54	Ladybridge Drive	According to NBC's AMR 2007 this site is now under construction	18 (completed)			72
N55	Newport Pagnell Road	According to NBC's AMR 2007 as of 31st March 2007 this site is under construction	57 (Completed)			75
N56	Woolmonger Street (N/2005/0730)	According to NBC's AMR 2007 this site is now under construction	70 (completed)	65		135
N57	Land at cotton end (N/2005/0446)	According to NBC's AMR 2007 this site is now under construction	25 (completed)	53		78

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N58	Station Rd	According to NBC's AMR 2007 this site is now under construction	5 (complete)	5		10
Sub Total						**2329**
N59	Pineham barns	Outstanding applications as Mar '08	625			625
N60	Gregory Street (Application No 07/0040/FULWNN)	Outstanding applications as Mar '08		46		46
N61	Nichols Street	Outstanding applications as Mar '08		52		52
N62	Princess Marina hospital	Outstanding applications as Mar '08	275	275		550
N63	Land off Ransome Rd	Outstanding applications as Mar '08	250	450	100	800
N64	Land at Nunn Mills	Outstanding applications as Mar '08 (on hold)	450	625	175	1250
N65	Nene Enterprise	Outstanding applications as Mar '08	34			34
N66	Pearce Leatherworks	Outstanding applications as Mar '08	100			100
N67	Grafton Street	Outstanding applications as Mar '08	19			19
N68	Pineham	Outstanding applications as Mar '08		950		950
N69	Far Cotton - phase II hill farm site, Towcester rd	Outstanding applications as Mar '08	100	141		241
N70	Gold Street	Outstanding applications. According to NBC's AMR 2007 as of 31st March 2007		6		6

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N71	Upton Lodge (Bryan) F	Outstanding applications as Mar '08 (due to go to committee 28th Oct 08)	80 (check figures with LPA)			80
N72	Upton Lodge (Bryan) G	Outstanding applications as Mar '08 (due to go to committee 28th Oct 08)	108 (check figures with LPA)			108
N73	Upton Lodge (Bryan) H	Outstanding applications as Mar '08 (due to go to committee 28th Oct 08)	136			136
N74	Dallington Grange	Outstanding applications as Mar '08 According to NBC's AMR 2007 a decision is pending	400	1750	1350	3500
Sub Total						**8497**
N75	Upton Lodge (excluding Norwood Farm)	Outline Application				**1,787**
N76	Grange Park	To be determined by WNDC (WNDC 2008)	200	250		**450**
N77	Lings wood	Pre-Application Stage		32		32
N78	Kingsthorp Rd	Pre-Application Stage		50		50
N79	Dallington Mill	Pre-Application Stage	30			30
N80	Gold Street	Pre-Application Stage		52		52
N82	Bridge Street	Pre-Application Stage	24			24
N83	Land off Maine, Far Cotton	Pre-Application Stage			340	340
N84	Northampton General Hospital	Pre-Application Stage		80		80
N85	Regent Street	Pre-Application Stage		43		43

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N86	Freeschool Street Site (is this a duplicate of N45)	Pre-Application Stage			370	370
N87	Castle Station	Pre-Application Stage		325	325	650
N88	Land east of Lenords Rd	Pre-Application Stage	50	50		100
N89	St Edmunds Hospital	Pre-Application Stage	85		200	285
N90	Hardingstone Allotments	Pre-Application Stage	71			71
N91	Banbury Lane	Pre-Application Stage			200	200
N92	Upton Park	Pre-Application Stage	100	400	400	900
N93	Abbots Way	Pre-Application Stage		50		50
N94	Arlington site, Bedford /rd	Pre-Application Stage		220		220
N95	55 Barrack Rd	Pre-Application Stage		290		290
N96	Sixfields District Centre	Pre-Application Stage		350	350	700
Sub Total						**4487**
N97	Hazelwood rd (N/2004/1375)	According to NBC's AMR this site has now been completed.	10			10
N98	St Peters Way (07/0141/FULW NN)	Refused by committee in April 08	86			86
N99	Victoria Rd (N/2003/0022)	According to NBC's AMR 2007 as of 31st March 2007 this site has now been completed		12		12

NORTHAMPTON (NIA)						
Site Ref	**Site**	**Planning Status**	**2008-2013**	**2014-2018**	**2019-2026**	**Total**
N100	St Michaels Rd	According to NBC's AMR 2007 planning permission has now lapsed on this site.		52		52
N101	Wallbeck Close	According to NBC's AMR 2007 the planning permission lapsed on 26/03/2008.	22			22
Sub Total						**182**
Total						**19,912**

Appendix B – Catchment Flood Management Plans

Table 1 Policy Units from the River Nene CFMP lying within West Northamptonshire. Source: Draft River Nene Catchment Flood Management Plan, 2008. The final CFMP expected to be published by the Environment Agency in 2009

Policy unit	**Area (km^2)**	**Characteristics**	**Location**	**Sources**	**Mechanism**	**Receptors**
1. Upper and middle Nene catchment	1331	Rural with scattered small settlements, but including the medium sized towns of Daventry, Rothwell and Desborough. Low population density.	Headwaters of the River Nene and tributaries, including the major tributaries of: Harpers Brook, Willow Brook, upper River Ise, Brampton Branch, and Dodford Branch.	River flooding from the River Nene tributaries. Considered to be potential for groundwater flooding in some areas, including the Harpers Brook and Willow Brook catchments.	Overtopping of the watercourses onto their functional floodplains, with only isolated flood defences across this policy unit. Exceedance of the capacity of flood storage areas leading to increased flooding.	Isolated people and properties, historic environment sites, BAP habitats, SSSIs, agricultural land, critical infrastructure, and transport infrastructure.
2. River Nene (Weedon to Kislingbury)	15	Rural with scattered small settlements. Low population density.	Floodplain of the Kislingbury branch of the River Nene, including parts of the lower Bugbrooke Brook and lower Weedon branch. Includes the settlements of Weedon, Kislingbury and Bugbrooke.	River flooding from the Kislingbury branch, Weedon branch and Bugbrooke Brook. Flooding as a result of defence failure in Kislingbury.	Overtopping of the watercourses onto their functional floodplains, with only isolated flood defences across this policy unit. Exceedance of the capacity of flood storage areas leading to increased flooding.	People and properties (predominantly in the settlements of Weedon, Kislingbury and Bugbrooke), SSSIs, historic environment sites, BAP habitats, critical infrastructure, and transport infrastructure.

Policy unit	Area (km^2)	Characteristics	Location	Sources	Mechanism	Receptors
					Overtopping or breach of flood defences in Kislingbury. This would lead to rapid and potentially life threatening, inundation of the areas protected by these defences.	
3. Wootton	11	Suburban areas of south Northampton. High population density.	Southern areas of Northampton focussed on the suburbs of Wootton and Collingtree Park, that are at risk of flooding from the Wootton Brook.	River flooding from the Wootton Brook. Considered to be some potential for groundwater flooding in some areas of the policy unit.	Overtopping of the watercourse onto the functional floodplain.	People and properties, critical infrastructure, transport infrastructure.
4. Northampton Central	15	Central area of Northampton including central business district and residential areas. High social vulnerability to flooding and high population density.	Central area of Northampton that is protected at present to a 0.5% AEP standard. This includes the St. James End, Cotton, Far Cotton and Brackmills areas of the town.	River flooding from the River Nene, Brampton Branch and Kislingbury Branch. Flooding as a result of defence failure. Surcharge of surface	Overtopping or breach of flood defences. This would lead to rapid, potentially life threatening, inundation of the areas protected by these defences. Heavy rainfall leading to	People and properties (significant risk to people in this policy unit for higher magnitude floods), SSSIs, historic environment sites, BAP habitats, community facilities, critical infrastructure, and

Policy unit	Area (km^2)	Characteristics	Location	Sources	Mechanism	Receptors
				and subsurface drainage systems.	local drainage network being unable to cope with runoff.	transport infrastructure.
5. Northampton Outer	43	Urban and suburban areas of Northampton. High population density.	Areas of Northampton excluding those which are part of the Northampton Central policy unit. This includes the Dallington Brook, Billing Brook, lower reaches of the Brampton Branch and River Nene in the Billing area of Northampton.	River flooding from the River Nene, Brampton Branch, Dallington Brook and Billing Brook. Surcharge of surface and subsurface drainage systems.	Overtopping of the watercourses onto the functional floodplain. Exceedance of the capacity of flood storage areas leading to increased flooding. Heavy rainfall leading to local drainage network being unable to cope with runoff.	People and properties, historic environment sites, BAP habitats, critical infrastructure, and transport infrastructure.

Actions from the Draft Nene CFMP (2008) relating to development. The final CFMP is due for publication by the Environment Agency in April 2009

Actions specific to development within the Upper and middle Nene policy unit are outlined below:

- Put in place policies within the Local Development Framework for no inappropriate development in the floodplain. Any new development should be located in the areas of lowest flood risk and must not increase risk to existing development. Developers should incorporate river naturalisation and environmental enhancement into new developments. Timescale: 2008 to 2100.

- Put in place policies within the Local Development Framework to link flood risk management planning with regeneration and redevelopment so that the location and layout of commercial development can help to reduce flood risk. Timescale: 2008 to 2100. This action is a priority for this policy unit to help maintain the current level of risk into the future by using more sustainable flood risk management activities.

- Develop a System Asset Management Plan to continue maintenance and inspection of Grendon Brook Villages, Barnwell Village, Great Oakley and Clipston flood storage reservoirs and Geddington flood relief channel. Timescale: 2008 to 2011.

Actions specific to development within the Weedon to Kislingbury policy unit are outlined below:

- Develop a Flood Storage Study to investigate creating/developing storage on the River Nene (Weedon to Kislingbury) policy unit. This will mitigate future flood risk to the Northamptonshire Central policy unit and commercial areas of the Northampton Outer policy unit. The study should consider the flood defence measures constructed at Upton. The study should determine the possible location of storage and combination of river restoration and engineered flood storage. Where possible the study should enhance the environment by improving the natural state of the river and its habitat. Timescale: 2008 to 2011 this action is a priority for this policy unit as it will help create sustainable flood risk management by mitigating future flood risk to several key towns, working with natural processes and making space for water.

- Put in place policies within the Local Development Framework for no inappropriate development in the floodplain. Any new development should be located in the areas of lowest flood risk and must not increase risk to existing

development. Developers should incorporate river naturalisation and environmental enhancement into new developments. Timescale 2008 to 2100.

Actions specific to development within the Wootton policy unit are outlined below:

- Put in place policies within the Local Development Framework for no inappropriate development in the floodplain. Any new development should be located in the areas of lowest flood risk and must not increase risk to existing development. Developers should incorporate river naturalisation and environmental enhancement into new developments. Timescale 2008 to 2100.

- Develop an Integrated Urban Drainage Plan for Wootton. This plan should investigate the risk from surface water flooding. Timescale 2008 to 2011.

Actions specific to development within the Northampton Central policy unit are outlined below:

- Develop a Flood Storage Study to investigate creating/developing storage on the River Nene (Weedon to Kislingbury) policy unit. This will mitigate future flood risk to the Northamptonshire Central policy unit and commercial areas of the Northampton Outer policy unit. The study should consider the flood defence measures constructed at Upton and the protection of the Upper Nene Valley Gravel Pits SSSI/pSPA/Ramsar site. The study should determine the possible location of storage and combination of river restoration and engineered flood storage. Where possible the study should enhance the environment by improving the natural state of the river and its habitat. Timescale: 2008 to 2011. This action is a priority for this policy unit as it will help create sustainable flood risk management by mitigating future flood risk to several key towns, working with natural processes and making space for water.

- Put in place policies within the Local Development Framework for no inappropriate development in the floodplain using methods in PPS25. Any new development should be located in the areas of lowest flood risk, targeted to previously developed land and must not increase risk to existing development. Developers should incorporate river naturalisation and environmental enhancement into new developments. Timescale 2008 to 2100.

Actions specific to development within the Northampton Outer policy unit are outlined below:

- Develop a Flood Storage Study to investigate creating/developing storage on the River Nene (Weedon to Kislingbury) policy unit. This will mitigate future flood risk to the Northamptonshire Central policy unit and commercial areas of

the Northampton Outer policy unit. The study should consider the flood defence measures constructed at Upton and the protection of the Upper Nene Valley Gravel Pits SSSI/pSPA/Ramsar site. The study should determine the possible location of storage and combination of river restoration and engineered flood storage. Where possible the study should enhance the environment by improving the natural state of the river and its habitat. Timescale: 2008 to 2011. This action is a priority for this policy unit as it will help create sustainable flood risk management by mitigating future flood risk to several key towns, working with natural processes and making space for water.

- Put in place policies within the Local Development Framework for no inappropriate development in the floodplain. Any new development should be located in the areas of lowest flood risk and must not increase risk to existing development. Developers should incorporate river naturalisation and environmental enhancement into new developments. Timescale: 2008 to 2100.

- Put in place policies within the Local Development Framework to link flood risk management planning with regeneration and redevelopment so that the location and layout of commercial development can help to reduce flood risk. Timescale: 2008 to 2100 this action is a priority for this policy unit to help maintain the current level of risk into the future by using more sustainable flood risk management activities.

The Great Ouse CFMP is still in draft and has been subject to review.

Catchment wide actions from the Draft Great Ouse CFMP include:

- Liaise with planning authorities to ensure that update cycles of the Regional Spatial Strategy are used in order to take specific opportunities for flood risk management. This is a medium priority action over the timescale 2007-2011.

- Liaise with planning authorities to make sure that brownfield sites within the floodplain are not automatically redeveloped. This is a medium priority action on-going from 2007.

- Identify opportunities to reduce runoff from landuse by future de-intensification. This is a medium priority action over the timescale 2007-2008.

- Encourage rigorous planning control to restrict new development in the floodplain. This is a high priority action over the timescale 2007-2100.

Appendix C – PPS 25

C1 *Introduction*

PPS25 – Development and Flood Risk replaced PPG25 (published in 2001) upon its publication in December 2006. PPS25 reflects the general direction set out in the report *Making Space for Water* (Defra 2004) and provides a first response to the longer term risks set out in the 2004 *Foresight Future Flooding* report.

The policies within PPS25 complement other national planning policies and should be read in conjunction with *Making Space for Water* and the Water Framework Directive.

Planning authorities should ensure that the Local Development Documents set out policies for the allocation of sites which avoid flood risk to people and property. A sequential approach should be taken at the site level to match the vulnerability of flood risk and land use and ensure that all new development in flood risk areas is appropriately flood resilient.

C2 *Risk Based Approach*

A risk based approach to flooding should be applied at all levels of planning and should avoid adding to the cause of flooding, manage the pathways to reduce likelihood and reduce the consequences should they occur. Appropriate Flood Risk Assessments should be used and the sequential test applied with the exception test only being implemented when departures from the sequential test are justified.

C3 *Responsibilities*

The Environment Agency has a statutory responsibility for flood management and defence in England and provides advice to planning authorities on planning applications. They have permissive powers to maintain flood defence in the public interest.

There is however no statutory duty for the Environment Agency to protect land against flooding as the primary responsibility falls upon the landowner to safeguard their land.

Regional Planning Bodies have a responsibility to take flood risk into account when determining strategic planning considerations and the Local Planning Authority should consult the Environment Agency when developing their Local Development Documents.

C4 *The Sequential Test*

The sequential test aims to steer development into flood Zone 1. The Environment Agency's flood zone maps should be used as a starting point for the sequential test. Table D.1 of PPS25 gives detail of flood risk zones as follows:

Zone 1 (Low Probability) – land with less than a 1 in 1000 chance of flooding from rivers in any one year and suitable for all of the land uses identified in Table D.2. Such development should have regard for flooding from other sources and the potential to make things worse elsewhere and are still subject to the need for a flood risk assessment if the development is classified as "major".

Zone 2 (Medium Probability) – land that has between a 1 in 1000 and 1 in 100 chance of river flooding which is suitable for water compatible, less vulnerable and more vulnerable uses of land and essential infrastructure as identified in Table D.2. High vulnerable uses are only appropriate if the exception test is passed. Any proposal should come with a flood risk assessment.

Zone 3a (High Probability) – land that has a 1 in 100 or greater chance of river flooding and is suitable for water compatible and less vulnerable land uses as set out in Table D.2. More vulnerable and essential infrastructure should come with a flood risk assessment.

Zone 3b (The Functional Flood Plain) – land where water has to flow or be stored in times of flood where only water compatible uses are permitted and where essential infrastructure passes the exception test. All development proposals in this zone should be accompanied by a flood risk assessment.

C5 *The Exception Test*

Paragraph D9 of PPS25 details of how the exception test is to be passed. The paragraph is reproduced below:

D9: For the Exception Test to be passed:

a) it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;

b) the development should be on developable[7] previously-developed land or, if it is not on previously developed land[8], that there are no reasonable alternative sites on developable previously-developed land; and

[7] Developable sites are defined in Planning Policy Statement 3 (PPS3) *Housing* as those sites which should be in a suitable location for housing development and there should be a reasonable prospect that the site is available for, and could be developed at the point envisaged.

[8] Previously-developed land definition (commonly known as Brownfield Land). See Annex B of Planning Policy

c) a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

C6 *Flood Risk Assessment*

Annex E of PPS25 outlines what is required in a FRA and includes a listing similar to that in PPG25. FRAs are required at regional, local and at site specific planning level. Any FRA should form part of an Environmental Statement under the Planning Regulations.

C7 *Managing Surface Water*

Annex F outlines that the management of surface water is a material planning consideration and should as far as possible mimic the pre-development state. FRAs should demonstrate the method of management to be used. The methods should use SuDS where appropriate and should ensure that both volume and peak is managed to the pre-development state. Ownership and responsibility for the sustainable drainage must be clear and the Environment Agency and the IDBs should be engaged to enable runoff to be managed as close to source as possible.

C8 *Residual Flood Risk*

Managing residual flood risk must be considered by those planning development. Development should not normally be permitted where flood defences, properly maintained, would not provide an acceptable standard of flood protection for the lifetime of the development. Flood resistance and resilience measures should not be used to justify development and where flood defences are considered necessary as part of a development then the developer is normally expected to fund them. Flood warning is an essential part of managing residual risk. The PPS25 Practice Guidance contains for more information regarding residual risk.

Appendix D – Flood Zone Maps

Appendix E – History of Flooding

History of flooding on the River Nene. Adapted from the River Nene CFMP and the West Northamptonshire SFRA:

Date	Source	Scale	River affected	Locations	Consequences
Autumn/Winter 1847	Fluvial	Major	River Nene	Northampton to Peterborough	Flooded 10,000 acres of land. Stopped all trains between Northampton and Peterborough for three days.
18 Oct 1939	Fluvial	Moderate	River Nene	Northampton	Extensive flooding of property in Northampton (St James' End and Far Cotton).
February 1940	Fluvial	Moderate	River Nene	Northampton	
November 1946	Fluvial	Moderate	River Nene	Weedon Northampton	Flooding of property in Weedon.
March 1947	Fluvial. A combination of heavy rain on a frozen catchment caused high run-off rates which, followed by a rapid snowmelt, resulted in flooding in the River Nene catchment from Northampton to	Major	River Nene	Sites along the River Nene: Northampton to Peterborough	Properties flooded in Weedon. Riverside properties were flooded in Northampton, but few if any were dwellings. Three bridges downstream of Northampton were damaged. The railway station, Victoria Mills, the tannery and a few houses were flooded.

Date	Source	Scale	River affected	Locations	Consequences
	Peterborough.				
Winter 1950/51	Fluvial	Minor	River Nene (seven flood peaks with sustained high discharge)		
June and July 1958	Fluvial	Moderate	River Nene		
November 1974	Fluvial	Minor	River Nene		Shallow inundation of the floodplain. No major flooding reported
March 1975	Fluvial	Minor	River Nene		
December 1981/January 1982	Fluvial	Minor	River Nene		Agricultural land flooded, but few roads and no properties were flooded
April/ May 1983	Fluvial	Minor	River Nene		Navigation on River Nene closed. Flood storage areas put to effective use to keep flows within bank other than at isolated low spots
September 1992	Fluvial	Moderate	River Nene and tributaries	Weedon	Severe flooding of property was experienced in several villages, the worst of which was: Weedon (12), Kislingbury (1), Clipston (3),

Date	Source	Scale	River affected	Locations	Consequences
				Kislingbury Clipston Geddington Nether Heyford	Geddington (1), Nether Heyford (1).
April 1998	Fluvial. Large areas along the River Nene and River Ise were flooded due to heavy rainfall. Flooding affected similar areas to the 1947 flood, but also further upstream of Peterborough and downstream of Northampton. This incident had severe consequences with fatalities in Northampton and extensive damage to property in several towns along the River Nene. The severity of the flood was of the order of 1% AEP.	Major	River Nene River Ise	Sites along the River Nene from Newnham to near Cogenhoe, from near Earls Barton to Guyhirn, and in Wisbech and Sutton Bridge. Pitsford Water to River Nene	Fatalities in Northampton and extensive damage to property in Northampton and damage to several other towns along the River Nene. Total of approximately 2800 properties affected, nearly 90% residential and about 90% in Northampton. About 340 caravans flooded, mostly in Billing Aquadrome.
October 2002	Surface water; drainage	Minor	-	Long Buckby	Two properties flooded

Date	Source	Scale	River affected	Locations	Consequences
January 2003	Fluvial	Minor/ Moderate	River Nene	Cogenhoe Earls Barton Northampton	Properties flooded: Cogenhoe (1); Earls Barton (2); Northampton (1).
June 2007	Fluvial. Intense rainfall (over 65mm in three hours at one gauge) amounting to a 1 in 15 year rainfall, fell on the already saturated Wootton Brook catchment in June 2007 leading to rapid run-off. Eight properties along the Wootton Brook were flooded.	Minor	Wootton Brook	Collingtree Park	8 domestic properties in Collingtree Park flooded from Wootton Brook.

History of flooding from the River Nene. From the BHS Chronology of Hydrological Events.

http://www.dundee.ac.uk/geography/cbhe/

Year	Month	Quotation	River basin	Entry date
1663	05	1663 May 8 About May 8th there was a violent thunderstorm at Northampton " which caused extraordinary floods in a few hours, bearing away bridges, drowning horses, men and cattle....." [River Nene]	032 - Nene	9/16/98
1260		1260 "Prodigious rainfall .... fresh water from the uplands, combining with high tides, overtopped embankments and inundated some 35,000 acres, causing great losses".	032 - Nene	10/12/98
1335		1335 " major flooding"	032 - Nene	10/12/98
1570	12	1570 December "After Christmas .... massive floods, both tidal and freshwater " .... "caused by melting of great quantities of snow in the uplands" ... after Candlemas [Feb 2, 1571] ... and some 38,000 acres were under water.	032 - Nene	10/12/98
1875		1875 The major flow in the Nene, resulting from the extremely wet year of 1875, produced further erosion in the tidal cut.....	032 - Nene	10/12/98
1919		1919 severe inundation	032 - Nene	10/12/98
1926		1926 severe inundation	032 - Nene	10/12/98

	1927		1927 Floods....when many acres were inundated	032 - Nene	10/12/98
	1929		1929 Thorney Drainage Board [TDB] minute records great shortage of water; too low in Thorney River for syphon to work.	032 - Nene	10/12/98
	1903	01	1903 January 6 Rainfall observer at Blisworth (Grafton House) south of Northampton noted "5th and 6th Large floods" [River Nene]	032 - Nene	10/13/98
	1887		1887 Rainfall observer at Thrapstone (Hargrave) noted "Cracks in the soil due to the drought could be traced to depths of 4 and 5 feet...."	032 - Nene	10/19/98
	1912	01	1912 January 15-24 (p[3]) Nene Valley 7,000 acres flooded between Northampton and "Peterborough."	032 - Nene	11/18/98
	1910	12	1910 December Rainfall observer, Leon G.H. Lee, at Raunds noted (p[35]) "Tremendous floods occurred in the Nene valley during the first half of December. The Midland Railway suffered serious damage owing to embankment slips."	032 - Nene	11/20/98
	1911		1911 Observer, W.B.Jacques, at Orlingbury (Hall) noted (p[52]) "Wells here failed on August 15th for the first time since 1868. Springs only began to move on December 24th." [Upper Nene]	032 - Nene	12/3/98
	1868		1868 (p[52]) Wells at Orlingbury failed, and did not do so again until 1911. [Upper Nene]	032 - Nene	12/3/98

	1883	11	1883 November 6 Observer at Northampton (Sedgebrook) noted (p[28]) "Great flood in the Nene valley."	032 - Nene	12/22/98
	1882	11	1882 November 7 Rainfall observer at Northampton noted (p[23]) "Heavy floods" [Nene]	032 - Nene	12/23/98
	1870	11	1870 November Rainfall observer at Northampton (Thorpelands) noted (p77) "in November the rain had only penetrated a few inches into the soil, and the springs had not increased in volume at the end of the year."	032 - Nene	1/4/99
	1877	01	1877 January Observer at Castle Ashby, below Northampton, noted (p[38]) "Excessive rainfall, which, following the very heavy fall in December, 1876, of 5.42 in., produced almost continuous floods in the Nene Valley."	032 - Nene	1/5/99
	1907	05	1907 May 13/14 Rainfall observer at Blisworth noted, p[11], "In the 24 hours ending 8.30 p.m. 14th, 2.09 in. of rain fell, causing large floods."[Nene]	032 - Nene	4/7/99
	1907	12	1907 December 16 Observer at Raunds noted, p[25], "High floods in the Nene valley."	032 - Nene	4/7/99
	1907	05	1907 May Rainfall observer at Huntingdon noted, p[37] "Both here and in the village of Brampton floods spoiled much of thehay crop."	032 - Nene	4/7/99
	1907		1907 autumn Rainfall observer, R.Soames, at Scaldwell, Northants, [noted, p[66], "The last three months were very wet, resulting in heavy floods."	032 - Nene	4/7/99

	1896	06	1896 June 2 [p7] "... Heavy thunderstorm in Northamptonshire, the main street of Wansford flooded..."	032 - Nene	4/12/99
	1869		1869 [p69] Rainfall observer at Northampton (Thorpelands) noted "Drought felt severely in July and August, and also in October and November. No extraordinary falls of rain in the year, and springs quite as low in November as in the previous year..."	032 - Nene	6/8/99
	1852	11	1852 November 25 [page 199] "Northamptonshire and Cambridgeshire suffered severely. Both the Midland and North-Western Railway traffic was interrupted. Whittlesea Mere, which had recently been drained at a vast expense, and had been brought into rich cultivation, was again an expanse of water, with no present hope of drainage, the whole country around being in a similar state. At Cambridge the students were rowing over the country, the fens and Isle of Ely being one sheet of water... Many individual cases of drowning occurred; large numbers of sheep were drowned; hares, rabbits, wild animals, and birds perished in vast numbers; all farm industry was interrupted, and low fevers became prevalent." [ha032, 033]	032 - Nene	8/12/99
	1870	12	1870 December [p78] Northampton "Thorpelands: In November the rain had only penetrated a few inches into the soil, and the springs had not increased in volume at the end of the year"	032 - Nene	8/19/99
	1890	12	1890 December Observer at Thrapstone (Hargrave) noted, p[75], "... ponds were still empty at the close of the year."	032 - Nene	8/24/99
	1898		1898 autumn "The drought of the past year (1898) in Northamptonshire and other Midland and Southern Counties, has been such a serious inconvenience to localities supplied by superficial or shallow-seated water ... I was recently informed by Mr Wallis, of Burton Latimer, that having occasion during the latter part of 1898 to dig into the ground a considerable depth, he found it to be thoroughly hard and quite dry to a depth of 45 in. to 50 in. Capilliarity had certainly acted through 4 feet or	032 - Nene	9/13/99

			more..."		
	1878	10	1878 October 30 Rainfall observer at Northampton noted, p[51], "... heavy snowstorm on 30th"	032 - Nene	9/22/99
	1879	07	1879 July Observer at Northampton noted, p[41], "...Floods in the Nene Valley"	032 - Nene	9/24/99
	1905		1905 Observer, R. Soames, at Scaldwell, Northants, [now just above Pitsford Reservoir] noted, p[68], "springs and ponds lower than ever".	032 - Nene	10/13/99
	1847	09	1847 September [p128] "For weeks that autumn and winter the floods had been out along the whole distance from Northampton to Peterborough, forming an enormous inland lake two miles wide in places, and covering 10,000 acres of land that could not recover from the soaking for months. Mr Hartshorne [Rev Charles Hartshorne, Rector of Cogenhoe] ... prepared a complete report on the problem ..." To a December meeting of gentry he is reported as saying '...Few seasons pass without a summer flood ... Sometimes the waters reach their height as quickly as a day and a half after rain.' [p132], Northampton: "...the flood of September 1847 put Northampton Bridge Street station under water and left gaps in embankments which stopped all trains between Northampton and Peterborough for three days,..." [Nene]	032 - Nene	11/9/99
	1852	11	1852 November [p132] Northampton: "... During a November storm five years later [there having been a flood in 1847] floods did great damage to the [railway] track and washed out bridges at Hignham Ferrers and Fotheringay. This time no trains could use the line for a week." [Nene]	032 - Nene	11/9/99
	1633		1633 [p130] "Another Commission [on Sewers] which sat at Kettering in 1633 and laboriously surveyed the Nene from Wansford to Kislingbury had 'all obstructions cleared and the river widened to its ancient breadth' ... or so it is claimed."	032 -	11/9/99

			[Nene]	Nene	
	1713		1713 [p131] "... an Act of Parliament was passed for making the river navigable from Peterborough to Northampton ... " [Nene]	032 - Nene	11/9/99
	1884		1884 autumn Observer at Northampton (The Holly's) noted p[90]: "The town was on short supply of water during a great part of the year - from 7 to 10 in the summer months, and 6 to 12 at the end of the year."	032 - Nene	1/5/2000
	1880	07	1880 July 14 Rainfall observer at Northampton noted, p[14]: "Heavy rain all day; total fall , 1.74 in., causing a flood on the outskirts of the town, with destruction of property and loss of life." [ha 032]	032 - Nene	5/16/2000
	1622	07	1622 July 2 Northampton, p102, identifying the floods of July 1622, May 1633, Christmas 1821 and July 1875 as the worst in 250 years: "On the 2nd July 1622, when the flood was so high that people in the south and west parts of the town had to be carried about in boats ..."	032 - Nene	5/16/2000
	1663	05	1663 May 6 Northampton, p102, identifying the floods of July 1622, May 1663, Christmas 1821 and July 1875 as the worst in 250 years: "... on the 6th May, 1663, when the water came as high as St. John's Hospital, forcing away two of the arches of the South Bridge..."	032 - Nene	5/16/2000
	1821	12	1821 December Northampton, p102, identifying the floods of July 1622, May 1633, Christmas 1821 and July 1875 as the worst in 250 years: "... at Christmas, 1821, when the water washed away the foundations, &c., of several houses and buildings at the lower end of town.	032 - Nene	5/16/2000
	1875	07	1875 July Northampton, p102, identifying the floods of July 1622, May 1663, Christmas 1821 and July 1875 as the worst in 250 years: "Fields adjoining rivers canals, and brooks, were entirely submerged, while in many instances the water ran over the	032 -	5/16/2000

			roads; hay and grain crops considerably damaged; much injury done to a tan yard by the pits being filled with rain water, and the liquor spoilt, an engine was set to pump out the water, but its furnace was gradually put out and rendered useless. Most mills breweries, foundries &c., had to stop work on account of the floods, the engines fires being in many cases extinguished ... Many of the inhabitants, remembering the floods in 1849 and 1872, had prepared forth the recent one by stopping up likely places for its entrance, or removing their property either to buildings standing higher, or to upper parts of their houses."	Nene	
	1849		1849 p102: Northampton flood still remembered in the higher one(s) of July 1875.	032 - Nene	5/16/2000
	1872		1872 p102: Northampton flood still remembered in the higher one(s) of July 1875.	032 - Nene	5/16/2000
	1875	07	1875 July 14/22 "In the fens of Cambridgeshire and Northamptonshire the water is said to cover the country for miles; the valley of the Nene, near Peterborough, is flooded..."	032 - Nene	5/19/2000
	1875	07	NOTES ON THE FLOOD OF- JULY 15TH ... Northampton - The Nene over its banks; great quantities of hay spoilt ...	032 - Nene	5/19/2000
	1897	08	1897 August Rainfall observer at Daventry (Fawsley) noted p[62]: "Following a very dry July, 6.10 in. of rainfell, the greatest in any month since observations began in 1879." [ha 032, Nene headwater]	032 - Nene	8/4/2000
	1951	04	"On April 10 the flow of the River Nene at Northampton was nine times the average winter flow..."	032 - Nene	10/1/2004

1663	05	Kislingbury, west of Northampton: " 1663:May Flood. Probably half to two thirds of the houses were flooded to a depth of over 4ft."	032 - Nene	12/8/2004
1998	04	Kislingbury, west of Northampton: "Very serious flooding again experienced in the village. The worst in living memory"	032 - Nene	12/8/2004
2003		Kislingbury, west of Northampton: 2003 Flood defences built by the Environment Agency along the river bank from The Whirly up to and including The Bridge and on to the playing fields. Cost £1.4 million"	032 - Nene	12/8/2004

History of flooding in the Great Ouse catchment.

http://www.dundee.ac.uk/geography/cbhe/

Year	Month	Quotation	River basin	Entry date
1852	11	1852 November 25 [page 199] "Northamptonshire and Cambridgeshire suffered severely. Both the Midland and North-Western Railway traffic was interrupted. Whittlesea Mere, which had recently been drained at a vast expense, and had been brought into rich cultivation, was again an expanse of water, with no present hope of drainage, the whole country around being in a similar state. At Cambridge the students were rowing over the country, the fens and Isle of Ely being one sheet of water... Many individual cases of drowning occurred; large numbers of sheep were drowned; hares, rabbits, wild animals, and	033 - Great Ouse	8/12/99

			birds perished in vast numbers; all farm industry was interrupted, and low fevers became prevalent." [ha032, 033]		
	1914	12	1914 December 30 Observer at Blisworth noted p[26] "Large floods out" [R. Tove]	033 - Great Ouse	10/27/99
	1875	07	1875 July "Brackley - The lower part of Syresham is so flooded that communication between one part of the village and another is stopped." [ha 033, Great Ouse headwater]	033 - Great Ouse	6/14/2000

Appendix F – Derivation of River Quality Objectives

Water Quality

Background and existing catchment

The Environment Agency assigns each river reach a River Quality Objective (RQO) based on the desired River Ecosystem (RE) Class for that reach. Table 7.1 describes the water quality for each RE class. RE classes are RE1 for the highest water quality (based on 8 key indicators) suitable for all fish species, to RE5 for the lowest quality and likely to limit fish species. Thus the corresponding RQOs are 1 (very good) to 5 (poor).

Class	Description
RE1	Water of very good quality suitable for all fish species
RE2	Water of good quality suitable for all fish species
RE3	Water of fair quality suitable for high class coarse fish populations
RE4	Water of fair quality suitable for coarse fish populations
RE5	Water of poor quality which is likely to limit coarse fish populations

Table: River Ecosystem Classification

Compliance with the RQO is determined on the basis of routine monitoring for the 9 key indicators. Compliance would indicate that the river reach would meet the water quality requirements for fish, wildlife and conservation (as well as other water uses). Failure to meet the RQO should trigger remedial action. The RE Class/RQO system is thus critical in determining conditions in discharge consents and in a range of decisions designed to protect rivers from the impacts of agriculture, leisure activities and development (including housing).

Surface water quality is also determined using the General Quality Assessment (GQA) scheme, which is based on monthly chemical monitoring with additional nutrient monitoring and biological assessment.

Both the GQA and RQO classifications consider quality against a statistical 90%ile target. This means that statistically the river quality has to be better than the 90%ile value for 90% of the time.

Compliance with the RQO is assessed on a three year rolling basis from the General Quality Assessment (GQA) routine monitoring undertaken by the Environment Agency. Although the methods of calculation and standards are not identical, GQA A

is approximately equivalent to RE1 etc, as shown in Table 7.C below. Therefore a river which has a river quality objective of RE1 is likely to meet its objective if it is reporting a GQA A for the preceding three years.

GQA	RQO (RE)	Ecological status
A	*RE1*	*Excellent*
B	*RE2*	*Good*
C	*RE3*	*Moderate*
D	*RE4*	*Poor*
E	*RE5*	*Unsustainable*

GQA and RQO correlation

Nutrient monitoring also supplements the chemical and biological GQA monitoring. Nutrient levels naturally exhibit considerable spatial and seasonal variability, and thus the results provide only an indication of the level of nutrient enrichment in a channel.

Nitrate Grade	Description	Phosphate Grade	Description
1	*Very Low*	*1*	*Very Low*
2	*Low*	*2*	*Low*
3	*Moderately Low*	*3*	*Moderate*
4	*Moderate*	*4*	*High*
5	*High*	*5*	*Very High*
6	*Very High*	*6*	*Excessively High*

General Quality Assessment (GQA) classes for nutrients

Whilton Wastewater Treatment Works discharges into the Whilton Branch, a tributary of the River Nene. It also discharges into the canal in winter. As indicated in Table 7.4, the Whilton Branch which flows to the east of Daventry to the River Nene has an RQO of RE2. The Nene from Whilton Branch to Weedon Brook was marginal in 2003-5 and Whilton Branch from the Headwaters to Surney Bridge was a significant failure in 2003-5 due to low levels of Dissolved Oxygen. Great Billing Wastewater Treatment Works discharges into the River Nene, downstream of Northampton. The Nene upstream of Great Billing WwTW has an RQO of 2 and downstream has a RQO of 3. Compliance with the RQO has been achieved during the most recent sampling periods (i.e. since 2003). Towcester Wastewater Treatment Works discharges into the River Tove. The upstream and downstream stretches of the River Tove have an RQO target of RE2. This target has also been met since 2003.

The General Quality Assessment (GQA) grades for chemistry indicate that water quality is generally good with GQAs of grade A and B commonly being achieved over the previous two recording periods (i.e. since 2003) on the Whilton Branch, the Nene and the Tove. Occasionally BOD and DO levels can be elevated on the River Nene at Northampton and levels of DO can be elevated on the Whilton Branch.

Whilton Wastewater Treatment Works discharges into Whilton Branch, a tributary of the River Nene, and into the canal in winter. The suspended solids limit is 25mg/l, BOD is 12 mg/l and Ammoniacal nitrogen is 5mgN/l (as 95%ile standards). Improved facilities for phosphorus removal have been implemented since 1999 and the total phosphorus limit is now 1mg P/l (or 80% removal of phosphorus), measured as an annual average. The stretch of the Whilton Branch from Surney Bridge to Weedon which receives the discharge from Whilton WwTW from 2001 to 2006 has achieved a chemical GQA grade of B (Good). In 2006 a biological GQA grade A was achieved between 2002 and 2005 Grade B was achieved. Phosphates have been classified as Grade 5 (Very High) since 2000 and nitrates as Grade 5 (high) since 2005.

Great Billing Wastewater Treatment Works receives sewage from Northampton, with a PE of over 300,000. The WwTW discharges via a tributary into the River Nene. The suspended solids limit is 25mg/l, BOD is 13 mg/l and Ammoniacal nitrogen is 5 mgN/l. The River Nene downstream of Great Billing WwTW is designated as a "Sensitive" watercourse under the European Urban Waste Water Treatment Directive. Improved facilities for phosphorus removal have been implemented since 1999 and the total phosphorus limit is now 1mg/l. The stretch upstream of the discharge from Great Billing WwTW has achieved a GQA Grade B since 1999. Downstream there is a deterioration in GQA Grade as the stretch of the River Nene which receives the discharge, from Ecton Brook to Earls Barton, has achieved a chemical GQA grade C (fair) since 2003 and grade B in 2002. It has achieved a biological GQA grade B since 1999. In the receiving stretch of the River Nene phosphates have been classified as Grade 5 (Very High) since 2000 and nitrates as Grade 6 (very high) since 2004 and grade 5 (high) between 2000 and 2003. The stretch upstream of the discharge has achieved a lower level of nutrients in recent years with Phosphates being classed as Grade 4 (High) and Nitrates as Grade 4 (Moderate) since 2003.

Towcester Wastewater Treatment Works discharges into the River Tove which is a tributary of the River Great Ouse. The suspended solids limit is 30mg/l, BOD is 15 mg/l and Ammoniacal nitrogen is 5 mgN/l. The River Tove downstream of Cappenham Bridge is designated as a "Sensitive" watercourse under the European Urban Waste Water Treatment Directive. Since 2003 the discharge consent for the WwTW has a total phosphorus limit of 2mg/l and a nitrate limit of 30mg NO3/l. The receiving stretch of the River Tove is from Cappenham Bridge to Stoke Park Pavilion. This stretch has achieved a chemical GQA grade B (good) since 2000, with the reach upstream of the discharge (Confluence Blakesley Brook – Cappenham Bridge) achieving Grade A. Biological GQA of the receiving stretch ahs been grade B since 2005 and grade A between 2002 and 2004. Phosphates have been classified as Grade 5 (Very High) since 2000 and nitrates as Grade 5 (high) in 2006, grade 6 in 2004-2005.

Additional research will be required at the detail stage.

River Stretch	River Quality Objective[1]			General Quality Assessment							
	Target	Compliance		Chemistry[2]		Biology		Nitrate		Phosphate	
		2004-6	2003-5	2004-6	2003-5	2004-6	2000	2004-6	2003-5	2004-6	2003-5
Daventry											
Whilton Branch – Headwaters – Surney Bridge	2	Yes	Significant failure (DO)	B	D (DO)	B	A	5	5	6	6
Nene – Whilton Branch – Weedon Brook	2	Yes	Marginal	B	C (DO)	B (2003 & 2006)	C	5	5	5	5
Nene – Everdon Brook – Whilton Branch	2	Yes	Yes	A	A	A -2005	B	3	4	4	5
Northampton											
Nene – Northampton – Weston Favell Lock	2	Yes	Yes	B (DO)	B (BOD & DO)	C	B	5	5	5	5
Nene – Weston Favell Lock- Ecton Brook	3	Yes	Yes	B (BOD & DO)	B (BOD & DO)	C	A	4	4	4	4
Nene – Ecton Brook – Earl's Barton	3	Yes	Yes	C (Amm & DO)	C (DO)	B (2002 & 2005)	B	6	6	5	5
Towcester											
Tove – Confluence Blakesley Brook – Cappenham Bridge	2	Yes	Yes	A	A	A	A	5	6	5	5
Tove - Cappenham Bridge –Stoke Park Pavillion	2	Yes	Yes	B (DO)	B (BOD & DO)	B -2005	A	5	6	5	5

Table 0-1: Water Quality Assessments for the Whilton Branch (Daventry), the River Nene (Northampton) and the River Tove (Towcester).

1. Determinand(s) responsible for failures are indicated: BOD = Biological Oxygen Demand; D.O. = dissolved oxygen; Amm = ammonia; u-Amm = unionised ammonia; pH = pH; H = hardness; Cu = copper; Zn = zinc
2. Determinand(s) resulting in the classification is (are) indicated: BOD = Biological Oxygen Demand; D.O. = dissolved oxygen; Amm = ammonia

Water Quality on all watercourses listed in Table 7.D is generally good and no specific areas of poor water quality are evident except for on the Whilton Branch (Daventry) where a significant failure of the RQO was recorded in 2003-5. This also resulted in a GQA Grade D being recorded in 2003-2005.

For both the Nene at Northampton and the River Tove deterioration in GQA grades achieved can be seen between the reach upstream of the discharge and the reach receiving the discharge from the WwTW. This is often evident by a decrease in the chemical GQA by one grade. On the Nene this is from GQA Grade B to C and on the Tove from GQA Grade A to B.

F1 *No deterioration policy*

Environment Agency policy indicates that if current water quality exceeds the planned RQO, a "no deterioration" consent will be required for future consent determinations rather than a consent calculated against the RQO.

The following river reaches outperform their objective, therefore may need future consents set against the actual performance of the river rather than the objective:

The River Quality Objective (RQO) downstream of Great Billing WwTW is RE3 (equivalent to GQA C). The actual water quality downstream of the WwTW on the Nene between Weston Favell Lock and Ecton Brook is better than the RQO, with the GQA results for 2004-2006 indicating an achieved standard of GQA grade B.

The RQO for the Whilton Branch upstream and downstream of the WwTW discharge is RE2 (equivalent to GQA B). Grade B has been achieved in 2004-6 and on the stretch downstream of the WwTW on the Nene from Everdon Brook to Whilton Branch the GQA has been Grade A, which is better than the RQO.

On the River Tove the RQO is RE2 (equivalent to GQA B). In the reach upstream of the WwTW discharge GQA A has been achieved indicating that water quality is better than the RQO requires. Although the GQA grade achieved at the stretch receiving the WwTW discharge is lower it is still equivalent to that required to meet the RQO.

F2 *Phosphate Removal and the Urban Wastewater Treatment Directive*

Phosphate removal to Urban Wastewater Treatment Directive limits were implemented at four WwTWs in the Upper Nene catchment including Great Billing and Whilton by the end of 1998. Since then a significant reduction in phosphorus concentrations can be seen in the river (>80%). However, the Environment Agency have stated that measurements of levels of Phosphates are still considered high in the watercourse and that eutrophication effects on plant communities are still evident. This is particularly evident further down in the Nene catchment where high DO % saturation limits (>200%) have been recorded. Eutrohic effects are strongly influenced by river flow as well as meteorological conditions and further

long-term monitoring is required. The Environment Agency have attributed the recording of high Phosphate levels in the water to phosphate being retained in the sediment, which will only be reduced over a long timescale and/or the importance of phosphate loads from smaller WwTWs and diffuse sources within the catchment.

F3 *Pollution incidents*

The most recent significant pollution incident on the Whilton Branch occurred in May 2004 due to sewer failure or overflow resulting in a discharge of process effluent. This resulted in a Category 2 incident to the water environment. A category 2 incident occurred on Ecton Brook in September 2005 which involved a discharge of crude sewage due to sewer failure or overflow. Near Towcester a pollution incident resulting crude sewage discharge occurred in May 2003 resulting in a Category 2 incident.

Appendix G – Derivation of Future Consent Requirements

Input Data

The indicative consents were calculated using the Environment Agency River Quality Planning (RQP) tool. Upstream river flow was taken from the National SIMCAT model of the catchment, and upstream quality for BOD and ammonia was taken from Environment Agency sampling data. There was no sampling point upstream of Silverstone WwTW so 25% of the RQO was as the upstream estimate, in accordance with Environment Agency guidelines. In the absence of other data upstream phosphate was taken from the National SIMCAT model of the Wash.

For Whilton WwTW there were discrepancies in upstream quality. For the purposes of the WCS the upstream quality was taken from the Environment Agency website, but ongoing modelling work is being carried out, which will supersede the results from this initial assessment.

WwTW	Upstream flow		Upstream BOD		Upstream ammonia		Upstream phosphate	
	Mean (Ml/d)	Q95 (Ml/d)	Mean (mg/l)	SD (mg/l)	Mean (mg/l)	SD (mg/l)	Mean (mg/l)	SD (mg/l)
Gt Billing	295.8	49.1	1.65	0.99	0.24	0.23	0.36	0.23
Whilton	48.88	7.37	1.67	0.82	0.16	0.16	0.43	0.32
Towcester	78.2	12	1.15	0.82	0.03	0.03	0.22	0.17
Brackley	47.96	8.3	1.04	0.85	0.02	0.02	0.093	0.067
Silverstone	5.73	1.07	3.7	2.2	0.92	0.55	0.0093	0.0001

Table 1: Water Quality Data Measurements

The data for actual discharge quality was taken from recent measurements by Anglian Water. The Coefficient of Variation (CoV) was calculated from these data, and these were used to generate a mean and standard deviation for BOD and ammonia based on the current consented quality (see <>). Phosphate final effluent was taken from the National SIMCAT model. DWF was calculated for 2008, 2016 and 2026, using population, consumption, trade and infiltration projections from Anglian Water. To calculate mean WwTW discharge, the DWF was multiplied by 1.3, thus allowing for a safety factor. Standard deviation of WwTW discharge was then calculated by Mean discharge/3.

Compliance was then assessed against three downstream water quality targets as listed below:

(a) No deterioration – the model was run with current DWF and current consent - growth then factored in, allowing for no deterioration in downstream quality compared to the current quality[9];
(b) RQO - consent required to hit RQO, and;
(c) WFD - consent required to 'good' ecological status chemical standards[10].

A summary of the three water quality targets used in the analysis is shown below in Table 2.

	Current planned water quality			RQO target			WFD target			
WwTW	**BOD (90%ile)**	**Ammonia (90%ile)**	**Phosphate (mean)**	**RE class**	**BOD**	**Ammonia**	**Status**	**BOD**	**Ammonia**	**Phosphate**
Gt Billing	4.4	1.2	0.68	3	6.0	1.3	Good	5.0	0.6	0.12
Whilton	3.7	1.0	0.29	2	4.0	0.6	Good	5.0	0.6	0.12
Towcester	3.0	0.4	0.29	2	4.0	0.6	Good	5.0	0.6	0.12
Brackley	3.4	0.7	0.28	2	4.0	0.6	Good	5.0	0.6	0.12
Silverstone	7.8	2.9	0.97	4	8.0	2.5	Good	5.0	0.6	0.12

Table 2: summary of the three water quality targets used in the analysis

[9] In this context 'no deterioration' was assessed under the guise of the WFD, which has 'no deterioration' as its first principle.

[10] For this study the lowland and high alkalinity standard was used – 5mg/l for BOD (90%ile) and 0.6mg/l for ammonia (90%ile)

Appendix H – Geology Maps

H1 Geological and Hydrogeological Setting in Daventry

H1.1 Introduction

The geology of the Daventry area is shown on BGS 1:63,360 Scale Geological Map Sheet No. 185 included in Appendix K.

The geological strata present around the Daventry area, and a summary of both their hydrogeological properties and their potential for infiltration drainage are described briefly on Table K.1

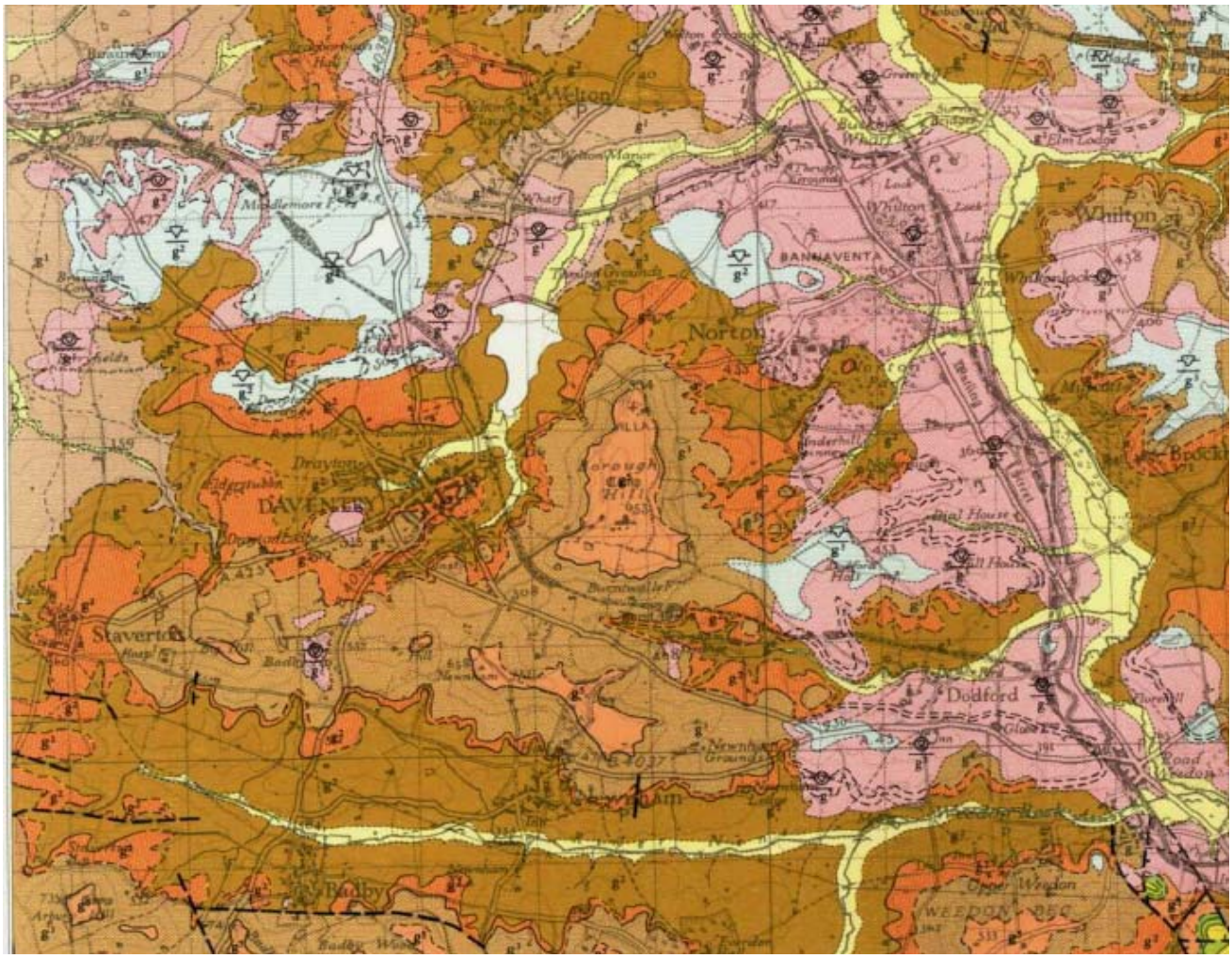

Figure H1: 'Daventry – Ecology (solid & drift)'

H1.2 Solid Strata

Silt and clay strata (Middle Lias Silt & Silty Clay and Lower Lias Clay) and Marlstone Rock Bed underlie much of the study area extending from Newham Grange in the south, northwards through Norton to Thrupp Lodge and Daventry Reservoir. The Marlstone Rock bed is a mix of interbedded limestone, sandstone, and mudstone beds. The Environment Agency (EA) classifies these deposits as a non-aquifer because they do not readily store or transmit groundwater. Groundwater occurs both in fissures in the limestones and from within the intergranular permeability developed in the sandstones.

Upper Lias Clays are present along the western edge of the study area on the flanks of Borough Hill. The Upper Lias Clays comprise mudstone and siltstone and is classified by the EA as a non-aquifer.

Northampton Sands (Inferior Oolite Series) occur on the crest and upper flanks of Borough Hill to the west of the study area. The Northampton Sands comprise sandy ironstone and sandstone and is classified by the EA as a minor aquifer.

H1.3 Drift Deposits

Drift deposits primarily comprise glacial sand and gravel present in the north of the study area around Monksmoor and to the east of the study area. Isolated pockets of glacial sand and gravel occur in the south around Newnham Grange.

Glacial Till is present to the north of Norton and in the valley around Dodford Hall.

Alluvium is present in the north of the area associated with an un-named watercourse. Alluvial deposits tend to be relatively thin and limited in extent. Alluvial deposits tend to have a shallow water table, in hydraulic continuity with, and drained by adjacent rivers and streams. When levels in the watercourses are high, less groundwater will be able to drain away.

Table H.1: Geological strata outcropping beneath Daventry and their hydrogeological properties

Geology			**Geological and Hydrogeological Properties[1]**	**Infiltration Drainage Potential[2]**	**Distribution and comment[3]**
Age	Formation	Unit			
Quaternary (Pleistocene and Recent)	Alluvium		Primarily silt and clay, occasional sand and gravel. Low intergranular permeability.	Poor	Localised - river flood plains. Negligible occurrence.
	Glacial Sand & Gravel		Sand and Gravel. Moderately permeable.	Good	Across north and east of study area. Moderate occurrence.
	Glacial Till		Likely to be primarily clays with occasional sands and gravels. Mostly impermeable.	Poor	Localised – across north and isolated pocket sin south. Moderate occurrence.
Upper Jurassic	Northampton Sands		Sandy ironstone and sandstone	Moderate	Localised on crest of Borough Hill to the wets of the study area. Minor occurrence
	Upper Lias Clays		Mudstones with siltstones	Poor	Across western edge of study area on flank of Borough Hill. Minor occurrence.
	Marlstone Rock Bed		Interbedded limestone, sandstone, and mudstone beds	Moderate	Occurs as thin band running along eastern edge of study area. Minor occurrence.
	Middle Lias Silt & Clay		Silts and Clays	Poor	Occur across the study area from north to south. Moderate occurrence

Notes to Table H.1

- Generalised descriptions only. Strata thickness and depth not always available. Major impermeable units may have very localised more permeable units but these are unlikely to be significant in extent.
- The infiltration drainage potential is based primarily on geological/lithological properties only – groundwater levels or topographic setting may further limit potential.
- Refer to geological map for distribution, some deposits described here may occur outside the study area.

H1.4 Soils

Soil type provides a generic description of the drainage characteristics of soils. This will dictate, for example, the susceptibility of soils to water logging or the capacity of a soil to freely drain to allow infiltration to groundwater. Soil type may only be fully determined after suitable ground investigations, although the mapped soil types (soil association) found beneath the study area are briefly described in Table K.2 below, which gives an indication of their permeability and infiltration potential.

Table H.2: Soil associations in the Daventry area and their characteristics[1]

Symbol and sub group2	Soil Association	Geology (see below)	Soil characteristics
712b	Denchworth	Jurassic and Cretaceous Clay	Slowly permeable seasonally waterlogged clayey soils with similar fine loamy over clayey soils. Some fine loamy over clayey soils with only slight seasonal waterlogging and some slowly permeable calcareous clayey soils. Landslips and associated irregular terrain locally.
544	Banbury	Jurassic and Cretaceous Ironstone	Well drained brashy fine and coarse loamy ferruginous soils over ironstone. Some deep fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging.

572h	Oxpasture	Drift over Jurassic and Cretaceous clay shale	Fine loamy over clayey and clayey soils with slowly permeable subsoils and slight seasonal waterlogging. Some slowly permeable seasonally waterlogged clayey soils.
411d	Hanslope	Chalky Till	Slowly permeable calcareous clayey soils. Some slowly permeable non-calcareous clayey soils. Slight risk of water erosion.
541r	Wick 1	Galciofluvial or river terrace drift	Deep well drained coarse loamy and sandy soils, locally over gravel. Some similar soils affected by groundwater. Slight risk of water erosion.
711f	Wickham 2	Drift over Jurassic and Cretaceous clay or mudstone	Slowly permeable seasonally waterlogged fine loamy over clayey, fine silty over clayey and clayey soils. Small areas of slowly permeable calcareous soils on steeper slopes.

Notes to Table H.2:

Based on "Soils of South West England. 1:250,000 Sheet 3. Soil Survey of England and Wales. 1983 and accompanying legend (which provides descriptions above). Note that UK soils mapping is being revised and some soils types and associations may change.

The soils are listed approximately in order of extent/occurrence in the study area and include significant groups only.

H2 Geological and Hydrogeological Setting in Northampton

H2.1 Introduction

The geology of the Northampton area is shown on BGS 1:63,360 Scale Geological Map Sheet No. 185 included in /figure K.2 on the following page.

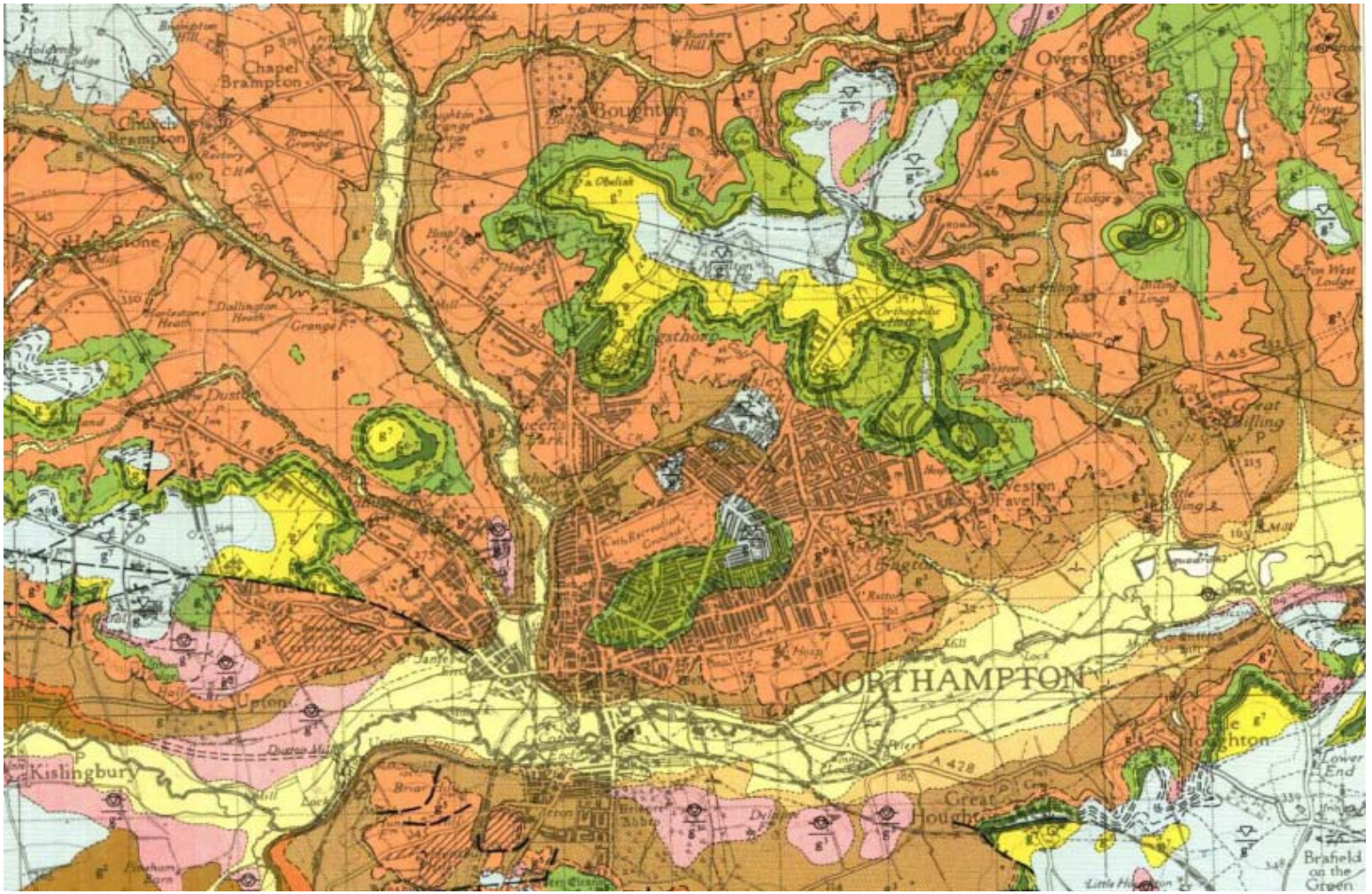

Figure H2: Northampton

The geological strata present around the Northampton area, and a summary of both their hydrogeological properties and their potential for infiltration drainage are described briefly on TableH.3

H2.2 *Solid Strata*

Clay strata (Upper Lias Clay) underlie much of the areas along the lower lying valleys associated with the River Nene and Grand Union Canal. The Environment Agency (EA) classifies these deposits as non-aquifer because they do not readily store or transmit groundwater.

Northampton Sand deposits (Inferior Oolite Series) underlie the majority of the study area. The Northampton Sands comprise sandy ironstone and sandstone and is classified by the EA as a minor aquifer.

Sequence of Lower Estuarine and Upper Estuarine Limestone deposits are present across areas of higher ground, around Maulton Park in the north, Kings Heath and in a line extending from Duston north-westwards along the line of Berrywood Road. The Great Oolite limestone caps the higher ground to the east of the study area and in areas around Kings Heath and Duston. The Lower and Upper Estuarine Series comprise mudstones, siltstones, sandstone and limestone respectively and are classified as a minor aquifer. The Great Oolite Limestone is classified as a major aquifer.

H2.3 *Drift Deposits*

Drift deposits primarily comprise alluvium associated with the River Nene and Grand Union Canal. These deposits tend to be relatively thin and limited in extent. Further to the south, there are more significant sand and gravel drift deposits associated with the River Nene and isolated pockets around Dallington. Significant deposits of Glacial Till are present extending from Duston north-westwards along the line of Berrywood Road.

Drift deposits tend to have a shallow water table and are in hydraulic continuity with, and drained by adjacent rivers and streams. When levels in these watercourses are high less groundwater will be able to drain away.

Table H.3: Geological strata outcropping beneath Northampton and their hydrogeological properties

Geology			Geological and Hydrogeological Properties[1]	Infiltration Drainage Potential[2]	Distribution and comment[3]
Age	Formation	Unit			
Quaternary (Pleistocene and Recent)	Alluvium		Primarily silt and clay, occasional sand and gravel. Low intergranular permeability.	Poor	Localised - river flood plains. Minor occurrence.
	Glacial Sand & Gravel		Sand and Gravel. Moderately permeable.	Good	Localised. Minor occurrence.
	Glacial Till		Likely to be primarily clays with occasional sands and gravels. Mostly impermeable.	Poor	Localised – across south east. Moderate occurrence.
Upper Jurassic	Great Oolite Limestone		Limestones	Moderate	Localised in areas of higher ground - Kings Heath and Duston. Minor occurrence.
	Upper Estuarine Series		Limestones	Moderate	Localised in areas of higher ground - Kings Heath and Duston. Minor occurrence.

Geology			Geological and Hydrogeological Properties[1]	Infiltration Drainage Potential[2]	Distribution and comment[3]
Age	Formation	Unit			
	Lower Estuarine Series		Mudstones, sandy mudstones, siltstone and sandstone. Typically 2m to 5m thick.	Moderate	Localised in areas of higher ground - Kings Heath and Duston
	Northampton Sands		Sandy ironstone and sandstone	Moderate	Centre of study area. Moderate occurrence
	Upper Lias Clays		Mudstones and siltstones	Poor	Associated with lower lying valleys associated with River Nene and Grand Union Cana. Moderate occurrence.

Notes to Table H.3:

1. Generalised descriptions only. Strata thickness and depth not always available. Major impermeable units may have very localised more permeable units but these are unlikely to be significant in extent.

2. The infiltration drainage potential is based primarily on geological/lithological properties only – groundwater levels or topographic setting may further limit potential.

3. Refer geological map for distribution, some deposits described here may occur outside the study area.

H2.4 Soils

Soil type provides a generic description of the drainage characteristics of soils. This will dictate, for example, the susceptibility of soils to water logging or the capacity of a soil to freely drain to allow infiltration to groundwater. Soil type may only be fully determined after

suitable ground investigations, although the mapped soil types found beneath the study area are briefly described in Table K.4 below, which gives an indication of their permeability and infiltration potential.

Table H.4: Soil associations in the Northampton area and their characteristics1

Symbol and sub group2	Soil Association	Geology (see below)	Soil characteristics
544	Banbury	Jurassic and Cretaceous Ironstone	Well drained brashy fine and coarse loamy ferruginous soils over ironstone. Some deep fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging.
712b	Denchworth	Jurassic and Cretaceous Clay	Slowly permeable seasonally waterlogged clayey soils with similar fine loamy over clayey soils. Some fine loamy over clayey soils with only slight seasonal waterlogging and some slowly permeable calcareous clayey soils. Landslips and associated irregular terrain locally.
813b	Fladbury 1	River alluvium	Stoneless clayey soils, in places calcareous, variably affected by groundwater. Flat land. Risk of flooding.
411d	Hanslope	Chalky Till	Slowly permeable calcareous clayey soils. Some slowly permeable non-calcareous clayey

			soils. Slight risk of water erosion.
541r	Wick 1	Galciofluvial or river terrace drift	Deep well drained coarse loamy and sandy soils, locally over gravel. Some similar soils affected by groundwater. Slight risk of water erosion.

Notes:

1 Based on "Soils of South West England. 1:250,000 Sheet 3. Soil Survey of England and Wales. 1983 and accompanying legend (which provides descriptions above). Note that UK soils mapping is being revised and some soils types and associations may change.

2 The soils are listed approximately in order of extent/occurrence in the study area and include significant groups only.

H3 Geological and Hydrogeological Setting in South Northamptonshire

H3.1 Introduction

The geology of the South Northants area is shown on BGS 1:63,660 Scale Geological Map Sheet No. 202 Towcester included in Figure H3 on the following page.

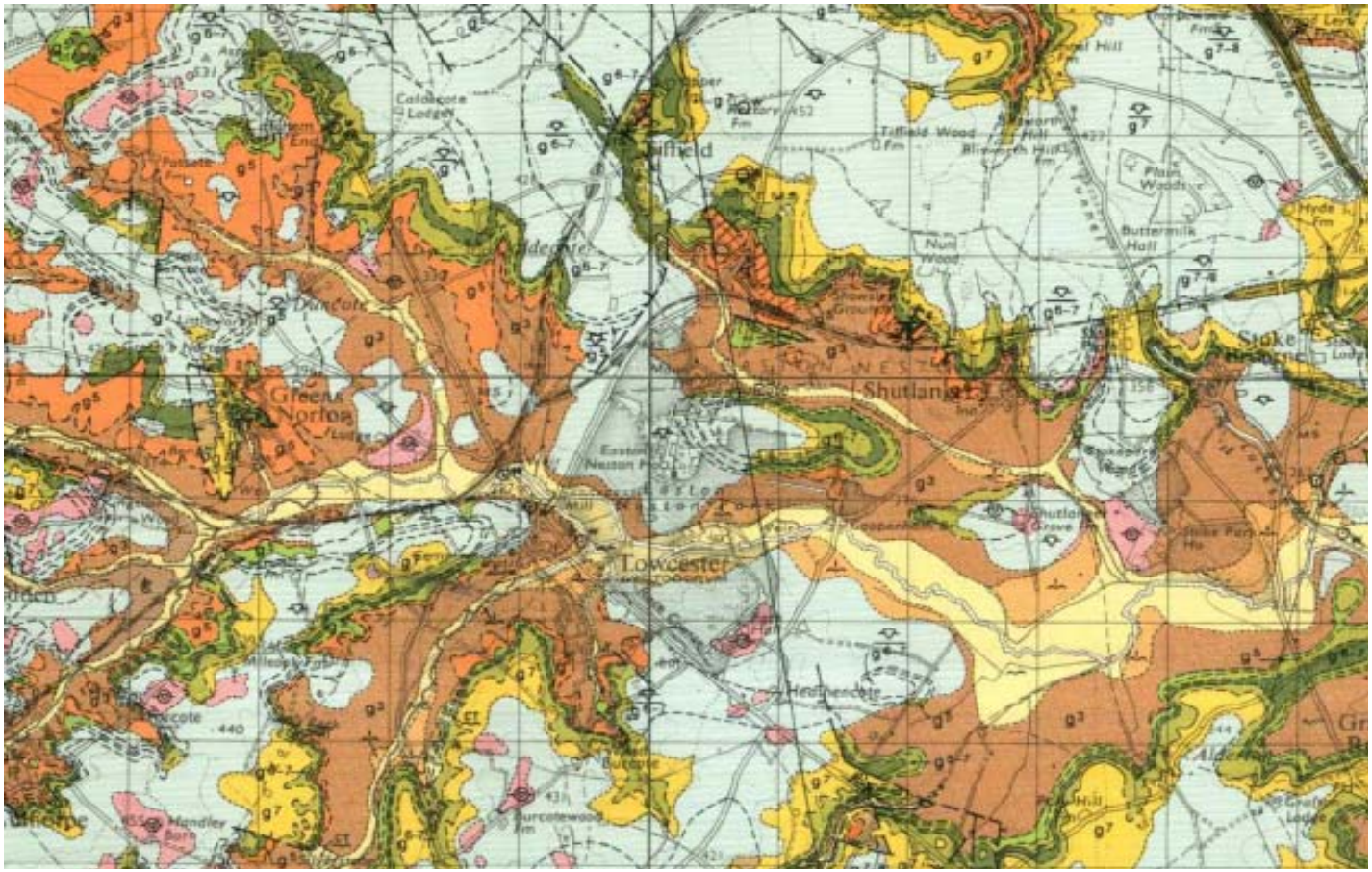

Figure H3: South Northamptonshire

The geological strata present around the South Northants area, and a summary of both their hydrogeological properties and their potential for infiltration drainage (see Section H3.3 below) are described briefly on Table H.5

H3.2 *Solid Strata*

Mainly Clay (Lower Jurassic) deposits underlie the north western and central areas. The Mainly Clay comprises mainly mudstones with some siltstones and is classified by the Environment Agency as a non aquifer as the strata does not readily store or transmit groundwater.

Northampton Sands (Inferior Oolite Series) and Lower Estuarine Series are present in a band running north to south through the centre of the study area. The Northampton Sands comprise sandy ironstone and sandstone and is classified by the EA as a minor aquifer.

Limestones of the Upper Estuarine Series are present across much of the central and western parts of the study area and are classified by the EA as a minor aquifer. Groundwater occurs in fissures in the limestones.

Limestones (Blisworth) underlie much of the southern area around Wood Burcote. Blisworth Limestones are a mixture of limestones, thin marls, mudstone, packstone and wackestones. The Blisworth Limestone is classified by the EA as a major aquifer and is the most significant aquifer in the study area.

H3.3 *Drift Deposits*

Drift deposits primarily comprise the alluvium and river terrace deposits associated with the tributary of the River Tove running through the study area. These deposits tend to be relatively thin and limited in extent. Drift deposits tend to have a shallow water table, in hydraulic continuity with, and drained by adjacent rivers and streams. When levels in these watercourses are high less groundwater will be able to drain away.

Further to the south, between Wood Burcote and Swinneyford Farm, there are isolated pockets of glacial sand and gravel. Across the southeast of the site extending from Wood Burcote to the A5 more significant deposits of boulder clay are present.

Table H.5: Geological strata outcropping beneath South Northants and their hydrogeological properties

Geology			Geological and Hydrogeological Properties1	Infiltration Drainage Potential2	Distribution and comment3
Age	Formation	Unit			
Quaternary (Pleistocene and Recent)	Alluvium		Primarily silt and clay, occasional sand and gravel. Low intergranular permeability.	Poor	Localised - river flood plains. Minor occurrence.
	River Terrace Deposits		Sand and Gravel. Moderately permeable.	Good	Localised - river flood plains. Minor occurrence.
	Glacial Sand & Gravel		Sand and Gravel. Moderately permeable.	Good	Localised. Minor occurrence.
	Glacial Till		Likely to be primarily clays with occasional sands and gravels. Mostly impermeable.	Poor	Localised – across south east. Moderate occurrence.
Upper Jurassic	Blisworth Limestone		Limestones with thin marls and mudstones, packstones and wackestones. Typically from 6 m to 7m thick, up to about 12m.	Moderate.	Across north of study area.

Geology			Geological and Hydrogeological Properties1	Infiltration Drainage Potential2	Distribution and comment3
Age	Formation	Unit			
	Upper Estuarine Series		Limestones	Moderate.	Centre of study area. Minor occurrence
	Lower Estuarine Series		Mudstones, sandy mudstones, siltstone and sandstone. Typically 2m to 5m.	Moderate	Centre of study area. Minor occurrence
	Northampton Sands		Sandy ironstone and sandstone	Moderate.	Centre of study area. Minor occurrence
Lower Jurassic	Mainly clay		Mainly clays	Poor	Across north of study area. Moderate occurrence.

Notes to Table H.5:

1. Generalised descriptions only. Strata thickness and depth not always available. Major impermeable units (e.g. Mainly clay) may have very localised more permeable units but these are unlikely to be significant in extent.

2. The infiltration drainage potential is based primarily on geological/lithological properties only – groundwater levels or topographic setting may further limit potential.

H3.4 *Soils*

Soil type provides a generic description of the drainage characteristics of soils. This will dictate, for example, the susceptibility of soils to water logging or the capacity of a soil to freely drain to allow infiltration to groundwater. Soil type may only be fully determined after suitable ground investigations, although the mapped soil types found beneath the study area

are briefly described in Table H.6 below, which gives an indication of their permeability and infiltration potential.

Table H.6: Soil associations in the South Northants area and their characteristics[1]

Symbol and sub group[2]	Soil Association	Geology (see below)	Soil characteristics
711f	Whickham2	Drift over Jurassic and Cretaceous clay or mudstone	Slowly permeable, seasonally waterlogged fine loamy over clayey, fine silty over clayey and clayey soils. Small areas of slowly permeable calcareous soils on steeper slopes.
511b	Moreton	Jurassic clay and limestone	Well drained calcareous clayey and fine loamy soils over limestone. In places shallow and brashy. Some deeper slowly permeable calcareous clayey soils.
411d	Hanslope	Chalky Till	Slowly permeable calcareous clayey soils. Some slowly permeable non-calcareous clayey soils. Slight risk of water erosion.
813b	Fladbury 1	River Alluvium	Stoneless clayey soils, in places calcareous, variably affected by groundwater. Flat land. Risk of flooding

Notes:

1 Based on "Soils of South East England. 1:250,000 Sheet 6. Soil Survey of England and Wales. 1983 and accompanying legend (which provides descriptions above). Note that UK soils mapping is being revised and some soils types and associations may change.

2 The soils are listed approximately in order of extent/occurrence in the study area and include significant groups only.

Appendix J – Possible Sustainable Drainage Systems

Possible Sustainable Drainage Systems

Table J1 Possible SuDS Options

SuDS Option	Description	How does it work?	Maintenance	Feasibility
Porous Option	Porous engineered surface, constructed from either grass concrete, porous concrete blocks, permeable block paving or porous macadam, placed on a high-void ratio aggregate sub-base layer such as gravel	Surface run-off infiltrates through the surface into the ground, rate of infiltration should be greater than or equal to design rainfall intensity. Pollutant materials are removed in the subsoil.	Silt and pollutants accumulates in the surface layers therefore major maintenance is required to remove silt build-up and other trapped contaminants.	Could be used for driveways and car parks. Water table must be at least 1m below ground level, not to be used in areas of chalk or highly susceptible aquifer due to possible contamination.
Swales and infiltration basins	Vegetated surface features. Swales are long shallow channels while infiltration basins are dry retention ponds within landscaped areas, which are usually grass lined and regularly mown.	Allows rainwater to run in sheets through the vegetation, slowing and filtering the flow. Swales could also include check dam to increase attenuation and where applicable, infiltration.	Little maintenance required – regular mowing, clearing litter, periodic removal of excess silt.	Could be used to attenuate and convey run-off from roads and car parks. Not recommended if leaching potential of underlying soils is high due to possible contamination of aquifer.
Soakaways and Infiltration trenches	Storage area constructed below ground either from dry brickwork or concrete ring units, filled with permeable material.	Stormwater runoff is diverted into the soakaway or trenches and gradually infiltrates into the surrounding soil and eventually reaches the water table	Needs to be inspected at regular intervals, areas draining to the infiltration device need to be kept clear of silt. Maintenance often left to private individuals or companies.	Can be integrated into recreational areas or public open spaces or used as a soakaway for an individual house.

Rainwater storage tanks	Design and material of tank dependent on end user. E.g. can be cylindrical, cuboid, made from pre-cast concrete, plastic, brick, ferrocement, Tank can be above or below ground, however if below ground is likely to require a pump to extract water.	Rainwater is collected from the roof of a building via a gutter into a storage tank. Water can then be filtered and used in the home or used directly in the garden.	Tanks should be inspected regularly for cracks or leaks, will need to drained cleaning. Maintenance often left to private individuals or companies.	Could be used for each household to store rainwater for re-use. Have been many case studies where this has been successfully achieved.
Inlet Control	Can be a simple orifice to control flow from an inspection chamber (or water butt) into the drainage system.	Allows either storage in storage tank or controlled flooding of parks and recreational areas.	Minimal – Orifice will need to be kept clear.	Could be used at the outlets of rainwater storage tanks to allow some flow to enter the drainage system.
On-Line storage tank	Created by either increasing the size of a storm sewer or incorporating a storage tank into the sewer system.	The excess flow in the flood peak is stored in the storage tank until the downstream sewer or watercourse has spare capacity.	Velocity of flow should be at m/s at dry weather flow to allow for self cleansing of pipes. Tanks should be drained down as rapidly as possible to prevent the risk of siltation.	Can be incorporated into the storm water sewer system at design stage.
Off-Line Storage tank	Storage tank incorporated into the sewer system however off-line	The excess flow in the flood peak is diverted off-line into downstream sewer or watercourse has spare capacity.	Tanks should be drained down as rapidly as possible to prevent the risk of siltation.	Can be incorporated into the storm water sewer system at design stage.
Permeable conveyanc e system	Can be either a French drain – trench filled with gravel and often wrapped in a geotextile membrane or a swale – shallow grassed depression, dry during dry weather, used to convey flow during wet weather.	They allow storm water to move slowly towards a receiving watercourse, allowing storage, filtering and some loss of water before the outfall.	Surface should be cleaned twice a year and kept clear of silt and weeds to keep voids clear. Use of grit and salt will affect the drainage potential so should not be used on the surface. Major maintenance could be required to remove silt build-up and other trapped contaminants.	Usually installed for highway drainage and provide a minimum level of mitigation for trunk roads.
Dry pond	Area of storage for surface runoff which is free from water during dry weather flow conditions. Consist of	Peak flows are stored in dry pond and released slowly into the downstream sewer or watercourse once the	Regular cutting of grass and annual clearance of aquatic vegetation and silt removal. Water quality can be	Can be integrated into recreational areas and public open space. Basins can be used for sport and recreation.

	excavated, berm-encased or dished areas lined with grass or porous paving.	risk of flooding has passed.	controlled by absorption, settlement of solids as in still water and biological activity.	
Permanent Wet pond	Area of storage for surface runoff. Contains during water during dry weather but designed to hold more water during wet weather.	Peak flows are stored during wet weather and released slowly into the downstream sewer or watercourse once the risk of flooding has passed.	Regular cutting of grass and annual clearance of aquatic vegetation and silt removal. Water quality can be controlled by absorption, settlement of solids in still water and biological activity.	Can be integrated into recreational areas and public open space. Visually attractive. Can offer opportunity for provision of wildlife habitat.

Appendix K

Figure 9.1: *Sensitive water or wetland sites – Northampton*

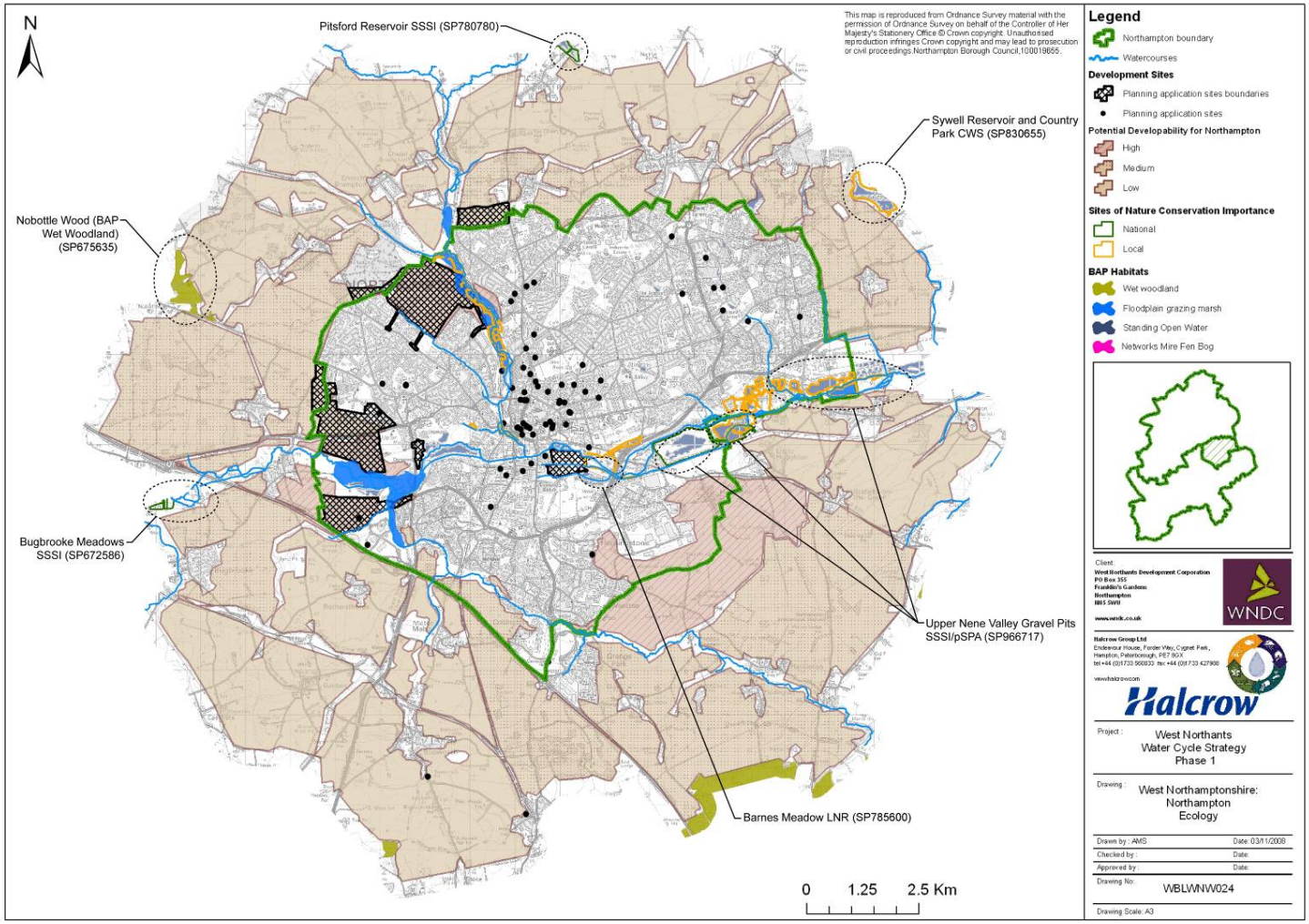

Figure 9.2: *Sensitive water or wetland sites – Daventry*

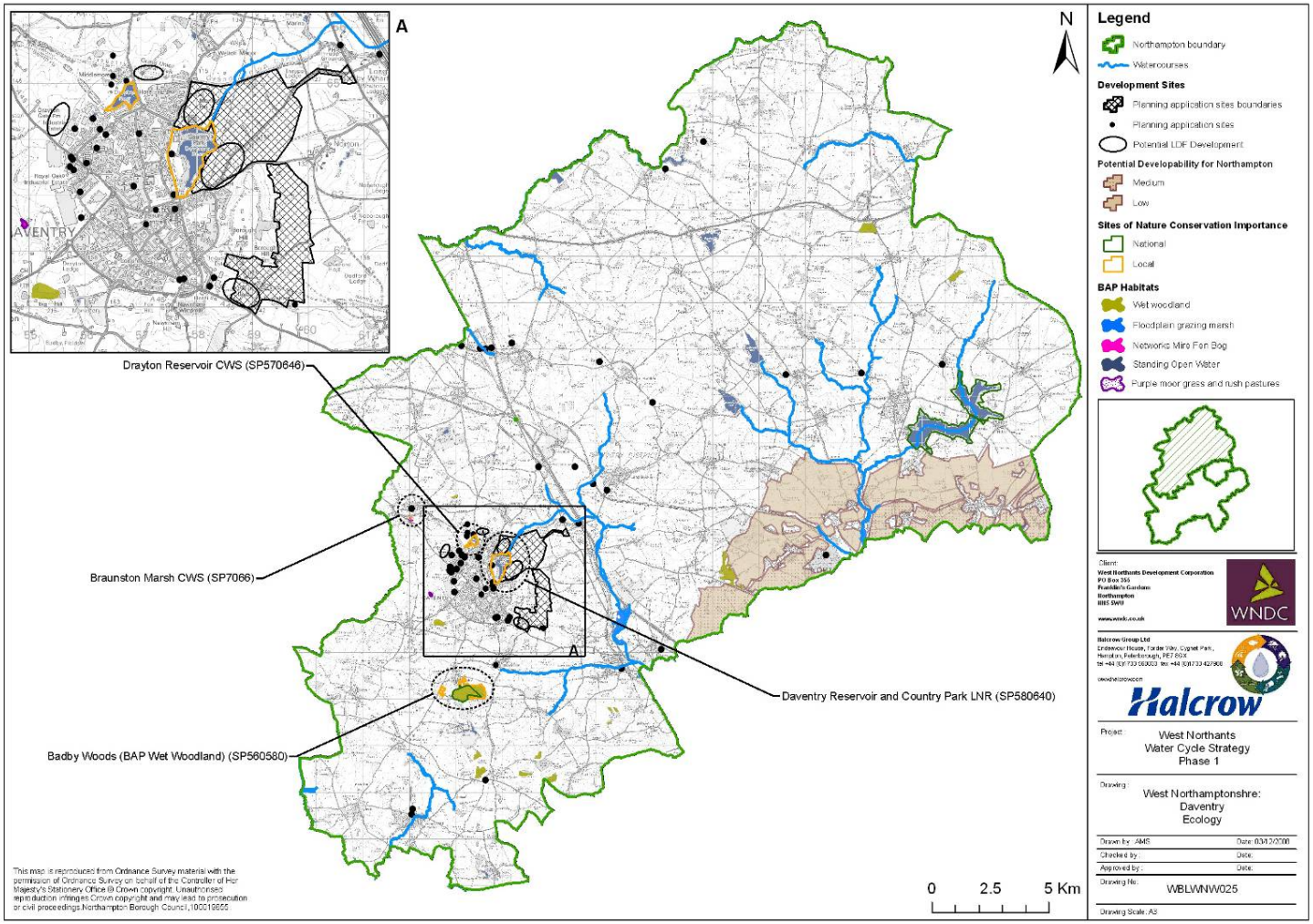

Figure 9.3: *Sensitive water or wetland sites – Towcester, Silverstone (Motor Racing Circuit only) and Brackley*

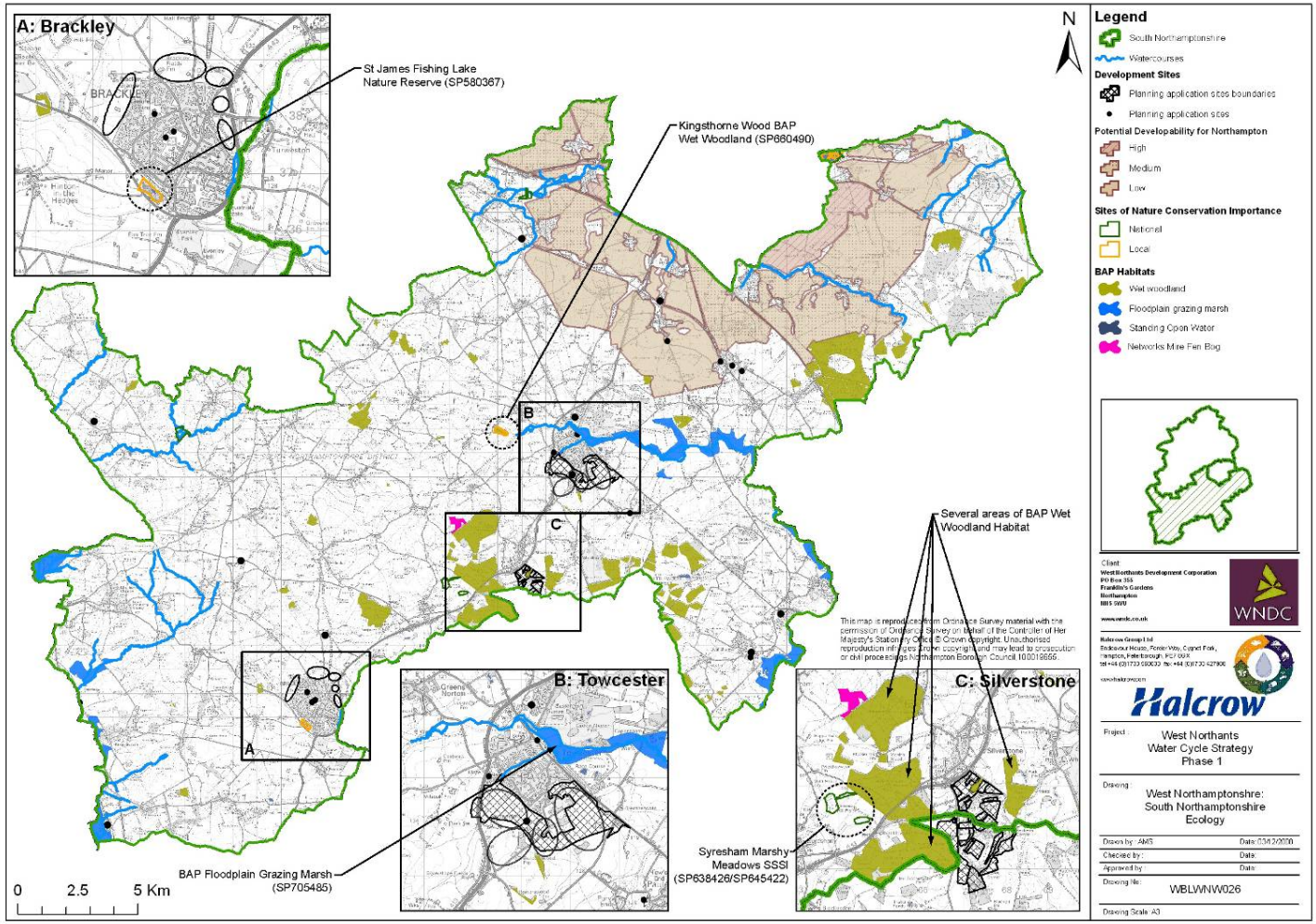

Table 1: *Nature Conservation Values of Features in the Study Area (High, Medium, Low)*

Sensitivity	Nature Conservation Value (water & wetland only)		
	International/National	**Regional/County**	**Local**
High	• pSPAs, SSSI • Important for UK BAP priority habitat or species • Large population of protected species	• LNR or NGO reserves • CWS	• Local BAP habitat or species significant locally
Medium	• Limited area of UK BAP priority habitat or small population of priority species • Limited population of protected species	• Local BAP habitat or species outside of LNR/CWS/etc. • Major river or other open water body	• Minor watercourses including ditches & ponds with ecological value
Low	• Small population of protected species	Local BAP species not occurring in designated areas and not protected or on national BAP	• Local BAP species which occur only in low numbers

Appendix L – Developer Check List

Water Cycle Strategy: Phase 1

Developer Checklist:

This list, although not exhaustive, will give Developers a useful reference to ensure Environment Agency advice is incorporated into site design.

	Checklist Items	Completed Y/N?
	Flood Risk Management	
1	Is a Flood Risk Assessment (FRA) submitted with the application in accordance with Annex E of PPS 25, Planning Policy Statement 25: Development and Flood Risk?	Y/N
2	Is development proposed within flood zone 2 or 3? (Refer to the flood maps published on the Environment Agency website)	Y/N
3	If yes, is the Sequential test applied? (See Annex D of PPS 25)	Y/N
4	Have the three elements of the Exception test been passed? (See para. D.9, Annex D of PPS 25)	Y/N
5	Does the FRA assess all possible sources of flooding? Is the development located outside flood flow routes? The risks may be from groundwater, overtopping or breach of flood defences, surface water, overland flow, breached reservoirs or sewer flooding. (See Annex C, PPS 25)	Y/N
6	Does the FRA assess the implications of climate change and suggest ways the impact can be minimised? (See Annex B of PPS 23)	Y/N
7	Provide evidence confirming whether there will be a reduction in flood risk to upstream or downstream communities?	Y/N
8	Confirm that the development allows adequate access for maintenance of watercourses in accordance with the byelaw margin. Has the developer consulted with the EA or the IDB to establish what the appropriate access on specific watercourse is?	Y/N
9	Is evidence provided for dry access/egress for residents in the event of flooding? (See Annex G of PPS 25)	Y/N

10	Provide outline details of any proposed flood resilience and resistance measures to reduce damage to your development? (See Annex G of PPS 25)	Y/N
11	If the development involves the raising of ground levels within flood zones 2 and 3, provide details of any proposed compensatory flood storage areas on a level for level volume for volume basis on land that is currently outside the floodplain.	Y/N N/A
	Surface water runoff	
12	Is the site over 1 ha? If so, a FRA is required to comply with PPS 25. Is the site is in FZ2 or FZ3? If so requirements of PPS25 for surface water must be met even if the site is less than 1ha.	Y/N Y/N
13	Confirm the previous use of the site, stating the extent of impermeable areas both before and after development.	% before % after
14	Provide evidence that the surface water runoff rate will be restricted to 2 l/s/ha, or demonstrate that the existing greenfield runoff rate will be maintained or reduced. Include calculations of greenfield runoff rate or existing runoff rates from the site.	Y/N
15	Confirm that any river flow estimates, and the sizing of balancing facilities, are in accordance with guidance in Preliminary Rainfall Runoff Management for Developments, Revision D. (Calculations must include adequate sensitivity tests to determine the effect of changing parameters).	Y/N
16	Confirm that any surface water storage measures are designed for the varying rainfall events, up to and including, a 1 in 100 year + climate change event in line with Table B2 in PPS25.	Y/N
17	Provide layout plans, cross section details and long section drawings of attenuation measures and details of flow controls, where applicable.	Y/N
18	Provide justification for any new crossings over watercourses and confirm that they are of clear span design or they are designed to convey the 1 in 100 year flow plus climate change. Has consent from the EA been obtained under section 109 of Water Resources Act 1991 (Main River)? Has consent from the IDB or the EA been obtained under Section 23 of Land Drainage Act 1991 (Ordinary watercourse)? Section 23 consent could be required from either EA or IDB depending on location. Any river crossings or weed screens to be designed to minimise risk of blockage. For further advice please refer to your local area Environment Agency office guidance.	Y/N or N/A

19	The number of outfalls from the site should be minimised. Any new or replacement outfall designs should adhere to standard guidance form SD13, available from the local area Environment Agency office. Outfalls to Main River will also require consent under section 109 Water Resources Act 1991.	Y/N
	Sustainable Drainage Systems (SuDS)	
20	Provide detail of any SuDS proposed with supporting information, for example, calculations for sizing of features, ground investigation results and soakage tests. See CIRIA guidance for more information.	Y/N
21	Where practical, quantify the percentage of surface water to be controlled through SuDS.	%
22	Confirm whether driveways and other hard surfaces are to be constructed from permeable paving. These will not be suitable for areas with clay soil or groundwater levels close to the surface, i.e. less than 0.5m below ground.	Y/N
23	Confirm whether the proposed SuDS are to be adopted as part of public open space, or by a wastewater undertaker and provide supporting evidence. Alternatively, provide details of the maintenance contributions to be provided over the life of the development.	Y/N Y/N
24	Provide details of any proposed measures to encourage public awareness of SuDS and increase community participation.	Y/N
	Water Consumption	
25	Confirm that the development can meet a water consumption target of 120l/h/d and enclose supporting details (e.g. proposals for measures such as rainwater harvesting, low/dual flush toilets and water saving tap and shower fittings).	Y/N
26	Confirm whether the development will utilise rainwater harvesting (minimum tank size 2.5m^3 per house, see Environment Agency Guidance).	Y/N
27	Has a practicable alternative strategy been included for the supply of water for fire fighting?	Y/N
28	Confirm whether grey water recycling is to be utilised and provide details.	Y/N
29	Provide details of any proposed measures to increase public awareness and community participation.	Y/N
	Pollution prevention	

30	Provide details of construction phase works method statement, outlining pollution control and waste management measures. See PPG2, PPG5, PPG6, PPG21 (**www.environment-agency.gov.uk/business/444251/444731**) and DTI Site Waste Management Plan, (SWMP, **www.constructingexcellence.org.uk/pdf/document/sitewastemanagement.pdf**)	Y/N
31	Provide details of pollution prevention measures for the life of the development, such as oil and silt interceptors. Consider whether permeable pavement areas are protected from siltation.	Y/N
	Water Supply and Sewage Treatment	
32	Provide evidence to confirm that water supply capacity is available, and that demand can be met in accordance with the Outline Water Cycle Strategy.	Y/N
33	Provide evidence to confirm that sewerage and wastewater treatment capacity is available, and that demand can be met in accordance with the Outline Water Cycle Strategy.	Y/N
	Conservation / Enhancement of Ecological Interest	
34	Confirm that the green infrastructure, such as the surface water system, links to the neighbouring green infrastructure to assist the creation and maintenance of green corridors?	Y/N
35	Confirm that at least 25% of flood attenuation ponds/wetlands will be designed for multifunctional uses, such as providing access, footpaths, cycleways, recreational uses, and submit outline details.	Y/N
36	Confirm that an environmental assessment, proportional to the size and nature of the development, has been undertaken. This should identify any impacts on wildlife habitats (include surveys) and detail suitable mitigation measures, where necessary.	Y/N
37	Confirm that development will not impact any river corridor continuity or river floodplain connectivity and buffer zones are provided adjacent to watercourses and other sensitive zones, such as wetland areas and floodplain grazing marsh.	Y/N
38	Confirm whether the development will impinge directly or indirectly on the quality of waters in and extents of habitats associated with any Main River (Wildlife Site) and confirm the status of any Designated Fishery.	Y/N
39	Confirm all ponds within 500m of the site boundary have been surveyed for presence of great-crested newt populations.	Y/N
40	Identify whether opportunities exist to use surface drainage/grey water for creating or enhancing wetland habitat areas including: • open water habitats (Daventry, Northampton) • floodplain grazing marsh (Northampton, Towcester Vale)	Y/N

41	Identify opportunities to increase linkages between habitats along the Nene Valley for use by otters, water voles and white-clawed crayfish, where practicable (Northampton).	Y/N
42	Identify opportunities for creating or improving watercourse habitats for otter and water vole, where practicable.	Y/N
43	Confirm whether the Local Biodiversity Action Plan (LBAP) and UK BAP have been consulted and whether any habitats or species detailed within the LBAP/UKBAP are present or near the development site.	Y/N
44	Confirm whether any County Wildlife Sites are present or near to the development area.	Y/N